CHAPTER 3
ENVIRONMENT AND HERITAGE PROJECT SUMMARIES

INTRODUCTION

The environment and heritage comprehensive regional assessments (CRA) have been designed to provide a systematic understanding of the values of the region by building on existing information and filling in knowledge gaps. As with all scientific surveys, time and resource constraints have limited the scope of the projects and as such, analyses of the data must take this into account.

The environment and heritage CRA projects address the objectives of the Queensland Scoping Agreement, the National Forest Policy Statement and the JANIS forests reserve criteria, i.e. to identify the key environmental values of biodiversity, old growth and wilderness. Commonwealth and Queensland statutory obligations relating to endangered species and National Estate values are also focus points for assessment.

The full project reports are available on request. Contact details are on the inside of the front cover of this Report.

FOREST VERTEBRATE FAUNA STUDY STAGE I

EH 1.1.1

PART A: DATA AUDIT AND GAP ASSESSMENT

Project objectives

The objectives of the Forest Vertebrate Fauna Study, Stage 1, were to:

- compile a database detailing the distribution of freshwater and terrestrial vertebrates and selected invertebrate species in South-East Queensland
- where possible, include information on the habitat use, abundance and occurrence of breeding by these species
- identify significant gaps (taxonomic, spatial and environmental) in the data set.

The first two objectives provided significant data to be used in the detection of gaps and in the analysis project (EH 1.1.2a). The gap identification provided some input into the selection of sites for the systematic fauna surveys (EH 1.1.1b).

Methods

Data were collected from a wide range of sources (departmental databases, museums, literature and unpublished reports). All records were validated with respect to current taxonomy and location, and entered into a relational database along with precision and sampling effort values.

Data audit methodology

Data adequacy was assessed using the DAM software. Developed by Environment Australia, the methodology assisted users to identify geographical and environmental bias in survey data and to ascertain the adequacy of sampling of biological entities within given environments.

Data separated into five vertebrate classes or 10 functional animal groups were also assessed spatially (tenure and provinces) and environmentally (grouped vegetation unit) through GIS intersections and tabulation.

Key results

A total of 306 269 records was collected for 586 native and 44 feral species using taxa known from the region. The number of records per species ranged from one to 7496.

Across the entire region, major taxonomic gaps were apparent for threatened insects, freshwater fish, reptiles and bats. At a finer spatial scale, data were limited for most animal groups in conservation (national park) and forestry (State forest/timber reserve) areas in those environmental provinces outside the south-east corner (i.e. provinces 5, 6, 7, 8, 10 and 16). The deficiencies in most provinces were real and not simply a reflection of the spatial extent of various tenures and habitat types. On the environmental scale, there were fauna in particular vegetation types that would benefit from a greater spatial coverage (distribution of species in the extensive dry forests of spotted gum and ironbark). In addition, several rainforest, wet sclerophyll forest and non-eucalypt dominated types, despite relatively intense work, might still yield new fauna species with more survey effort.

The audit of the historical data identified the lack of an extensive systematic survey of terrestrial vertebrates in the region to provide more recent information on the abundance and distribution of forest-dwelling species. The products of the project will be a relational database containing historical, incidental and systematic fauna data, and a report detailing database structure, data sources and validation, maps describing the distribution of the major fauna classes, and lists of species groups, areas and habitat types under-represented in the database.

FOREST VERTEBRATE FAUNA STUDY STAGE I

EH 1.1.1

PART B: SYSTEMATIC FAUNA SURVEY

Project objectives

The Systematic Fauna Survey project was the first large scale, systematic and standardised vertebrate fauna survey undertaken within South-East Queensland. Specifically, the project's objectives were to:

- assess the relative abundance and relative diversity of vertebrate species (excluding fish) throughout State forests, timber reserves and national parks within the South-East Queensland bioregion
- increase present knowledge on the distribution and habitat preferences of vertebrate species
- provide information on the distribution and habitat requirements of vertebrate species to Comprehensive Regional Assessment (CRA) projects and to assist in the development of forest management codes of practice.

Methods

Survey design

Stratification of the South-East Queensland bioregion

The project used modelled regional ecosystems and a geological/geomorphological variable known as landzones (Young, in press) as the primary environmental variables for the stratification of the South-East Queensland bioregion. Regional ecosystems or landzones were not digitally available at the time of stratification for the Blackdown Tableland area, so it could not be stratified with the rest of the bioregion. Instead, the project used the 1:100 000 Dingo mapsheet vegetation coverage, produced by the Queensland Herbarium.

Site selection and sampling intensity

Between February 1997 and December 1997, 36 stratified survey areas across the region and Blackdown Tableland were sampled for vertebrate fauna, including a total number 267 systematic survey sites. Strata which encompassed less than 0.2 per cent of the total forest area were not sampled. Also strata which were not located within the public forest tenure system were not sampled, since surveys were restricted to forest areas within State forest, timber reserve or national park tenure only. The number of sites to be surveyed within each strata unit was determined by using an index of sampling intensity based on the proportion of total area of each stratum. This index was then multiplied by three to ensure at least one systematic gully site, one systematic midslope site and one systematic ridge site were

sampled across each stratum. The number of systematic sites surveyed in Blackdown Tableland was determined by the proportion of the total forest area each of the mapped vegetation units encompassed.

Systematic sites were located more than one kilometre from each other to ensure independence between the sites and, for accessibility reasons, were constrained by the established road network. The fauna survey team assigned to each survey area were given an indication of sampling requirements within each target stratum, i.e. whether a gully, midslope or ridge systematic site was required. The site was then selected in the field, and a 300 x 50 m transect was marked and measured out following the contour. Map 1 illustrates the distribution of systematic sites throughout the forests of the South-East Queensland bioregion and Blackdown Tableland area.

Field survey methods

The CRA systematic fauna survey used a range of standard survey methods to obtain data on the abundance, presence/absence and/or presence of priority vertebrate species (excluding fish) throughout the bioregion. At each systematic site a set of standard survey methods was used, and additional standard methods were used if the site was suitable, e.g. harp trapping for microbats if a flyway was available on-site. Table 1 provides a summary of the set of standard survey methods and effort undertaken at each systematic site during the CRA surveys. One or more standard survey methods were also conducted away from the systematic sites at opportunistically chosen sites within each survey area. These sites were referred to as opportunistic sites.

Table 1. Summary of survey methods used

Survey site type	Survey methods	Effort
At each systematic site (ridge, gully, midslope)	diurnal bird count	two x 30 minute count within 200x50m area.
	diurnal herpetofauna search	one person hour within 100x50m area
	nocturnal herpetofauna search	one person hour within 100x50m area
	nocturnal call playback	calls of powerful, masked and sooty owls played for 3 mins each. (plus plumed frogmouth call in rainforest sites)
	spotlighting	one person hour within 300x50m area
	ultrasonic microbat detection	30 minutes
	hair-tubes	10 @ 20 m along 200m transect
	'A' type Elliott trapping	25 @ 8 m along 200m transect; 3 nights
	predator scat search	collected from within 300x50m
	incidental records	recorded as on-site within 300x50m
Additonal methods at systematic sites where suitable	dry pitfall line	5 buckets @ 6m along 30m drift fence; open for 3 nights
	harp trapping	open for 2 nights
Non-standard methods	mist-netting	no standard effort
	trip-lining	
	cave and roost searches	
	turtle trapping	
	vehicle spotlighting	
	non-predator scat collection	

External systematic fauna survey data sets

Data from three systematic fauna survey projects contributed to the CRA systematic fauna survey project by helping to fill geographical and seasonal gaps in the survey effort for priority species. These external data sets included the South-East Queensland frog survey project (provided by Harry Hines, DEH), the Conondales plumed frogmouth survey (provided by Geoff Smith, DNR) and the yellow-bellied glider survey project (provided by Teresa Eyre, DNR).

Limitations

Due to the rigid time constraints (10 months to design survey methodology and database, conduct fauna surveys, data entry, validation and manipulation, and report writing) the following limitations were evident during the project:

a) Most survey effort was expended during one season (winter), which will have influenced the detection of particular species sensitive to seasonal changes (e.g. frogs, reptiles and migratory species).
b) Sites could only be sampled once.
c) Relatively few sites could be sampled (compared with other RFA regions such as East Gippsland and north east New South Wales, where systematic surveys have been conducted over several years). The majority of the larger State forests and national parks in the region were sampled. Areas that remain unsampled include Fraser Island and the southern D'Aguilar Range (there have been previous surveys in these areas however), Brooweena-Woowoonga, western Eurimbula and the northern Many Peaks Range e.g. Castle Tower National Park.

Key results

This project represents the first large scale, standardised and systematic survey of the vertebrate fauna of southern Queensland.

Three field survey teams collected data from March 1997 to December 1997. In all, 36 forest areas were surveyed during 39 survey trips, and a total number of 267 systematic sites were surveyed for bats, small and large ground mammals, arboreal mammals, diurnal and nocturnal birds and herpetofauna (see Table 1). Further sites within the survey areas were surveyed using non-standard techniques.

Further systematic data were obtained from external sources, adding a further 78 frog survey sites, 15 plumed frogmouth survey sites, and 60 arboreal mammal survey sites.

Using standard and non-standard methods, the CRA Vertebrate Fauna Survey Project recorded 36 amphibian species, 92 reptile species, 296 diurnal bird species, 10 nocturnal bird species, 19 small terrestrial mammal species, 11 macropod species, three predator species, four ungulate species, 10 arboreal mammal species, five megachiropteran bat species and 27 microchiropteran bat species.

A number of records obtained during the survey were regionally significant, including extensions to the previously known range of priority species such as the green-thighed frog *Litoria brevipalmata*, banded leaf-tailed gecko *Phyllurus caudiannulatus*, collared delma *Delma torquata*, Nangur skink *Nangur spinosa*, common blossom bat *Syconycteris australis*, little pied bat *Chalinolobus picatus*, and eastern pebble-mound mouse *Pseudomys patrius*.

Products from this study include a relational database containing systematic and incidental fauna data (including that from external datasets) and detailed faunal habitat information, and a report detailing the survey results including tables, maps and summaries of the findings for priority taxa.

FOREST VERTEBRATE FAUNA STUDY STAGE II

EH 1.1.2

PART A: ANALYSIS AND RESERVE OPTION EXAMPLE

Project objectives

The objectives of this project were to:

- assess the adequacy of the sampling to determine whether there are sufficient data with which to assess the faunal values (terrestrial vertebrates only) of the South-East Queensland CRA region
- discern and describe any patterns in the composition and distribution of species assemblages across the region to determine the location of the richest areas and which areas were most similar to each other in terms of fauna, which species tend to be found together, and what species/species assemblages were absent or poorly represented in the existing reserve system. This was addressed in terms of broad categories (total species number, priority taxa which includes endemic and threatened species, and species assemblages at the habitat or function level) with respect to tenure (broad spatial scale), grouped vegetation units (broad environmental scale) and regional ecosystem types (fine spatial and environmental scales).
- examine priority taxa in terms of known past and present distributions, life history traits, threatening processes and reservation status to determine which species were adequately reserved, could be accommodated within a reserve system, or require both on and off-reserve actions for their conservation. A number of other species,

either marginal to being listed as priority or considered representative of certain JANIS (1997) criteria (e.g. migratory species) were also assessed with respect to their reservation status as secondary assessment taxa.

- explore reserve options using the above information to determine the areas, alternative areas and management actions which were important in the conservation of regional faunal values, and how well the proposed areas would satisfy the CAR criteria.

Methods

Historical and CRA fauna survey data were combined and then adequacy assessed using DAM software (See EH 1.1.1 Part A). The same data set was intersected with tenure, grouped vegetation and regional ecosystem coverages to provide species lists at each of these scales.

Data for each faunal category (total, priority, endemic and threatened) at each spatial/environmental scale were analysed using PATN software which detects relationships between data sets based on the values within those data sets. The analysis determined dispersion and composition of location and species classifications.

Species summaries were compiled from the literature, unpublished reports and personal communications. Reserve options were examined based on a few simple rules.

Key results

The available information is reasonable for the purposes of this assessment although more data for certain taxonomic groups (reptiles and bats) and certain habitat types (semi-evergreen vine thicket and non-eucalypt dominated forests) would have been desirable.

Examination of the spatial and environmental distributions of faunal values at the broad level (biodiversity, priority and endemic species), species assemblages (habitat and functional associations) and individual taxa (priority and secondary assessment taxa) resulted in the following preliminary conclusions about CAR reserves and fauna in South-East Queensland. In terms of comprehensiveness, the majority of terrestrial vertebrate species (90 per cent of 544 species) recorded in the region have been found in at least one national park. Those not accounted for included species not necessarily typical of the region (seven per cent), for example vagrants from adjacent bioregions, several highly restricted endemics or patchily distributed species (1.3 per cent) and a few widespread but difficult to detect species (1.1 per cent).

At tenure, grouped vegetation and regional ecosystem scales, most of the terrestrial fauna in the region do not occur in clearly defined associations based either on habitat (have broad niches aligned along a wet-dry/closed-open gradient) or geography (occur throughout the region given appropriate broad habitat type). The analyses indicate the reserve system is not well represented in the dry forest types (mixed, western/ironbark and *Corymbia citriodora*) especially in the northern inland and western parts of the region, *Eucalyptus saligna* wet forest, and dry rainforest (*Araucaria*-dominated and semi-evergreen vine thicket) in the central and northern inland areas.

Adequacy could not be assessed directly or quantitatively (i.e. number of animals/populations required or amount of habitat needed).

The reserve option study results are incomplete. However it is possible to say that, within the ecosystem deficiencies identified above, various alternative locations can be determined to address the representativeness issue for fauna.

Products from this study include a report which contains full details of the analyses undertaken, tables and maps. It also includes an attachment which contains species summaries with maps indicating past and current distributions.

FOREST VERTEBRATE FAUNA STUDY, STAGE II

EH 1.1.2

PART B: ASSESSMENT OF HABITAT QUALITY FOR PRIORITY SPECIES

Project objectives

The objective of the Assessment of Habitat Quality for Priority Species project was to identify potential areas of medium and high quality habitat for priority fauna species listed for the South-East Queensland bioregion.

Methods

1. Habitat quality maps were generated using an environmental GIS database and fauna data derived from historical sources (EH 1.1.1A), recent surveys (EH 1.1.1B and other non-CRA systematic surveys) and expert knowledge (other CRA environment and heritage project workshops).
2. Thirty-one environmental layers, including vegetation, feral predator distribution, elevation and a range of climatic variables, were available for use in the analyses.
3. Appropriate analysis for each taxon was dependent on data adequacy and type. If adequate, various statistical models were used (GLM – Generalised Linear Model & GAM – Generalised Additive Model) employing presence/absence or presence only data. If inadequate, then maps were based on expert assessment or sites only.
4. All models and maps were validated by experts and given an accuracy rating.
5. Final maps, depicting the distribution of medium and high quality habitat, were produced after digital adjustment of maps to comply with expert assessment.

Limitations

The project had some limitations that need to be taken into account before interpreting the results, including:

a) insufficient data for many priority taxa to permit statistical or expert assessment of distribution and habitat quality
b) not all experts were available to examine the models and maps produced at the workshop
c) not all environmental layers were available at the time of modelling. Modelling involving taxa present on Blackdown Tableland was not possible due to this factor.

Key results

One hundred and ten taxa were assessed in the project (invertebrates = 11, fish = 8, frogs = 14, reptiles = 18, birds = 17 and mammals = 42). With the exception of the invertebrate and fish, where only expert models were attempted, the distribution of potential habitat for the remaining taxa were modelled using presence/absence, presence only, expert or sites data.

Accuracy of the models, as evaluated by the expert panel, varied. Thirty-two were given a high rating, 36 were rated medium, 22 low and 20 were not assessed (due to data inadequacy). The extent of high accuracy maps ranged widely among the animal groups (invertebrate = 40 per cent, fish = 75 per cent, frog = 73 per cent, reptiles = 28 per cent, birds = 29 per cent and mammals = 10 per cent).

The final maps fell into these categories: presence/absence GLM = 6, presence/absence GAM = 2, presence only GLM = 11, presence only GAM = 2, expert = 33, sites = 47. No maps were produced for nine taxa.

Products from this study include a report, containing details of the analyses undertaken, tables and maps along with summaries for each taxon examined, and digital habitat quality maps that are of high or medium accuracy

SURVEY OF THREATENED PLANT SPECIES IN THE SOUTH-EAST QUEENSLAND BIOGEOGRAPHIC REGION

EH 1.1.3

Project objectives

The Survey of Threatened Plant Species project was undertaken to provide information and data on the distribution, population attributes, ecology and threatening processes pertaining to threatened, vascular plant species of forests in the South-East Queensland biogeographic region.

The objectives of the project were to:

- survey populations and other potential habitats for additional populations of each target species in the region
- obtain information on population structure and size and habitat parameters for each species
- document the current knowledge about each target species and the possible threats to the long term viability in the wild
- assess the threats and conservation status of each species and make recommendations for management of existing populations.

Methods

Selecting target species

Compilation of the list of species in the forested areas within the region was based on locality information from the Queensland Herbarium database intersected with the bioregion boundaries. From this, 49 endangered and 94 vulnerable species listed on the schedules of the Queensland *Nature Conservation Act 1992* are recorded in the region. Of these, 20 endangered and 41 vulnerable species have been recorded as occurring in State forest or timber reserves. The list of species in the region is relatively large. As it was not possible to examine all species, given the project's time constraints, a number of species was selected and targeted for survey work. Selection was based on:

- The amount of information available. The less information available, the more important it was considered to survey the species. Those species that presently have recovery plans or had been previously searched for, directly or in association with other studies, were considered of lesser priority.
- The visibility of the species in the field at the time of survey. Grass species are difficult to identify without fertile material and preliminary information indicated that those grass species on the list did not flower during the survey period. The orchid species were not studied as these are often cryptic and seasonal in occurrence, and require a high level of specialised expertise for their identification.

Within the time available a total of 10 species were searched for during this project. Outlines were prepared for a further 22 species, based on information available from Queensland Herbarium (HERBRECS) records and vegetation mapping records (CORVEG), botanists and amateur naturalists.

The species outlines presented in the technical report give a brief description of the species' morphology, distinguishing features and conservation status. Descriptions of species were compiled by consulting references, herbarium material and from discussions with botanists. Specimens at the Queensland Herbarium were examined and identifications were confirmed by comparison with the type material and consultation with relevant experts.

Field survey methods

Surveys were carried out during September–November 1997. Searches were initially undertaken at sites where the species in question had been most recently collected and for which useable locality information was available. Information was obtained from Queensland Herbarium records, site data from vegetation mapping, botanists, DPI–Forestry officers and amateur organisations. Subsequently, similar habitats in other areas were searched when time was available. Where populations were not represented in Queensland Herbarium collections, voucher specimens were collected and deposited there.

When a population of a targeted species was located, the following features were recorded:

- location details with Global Positioning System data
- habitat attributes within a 20 x 50 m plot placed within the population:
  - landform and land surface (McDonald et al. 1990)
  - soil type: field texture was measured by the method described by Northcote (1971). Soil colour was recorded by comparing moist soil with colour charts. Soil pH was measured using a TPS electronics WP-80 pH meter
  - geology: as mapped on Queensland Department of Minerals and Energy 1: 250 000 geological series
  - vegetation: structure of associated vegetation (Walker & Hopkins 1990); associated dominant and common plant species (plant nomenclature according to Henderson 1997).
- an estimate of the area that the population covered, based on a comprehensive search of the area
- a measurement of the population size of the targeted species. Populations were measured by one of two methods. If the site was small, or consisted of isolated clumps, a direct count of individual plants was undertaken. For larger sites, or where direct counts were impractical, density and abundance were estimated by counting individuals in transects placed through the populations. Each transect was placed in what was assessed to be a representative sample of the population.
- where practical, population characteristics were recorded such as breeding biology, age structure and response to disturbance and fire.

Key results

Species included are those listed under the Queensland *Nature Conservation (Wildlife) Regulation 1994* and those species identified by expert groups as warranting regional threatened status but currently not listed on the Queensland schedule (i.e. species pending listing). Thirty-two of the 64 target species are documented in Halford (1998). Survey data for 10 species are presented with information on distribution, population size and habitat parameters. The threats to these species and their conservation status were assessed. The distribution and habitat parameters are presented for the other 22 species based on collated information from literature, Queensland Herbarium records, vegetation mapping site data (CORVEG) and consultation with botanists and naturalists. See Tables 2 and 3.

Table 2. List of threatened plant species surveyed

Botanical name	NCR[1]	ESP[2]
Allocasuarina rigida subsp. *exsul*	vulnerable (pending)[3]	
Daviesia discolor	vulnerable	vulnerable
Dodonaea rupicola	vulnerable	vulnerable
Leucopogon recurvisepalus	endangered	
Macrozamia lomandroides	endangered	endangered
Macrozamia parcifolia	vulnerable	vulnerable
Macrozamia pauli-guilielmi	endangered	endangered
Oldenlandia sp. (Wietalaba N.Gibson 1344)	endangered (pending)	
Prostanthera sp. (Mt Tinbeerwah P.R.Sharpe 4781)	vulnerable	vulnerable
Rhodamnia sp. (Calliope N.Gibson 1335)	endangered (pending)	

1. Nature Conservation (Wildlife) Regulation 1994 (Queensland)
2. *Endangered Species Protection Act 1992* (Commonwealth)
3. Pending inclusion on the schedule of the Queensland *Nature Conservation (Wildlife) Regulation 1994*

Table 3. List of threatened plant species outlined in this project

Botanical name	NCR[1]	ESP[2]
Acacia attenuata	vulnerable	vulnerable
Acacia baueri subsp. *baueri*	vulnerable	vulnerable
Acacia grandifolia	vulnerable	vulnerable
Acacia perangusta	vulnerable	vulnerable
Arthraxon hispidus	vulnerable	endangered
Bothriochloa bunyensis	vulnerable	vulnerable
Clematis fawcettii	vulnerable	vulnerable
Cycas megacarpa	vulnerable	endangered
Eucalyptus hallii	vulnerable	vulnerable
Eucalyptus taurina	vulnerable (pending)[3]	
Haloragis exalata subsp. *velutina*	vulnerable	vulnerable
Lasiopetalum sp. (Proston J.A.Baker 17)	endangered (pending)	
Marsdenia coronata	vulnerable	
Medicosma elliptica	vulnerable	vulnerable
Notelaea lloydii	vulnerable	vulnerable
Parsonsia kroombitensis	vulnerable (pending)	
Parsonsia larcomensis	vulnerable (pending)	vulnerable
Paspalidium grandispiculatum	vulnerable	vulnerable
Plectranthus nitidus	endangered	endangered
Plectranthus omissus	endangered	endangered
Plectranthus torrenticola	endangered	endangered
Sophora fraseri	vulnerable	vulnerable

FLORA DATA ANALYSIS

EH 1.1.4

Project objectives

The objectives of the Flora Data Analysis project were to:

- determine areas of high conservation significance for flora (with reference to JANIS criteria) of:
  - rare and threatened species (defined under the *Nature Conservation Act 1992*) and the geographic locations of such species
  - species considered to be regional endemics, the geographic locations of such species, and the identification of centres of endemism
  - areas of high species richness
  - species at the limits of their geographic range and the locations of such species
  - disjunct populations and their geographic locations.
- identify the biotic similarity or dissimilarity between areas which capture significant flora values (e.g. centres of endemism and high species richness)
- determine the adequacy of data for assessing areas of high conservation value at the regional scale.

Some of the information contained in the report will be revised or updated because new information has, or will shortly, become available. The revised data will be available to inform the integration and planning state of the RFA.

Methods

Data compilation and validation

Three major data sets contributed to the analysis: specimen-backed records and site data collated by the Queensland Herbarium, and incidental, and systematic records collated by the Department of Environment (central coast management region). The final number of records used for grid-based analyses totalled 174 500. The number of sites databased under the Queensland Herbarium's CORVEG system exceeded 2900. The distribution of these sites across the region is depicted in Map 2.

Validation procedures included:

- records restricted to post-1947 in recognition of the extent of clearing and fragmentation in south-eastern Queensland and the lower geocode accuracy associated with older records
- data accuracy threshold set at 2000 metres or less for grid-based analyses to maximise available information (approximately 87 per cent), while rejecting records which could not be attributed to assessment units due to scale differences
- taxonomic currency–1997 Queensland Herbarium census
- geocode validation carried out in detail for 105 endangered and vulnerable forest-dependent flora through the response to disturbance project. Standard validation procedures performed by the Queensland Herbarium on CORVEG data.

Assessment of priority status

Assessment of priority status (e.g. endemic, at-limits of range, disjunct) for all species occurring in the region was determined using distributional information from the Queensland Herbarium and expert opinion.

Identification of appropriate reference units

The identification of appropriate reference units enabled a comparative assessment of values across their regional extent (i.e. five km and 10 km grid overlays).

Key results

Species richness

In the extreme south of the region, parts of the scenic rim have been identified as important for conservation on the basis of high species richness. The diversity of habitats and the complexity of vegetation in this area have long been recognised and have been significant factors in the recognition of the Eastern Rainforest Reserves World Heritage area. Other parts of the region with high species richness include Mt Walsh National Park and State Forest 1344 (Boompa); the Kroombit Tops area in the extreme north-west; the northern coast from Deepwater to Eurimbula national parks; the southern coastal lowlands including Cooloola, Noosa and Coolum National Parks and State Forests 1239 (Kenilworth) and 689 (Maroochy). The mid to south-western part of the region does not contain any areas identified with high species richness, due in part to lower collecting effort and high rates of clearing resulting in low remnant vegetation values. In the similarity assessment based on species composition, the flora of the scenic rim was shown to be most dissimilar to other areas of high richness, having a greater affinity with the flora of northern New South Wales.

Regional endemics

A total of 273 taxa from 63 families were identified and listed as regional endemics on the basis that at least 75 per cent of their range occurs in the region. Various rainforest ecosystems and montane shrublands were identified as having specific regional importance for the high number of endemic taxa they contain, for example *Macadamia integrifolia*, *M. ternifolia*, *Pittosporum oreillyanum*, *Triunia robusta*, *Leptospermum oreophyllum*, *Westringia rupicola* and *Banksia conferta* ssp. *conferta.* A comparative assessment revealed high levels of endemism in areas such as Great Sandy National Park, Burrum Coast National Park and eastern State forest 840 (Bingera) in the north; Mount Walsh National Park in the central west; the Noosa area (including Noosa, Mount Coolum and Poona National Parks, and State forests 561 (Bribie) and 915 (Poona) on the central coast; and Main Range, Lamington National Park, the Moogerah Peaks National Park and State forest 745 (Palen) along the scenic rim in the south.

Eucalyptus richness

An assessment of eucalypt richness identified many areas coinciding with areas thresholded under other criteria. Kroombit Tops, Mount Walsh, Mount Barney and the forests of the D'Aguilar Range are all included within grid

cells identified in the analysis. However, elevated areas around Crows Nest on the western margins of the region were also identified as regionally significant and contain the largest single block of high eucalypt richness cells in the region (over 35 000 ha of remnant cover). Variable collecting effort contributed to unmeasured bias in these results.

Range limits

A total of 556 and 355 taxa were identified as at their northern and southern limits respectively in the region. Fraser Island marks an important zone for concentrations of at-limits of range taxa, in addition to the central elevated area west and north of Gympie, the western scenic rim around Mt Barney and the eastern section around Lamington and Springbrook National Parks, south and west of Miriam Vale, and Toohey Forest in metropolitan Brisbane.

Rare, threatened and disjunct species

Thirty-three endangered, 76 vulnerable and 152 rare taxa occur in the region. The coincidence between areas of high species richness, concentrations of rare species and other values highlighted the regional significance of the scenic rim (Lamington, Springbrook and Mount Barney), the Moogerah Peaks, the coastal environments from Noosa to Great Sandy, and inland to Mount Walsh and surrounding State forests. Additional significant areas for concentrations of rare taxa such as *Hernandia bivalvis*, *Atalaya rigida* and *Macropteranthes fitzalanii* are found in the north-west around Mt Colosseum National Park and State forests 391 (Boompa) and 121 (Degalgil).

The identification of taxa with disjunct populations in the region considered records collected prior to 1947. Fifteen taxa have not been recorded since 1947 and are possibly extinct in the region. These taxa are generally in the grass or herbaceous layer and, with a single exception, are listed as common under the *Nature Conservation (Wildlife) Regulation 1994*. The RFA region captures 135 taxa from 61 families with disjunct populations, many of which have other occurrences only in far north Queensland.

GENETIC DIVERSITY AND THE DESIGN OF A COMPREHENSIVE, ADEQUATE AND REPRESENTATIVE (CAR) RESERVE SYSTEM FOR FORESTS IN SOUTH-EAST QUEENSLAND

EH 1.1.6

Project objective

The main objective of the project was to compare the extent of geographic genetic diversity among flora and fauna from rainforest and wet and dry sclerophyll forest in South-East Queensland.

Methods

Genetic diversity was examined in six fauna species (four lizards, two frogs) using DNA sequencing and six species of plants using allozyme electrophoresis. The plants and animals analysed live in a range of forest types and include taxa with both localised and widespread distributions.

Key results

- All of the animal species showed evidence of populations being isolated from each other through time although this appears to be least for taxa that mainly live in dry forests and greater for those that live in cool moist uplands that are isolated from one another. Such areas are scattered throughout South-East Queensland.
- The strong geographic patterns evident among the animal species studied were less pronounced among the plants studied. However, dry sclerophyll forest taxa showed low levels of population differentiation and high levels of mixing between populations while the rainforest and wet sclerophyll taxa exhibited low levels of mixing of populations and pronounced genetic differences between populations.
- populations of plants and animals that are scattered (disjunct) or isolated from other populations by considerable distances are often considered to have special conservation value. The study reinforces this view by demonstrating that through time such isolated populations have developed distinctive genetic characteristics.

FOREST ECOSYSTEM MAPPING AND ANALYSIS OF THE SOUTH-EAST QUEENSLAND BIOGEOGRAPHIC REGION

EH 1.2

PART A: VEGETATION SURVEY AND MAPPING

Project objectives

The objective of this project was to produce the first comprehensive vegetation ecosystem survey and mapping across the whole South-East Queensland RFA region. The survey and mapping was not restricted to forests but encompassed all terrestrial vegetation ecosystems and covered all tenures. The mapping is at a scale of 1:100 000, with a minimum polygon size of 20 ha. The 1:100 000 scale has been widely used in other states for their CRA (e.g. East Gippsland in Victoria, and Tasmania and Western Australia) and is the scale advocated as a suitable scale for vegetation map unit assessment in the JANIS (1997) document.

Some of the information contained in the report will be revised or updated because new information has or will shortly become available. The revised data will be available to inform the integration and planning stage of the RFA.

Methods

The methodology for the vegetation survey and mapping has been previously developed through more than 20 years of Queensland Herbarium mapping activity (see Neldner 1993). The methodology was outlined in detail in Thompson et al. 1996.

Two seamless digital coverages of vegetation ecosystems have been produced: existing remnant native vegetation (summarised in Map 3), and pre-clearing vegetation.

Remnant vegetation in this study was defined as vegetation where the structure of the woody vegetation was still intact (i.e. there was more than 50 per cent of the normal canopy cover of the community present). The distribution of remnant vegetation was determined from 1995 Landsat imagery by either interpretation of high quality hard copy prints or digital imagery on screen using ARC INFO and ARCVIEW software. The Landsat imagery was supplied and rectified through the State Landcover and Tree Study (SLATS 1997). Although the basic structural components of the canopy were relatively intact, the condition of the ground and shrub layers and floristic composition of the community could be significantly altered from its natural state. There was no reliable method to determine the condition of the community from this scale of imagery.

Pre-clearing vegetation equates to what is generally mapped as ‘pre-1750’ or ‘pre-European’ vegetation in other studies. The pre-clearing vegetation is simply the vegetation present before clearing. In South-East Queensland this was interpreted from older aerial photographs (1962-1986). These photographs provided complete coverage but also showed more extensive areas of natural vegetation than presently exist. Where vegetation had already been cleared on these aerial photographs it was reconstructed by the botanist using the landform, soils, geology and field knowledge (e.g. remnant roadside trees, extrapolation from uncleared areas in similar environments). In addition, historical survey records of vegetation types have been extensively used in this reconstruction (see Fensham and Fairfax 1997 for a discussion of the technique). The reliability of this reconstruction varied depending on the terrain, the predicability of the vegetation community and the available data sources for that polygon (Unique Map Area). Reliability and source data were attached to each individual polygon. Our understanding of the composition of the pre-clearing vegetation is based on the data collected in most cases since 1994, and as such is influenced by the contemporary grazing, fire and management regimes and the presence of feral plant and animal species. Extensive field work involving traverses and site sampling have been used to ground-truth the coverages.

The process of vegetation mapping involved the production of three distinct coverages:

1. A pre-clearing vegetation coverage primarily based on aerial photo interpretation of black and white photographs, while consulting with other data sources for geology, land system, vegetation and soils maps (where available) and the Landsat imagery.
2. A landcover coverage derived from most recent Landsat imagery, through manual examination of the imagery.

3. The remnant coverage produced through a GIS intersect of the pre-clearing and landcover coverages to derive a remnant vegetation coverage. Each Unique Map Area (UMA) in the coverage is re-examined on the Landsat imagery in consultation with the aerial photographs to assign the proportion of each of the vegetation map units making up each remnant. This step is necessary to account for preferential clearing of particular vegetation map units (Fensham et al. 1998).

Integrating individual map sheets into a seamless coverage

The study area covers all or part of 41 individual 1:100 000 map sheets. To complete the mapping of this area within the required three years, a number of different sheets were surveyed and mapped simultaneously. Vegetation legends were devised for each individual sheet. The data attached to each UMA in the digital coverage have retained the original vegetation codes for each 1:100 000 map sheet so that each sheet can be produced as a stand alone product. The production of the seamless coverage for the RFA region required the integration of a number of different vegetation legends. This process required:

- the databasing of legend unit attributes to allow efficient sorting
- the production of a draft bioregion legend
- testing of the legend by consulting all the botanists with knowledge of the area
- finalisation of the legend for South-East Queensland.

On finalisation of the legend and translation table, global translations to the vegetation coding on all sheets were made with the universal codes added to extra fields in the attribute tables. All mismatches across map sheets were examined by the botanists involved in the mapping for the area and corrected by examining the aerial photographs. In some cases additional field work was conducted to check the modified boundaries or coding in the field.

Key results

The vegetation mapping is underpinned by a total of 2500 secondary-level and tertiary-level detailed sites based on 0.1 ha plots (shown in Map 2). Thousands of quaternary sites for ground-truthing purposes were also collected during the project. The sites and traverses were distributed so as to sample the environmental variability across the landscape, given the time and accessibility constraints.

A total of 170 vegetation ecosystems are defined and mapped for the South-Eastern Queensland RFA study area, comprising 32 open-forest, 71 woodland and 10 open-woodland ecosystems, 37 rainforest and vine thicket ecosystems and 20 non-forest ecosystems.

A comprehensive technical report (Bean et al. 1998) provides detailed descriptions and distribution data for each of the forest ecosystems. A small map showing the pre-clearing and existing distributions is provided for each forest ecosystem, together with a listing of the characteristic species in each stratum, ecological notes on the environmental and landscape conditions where it occurs, and statistics on the areas in current conservation reserves. The regional ecosystems coverage was derived from the vegetation ecosystem coverages. The JANIS (1997) criteria have been applied to the regional ecosystems, and the results of this analysis are discussed in the regional ecosystems report.

FOREST ECOSYSTEM MAPPING AND ANALYSIS OF THE SOUTH-EAST QUEENSLAND BIOGEOGRAPHIC REGION

EH 1.2

PART B: REGIONAL ECOSYSTEMS

Project objectives

The two main objectives of the Regional Ecosystems Component of EH 1.2 were to:

- convert vegetation mapping units from EH 1.2 Part A to regional ecosystems (REs) and compile an RE map for South-East Queensland. REs are classification units that combine the living components of the landscape (plants and, where data permit, animals) with the non-living components, in particular geology, landform and climate.

REs are used as a basis for conservation planning across Queensland by the Queensland Department of Environment and Heritage.

- provide information about the pre-clearing and present areas of each RE and the distribution and extent within protected areas and State forests.

Methods

Vegetation maps show the distribution and extent of groupings of plant species. These map units have been combined with environmental features to form regional ecosystems. In recognising and describing REs, emphasis is placed on groupings of species that grow under particular environmental conditions. For example, in inland parts of South-East Queensland, hillsides of sedimentary rocks and some volcanic rocks support patches of forest containing spotted gum and narrow-leaved ironbark. The groupings of species associated with particular environments may be localised or, in the example of spotted gum and narrow-leaved ironbark forests, relatively widespread. The present and pre-clearing extent of each RE has been calculated using a computer-based geographic information system (GIS). The GIS has also been used to calculate the distribution and extent of REs within protected areas (national parks, conservation parks and resource reserves declared under the *Nature Conservation Act 1992* and State forests.

Key results

A total of 142 REs have been defined in South-East Queensland. In terms of broad vegetation classes there are:

- 52 *Eucalyptus* forest REs
- 31 *Eucalyptus* woodland REs
- 20 non-*Eucalyptus* forest and woodland REs (e.g. paper-barked tea tree forest)
- 26 rainforest and vine thicket (softwood scrub) REs
- 13 non-forest REs (e.g. coastal wallum shrublands).

A description of *Eucalyptus* forest and woodland REs, the current and pre-clearing extent of each and the percentage of pre-clearing extent in protected areas are provided in Table 4. These descriptions are heavily abbreviated.

The *Eucalyptus* forest and woodlands listed support a wide range of uses including native hardwood timber, grazing, honey production, nature conservation and environmentally-based recreation.

The major output from the project is maps of RE distributions compiled at a scale of 1:100 000. These are stored in computer systems and can be produced for any part of the region. The mapped information can also be used to generate indicative statistics about REs such as the total area present within any prescribed part of the region.

Table 4. Selected regional ecosystems and approximate area statements

Regional ecosystem		Preclearing extent (ha)	Current extent (ha)	Current extent (%)	% Preclearing extent in protected areas
12.2.6	scribbly gum forest on dunes	77 000	75 200	97	80
12.2.8	blackbutt forest on dunes	20 500	19 800	96	90
12.3.2	rose gum tall open forest fringing streams	23 500	13 800	58	6
12.3.3	forest red gum open forest on alluvial plains	694 000	73 000	10	<1
12.3.9	*Eucalyptus* nobilis tall open forest fringing streams	900	600	72	<1
12.3.10	poplar box on alluvial plains	27 200	200	<1	0
12.3.11	grey ironbark-forest red gum-pink bloodwood open forest on alluvial plains	129 100	49 800	38	<1
12.5.1	mixed forest with spotted gum, grey gum, brown bloodwood on red soil plateaus	36 500	18 000	49	<1
12.5.2	forest red gum and/or pink bloodwood forest on red soil plateaus	24 800	7100	28	4
12.5.3	scribbly gum and/or Queensland white stringybark on coastal Tertiary surface remnants	51 700	6900	13	1
12.5.5	narrow-leaved ironbark woodland on red soil plateaus	43 300	6500	15	0
12.5.6	grey ironbark, grey gum, tallowwood ± blackbutt tall open forest on red soil plateaus	13 400	3800	28	0
12.5.7	spotted gum ± white mahogany, broad-leaved red ironbark open forest on red soil plateau remnants	39 100	28 000	71	<1
12.5.8	Goodwood gum woodland on coastal Tertiary surface remnants	16 400	10 100	37	9
12.5.11	turpentine on coastal Tertiary surface remnants	9900	2100	26	<1
12.5.12	broad-leaved white mahogany, bloodwood, rusty gum on coastal Tertiary surface remnants	104 000	47 000	38	2
12.7.1	gum-topped ironbark and/or brown bloodwood woodland on rocky jump ups	300	230	59	0
12.7.2	*Eucalyptus rhombica*, brown bloodwood, *E. virens* woodland on rocky jump ups	750	750	17	0
12.8.1	New England blackbutt and/or blackbutt tall open forest on Tertiary volcanics	10 500	8600	8	36
12.8.2	Blue Mountains ash open forest on Tertiary volcanics	370	370	67	100
12.8.8	Sydney blue gum or flooded gum tall open forest on Tertiary volcanics	14 900	6400	100	5
12.8.10	silvertop stringybark tall open forest on Tertiary volcanics	700	500	56	3
12.8.11	Dunn's white gum tall open forest on Tertiary volcanics	300	200	48	46
12.8.12	messmate stringybark open forest on Tertiary volcanics	200	200	40	100
12.8.14	mixed open forest with thin leaved stringybark, forest red gum, yellow box, grey gum on Tertiary volcanics	48 500	39 900	75	25
12.8.16	narrow-leaved ironbark woodland on Tertiary volcanics	130 000	35 000	94	5
12.8.17	silver-leaved ironbark woodland on Tertiary volcanics	46 000	24 000	62	4

Table 4. Selected regional ecosystems and approximate area statements

12.8.20	scribbly gum or gum-topped ironbark woodland on Tertiary volcanics	8400	6600	87	22
12.8.24	spotted gum, narrow-leaved ironbark open forest on Tertiary volcanics	5200	1000	100	4
12.8.25	white mahogany, grey gum, ironbark open forest on Tertiary volcanics	6100	3400	68	8
12.9/10.1	lowland tall open forest with pink bloodwood, red mahogany, swamp mahogany, rose gum, turpentine on sedimentary rocks	7100	2000	66	<1
12.9/10.2	spotted g um, narrow-leaved ironbark open forest on sedimentary rocks	220 000	82 000	41	1
12.9/10.3	gum-topped box open forest on sedimentary rocks	84 400	22 000	63	<1
12.9/10.4	mixed coastal open forest with scribbly gum and/or Queensland white stringybark on sedimentary rocks	102 000	39 000	61	9
12.9/10.5	mixed open forest with brown bloodwood, spotted gum, stringybark, grey gum, ironbark on quartzose sandstone	48 500	28 700	21	<1
12.9/10.7	narrow-leaved ironbark woodland on sedimentary rocks	193 000	34 000	45	<1
12.9/10.8	silver-leaved ironbark woodland on sedimentary rocks	10 500	900	80	0
12.9/10.9	mixed coastal open forest of broad-leaved white mahogany, rusty gum, brown bloodwood, Queensland peppermint on sedimentary rocks	36 600	24 700	100	<1
12.9/10.13	*Eucalyptus corynodes* open forest on sedimentary rocks	100	100	82	100
12.9/10.14	blackbutt tall forest on sedimentary rocks	22 900	12 800	100	<1
12.9/10.17	mixed open forest with grey gum, grey ironbark, white mahogany ± spotted gum on sedimentary rocks	133 000	64 400	43	2
12.9/10.18	rusty gum woodland on sedimentary rocks	9500	3800	65	0
12.9/10.19	broad-leaved red ironbark open forest on sedimentary rocks	65 700	49 400	70	<1
12.9/10.20	New England blackbutt open forest on sedimentary rocks	5700	5400	100	2
12.9/10.21	white mahogany open forest on sedimentary rocks	27 500	17 200	82	0
12.9/10.23	Yarraman ironbark open forest on sedimentary rocks	4600	4000	26	29
12.9/10.24	*Eucalyptus suffulgens* woodland on sedimentary rocks	3700	3700	51	1
12.11.2	Sydney blue gum/flooded gum, tallowwood, brush box tall open forest on metamorphics	24 500	16 700	78	10
12.11.3	mixed tall open forest with grey gum, grey ironbark, white mahogany on metamorphics	149 000	100 000	18	2
12.11.5	mixed tall open forest with spotted gum on metamorphics	194 000	80 000	55	<1
12.11.6	spotted gum, narrow-leaved ironbark open forest on metamorphics	348 000	222 000	17	<1
12.11.7	narrow-leaved ironbark woodland on metamorphics	165 000	57 000	34	<1
12.11.8	silver-leaved ironbark woodland on metamorphics	33 000	8800	26	0
12.11.9	forest red gum, grey gum, yellow box open forest on metamorphics	5000	4000	79	12
12.11.14	Clarkson's bloodwood, forest red gum woodland on metamorphics	17 000	8900	52	0

Table 4. Selected regional ecosystems and approximate area statements

12.11.15	woodland on serpentinite	16 500	10 500	63	0
12.11.16	mixed tall open forest with Gympie messmate on metamorphics	16 600	4800	29	0
12.11.17	white mahogany tall open forest on metamorphics	56 500	41 500	73	<1
12.11.18	gum-topped box open forest on metamorphics	53 300	21 200	39	<1
12.11.19	broad-leaved red ironbark open forest on metamorphics	17 300	10 600	61	0
12.12.2	blackbutt tall open forest on older volcanics	32 200	21 200	65	3
12.12.3	mixed tall open forest with spotted gum, grey gum, grey ironbark, white mahogany on older volcanics	91 000	61 900	67	<1
12.12.4	mixed tall open forest with red mahogany, white mahogany, *Eucalyptus decolor*, turpentine on older volcanics	18 200	17 400	95	6
12.12.5	spotted gum, narrow-leaved ironbark open forest on older volcanics	296 000	152 000	51	<1
12.12.6	Queensland ash open forest on older volcanics	1200	1000	83	28
12.12.7	narrow-leaved ironbark woodland on older volcanics	275 000	72 000	26	1
12.12.8	silver-leaved ironbark woodland on older volcanics	117 000	29 800	23	<1
12.12.9	brown bloodwood gum-topped ironbark, Queensland peppermint woodland on older volcanics	14 200	12 700	89	20
12.12.11	white mahogany open forest on older volcanics	99 000	86 000	86	6
12.12.12	forest red gum, ironbark, swamp mahogany open forest on granite basins	39 400	11 100	28	3
12.12.14	scribbly gum woodland on older volcanics	6100	2600	42	<1
12.12.15	mixed tall open forest with pink bloodwood, tallowwood, grey ironbark, grey gum on older volcanics	48 700	35 800	73	1
12.12.20	Sydney blue gum tall open forest on older volcanics	5800	5800	100	1
12.12.21	narrow-leaved ironbark, Clarkson's bloodwood, Queensland peppermint, paperbark woodland on coastal older volcanics	8200	8000	96	18
12.12.22	Clarkson's bloodwood, forest red gum woodland on older volcanics	17 800	7900	44	0
12.12.23	forest red gum, pink bloodwood woodland on granite ranges	89 000	28 000	31	<1
12.12.24	rusty gum woodland on older volcanics	9900	8200	83	<1
12.12.25	broad-leaved ironbark woodland on older volcanics	10 500	9000	85	<1
12.12.27	brown bloodwood woodland on older volcanics	8200	900	98	0
12.12.28	gum-topped box woodland on older volcanics	19 500	19 200	33	22

OLD GROWTH ASSESSMENT, MAPPING AND ANALYSIS

EH 2.1

Project objectives

The objective of the Old Growth Assessment, Mapping and Analysis project was to map the distribution of old growth forest of eucalypt-dominated forest types for all land tenures throughout the South-East Queensland RFA region.

Methods

A methodology for mapping old growth forest in South-East Queensland was described in the *Assessment of old growth forest in South-East Queensland: interim report* (DNR 1996). Refinements to the methodology, based on recommendations from the interim report, resulted in a system of mapping appropriate to the complexity of the forest systems in South-East Queensland. The methods used in the project have built on experience gained in similar projects in other States of Australia and overseas. In particular, important lessons have been learned from old growth assessments conducted in East Gippsland in Victoria (DCNR 1990) and in northern New South Wales (RACAC 1996). The methodology is a synthesis of information collected over two years of intensive air photo interpretation (API), field research, disturbance information collection and validation. Figure 3 summarises the components of the method and the interaction between those components.

As was the case for old growth assessment projects in other states, API provided the primary layer in the interpretation of the forest stands of South-East Queensland. In this assessment, forests are categorised on crown structural attributes (i.e. growth stage and/or presence of disturbance) for eucalypt forests and includes broad stratification of non-eucalypt types (see Figure 4). The approach used to assess old growth in East Gippsland was based principally on the use of API to classify forests according to the growth stage characteristics of canopy trees as demonstrated by crown form. This approach assumes that all eucalypts progress through identifiable growth stages characterised by morphological features of the crown structure, as first described by Jacobs (1955). The subtropical forests of South-East Queensland are generally quite complex, with a diverse range of ages and species, and differ significantly from East Gippsland forests in their composition and function. At the beginning of this project it was already recognised that an API-based crown-form assessment, such as was used in East Gippsland, was unlikely to be directly transferable to the forests of South-East Queensland (Norman 1995). Consequently, considerable effort was directed in this project both towards establishing the limits to which such an approach could be reliably applied in South-East Queensland, and in investigating alternative approaches that could be used to address the inadequacies of the method. In response to this, the project team tailored an approach that incorporated both crown form and other indicators of disturbance, with varying emphases and thresholds depending on the nature of the forest ecosystem and of the disturbance environment.

The study included field validation of API polygons in order to assess the accuracy of API across a range of forest types. In addition, more intensive field research was performed in an attempt to resolve the issue of old growth delineation within dry mixed-age forests, and resulted in the construction of a set of ‘decision rules’ for these forests.

The project identified a number of disturbance types that are considered likely to have significant impacts on the condition of eucalypt-dominated forest ecosystems in South-East Queensland. These included:

- logging and silviculture
- grazing and treatment
- fire (controlled and wild)
- clearing and agriculture.

Information on these disturbance types was collected in the study through intensive consultation with district staff, management of a large database and digitisation of a great number of hard copy maps. The project compiled a comprehensive Geographical Information System of digital coverages of historical records for multiple-use forests (State forests and designated timber reserves). A lesser level of information was available for conservation reserve tenures, and information for other tenures such as freehold was even more limited. The process of collection of the data, coupled with field validation, revealed that there were differences between districts and data types in the accuracy of the data. In addition, accessibility modelling was used as a surrogate for disturbance information in

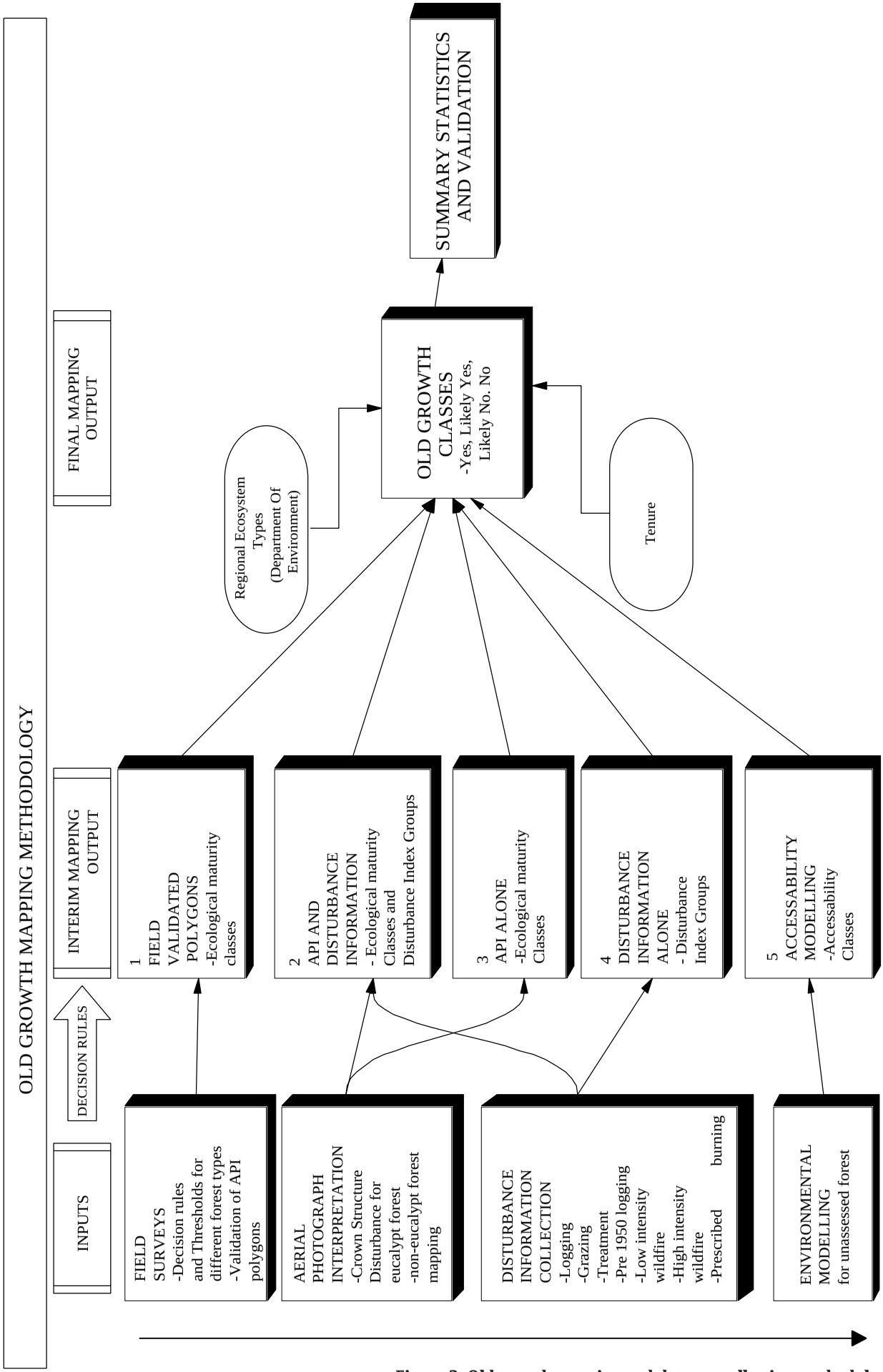

Figure 3. Old growth mapping and data set collection methodology

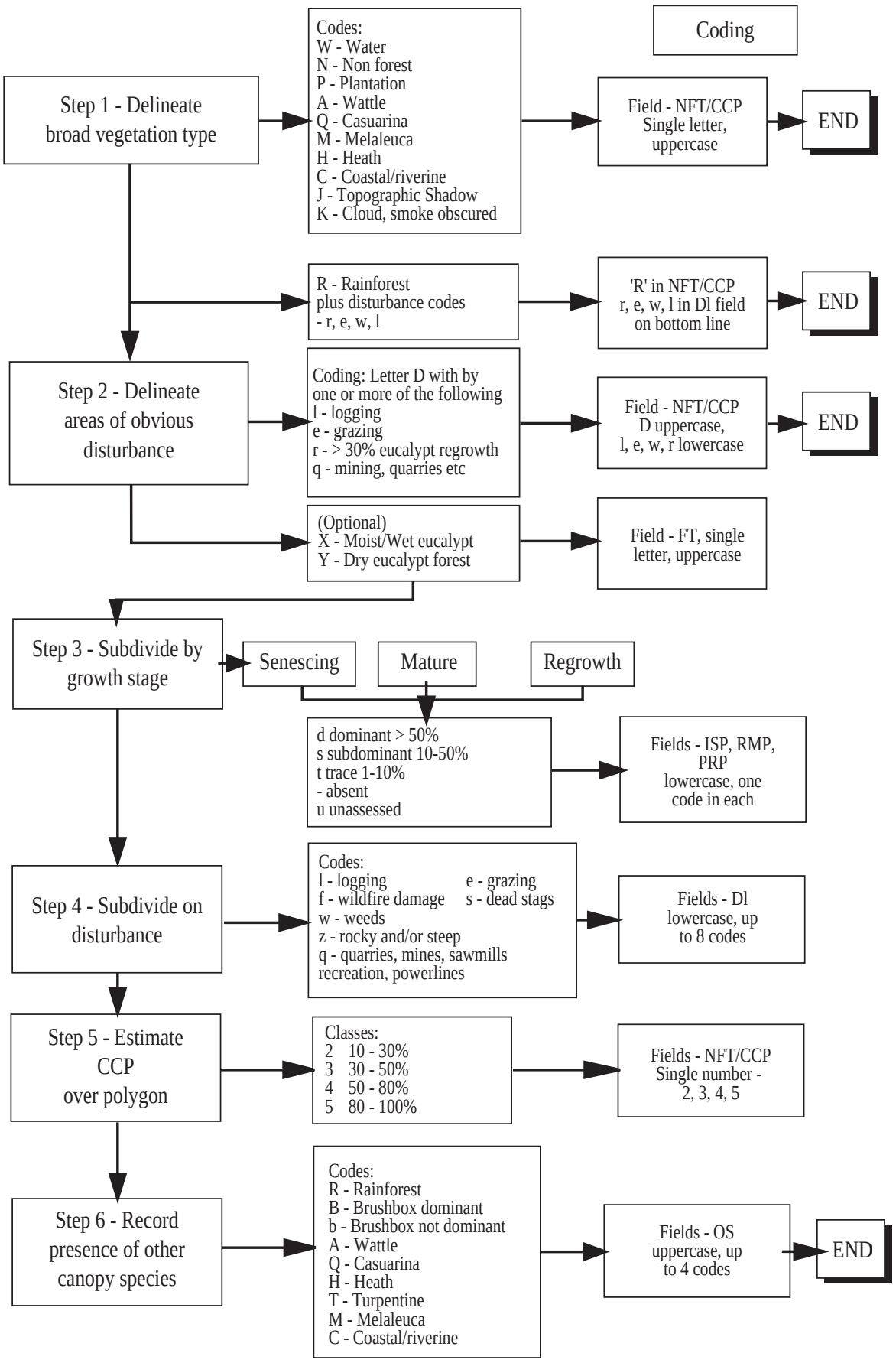

Figure 4. API decision pathway

limited areas within the bioregion where there was no other available information. Access modelling provides an indication of the likelihood of areas being subjected to logging disturbance based on the presence of roads, ridgelines and barriers to mechanical logging such as escarpments and cliffs.

Data sets compiled from these sources were then processed through decision rules to produce a set of classes or groups ranging from most ecologically mature to least ecologically mature with varying degrees of confidence depending on the data sets used. Different rules for defining the level of disturbance and ecological maturity were used depending on the underlying vegetation as defined by the Department of Environment and Heritage herbarium vegetation coverage. These groups were then categorised into four classes ranging from areas most likely to be classifiable as old growth to disturbed areas not classed as old growth.

Key results

The region contains 3 545 237 hectares defined as forest, of which 1 360 360 hectares (approximately 43 per cent) were assessed by this project. Areas not assessed were primarily plantation and non-eucalypt natural forest, largely rainforest. These areas were excluded either because it was inappropriate to assess them or because it was not possible within the resources available to apply or interpret a definition of old growth relevant to them.

Based on the analysis contained within this report, the total area of class 1 ('Yes' old growth) old growth forest within the region is 97 201 hectares or 2.7 per cent of the total area of forest, and the total area of class 2 ('Likely yes' old growth) old growth forest is 204 325 hectares or 5.8 per cent of the total area of forest.

Of the 301 526 ha of old growth forest (classes 1 and 2) within the bioregion, 40 per cent is concentrated within conservation reserves, with a lesser proportion within State forests (16 per cent). The remaining proportion occurs in forested areas other than State forests and conservation reserves (44 per cent).

The output layers provided by this project for the purposes of the CRA are characterised as follows in Table 5. The GIS layer outputs available are classified into two groups based on the process of derivation used during analysis.

Table 5. Output layers from the old growth project

Base layers	Modelled layers
aerial photograph interpretation	logging accessibility layer
logging history	
grazing history	
treatment history	
fire history (prescribed burns and wildfire) woody/non-woody mask (NFI) grouped vegetation mapping (DoE)	

The final extent of data captured during the project has been spatially represented in Map 4 detailing the spatial occurrence of the fire, logging, grazing and grazing treatment as well as the API and field-validated coverages. These data sets represent a snapshot of disturbance over the region that will become outdated as new leases are issued or expire, new fires have occurred and logging and grazing treatment activities take place. The issue of currency about these coverages is being addressed, and a program of data update is anticipated. All forestry districts were covered during the project, and all available relevant data retrieved and compiled from these offices, representing the most complete inventory of disturbance that occurs for this region.

WILDERNESS ASSESSMENT, NATIONAL ESTATE WILDERNESS AND EXTENSIVE NATURAL VALUES

EH 3.1

PART A: WILDERNESS ASSESSMENT

Project objectives

The identification of wilderness areas is a key component of the Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia (Commonwealth of Australia 1997), commonly referred to as 'the JANIS criteria'. This agreement specifies that 90 per cent (or more if practicable) of areas of high quality wilderness that meets the minimum area requirements should be protected in reserves.

Wilderness

Wilderness is defined in the National Forest Policy Statement (NFPS) as:

> land that, together with its plant and animal communities, is in a state that has not been substantially modified by, and is remote from, the influences of European settlement or is capable of being restored to such a state; is of sufficient size to make its maintenance in such a state feasible; and is capable of providing opportunities for solitude and self-reliant recreation (National Forest Policy Statement 1992).

In relation to wilderness, the Scoping Agreement for Queensland Regional Forest Agreements states:

> This assessment will include wilderness areas identified under the National Wilderness Inventory (NWI) analysis of wilderness in the region. The NWI analysis will be refined by the application of disturbance information from old-growth forest surveys, improved information on the nature of road access and additional information of relevance.

Stakeholder groups have expressed strong interest in identifying areas that have wilderness quality of less than 12, but which may be readily restored to wilderness. The identification of such areas involves investigation of the four wilderness quality 'indicators' of remoteness and disturbance that combine to comprise wilderness quality in the National Wilderness Inventory (NWI).

Methods

Wilderness

The detailed methodology for the identification of wilderness is that developed by the National Wilderness Inventory (NWI) and implemented in previous CRAs (Lesslie and Maslen 1995a).

Wilderness identification is conducted in two general stages:

- updating and analysing data using the National Wilderness Inventory (NWI) to produce maps of wilderness quality
- delineating wilderness areas (boundary identification), using the National Wilderness Inventory (NWI) database and other relevant information.

In accordance with JANIS, the identification of wilderness does not take into account land tenure or reservation status. Issues concerning land tenure and reservation status will be addressed later, during the integration process.

The NWI is a computer-based mapping system that presents wilderness as being part of a continuum of remote and natural conditions that vary from essentially undisturbed at one end of the continuum to urban at the other end (Lesslie and Taylor 1985). Consistent and objectively measurable criteria are used in the collation and analysis of data (Lesslie and Maslen 1995a).

NWI assessments seek to identify and assess the common environmental attributes that many wilderness-related benefits are based on. They do not include anthropocentric characteristics such as aesthetic, landscape or recreational values. Some physical characteristics of the land that are relevant to the identification of wilderness, such as topography, are also not included in NWI assessments but are taken into account at the delineation stage.

The NWI measures wilderness quality across the landscape by using four wilderness quality 'indicators' that

represent the two essential attributes of wilderness: remoteness and naturalness. The indicators are derived from the definition of wilderness quality as the extent to which a location is remote from, and undisturbed by, the influence of modern technological society. The distance related indicators (settlement, access and apparent naturalness) are essentially current AUSLIG digital mapping data updated with additional information in the detailed study areas.

The four wilderness quality indicators are:

1. *Remoteness from settlement*–remoteness from places of permanent occupation
2. *Remoteness from access*–remoteness from established access routes
3. *Apparent naturalness*–the degree to which the landscape is free from the presence of permanent structures associated with modern technological society
4. *Biophysical naturalness*–the degree to which the natural environment is free from biophysical disturbance caused by the influence of modern technological society. In South-East Queensland, the factors that determine biophysical naturalness are logging and grazing.

The rating scheme for biophysical naturalness used in the National Wilderness Inventory as applied to the RFA is outlined in Table 6.

Table 6. Biophysical naturalness rating scheme used in the National Wilderness Inventory for South-East Queensland

Indicator value	National Wilderness Index descriptor
5 (high)	No evidence of logging or grazing. Natural vegetation cover, free from disturbance
4	Pre-1950s logging, regrowth or evidence of slight small scale disturbance to canopy with no associated records of logging in areas of rainforest or natural canopy cover.
3	Evidence of disturbance by light grazing or disturbance to canopy in unlogged or pre-1950s logged areas including grazed land.
2	Grazed lands under altered canopy.
1 (low)	Clear fell logging since 1950 with minimal regrowth.
0	Agricultural, urban and developed land, pine and other exotic plantations, reservoirs.

Aerial photo interpretation, and the logging and grazing disturbance information developed as part of the CRA Old Growth Forest project (EH 2.1), was used to update the biophysical naturalness indicator. The Old Growth project is summarised elsewhere in this report.

Each grid cell across a project area is assigned a value of between 0 and 5 for each of the four NWI indicators. A total wilderness quality index is produced by summing the values of the four indicators, resulting in a total wilderness quality scale ranging from 0 to a maximum value of 20. This procedure rests on the assumption that each indicator contributes independently and equally to total wilderness quality.

Areas with a wilderness quality index equal to or above 12 are considered significant for identifying wilderness. Map 5 shows potential wilderness areas in the RFA region, based on the application of the JANIS criteria.

The JANIS criteria that deal specifically with wilderness identification and assessment in the CRA/RFA process are:

- Potential areas (of high quality wilderness) will have a minimum National Wilderness Inventory (NWI) rating of 12. In addition, minimum thresholds for each of the wilderness quality indicators will be set within the regional context. These thresholds will take into account the importance of the indicators, and in particular the biophysical naturalness component as a primary indicator.
- The guideline for size which is considered generally appropriate for areas encompassing forested wilderness is 8000 hectares. However, thresholds of less than 8000 hectares may apply to areas contiguous with the sea or which adjoin wilderness areas in adjacent regions.
- The presence of nodal areas with higher wilderness quality may provide an indication of their significance and may guide the future management of identified wilderness areas.
- Other factors which are not considered in determining the NWI rating may need to be considered, in determining wilderness quality. These factors may include the impacts of exotic plants and feral animals on biophysical naturalness.
- As forest and non-forest vegetation types form a mosaic, non-forest vegetation types may be included within largely-forested wilderness areas.

Delineating wilderness areas

The delineation of wilderness areas is guided by the JANIS report and general principles of conservation reserve boundary identification. The process concentrates on identifying rational and manageable boundaries for wilderness areas that are clearly identifiable on the ground wherever possible. The JANIS report includes the following guidelines for determining appropriate boundaries for areas of high wilderness quality:

- potential areas identified using the NWI database will be considered in a regional context to ensure their viability as wilderness, including considerations of shape
- both ecological and management features such as topography, water catchment boundaries, roads and other transport routes, may be useful when delineating boundaries
- wilderness values also will need to be maintained by appropriate management and design of wilderness areas.

Key results

Wilderness

The following areas have been identified as meeting JANIS wilderness criteria. The areas (ha) are approximate only and will be finalised during integration:

Fraser Island north	50 000
Kroombit Tops	55 000
Cooloola East	27 000
Blackdown Tableland	47 000
Bania (upper Burnett River)	10 000
Mts Huntley, Roberts	14 400
Pine Creek	8 600
Mt Molangul (Many Peaks Range)	8 000
Lamington Plateau	7 000 (contiguous with NSW wilderness)
Mt Barney	8 000

WILDERNESS ASSESSMENT, NATIONAL ESTATE WILDERNESS AND EXTENSIVE NATURAL VALUES

EH 3.1

PART B: EXTENSIVE NATURAL VALUES

Project objectives

This project identifies the following natural values that are extensive in nature and operate at the landscape scale:

- wilderness areas
- remote and natural areas
- natural landscapes
- undisturbed catchments

All of these extensive natural values are assessed against national estate sub-criterion B.1: ‘importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness’. (See Appendix D.)

Wilderness

The wilderness assessment undertaken for the CRA was used as the basis for the national estate wilderness assessment.

Remote and natural areas

Remote and natural areas are areas that have significant value for their relative lack of disturbance, remoteness, and relatively natural condition but that are considered to be too small to qualify as wilderness. They are not a substitute for wilderness areas.

Natural landscapes

Natural landscapes are large, relatively undisturbed areas with topographic and catchment integrity, where natural processes continue largely unmodified by the impacts of European settlement. Natural processes include the following:

- energy flows
- nutrient cycling
- hydrological processes
- ecological and evolutionary processes, such as succession and speciation.

Within the context of forested regions of Australia, natural landscapes are uncommon and in some regions rare occurrences. The essential difference between natural landscapes and wilderness is that remoteness indicators do not form part of the analysis of natural landscapes.

Undisturbed catchments

Catchments or sub-catchments that are essentially undisturbed are an uncommon if not rare component of the Australian landscape. Through the work and datasets maintained by the Wilderness and Wild Rivers section of Environment Australia it is possible to identify these catchments. The analytical tools used to identify undisturbed catchments are closely linked with the data sets and methods used to determine wilderness.

Methods

Wilderness

As the wilderness assessment undertaken for the CRA was used as the basis for the National Estate wilderness assessment, the methods for deriving wilderness quality and delineating the boundaries of wilderness areas are described in more detail under the Wilderness Assessment project in this chapter.

Remote and natural areas

Remote and natural areas may be identified using the National Wilderness Inventory and wilderness quality index in the same way that wilderness is identified. The same principles used to delineate wilderness boundaries are applied to those of remote and natural areas, though a lower index value and smaller minimum area may be used.

Natural landscapes

The assessment of natural landscapes is based on the biophysical naturalness indicator of the National Wilderness Inventory, which indicates the degree to which the natural environment is free from biophysical disturbance caused by the influence of modern technological society. The indicator provides a six class rating, from a value of 0, representing cleared land, to a value of five, representing areas free of significant unnatural disturbance. A description of the indicator values is shown in Table 6.

Areas with potential value as natural landscapes are contiguous areas of high biophysical naturalness that have a size and integrity in the landscape, that allow natural processes to continue largely unmodified.

Undisturbed catchments

Undisturbed catchments are identified by analysing impediments to river flow and the naturalness of catchments.

The assessment of undisturbed catchments is based on the wild rivers database (Stein 1995) held by the Wilderness and Wild Rivers section, Environment Australia. The database is made up of geographical data derived from topographical map series and the NWI database. The NWI sources provide information about settlement infrastructure features , the extent of non-natural landcover and an index of biophysical naturalness. Topographic map series provide data on watercourses, built up areas, infrastructure, reservoirs and canals.

The wild rivers database delineates a modelled sub-catchment for each stream segment, as defined on the AUSLIG 1:250 000 scale hydrography theme database. The database allows an assessment of river/stream quality across the sub-catchment areas based on an index of the naturalness of the river flow regime and an index of the naturalness of the sub-catchment.

Key results

For a list of wilderness areas identified as meeting JANIS wilderness critieria see page 50.

Natural landscapes

Areas with most potential value as natural landscapes in the South-East Queensland RFA region have been identified in the Blackdown Tableland, Fraser Island, Cooloola, Bunya Mountains, Main Range and Mt Barney. The Conondale and D'Aguilar Ranges are also notable for potential natural landscapes.

Undisturbed catchments

An undisturbed catchment coverage was generated from information held in the Wild Rivers database. The coverage indicated undisturbed catchments in the Blackdown Tableland, Kroombit Tops and the north of Fraser Island. However a threshold to capture undisturbed catchments is yet to be determined for South-East Queensland. In the process of identifying potential wilderness areas in South-East Queensland, significant new infrastructure and disturbance information was identified. Work to incorporate this updated information has commenced and the Wild Rivers database will be interrogated again to generate a new coverage. Undisturbed catchments will then be re-assessed in the context of the most recent disturbance information.

NATIONAL ESTATE PROJECTS

This section presents the outcomes of the National Estate component of the comprehensive regional assessment (CRA) of South East Queensland's forests. It will contribute to the development of the Regional Forest Agreement (RFA) for this region.

As defined in the *Australian Heritage Commission Act 1975*, the National Estate comprises:

> those places, being components of the natural environment of Australia, or the cultural environment of Australia, that have aesthetic, historic, scientific or social significance or other special value for future generations as well as the for the present community.

The Australian Heritage Commission (AHC) is responsible for the identification of the National Estate and, under section 30 of the Act, for advising the Commonwealth Government on the conservation of National Estate places. It also advises on the potential impact of Commonwealth decisions relating to National Estate places. The Act also requires the establishment of the Register of the National Estate. The Register includes places of importance at a local, regional, state or national level. The identification and assessment of places for inclusion on the Register is guided by the National Estate criteria (Appendix D).

Areas identified as having potential National Estate value, as a result of the work undertaken in these projects, are indicative only. These projects document the values that need to be taken into account in determining National Estate places; the data generated by these projects will form the basis of that determination by the AHC. The data layers and indicative areas will remain indicative until they have been considered by the AHC.

Areas endorsed by the AHC will be entered in the interim list of the Register of the National Estate. The AHC will delineate National Estate places based on the value assessments and protection afforded in the formal and informal reserve system. Those places will then be advertised and subject to the statutory period of three months allowed for public comment. Interim listing of areas identified through this process can then occur.

Indicative National Estate areas of natural value are identified in value layers covering wilderness and extensive natural values, flora and fauna values, old growth and geoheritage and natural history sites. Indicative National Estate areas of cultural value may occur in areas identified as having natural National Estate value. The National Estate areas of cultural value are identified in value layers covering social, historic and aesthetic cultural values.

The National Estate component of the CRA has greatly enhanced our knowledge of the occurrence of National Estate values in the forests of South-East Queensland. Some of the indicative places and areas identified within the CRA region occur in existing National Estate listed places. Places already in the Register of the National Estate and those on the interim list will be reviewed in the light of the information gathered during the CRA.

It is expected that the South-East Queensland RFA will include details for agreed National Estate outcomes. It is expected this will provide a basis for both the listing of places and the long term management of National Estate values in forests.

Maps of the distribution of identified potential National Estate values do not accompany this report. Copies of mapped values for these projects are available at the following internet address: http://www.rfa.gov.au/rfa/seq/assessment/index.html.

NATIONAL ESTATE: COMPILATION AND ASSESSMENT OF PLACES OF GEOHERITAGE SIGNIFICANCE

EH 5.1.1

Project objectives

This project identified indicative areas of National Estate geoheritage significance in the South-East Queensland RFA region. The full range of geodiversity values were addressed, including geological, landform and soils features and processes, as well as evidence of past life, ecosystems and environments. Consistent with National Estate criteria, representative as well as outstanding sites were considered (Cook et al. 1997).

The project collated existing information on places of geoheritage significance and aimed to identify and fill major gaps in this information. The project assessed potential sites of geoheritage significance against National Estate criteria and identified conservation management guidelines for these sites.

Methods

A review of the geodiversity within the region highlighted the the broad classes of features and processes. A preliminary list of potentially significant geoheritage sites was developed based on a review of published and unpublished documentary sources, and consultation with relevant experts.

Data sets were compiled using published records of geological heritage sites, field guides, geological maps and Queensland Museum corporate datasets. Type fossil localities were identified using sources that included the published catalogues of Lees (1986), Rozefelds (1986), Rozefelds, McKenzie & Mobbs (1990), Turner (1982), Parfrey (1996) and Queensland Museum datasets.

Geological information was compiled from field guides and 1:250 000 geological maps and explanatory notes. Updated national parks and forestry information were identified from recently published maps.

Key sites were identified and located on 1:100 000 scale topographic maps.

Initially 53 sites were identified. All identified sites were placed in broad groupings to identify potential gaps in the landscape and geoheritage sites examined. Additional sites were examined as a result of this review.

An expert workshop was held to assess sites of geoheritage significance against the National Estate criteria described in Appendix D.

The workshop agreed that broad divisions of sites would be the most effective way of dealing with the range of landscapes and geological sites discussed. These divisions were:

- fossil sites
- sites of the Great Sandy Region representing aeolian coastal processes
- sites related to volcanism and igneous activity
- soil sites
- sites relating to weathering and erosional features
- other sites, ungrouped.

Key results

The geoheritage expert workshop determined the sites listed in Table 7 to be above threshold. Appendix D describes the National Estate criteria.

Table 7 Geoheritage sites above threshold value

Grouping	Site name	National Estate Criteria
Great Sandy Region aeolian coastal sites	Giant Sand Dunes Moreton Island	*A1, B1,A2, E1,C1,D1*
	Bribie Island	*A1,A2,C1,E1,D1*
	Cooloola-Noosa R.	*A1,B1,C1,A2,D1*
	Amity Point fossil reef site	*A1, C1, B1*
	Fraser Island	*A1 Most of A,B, C, D,E criteria*
Sites relating to volcanism and igneous activity	Deception Bay Beach ridges	*A1,C1,D1,A2,B1*
	Minto Crags Ring Dyke	*A2,A3,C1, E1*
	Ivory's Rock South Ipswich	*A3,C1,E1*
	Laminton volcanics peaks include. Moogerah Peaks, Mt Greville,Mt French	*D1,B1,A3,D1,E1,C1*
	Coalstoun Lakes & Dundurrah Lava Tube	*A1,C1,B1,A3,E1*
	Mt Pinbarren	B1,E1,D1
	Mt Barney igneous complex	*A1,C1,A3*
	Mt Cooroy	C1
	Noosa National Park	*A1,C1,B1,E1*
	Monsildale Gabbro	*C1*
	Glasshouse Mountains	*A1,B1,C1,D1,E1,A3*
	Kangaroo Point Cliffs and sedimentary dyke	*C1,A1,B1, E1*
	Mapleton/ North arm volcanics	*D1,A1*
	Mount Tamborine Pillow Basalts	*C1,A1,D1*
	Childers Basaltic plateau	*C1, A1,D1*
	Somerset Dam	*C1,D1,A1*
Structural or stratigraphic	Shorncliffe deformed sedimentary rocks and fossil site	*C1*
	Lutwyche Rd unconformity	*C1*
	Salisbury Unconformity	*C1*
	Vulture Street Folds	*C1*
	Pine Mtn Serpentinite and related mine	C1
	Lake Kurwongbah Metamoprhics	*C1*
	Mt Elphinstone	*C1*
	Mount Gravatt Folded Cherts	*C1*
	Brassal Quarry, Triassic fossil plant locality	*C1,B1*
	Baroone Rd fossil insect locality	*A1,B1,C1*
	Mount Crosby Fossil Insect Locality	*B1,A3,C1,A1*
	Cordalba Triassic invertebrate marine fossil site	*A1,B1,C1*
	Woodnum Triassic fossil invertebrate locality	*A1,B1,C1*
	Redbank Plains fossil vertebrate site	*A1,B1,C1*
	Wivenhoe fossil plant and insect localities	*A1,B1,C1*
	Torbanlea-Hervey Bay Rd invertebrate fossil locality	*C1,A1*
	Murgon Jurassic invertebrate locality	*A1,B1,C1*
	Murgon Vertebrate Fossil Site	*A1,B1,E1,C1,D1*
Weathering and erosion	Ravensbourne Sandstone Caves	*A1,C1,E1*
	Sea Caves and Cliffs, North Stradbroke Island	*A1,A2,E1*
	Bunya Mountins Basalt Caves	*A1,B1,C1, A2,A3,D1,E1*
	St Helena Island	*A1,C1, E1, D1*
	Natural Bridge Numinbah Valley	*B1C1,A3*
	Turtle Rock Caves	
	Flagstone Creek Caves	*A1,B1,C1, D1*
	Mount Tamborine Bauxite	*C1,A1,D1*
	"Mystery Craters" Kolan	*A1,C1,E1*
	Laterite Profile, Woody Point	*A1,C1*
	Deception Bay Concretionary Structures	*C1,B1*
	Cave In Valley, Mount Gravatt	*B1,C1,A3*
	Blackdown tableland escarpment	*B1,C1,D1,A3,E1*
Soil sites	Cooroy Xanthozem	*D1*
	Hillfan and xanthozem, Kin Kin Rd, Cooroy	*D1*
	Motham Mtn podsol	*D1*
	Palmwoods	*D1*
	Snake Gully crossing soloth	*D1*
	Kenilworth Rd soil on Tonalite	*D1*
Other ungrouped sites	The Narrows, Gladstone	*A1,B1,C1,D1*

The report did not consider stratotype localities known from drill core.

Many soil reference sites of potential significance exist in the study area. The study recommended that the national estate significance of these sites needs further investigation.

Conservation management

The study noted that in general geological heritage sites need limited levels of conservation management. Most of the sites identified in the study are robust, affected only by quarrying activity. The exceptions are the aeolian coastal systems, which need high levels of conservation management. The study also noted that much of the value of fossil sites lies in the material removed from them for scientific purposes and that fossils in their field locations usually weather and deteriorate quickly.

NATIONAL ESTATE: REFUGES AND SUCCESSION

EH 5.1.2

Project objectives

The objectives of this project are to:

- identify forest-related places that have National Estate significance through their role as species' refugia in response to quaternary climate changes and contemporary natural events (e.g. fire, drought)
- identify forest-related places that have National Estate significance because they illustrate succession processes for specific forest vegetation communities.

Methods

Refugia

Refugia are places where physical and biological attributes combine to provide an environment that is more resilient to climatic variation and the effects of fire than the surrounding landscape. The presence in the landscape of refuges, and the taxa that are largely restricted to them, constitutes an important source of genetic variation. Consequently, these places are important for maintaining flexibility and adaptability in times of climatic change, as well as providing an insight into the vegetation of the past.

Both climatic refugia and contemporary refugia were considered. Climatic refugia relate to National Estate sub-criterion A.1: 'importance in the evolution of Australian flora, fauna, landscapes or climate'. Contemporary refugia relate to National Estate sub-criterion A.2: 'importance in maintaining existing processes or natural systems at the regional or national scale'.

Succession

Places important for succession are forest communities that provide dynamic examples of succession occurring within them, including areas which have been affected by fire (halting primary succession processes). Such places are likely to demonstrate natural processes associated with forest succession over time, and recovery of forest communities in the wake of disturbances such as fire.

Places of importance for succession are relevant under national estate sub-criterion A.2: 'importance in maintaining existing processes or natural systems at the regional or national scale'.

Contemporary and climatic refugia and places important for succession were identified by expert opinion in the context of data sets produced by the Forest Ecosystem Mapping and Analysis project. Candidate areas were examined in relation to the National Estate criteria. In developing thresholds in the South-East Queensland context, the paucity of reliable knowledge on the attributes of refugia and the wide range of temporal and spatial scales over which refugia and succession may function were noted.

The expert panel considered the application of size thresholds inappropriate when identifying indicative areas for refuges. The size of refuges or their apparent fragmentation were not considered to be valid predictors of their importance, viability or 'integrity' in the South-East Queensland context.

Areas with relatively high levels of disturbance were not considered to be above threshold. These areas were identified as cells that were entirely classed as biophysical naturalness 2 or less. The biophysical naturalness rating scheme is described in the Wilderness and Extensive Natural Values section of this report (Table 6).

Higher disturbance thresholds were not accepted for South-East Queensland because much of the landscape is relatively highly disturbed and fragmented.

Key results

Climatic refugia

The following places were determined to be above threshold as climatic refugia:

- Border Ranges–elevated areas with cool and warm temperate rainforest ecosystems. Additionally, *Eucalyptus obliqua* ecosystems.
- Kroombit Tops–characterised by *Ceratopetalum*, *Calicoma*, Ferns (*Blechnum watsii*)
- Kingaroy/Murgon Gayndah region–Tertiary surface remnants (lateritic profile relicts)
- Bunya Mountain 'Balds'–grasslands on elevated basalts
- Moreton Basin–Brigalow, vine thicket, poplar box communities (west of Ipswich)
- Fraser Island, Cooloola, Eurimbula–rainforest complexes associated with dune systems/swales.

Contemporary refugia

The following vegetation units in the locations specified were considered above threshold for contemporary refugia (drought/fire):

- *Notophyll* vine forest
  – moist subcoastal ranges Moreton region
  – Conondale Ranges
  – Buderim Mountain footslopes
  – Kin Kin Scrub remnants
- *Notophyl*l vine forest
  – Upland Kroombit occurrence
- complex *Notophyll* vine forest
  – McPherson Range, Mt Tamborine, Mt Glorious Main Range and Mt Mee.
- *Microphyll* mossy forest
  – *Acmena smithii, Acacia melanoxylon* Main Range and Bunya Mountains crests

Dry places may also constitute refuges from contemporary processes of drought/fire. The following vegetation units were considered contemporary refugia above threshold:

- Helidon Hills – southern Lockyer region
  – sandstone outliers
- Moreton basin
  – Brigalow, vine thicket, poplar box communities.

Places illustrating succession processes

- Lamington Plateau
  – succession processes evident in both windthrown and cleared *notophyl*l rainforest.
- Conondale Ranges
  – outstanding example of eucalypt succession evident in both State forest and National Park, most notably *Eucalyptus grandis – notophyll* vine forest succession and *Eucalyptus saligna – notophyll* vine forest elements.
- Bunya Mountains

1. North-west woodland – dry rainforest succession
2. Bunya Mountains 'balds' *Poa labillardieri* grassland on Cainozoic igneous rocks showing grassland – rainforest succession/ invasion by woody species in absence of fire.

- Fraser Island, Cooloola, Eurimbula
  – dune systems/swales.

NATIONAL ESTATE – FLORA SPECIES VALUES

EH 5.1.3

Project objectives

The objective of this project is to ensure that the National Estate requirements for assessing attributes related to particular flora species are undertaken and included in the CRA process.

The particular attributes or National Estate values to be considered as part of this project are:

- species whose distribution is endemic to the RFA region
- species whose distribution within the region demonstrates a disjunct species distribution
- species at the limit of their range within the region
- places that are notable for their richness of species within the context of the region
- rare and threatened species
- species with Gondwanan affinity or association and species that are phylogenetically distinct.

This project has been based on data collected as part of the Flora Data Analysis project (EH 1.1.4). Additional information on the distribution of flora species values may be collected to supplement the Flora Data Analysis Project. This supplementary information may be incorporated into this project subject to the time constraints imposed by the wider RFA process.

Methods

This project was based on data developed as part of the Flora Data Analysis project (EH 1.1.4), and the Forest Ecosystem Mapping project (EH 1.2). Both projects are described earlier in this report.

This project has been based on data collected as part of the Flora Data Analysis project (EH 1.1.4). Additional information on the distribution of flora species values may be collected to supplement the Flora Data Analysis Project. This supplementary information may be incorporated into this project subject to the time constraints imposed by the wider RFA process.

The Flora Data Analysis project compiled and validated survey and incidental flora data from a range of sources, creating a database of about 170 000 records for more than 5700 flora species. Records compiled were restricted to those post-1947 in recognition of the extent of clearing and fragmentation in South-East Queensland and the lower spatial accuracy of older records. Records known to be no longer extant were removed from the database. Distributional information on species occurring in Queensland is catalogued by pastoral district (for Queensland) and regions (national/international) by the Queensland Herbarium. This allowed assessment of the distribution of species outside the RFA region by the Flora Data Analysis project. For National Estate assessment purposes, some 150 000 records with a spatial accuracy of 2000 m or better were used.

The flora records used for National Estate assessment have a number of significant biases. Taxa prevalent in historical records reflect the preoccupations and interests of recorders and ease of identification. Records are biased toward sites with easy access and sites close to centres of population. Records may also reflect places of pre-conceived value for flora attributes. Areas identified as significant for flora species values will, to an extent difficult to measure, reflect these biases. A substantial number of records for Fraser Island (centroids) were not sufficiently accurate to be incorporated into this study. Notwithstanding these caveats, the flora workshop considered that indicative areas identified are areas of significance for the National Estate flora species values.

Areas rich in each of the National Estate flora species attributes were identified through grid analyses of the flora records. Species locations were intersected with a five kilometre grid coverage, identifying the number of unique species with each of the national estate flora values occurring within each cell. This grid size was selected to reflect the locational accuracy of the database records.

The grid analyses of each of the National Estate flora species values were assessed by expert workshop. The workshop developed and applied thresholds to the grid analyses to identify indicative areas significant for each species value.

The panel considered the application of size thresholds inappropriate when identifying indicative areas of significance for flora species values. The size of indicative areas was not judged to be a valid predictor of their importance, viability or ‘integrity’.

Areas with relatively high levels of disturbance were not considered to be above threshold. These areas were identified as cells that were entirely classed as biophysical naturalness 2 or less. The biophysical naturalness rating scheme is described in the Wilderness and Extensive Natural Values section of this report (Table 6). Higher disturbance thresholds were not accepted for South-East Queensland because much of the landscape is relatively highly disturbed and fragmented. It was considered that the application of higher thresholds would have excluded areas important for the National Estate flora species values.

Endemic species, species with disjunct populations, species at the limit of their range, and places rich in species

The identification, for National Estate purposes, of places expressing endemic and disjunct species, species at the limit of their range, and places rich in flora species was based on the data compilation and analysis of these attributes undertaken by the Flora Data Analysis project. The identification of species attributes by this project was subject to expert review as part of CRA work undertaken into forest taxa at risk.

Endemic species were defined as those species that have at least 75 per cent of their range in the region. Disjuncts were defined, following Groves (1981), as continuous populations broken by climatic, topographic or edaphic barriers bridged by long distance dispersal of propagules; or as insurmountable barriers to dispersal requiring a geological rather than behavioural explanation for their presence. Areas significant for endemic and disjunct fauna are assessed under National Estate criterion A.1: 'importance in the evolution of Australian flora, fauna, landscapes or climate', which relates to past processes including the evolution of biota.

Vascular plants that have their most northerly or southerly record in the region were identified as occurring at the limit of their range. Species at the limit of their range may be evidence of past distributions or biogeographic events and therefore demonstrate past processes, as required by criterion A.1. The most northerly or southerly database record of each species reaching the northern or southern limit of its range in the South-East Queensland RFA region were subject to grid analysis. Limit of range records were analysed on a 10 km grid in preference to a five kilometre grid because only a single record for each species was used, and these were more dispersed in the landscape.

Areas rich in flora species are considered to be of National Estate significance under criterion A.3, 'importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features'.

Endangered, vulnerable and rare species, Gondwanan species and phylogenetically distinct species

Endangered, vulnerable and rare taxa defined under the *Queensland Nature Conservation Act 1992*, incorporating status changes in the most recent *Nature Conservation Amendment Regulation* (No.2) *1997*, and endangered and vulnerable species listed under the *Commonwealth Endangered Species Protection Act 1992* as at July 1998, were considered. Database records for endangered and vulnerable forest-dependent taxa under the *Queensland Nature Conservation Act 1992* were validated through a series of workshops run as part of CRA work undertaken on forest taxa at risk

National estate criterion B.1 refers to 'importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness'.

Gondwanan species are those that existed during, or are connected with, periods of continental change (i.e. Gondwanan species or species whose distribution reflects other land bridges). Occurrences of the species provide information on past continental scale environmental regimes. Grid analysis on Gondwanan taxa was applied to genera rather than to species to overcome biases related to more recent speciations (e.g. Lauraceae).

Phylogenetic distinct species were identified as monotypic genera, species which are the only Australian representative of a genus, or families species with only a 'few' species representatives.

Gondwanan relictual and phylogenetically distinct species are assessed under National Estate criterion A.1: 'places important in the evolution of Australian flora and fauna'.

Key results

Indicative areas of significance for National Estate flora species values thresholded by the National Estate flora values workshop included Kroombit Tops, the Great Sandy National Park, Noosa/ Mt Coolum area, Mt Barney, the Lamington Plateau, Mt Walsh, the Burrum Coastal and Eurimbula area, Bulburin State Forest and the Conondale Ranges.

NATIONAL ESTATE: FLORA COMMUNITY VALUES

EH 5.1.4

Project objectives

The objective of this project is to ensure that National Estate requirements for assessing attributes related to flora communities are undertaken and included in the CRA, the development of the CAR reserve system, and the RFA.

The attributes of National Estate significance to be considered as part of this project are:

- rare, threatened or uncommon plant communities
- old growth flora communities
- places containing a high richness of forest communities
- flora communities characteristic of their class.

Methods

The assessment of flora community values is based on the data and analyses of the Forest Ecosystem Mapping and Analysis project (EH 1.2) and the Old Growth Forest project (EH 2.1). Both projects are described elsewhere in this report.

Forest community richness

Forest community richness is often a good reflection of environmental diversity, where strong gradients produce rapid transitions of different forest communities and their associated species. Forest community richness is assessed under National Estate sub-criterion A.3: 'importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features'.

To indicate areas potentially rich in forest communities, five and 10 kilometre digital grid coverages were created to cover the South-East Queensland RFA region. Unique mapping areas (vegetation polgons) identified and mapped by the Forest Ecosystem Mapping and Analysis project, were intersected with the grid coverages. The number of regional ecosystem types in vegetation polygons intersecting each grid cell was calculated. The number of regional ecosystems was calculated on a presence/absence value and irrespective of their area. The heterogeneity of regional ecosystems within vegetation polygons was a limitation to the accuracy of this analysis of community richness. The results, however, were sufficiently consistent with expert knowledge of community distribution and diversity to be accepted as indicating indicative areas for National Estate flora community richness.

A threshold of 10 regional ecosystems or more for each five kilometre grid cell was determined.

Rare, threatened or uncommon plant communities

Rare, threatened or uncommon plant communities are assessed under National Estate sub-criterion B.1: 'importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness'.

The Forest Ecosystem Mapping and Analysis project mapped current vegetation and developed a pre-clearing vegetation coverage, mainly based on aerial photo interpretation, field knowledge and historical vegetation surveys, in consultation with other data sources for geology, land systems and soils. These projects addressed a range of ecosystem attributes relevant to CAR requirements including:

The identification of rare threatened or uncommon plant communities was based on the regional ecosystems identified in the Forest Ecosystem Mapping and Analysis project.

Guided by JANIS criteria, rare, endangered and vulnerable regional ecosystems were identified. Rare ecosystems are those with a total range of less than 10 000 ha; a total area of less than 1 000 ha; or a patchy distribution comprising patches of less than 100 ha where the total area of the combined patches is not significant. Endangered ecosystems are those whose current extent is less than 10 per cent of their pre-clearing area or range. Endangered ecosystems also include those with 90 per cent of their area in patches and those with threatening processes that have caused significant changes in species composition, or loss or significant decline in species that play a major role within the ecosystem, or significant alteration to ecosystem processes. Vulnerable ecosystems are defined as those with less than 30 per cent of their former area or range remaining. Additional ecosystems with or those with greater than 30 per cent remaining and with threatening processes.

Old growth communities

The national operational definition of old-growth forest is 'ecologically mature forest where the effects of disturbances are now negligible' (JANIS 1997).

Old growth communities are assessed under two national estate sub-criteria:

- B.1: Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness
- A.2: Importance in maintaining existing processes or natural systems at the regional or national scale.

The Old Growth Forest project mapped the distribution of old growth forest of eucalypt dominated forest types. Aerial Photograph Interpretation (API) was the primary source of mapped data for the old growth project. It provided forest structural information (e.g. crown form, canopy density) and permitted the mapping of disturbance from other visual clues. Historical records of various forest management activities, in particular timber harvesting, fire, and grazing, were a major source of information. Management history was the primary source of disturbance information used in the study. The project compiled comprehensive historical records for State forests and designated timber reserves. A lesser level of information was available for conservation reserve tenures, and information for other tenures such as freehold was even more limited. Where gaps existed, such as across freehold land, disturbance history was inferred from relationships with tenure, accessibility and productivity.

Flora communities characteristic of their class

Flora communities characteristic of their class relate to national estate sub-criterion D.1 which recognises the significance of places demonstrating the principal characteristics of a class of Australia's landscapes, environments or ecosystems.

Forest ecosystems have been mapped as part of the South-East Queensland CRA. This mapping forms the basis for the identification of indicative areas of national estate significance as characteristic of the classes of ecosystems within the region.

The identification of areas of forest ecosystems characteristic of their class is undertaken in conjunction with the development of a comprehensive, adequate and representative (CAR) reserve system for the region. JANIS criteria seek the representation in reserves of:

- 15 per cent of the pre-1750 distribution of each forest ecosystem
- 60 per cent of the remaining extent of vulnerable ecosystems
- 100 per cent of the remaining extent of rare and endangered forest ecosystems (JANIS 1997).

The consideration of the JANIS criteria and reserve design principles, and the incorporation in the development of the CAR reserve system of National Estate values such as natural landscapes, will ensure the inclusion within CAR reserves of examples of forest ecosystems characteristic of their class at appropriate levels of condition and integrity to be considered as meeting the threshold of National Estate significance for this value.

Areas meeting threshold of national estate significance for forest ecosystems characteristic of their class will be identified in conjunction with the development of the CAR reserve system for the RFA.

Key results

Forest community richness

Areas above threshold for flora community richness include:

Eurimbula – Baffle Creek
North Coast – Cooloola
Burrum Coast
Conondale Ranges
Burrum Coast
Kroombit Tops
Woowoonga – St Marys

Rare, threatened or uncommon plant communities

Fifty-two regional ecosystems were identified as rare, threatened or 'uncommon'. Rare endangered or vulnerable regional ecosystems were accepted to be above threshold for this flora community value.

Old growth flora communities

The National Estate flora values workshop determined all old growth to be rare in South-East Queensland and above threshold for National Estate sub-criterion B.1. Different old growth ecosystem types were not identified in South-East Queensland. Assessment of the rarity of specific old growth communities is thus not yet possible.

The National Estate flora values workshop considered that all old growth was important in maintaining existing processes or natural systems and accordingly all mappable old growth was determined to be above threshold for National Estate sub-criteria A2. It was considered that small/fragmented patches of old growth were important to maintain ecological processes at the regional scale in the South-East Queensland context.

The expert panel considered the application of size thresholds inappropriate when identifying indicative areas for old growth. The size of areas of old growth was not considered to a valid predictor of their importance, viability or 'integrity' in the South-East Queensland context.

The area of old growth in South-East Queensland RFA region is identified as about 301 526 hectares, or 8.5 per cent of the forested area.

NATIONAL ESTATE: FAUNA SPECIES VALUES

EH 5.1.5

Project objectives

The objective of this project was to ensure that the National Estate requirements related to the identification and assessment of fauna species values was undertaken and included in the CRA process.

The fauna species attributes considered as part of this project are:

- species whose distribution is endemic to the South-East Queensland RFA region
- species at the limit of their range within the region
- rare and threatened species with identified populations in the region
- places that are notable for their richness of species within the context of the region
- species whose distribution within the region is disjunct
- species that are phylogenetically distinct.

Methods

This project was based on data developed as part of the Forest Vertebrate Fauna Study EH 1.1.1 which is summarised elsewhere in this report. The Forest Vertebrate Fauna Study compiled a database of the distribution of freshwater and terrestrial vertebrates and selected invertebrate species in South-East Queensland. The database contains historical, incidental and systematic fauna data. Data on species distribution were obtained from museum collections and major institutions such as the Queensland Department of Environment and Heritage and Department of Natural Resources, Royal Australian Ornithologists Union and NatureSearch 2001 databases, published literature, unpublished reports and departmental files. The taxonomy and location of all records was validated by the study.

The Forest Vertebrate Fauna Study found major taxonomic gaps in the data for threatened insects, freshwater fish, reptiles and bats across the whole region. The study found that data are limited for most animal groups in conservation (national park) and forestry (State forest/timber reserve) areas in environmental provinces outside the south-east corner of the RFA region.

A vertebrate fauna survey conducted under the Forest Vertebrate Fauna Study obtained systematic data on the distribution of vertebrate species (excluding fish) across the RFA region. The South-East Queensland bioregion was stratified to ensure representative sampling of major environmental and geographical gradients. A total of 267 systematic sites were surveyed for bats, small and large ground mammals, arboreal mammals, diurnal and nocturnal birds and herpetofauna. Further systematic data was obtained from external sources. Surveys were restricted to forests under Crown tenure. Sites were located with an accuracy of 300 m.

To assess National Estate fauna species values, the databases produced by both the historic and systematic surveys of the Forest Vertebrate Fauna Study were consolidated into a single database. Records were collected for 586 native forest species. Records collected after 1974 and with an accuracy of 900 m or better were used to assess National Estate fauna species values. This represented about 300 000 fauna records for the South-East Queensland RFA region

The fauna records used for National Estate assessment have a number of significant biases. Taxa prevalent in historical records reflect the preoccupations and interests of recorders and ease of identification. Invertebrates are very poorly represented in the databases. The systematic vertebrate fauna survey was restricted to Crown land. Records are biased toward sites with easy access and sites close to centres of population. Records may also reflect places of pre-conceived value for fauna attributes. Areas identified as significant for fauna species values will, to an extent difficult to measure, reflect these biases. Notwithstanding these caveats, the fauna workshop considered that indicative areas identified are areas of significance for the national estate fauna values based on the available data.

Areas rich in each of the National Estate fauna species attributes were identified through grid analyses of the fauna records. Species locations were intersected with a two kilometre grid coverage, identifying the number of unique species with each of the national estate fauna values occurring within two kilometres of the centre of each cell. This grid size was selected to reflect the locational accuracy of the database records.

The grid analyses of each of the national estate fauna species values were assessed by expert workshop. The workshop developed and applied thresholds to the grid analyses to identify indicative areas significant for each National Estate fauna species value.

The panel considered the application of size thresholds inappropriate when identifying indicative areas of significance for fauna species values. The size of indicative areas was not judged to be a valid predictor of their importance, viability or 'integrity' on the information available.

Areas with relatively high levels of disturbance were not considered to be above threshold. These areas were identified as cells that were entirely classed as biophysical naturalness 2 or less. The biophysical naturalness rating scheme is described in the Wilderness and Extensive Natural Values section of this report (Table 6). Higher disturbance thresholds were not accepted for South-East Queensland because much of the landscape is relatively highly disturbed and fragmented. It was considered that the application of higher thresholds would have excluded areas important for the National Estate fauna species values.

Reflecting the concentration of settlement, transport infrastructure and surveys, fauna records are concentrated in the south of the RFA region. For the purpose of setting thresholds, the region was divided by a line extending north-east from south of the Bunya Mountains, passing to the south of Cherbourg State Forest and extending east to Lake Cootharaba. Lower thresholds were generally applied for fauna species values in the north of the region.

Endemic species, species at the limit of their range, disjunct species and phylogenetically distinct species

Endemic species, species at the limit of their range, disjunct species and phylogenetically distinct species are assessed under National Estate criterion A.1: 'importance in the evolution of Australian flora, fauna, landscapes or climate'. Taxa with these national estate fauna species values were identified as part of the Forest Vertebrate Fauna Study and CRA work undertaken on forest taxa at risk.

Endemic species were identified as taxa with at least 75 per cent of their known ranges within the region or which have total ranges of 100 000 square kilometres or less. These threshold values are arbitrary but assist in identifying geographically restricted species that depend on habitats within the region. Taxa considered endemic by the Joint Scientific Advisory Group are included.

Phylogenetically significant species were identified by expert nomination and review through CRA work undertaken on forest taxa at risk. No single definition was adopted for this category by experts as the field is in a rapid stage of development and agreed definitions or methodologies have not yet emerged.

Disjunct species and species at the limit of their range may be evidence of past distributions or biogeographic events and may therefore demonstrate past processes, as required by National Estate sub-criterion A.1. Disjunct populations are those which have become physically separated due to the appearance of a break in a formerly continuous distribution. Disjunct populations are frequently morphologically or structurally distinct and, commonly, have diverged genetically from parent stocks.

Disjunct species and species which reach the northern, southern, eastern, north-eastern and south-eastern limit of their range in the RFA region were identified through the Forest Vertebrate Fauna Study data base and CRA work undertaken on forest taxa at risk. Indicative areas for disjunct species, and species at the eastern, north-eastern and south-eastern limits of their range were not identified. The landscape of South-East Queensland is relatively highly fragmented geologically and through human disturbance, and disjunctions are apparently common. The nature and importance of disjunctions of species could not be determined from the available data in a way that would allow meaningful assessment under National Estate sub-criterion A.1. The Forest Vertebrate Fauna Study noted that without extensive spatial and temporal survey data it would be difficult to be sure that the edges or isolates indicated by records truly reflected either boundaries of viable populations (rather than chance extensions by single individuals) or simply a lack of sampling in intervening areas in the case of disjunct range.

A number of indicative areas for species at the northern and southern limits of their range were identified as these distributional limits were seen to be related to topography.

Rare or threatened species and fauna species richness

National Estate criterion B.1 refers to 'importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness'.

For National Estate assessment, rare or threatened species have been defined as taxa classified as endangered, vulnerable or rare in the Queensland *Nature Conservation Act 1992* and *Nature Conservation (Wildlife) Regulation 1994* (schedules as of November 1997), or endangered or vulnerable under the Commonwealth *Endangered Species Protection Act 1992*.

Areas of fauna species richness are considered to be of National Estate significance under criterion A.3, 'importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features.

Key results

Indicative areas for richness of fauna species included the Blackdown Tableland, Kroombit Tops, the Lamington Plateau, Bulburin, Bania and Yarraman State Forests, the Conondale Ranges, Mt Tamborine and the D'Aguilar Range. State Forest 616, extending to the south west of Helidon was also high in richness. Indicative coastal areas included the mouth of the Caboolture River and the south of Bribie Island. High, though more fragmented indicative areas for fauna species richness occur in the Coolum and Noosa coastal region and hinterland. The occurrence of indicative places for phylogenetically distinct species closely corresponded to places rich in fauna species.

Indicative areas for endangered, vulnerable and rare species included Blackdown Tableland, Kroombit Tops, Bulburin State Forest, Main Range, Mt Tamborine and the D'Aguilar and Conondale ranges. The Great Sandy National Park, Moreton Island, North Stradbroke Island and the Coolum/Noosa coast and hinterland were also important areas for this value. The occurrence of indicative areas of significance for endemic species closely corresponded with places important for endangered, vulnerable and rare species.

Topographic isolates in the north of the RFA region constituted important indicative areas for species at the southern and northern limits of their range. Indicative areas for species at the south of their range include the Blackdown Tableland, Kroombit Tops and Bulburin State Forest. Indicative areas for species at the northern limit of their range included the Lamington Plateau, Mt Tamborine, and the D'Aguilar and Conondale Ranges. Wallum/heathland communities were also significant areas for species at the northern limit of their range.

These areas are to be examined, potentially refined and thresholded using site records of the identified priority species from the Forest Vertebrate Fauna Study databases.

Locational data for many important Gondwanic and phylogenetically distinct invertebrate species were not collected as part of the CRA. Revised locations based primarily on vertebrate site records are limited by that fact.

Resources did not allow a comprehensive identification of phylogenetically distinct and relictual fauna species throughout the CRA region.

NATIONAL ESTATE: NATURAL HISTORY PLACES

EH 5.1.6

Project objectives

The aim of this project was to identify and assess sites of National Estate significance in the South-East Queensland bioregion that have the potential to contribute to a wider understanding of Australian natural history and be made known to the Australian Heritage Commission (AHC) for listing on the Register of the National Estate.

The project further aimed to outline conservation and management issues relating to the nature of places and values identified. This information could be used to develop conservation management guidelines for such places.

Methods

Sites were identified based on their significance against criterion C.1 of the Australian Heritage Commission Significance Criteria (Appendix D):

- Criterion C–its potential to yield information that will contribute to an understanding of Australia's natural or cultural history
- C.1–importance for information contributing to a wider understanding of Australian natural history, by virtue of its use as a research site, teaching site, type locality, or reference or benchmark site.

Site selection

A preliminary data set was compiled of potential research sites, teaching sites and reference or benchmark sites. Information was obtained by searching existing databases. This included:

- Department of Environment and Heritage (DEH) protected area databases for Queensland that included national parks, conservation parks, nature refuges and other protected areas
- databases of the DoE GIS Unit on protected areas in the South-East Queensland bioregion
- databases of the DoE GIS Unit on State forests and timber reserves in the South-East Queensland bioregion
- databases of the National Parks and Wildlife Service (NPWS) of research permits issued by the department over the last 18 months for the State of Queensland
- databases of management plans and Statement of Interim Management Intent of South-East Queensland
- databases on State forests and timber reserves of the Department of Natural Resources (DNR) on information about scientific areas, feature protection areas, State forest parks and forest drives
- database of the Queensland Herbarium on research sites within the South-East Queensland bioregion.

A map was generated with the results of this process.

Information gathering

All shire councils, city councils and non-government organisations within South-East Queensland were contacted with a questionnaire and data sheet to be completed by respondents. The proformas were sent to the chief executive officers of 51 local governments, 27 non-government organisations and all known environmental education centres in the region. Proformas were returned by mail or information was obtained by personal interview over the telephone.

Additional information was received from the 13 community heritage workshops held throughout the RFA area to assess sites of cultural heritage significance.

A large number of research licences (NPWS database) was issued by DEH to universities, academics and other researchers.

Additional information on potential sites was also sought from the Queensland Museum, the Queensland Herbarium, the DNR and the Department of Primary Industries.

Thresholding

An expert heritage workshop was held to determine which of the identified sites were of National Estate significance. A significance rating was assigned to each location, with further experts consulted out of session. The significance rating was used to develop thresholds against which the identified sites could be assessed.

Key results

A total of 562 sites were identified in the above process, with 163 places being found to be above threshold. Sixty-seven were rejected as not having National Estate significance, and a further 330 were not assessed because insufficient information was available to assess them. Of the places found to have National Estate significance, 102 are in State forest areas and 61 in national parks or on private land.

Limitations

There was not enough time to field check, and boundaries were insufficiently defined.

NATIONAL ESTATE: CULTURAL HERITAGE PLACES AND VALUES (NON-INDIGENOUS)

EH 5.2

Project objectives

The National Estate: Cultural Heritage Places and Values (Non-Indigenous) project aimed to identify places of cultural (non-Indigenous) heritage significance in the forested areas of South-East Queensland and to assess those places according to National Estate and State heritage criteria. Assessment was undertaken by a team of technical experts, using all available comparative and contextual information.

A cultural heritage place can be a site, an area, a landscape, a building or structure, a group of buildings or structures or other works together with associated contents and surroundings that are significant for their historic, social, aesthetic or scientific value. The value of a cultural heritage place is usually determined by assessment against a set of significance criteria. In the forest environment these values can be expressed, for example, through the tangible fabric of an archaeological or historic site, intangibly through spiritual associations with particular places, or through a landscape with a combination of tangible and intangible elements.

A further objective of the cultural heritage (non-Indigenous) project was to assess the general effectiveness of current protective mechanisms and management practices for cultural heritage places and values, and to establish workable conservation principles and guidelines for the protection and management of non-Indigenous cultural heritage places and values in forested areas (Lennon et al. 1998, in prep.). This project reviewed statutory and legislative obligations as set out in State and Commonwealth legislation. The criteria for nominating places to the Register of the National Estate (Appendix D) and the criteria in the *Queensland Heritage Act 1992* were to be used. The components of the cultural heritage (non-Indigenous) studies were:

- a cultural heritage data audit that identified the main sources of information on cultural heritage places in forested areas in the South-East Queensland biogeographic region, and provided a preliminary assessment of the number, type and location of cultural places in the area and their relationship to the forest, as well as an analysis of those places not represented or under-represented in the sources
- identification and significance assessment of non-Indigenous cultural heritage places in State forests, national parks, and off-park forested land, especially places pertaining to forest history
- identification through community workshops of those cultural heritage places which the communities consider have heritage value (i.e. those places of social value)
- identification and significance assessment of National Estate aesthetic values
- an overview of existing legislation (Commonwealth and State) directly and indirectly relevant to the protection and management of cultural heritage places and values in Queensland's forests (public and private land), identification of the agencies/authorities responsible for ensuring legislation is acted upon and the methods by which it is implemented, assessment of the general effectiveness of current protective mechanisms and management practices for cultural heritage places and values, identification of protection and management issues that need to be addressed, and the establishment of workable conservation principles and guidelines for the protection and management of non-Indigenous cultural heritage places and values.

Methods

The various sub-projects used different methods, including database reviews, archival research and field surveys, and community and expert workshops.

Cultural heritage forest studies in the South-East Queensland biogeographic region began in April 1995 as part of the Greater Planning Certainty for Queensland's Wood Products based on Crown Native Forests project (GPC). Work undertaken during the GPC project included a draft historical overview of the region with particular reference to forested areas, broadscale survey work, and a data audit to identify gaps in existing data regarding cultural heritage places in forests in the region (Kowald 1996; Jenkins 1995). Over 130 places in State forests were recorded as a result of the GPC project and these results were incorporated into the project. Other aspects of this project were undertaken as part of the CRA, with detailed methodologies available in the individual project reports.

Historic studies

A thematic history of the region has been written, with particular reference to forested areas (Powell 1998a). Based largely on secondary material, it employs the Principal Australian Historic Themes as outlined by the Australian

Heritage Commision (AHC). Two further desktop historical studies were also undertaken on historic themes that were relevant to the region's forests:

- 'Travel routes, forest towns and settlements'. This project identified forest towns and settlements associated with forestry and timber industries in the region, and discusses travel routes associated with these industries (Powell 1998b)
- 'Sawmills and tramways'. This project provided an historical overview of sawmilling, an inventory of sawmills and tramways and field documentation of selected sawmills and tramways in the region (Kerr 1998).

Historic values

The identification of historic places and values, 'the historic project', was undertaken by officers of the Forest Assessment Unit (FAU), Conservation Strategy Branch in the Queensland Department of Environment (DoE). Prior to this project, the cultural heritage of South-East Queensland's forested areas was largely undocumented. The historic project therefore focused on broadscale survey work across the region to record and document places in forested areas in the region, and to compile a Historic Places Inventory (Forest Assessment Unit 1998a).

The range of places to be recorded during this project was broad, and included any place or site where people had carried out some activity in a forested area, whether that activity was directly or indirectly related to forests. An 'indicative list' developed during the GPC project of places that might exist in forested areas included bridges, buildings, bullock wagons, cemeteries, charcoal pits, defence/war relics, ethnic settlement camps, explorers' routes or marked trees, fences, fire towers, forestry barracks and camps, machinery, mines, railways, sawmills, tramways and workers' camps. Classification of this list was aided by the incorporation of the groups, categories and themes developed by the AHC into the recording process.

The historic project focused predominantly on public land in the region, particularly State forests and national parks.

Social values

Thirteen workshops were held throughout the region with a wide range of community groups that were invited to identify places they valued (Forest Assessment Unit 1998b). The quantitative information obtained during the workshops was assessed to determine which places were above threshold for National Estate social significance.

Aesthetic values

A series of sub-projects focusing on art, photography and film, literature and music, tourism publications, and incorporating data from the 13 community heritage workshops identified places of aesthetic value which were assessed by an expert panel against AHC criterion E and the working definition of aesthetic value (Lennon and Townsley 1998):

> Aesthetic value is the response derived from the experience of the environment or of particular cultural and natural attributes within it. This response can be either to the visual or to non-visual elements and can embrace emotional response, sense of place, sound, smell and any other feelings and attitudes (Paraskevopoulos 1993).

Significance assessments for places of historic and aesthetic value were undertaken by an expert group, the Cultural Heritage Focus Group, which defined the thresholds for heritage values against the AHC and State heritage significance criteria in a series of workshops. Social value was assessed as part of a quantitative sieving process resulting from the community heritage workshops.

Management guidelines

A comprehensive overview of the legislative framework for the conservation of cultural heritage places and values (Indigenous and non-Indigenous) in forested areas of the region has been undertaken (Lennon et al. 1998, in preparation). A set of conservation principles and guidelines will be developed for the protection and management of non-Indigenous cultural heritage places and values in forests in the region.

Limitations

Lack of existing data. There have been few historic studies undertaken of either Queensland's forests or the history of forestry. Most information on forest-related activity is embedded in regional and local histories which vary in coverage and quality. Similarly, cultural heritage data and place documentation for the South-East Queensland biogeographic region was relatively poor prior to the commencement of the CRA process. A cultural heritage data audit completed in 1995 acknowledged the paucity of data both in the number of places (164 Indigenous and non-Indigenous) and in the detail concerning those places.

Only limited work had previously been undertaken on the identification and assessment of places of social and aesthetic value in the region.

Size of study area. Oral sources of information were an important feature of the recording of historic places, but limited time was available for follow-up archival research to confirm details of these oral histories. Similarly, although areas known to have high cultural heritage significance were targeted, the length of time spent in any one area was restricted by the extensive size of the study area.

The size of the study area also impacted on the data provided at community heritage workshops and used to identify places of social value as part of the national estate. The 13 workshops conducted throughout the region covered 44 local government areas. Participants at workshops that had a catchment of up to six local government areas did not always identify with a common region and could not adequately reflect the social values of the communities represented in such a large area.

Key results

The project did provide a broad contextual survey of the cultural heritage values of forested areas of South-East Queensland which was sufficient to gain an understanding of the nature and extent of these values so that the conservation of cultural heritage values could be taken into account within the RFA.

Table 8 sets out a summary of the key results and outcomes of the thresholding processes applied to the cultural heritage places identified during the various projects.

Table 8. Numbers of places (non-Indigenous) of cultural heritage significance

Values	Places above threshold		Places considered	
Historic	76		830	
Social	22		455	
Aesthetic	47		163	
Tenure of places above threshold	National park/ conservation park	State forest/ timber reserve	Private	Other (e.g. road reserve, quarry, local govt reserve)
Total	**51***	**64***	**69***	**60***

*As places may be located across more than one tenure, or meet more than one value, the sums of these totals are higher than the actual numbers of places above National Estate threshold.

Historic value

An Historic Places Inventory (the 'inventory') of 830 places was recorded as a result of primary, secondary and oral research, and field surveys.

There are six groups of places that together comprise approximately 75 per cent of the inventory. Forestry-related buildings and structures, including sawmills and tramways, make up a large number (41 per cent) of the places recorded in the inventory. An indication of the multiple use of forested areas is the high number of places representing recreation activities (11 per cent), farming and grazing activities (seven per cent) and mining and mineral processing activities (five per cent). A number of places comprising landscapes and trees were also recorded (eight per cent), indicative of the overlap between natural and cultural heritage. The remaining 23 groups of places each comprise less than five per cent of the inventory.

Geographically, a number of areas within South-East Queensland stand out as important to the cultural heritage of forested areas within the region, including Lamington, Springbrook and Tamborine National Parks, the D'Aguilar Range, Crows Nest/Ravensbourne, the Bunya Mountains, the Yarraman district, the Beerwah/Beerburum district, the Mary Valley, the Great Sandy region including Cooloola and Fraser Island, Maryborough/Howard/Cordalba, and the Many Peaks/Calliope area.

Through a series of cultural heritage assessment workshops, held subsequent to the field survey phase, places and values on the inventory were assessed for significance against National Estate heritage criteria. Thresholding indicators were applied to determine whether places were of sufficient significance to be included in the Register of the National Estate for Historic Values. Eighty-nine places were considered to be above threshold for potential National Estate listing for historic and social values. Of these, 13 places were considered above threshold for social values only. The remaining 76 places were considered to be above threshold for historic or historic and social values. A separate report contains the detailed documentation for those places. In certain instances, places recorded in the inventory that share a common history or context have been grouped as a complex or a cultural landscape. One hundred and eighty-eight places were significant as part of a national estate complex. Eighty-six places fell below the

threshold for National Estate, and 15 places were considered not significant. A total of 452 places were unable to be assessed due to insufficient information to enable an assessment to be made.

Social value

Of the 1123 places identified and documented in the community heritage workshops, 455 were considered to have potential social value. A further thresholding sieve identified 22 of those places to be above threshold for the National Estate based on social value. These values are documented in detail in the final project report.

The 22 places were seen as important symbols of the region and its history. Places such as the Town of 1770, Boolboonda Tunnel, Elginvale Sawmill and Glassford mining area had very strong local support, while others such as Fraser Island and the National Trail had appeal to the wider South-East Queensland community. Some places were valued for their recreational value, for example Bunya Mountains, Diana's Bath and Wongi Waterholes, while others showed value over a long period of time, for example the Glasshouse Mountains.

Aesthetic value

This study surveyed artistic endeavour related to forest places in South-East Queensland, the results of which have been mapped to show their occurrence. Without outline histories of landscape depiction in the region, research was particularly difficult and it is considered that further work will provide additional aesthetic data.

Nonetheless, a total of 163 places were identified as places of potential National Estate significance for aesthetic value. Fifty-three places were identified as over the threshold set for determining aesthetic value, but only 47 of these places were able to be mapped. The project was one of discovery, with significant contemporary artists and historic figures inspired by forest places in the region under study, including Judith Wright, Peter Carey, Janette Turner Hospital, Conrad Martens, Lloyd Rees and Arthur Boyd. Map 6 shows the location of cultural heritage (non-Indigenous) places of National Estate significance in South-East Queensland.

NATIONAL ESTATE: CULTURAL HERITAGE PLACES AND VALUES (INDIGENOUS)

EH 6.1

Project objectives

This project comprises two sub-projects: the Indigenous cultural heritage data audit and the Indigenous cultural heritage management guidelines.

The Indigenous cultural heritage data audit aims to:

- identify sources of information on the known Indigenous cultural heritage places in the forested areas of the South-East Queensland biogeographic region
- provide a broad overview of the location and types of Indigenous cultural heritage places studied in the region
- provide an understanding of those cultural heritage places, themes or related data not represented or under-represented in the sources
- ensure that any Indigenous cultural heritage information used within the project is presented in a culturally appropriate and sensitive way which does not compromise the confidentiality of the information or its source.

The Indigenous cultural heritage management guidelines project aims to formulate conservation principles and guidelines for the protection and management of Indigenous cultural heritage places and values in forested areas of the South-East Queensland biogeographic region, including consultation and decision-making guidelines.

Methods

Indigenous cultural heritage data audit

This project will identify sources of information about the known Indigenous cultural heritage places in the forested areas of the region. Sources will include:

- records held by various government departments, including their regional and local offices. These departments included: *Queensland*, the Department of Environment and Heritage (DEH) Cultural Heritage Branch (including Indigenous sites database and reports) and National Parks and Wildlife Service, the Department of Natural Resources and the Department of Primary Industries–Forestry; *Commonwealth*, the Australian Heritage

Commission (including the Register of National Estate and National Estate grants reports)
- publications and theses
- local government heritage studies
- other data sources (e.g. representative bodies).

The project will also prepare a list of sources and include details (e.g. author, title of report, study area, purpose of the report, types of places identified and Aboriginal consultation), prepare a broad overview of the location and types of cultural heritage places studied in the area, and highlight areas that require further study in order to arrive at a basic understanding of Indigenous cultural heritage places in the currently forested areas of the region.

Indigenous cultural heritage management guidelines

This project will consult the relevant results of sub-project EH 5.2.1 Protecting Cultural Heritage Values and Places in Forests, which will have:

- outlined the legislative framework (Commonwealth and State) for the protection and management of Indigenous cultural heritage places and values in forested areas of the region, including on public and private land
- assessed current levels of protection and threats to Indigenous cultural heritage places and values
- reviewed conservation principles and management guidelines for the protection and management of Indigenous cultural heritage places and values which have been developed elsewhere, such as in other States and by the Commonwealth, including the draft Guidelines for the Protection, Management and Use of Aboriginal and Torres Strait Islander Cultural Heritage Places (DCA 1997) and also cultural heritage management guidelines developed for other RFAs
- based on the above, liaised with the Foundation for Aboriginal and Islander Research Action, the Gurang Land Council, the Goolburri Aboriginal Corporation Land Council, traditional owners, land and natural resource managers and stakeholders to discuss options to improve protection, management and decision-making processes for Indigenous cultural heritage places and values.

The project will develop a set of practical conservation principles and guidelines for the protection and management of Indigenous cultural heritage places and values in the forested areas of the region by:

- drafting broad principles and guidelines
- refining these in consultation with the Aboriginal community and land and natural resource managers and stakeholders
- recommending conservation principles and management guidelines for inclusion in the proposed RFA.

Key results

The assessment is currently underway with results expected in early 1999.

WORLD HERITAGE ASSESSMENT AND EXPERT PANEL PROCESS

EH 7.1

Project objectives

In accordance with the Commonwealth/Queensland Scoping Agreement and the Commonwealth's obligations under the World Heritage Convention, there is a commitment by both governments to identify and assess World Heritage values in the South-East Queensland region as part of the RFA process.

Places on the World Heritage List are defined as those that have outstanding universal value. The UNESCO World Heritage Committee, in evaluating whether a place nominated to the World Heritage List has outstanding universal value, uses a shorthand way of considering this level of significance by asking 'is this place the best of the best in the world?'

Methods

The methodology used in the RFA forest assessment process to identify and assess places which are the most outstanding of their kind in the world is based on a thematic approach being applied to forested areas. The method

assesses significance by developing themes of outstanding universal value, and then testing places against these themes by working through a series of steps. This approach is only one of those being used by the Commonwealth to ensure the protection of Australia's World Heritage.

The thematic methodology involves the use of a panel of experts and provides a systematic means of identifying a list of places that meet the criteria and operational guidelines of the World Heritage Convention.

The first step (Step A) of the thematic methodology involves the panel of experts providing advice to governments on themes of outstanding universal value relevant to Australia. These themes are used in the second step (Step B) to develop a list of places that might include those that best represent the identified themes in a global context.

These potential places are then further examined against the operational guidelines for the World Heritage Convention to determine whether they have World Heritage value. They are tested using a series of sieves where the places identified at Step B are assessed for authenticity and integrity (Step C), and adequacy of management and legal protection (Step D), prior to formal assessment against the World Heritage criteria in the final step (Step E). Places that do not meet the required criteria are eliminated at each step of the assessment process.

It should be emphasised that none of the places identified by Steps B to E fulfil the definition of 'identified property' in the *World Heritage Properties Conservation Act 1983.*

An expert panel met in October 1998 to complete Steps A and B of the thematic method for all States involved in the RFA process. At this three day meeting the panel considered the States of Western Australia, New South Wales and Queensland. Panel members were drawn from among Australia's foremost specialists in disciplines relevant to the World Heritage natural and cultural criteria. Members were required to have international standing in their fields of expertise to ensure the assessment of themes and places in their global perspective, in addition to expertise and experience in World Heritage identification and assessment. Details of the membership of the panel is found at Appendix B.

Step A of the methodology required the panel to:

- provide advice on the identification of significant themes relating to World Heritage natural values (flora, fauna, geological and geomorphological) or cultural values (Aboriginal and European) for all terrestrial areas of Australia
- assess these themes in their global context in order to provide advice to governments on which themes are of outstanding universal value
- identify those outstanding universal themes which are relevant to forested areas in Australia.

The panel was then asked to undertake Step B of methodology for places in Queensland and to:

- determine which, if any, of the outstanding universal themes for forested areas identified in Step A are relevant to Queensland, as well as to Australia as a whole
- provide advice on whether there are places in Queensland which best express the themes and which therefore need to be further investigated as part of the CRA process.

Key results

The outcomes of the panel's work for the whole of Queensland are summarised in Table 9 and shows the relevant outcomes of Steps A and B for forested areas in Queensland. The table has been constructed to show the sieving approach that the panel adopted in reaching these outcomes.

Table 9. Summary showing sieving of themes, sub themes and forested places in Queensland warranting further investigation into potintial World Heritage value

STEP A				STEP B
AUSTRALIA				QUEENSLAND
	All terrestrial areas		Forested areas	Forested areas
Australian themes of outstanding universal value	Australian sub-themes/ exemplars	Explanatory sentence	Forest sub themes/ exemplars	Potential forested places warranting further investigation
NATURAL				
Origin and development of biota and landforms as a result of Gondwanan plate tectonics and recent stability and long isolation	Rainforest	Rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relict species, many of which are similar to fossils from Gondwanaland.	Rainforest	**Possible addition to the Central Eastern Rainforest Reserves WHA:** Bunya Mountains National Park **Possible addition to the Wet Tropics of Queensland WHA:** McIlwraith Range rainforest areas
	Scleromorphy	Flora includes outstanding examples of the evolution of a diverse range of scleromorphic characteristics in response to low-nutrient soils and a highly variable climate.	Scleromorphy	**Best global expression, or possible addition to the Wet Tropics WHA:** Coastal eastern Cape York Pen. incl. Shelburne Bay, Temple Bay, Jardine National Park, Starcke Nat. Park, Dunefields at Cape Flattery)
Evolution of landforms, species and ecosystems under conditions of stress	*Eucalyptus*-dominated vegetation	*Eucalyptus*-dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency and high fire frequency.	*Eucalyptus*-dominated vegetation	**Best global expression based on a series of areas:** Carnarvon Ranges (including Carnarvon National Park) **Possible addition to the Wet Tropics WHA:** Eucalypt forest areas on the inland slopes, and eucalypt- and *Melaleuca*-dominated areas on the adjacent coastal plains. **Possible addition to the Fraser Island WHA**:Cooloola Nat. Park. **Possible addition to the Central Eastern Rainforest Reserves WHA:** Eucalypt-dominated areas including Bunya Mountains National Park.
CULTURAL				
Artistic expression	Rock art	Australia has Aboriginal art sites that represent a unique artistic achievement and provide an outstanding record of human interaction with the environment over tens of thousands of years.	Rock art	**Best global expression based on a series of areas:** Carnarvon Gorge rock art sites
Religious expression	Dreaming sites	Australia provides an outstanding example of where the religious system of hunting-and-gathering societies is embodied in the landscape.	Dreaming sites	Status unknown. Further work is required on all Aboriginal dreaming sites, incl. south-east region dreaming sites and bora grounds.

Three of the sub-themes are potentially relevant to the RFA region and these are listed in Table 10, with the relevant identified forested places warranting further investigation

Table 10. Sub themes relevant to the RFA region

Relevant sub theme	Forested places in Queensland warranting further investigation
Australian rainforest as an outstanding example of ecosystems from which modern biota are derived	Bunya Mountains National Park - as a possible addition to the existing Central Eastern Rainforest Reserves (CERRA) World Heritage Area.
Eucalyptus-dominated vegetation as an outstanding example on a continental scale of forest vegetation dominated by a single genus	Best global expression based on a series of areas including in South-East Queensland: . Cooloola National Park (as possible addition to Fraser Island World Heritage Area) . Eucalypt-dominated areas including Bunya Mountains National Park (as a possible addition to the existing CERRA World Heritage Area).
Aboriginal dreaming sites	South-east region dreaming sites and bora grounds - no specific areas identified.

The panel noted that a potential nomination focused on *Eucalyptus* evolution and diversity would include a series of places across the continent, most of which could be expected to already have protected area status, rather than a single contiguous area. The panel identified the several natural forest areas in South-East Queensland that could potentially contribute to such a nomination. This work is being progressed with the Commonwealth and State Governments.

The panel considered its discussion and consideration of the Aboriginal dreaming sites sub theme to be tentative and noted that this theme would require a comparative, continent-wide study of sites of possible religious significance, including dreaming tracks.