

East Coast Conservation Corridor

A landscape of national significance



North East Bioregional Network

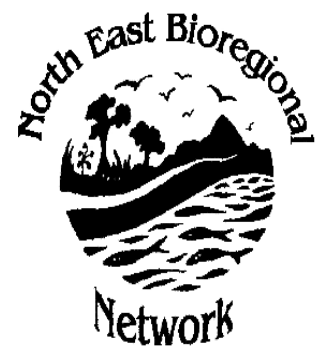
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Summary

This report presents a concept for a large-scale conservation initiative to connect, restore and maintain the outstanding ecological values of Tasmania's East Coast and North East. This landscape-scale conservation corridor extends 280 km north-south from Cape Portland to Cape Pillar, covering 2 ½ degrees of latitude. The existing reserve system and a number of established conservation projects provide a solid foundation for this integrative corridor concept.

Tasmania's North East and East Coast (defined here as the region bounded by the Tamar Estuary and the Midlands region in the west) contains a diverse variety of landscapes and ecosystems. A mosaic of natural and modified environments reflects a history of varied land uses including farming, grazing, mining, forestry (native forest and plantation) and nature conservation.

A wide variety of threatened species inhabit the region, ranging from highly localised species such as flightless stag beetles (*Hoplogonus* spp.) and recently described plants known from a single location (e.g. *Boronia hemichiton*) to large wide-ranging predators (e.g. Tasmanian devil, wedge-tailed eagle, masked owl).

Examples of island gigantism are evident in the Tasmanian fauna, with the Tasmanian subspecies of the wedge-tailed eagle being the largest eagle in Australia, the Tasmanian masked owl the largest barn owl in the world and the world's largest freshwater crustacean, the giant freshwater crayfish. All of these species have key habitat in eastern Tasmania, along with Australia's largest cockatoo, the yellow-tailed black cockatoo, and the largest extant marsupial carnivore, the Tasmanian devil. Four of the world's ten tallest tree species occur in eastern Tasmania, including the tallest angiosperm, the giant ash (*Eucalyptus regnans*).

The native vegetation of the North-East and East Coast is largely intact and is less fragmented than many settled parts of Tasmania. However some local areas have been subject to extensive land clearing and fragmentation, particularly the lowlands of the Great Northern Plain and the alluvial valleys of the major rivers (e.g. South Esk). Highland areas and lowlands with poor soils tend to retain native vegetation, although extensive areas are subject to modification by forestry.

These landscapes present a significant opportunity for a connectivity conservation initiative comprising two intersecting large-scale 'corridors':

- 1) *North East Cluster* - an east-west linkage through the North-East Highlands from the East Coast to Mounts Barrow and Arthur,
- 2) *East Coast connectivity corridor* - a north-south linkage along the East Coast from Mt William National Park to the Tasman Peninsula, comprising a mix of coastal zone and hinterland.

These broad-scale corridors capture major environmental gradients (e.g. elevation, latitude, distance from coast) and a wide variety of local climates and geological substrates with a consequent diversity of natural ecosystems. The reserve networks proposed under the Tasmanian forests Inter-governmental Agreement (IGA) process contain values of national significance, as noted by heritage expert Peter Hitchcock in a recent report to the Tasmanian and Commonwealth governments (Hitchcock 2012):

“A physically continuous connection of native habitat extends from near St

Marys on the Esk Highway south to near the Arthur Highway.”

“The East Coast connectivity corridor (E3C) is further enhanced by being physically connected to the North East cluster, essentially establishing a major habitat connection across the north-east and down the east coast of Tasmania—a latitude range of more than two degrees.”

“...the East Coast connectivity corridor have been assessed collectively to have National Heritage significance—one of the more important latitudinally connected tracts of native habitat in Australia.”

A number of conservation initiatives are already contributing to maintaining and restoring landscape integrity and connectivity in the North-East and East Coast. An East Coast Conservation Corridor would improve ecological resilience by increasing habitat connectivity and integrating off-reserve conservation. Landscape-scale conservation is inherently ambitious yet increasingly proving to be achievable and, moreover, critically necessary for sustaining biodiversity and functioning ecological processes.



Nicholas Range near St Marys



Introduction

This report presents a concept for a large-scale conservation initiative to connect, restore and maintain the outstanding ecological values of Tasmania's East Coast and North East. This landscape-scale conservation corridor extends 280 km north-south from Cape Portland to Cape Pillar, covering 2 ½ degrees of latitude. The existing reserve system and a number of conservation projects provide a solid foundation for this integrative corridor concept.

Tasmania's North East and East Coast, defined here as the region bounded by the Tamar Estuary and the Midlands region in the west, contains a diverse variety of landscapes and ecosystems. A mosaic of natural and modified environments reflects a history of varied land uses including farming, grazing, mining, forestry (native forest and plantation) and nature conservation. Most of this landscape is native forest with considerable habitat value.

A recent expert independent review¹ of the Inter-governmental Agreement (IGA) proposed reserves for forests on public land has validated the high conservation values of the majority of these areas. Notably most of the North East and East Coast proposals have been identified as meeting National Heritage standards and are specifically recognised for their emphasis on connectivity:

“Instead of a geographic cluster of reserves of mostly state significance, the ‘regional protected area’ becomes an ecologically linked protected area system, one of the major protected area entities of Australia, and so deserves to be recognised as being of National Heritage significance”
(Hitchcock 2012).

National Parks and other types of reserves are the cornerstone of nature conservation in Tasmania. But they have limitations. Many natural processes occur on a larger scale than the small island-like reserves which presently occur in eastern Tasmania. Large, well-connected areas of protected land are needed to ensure biodiversity can adapt and persist in times of environmental change. Threats to the integrity and functioning of ecosystems include climate change, coastal development, forestry, land clearing, large dams, feral species and diseases.

The traditional approaches to conservation such as threatened species priorities and protected areas are still valid, however in a rapidly changing climate conservation demands more flexibility, a greater emphasis in maintaining biologically functional landscapes and planning at time scales of 50 to 100 years (Lovejoy 2005).

¹ This report draws on the recent work of the Independent Verification Group (IVG) for the Tasmanian Intergovernmental Agreement on forestry on public land. The IVG reports were prepared by a selection of leading experts and represent a comprehensive and up to date review of conservation issues, priorities and science. Although focussed on specific areas of native forests proposed for protection, the IVG reports present novel analyses and thorough reviews which in some cases apply to all forests and other ecosystems in Tasmania. Notably there are significant updates and improvements to work done for the Tasmanian Regional Forest Agreement (RFA) in the 1990s (e.g. new modelling of dasyurid core habitat, recent research on genetics for key fauna and tree species, expanded knowledge of eucalypt diversity) and novel research (e.g. spatial analysis of representativeness of vascular plant species, identification of fire refugia). Moreover several of these reports address the shortcomings of the Comprehensive, Adequate and Representative (CAR) process of the RFA and address contemporary approaches to conservation planning, notably connectivity. Readers are encouraged to refer to these reports and the references therein for more information on specific values and locations.

Geology and Geomorphology

Dolerite is the most widespread rock type in Eastern Tasmania, with Permian and Triassic sediments and other rock types occurring locally. A continuous range of dolerite hills known as the Eastern Tiers forms the drainage divide of the East Coast from Wielangta in the south to Fingal Tier in the north. The Tasman and Forestier peninsulas form a continuation of this landform to the south, with tall sea cliffs composed of dolerite columns. In north-eastern Tasmania dolerite highland peaks and plateaus have been subject to glacial and periglacial processes. The lowlands comprise a complex mix of rock types including metamorphosed sandstone and siltstone (Mathinna Beds) and Devonian granites. The northern coastal region – the Great Northern Plain – is one of the flattest regions of Tasmania, with sandy soils and coastal dune systems.



Granite boulder at Mt Cameron, North-East Tasmania.

Climate

Eastern Tasmania has a cool temperate climate with four distinct seasons. Rainfall varies from around 600 mm per annum on the east and north coasts to over 1600 mm in the North-East Highlands with little seasonal variation. The East Coast is subject to intense rain events at times, for example, in the 12 years from 1999 to 2010, Gray near St Marys has recorded 24 hour rainfall greater than 100 mm on 18 days and monthly totals of over 500 mm on two occasions, including in a single 4 day rainfall event.

Snow is common in winter in the North East Highlands. The treeline occurs at 1300-1400 metres in North-East Tasmania with several peaks reaching this elevation and consequently providing an alpine environment (Kirkpatrick 1997). Ben Lomond Plateau is one of Tasmania's most extensive alpine zones.

Droughts, floods and frosts are important influences on vegetation in the region.



Frost at Upper Blessington, from Ben Lomond

Climate Change

The best available climate modelling for Tasmania predicts a mean temperature rise of between 1.3°C and 3.3°C by the end of the century, with a reduction in number of frost days and an increase in heatwaves (Grose *et al.* 2010, White *et al.* 2010). Rainfall is more complex and less predictable, with marked geographic and seasonal changes. Most models show an increase or little change in annual rainfall for most of eastern Tasmania, with the northern part of the East Coast potentially receiving more than 10% higher rainfall due to an increase in Autumn and Summer rain (Grose *et al.* 2010).

As little as 0.5-1°C warming is predicted to displace or fragment the ranges of animal and plant species including eucalypts (Peterson *et al.* 2005). To put it in perspective, the nearest prehistoric analogue for the present warming trend was 55 million years ago; however the IPCC estimates for warming over the next two centuries are two orders of magnitude faster than this event (Krosby *et al.* 2010). This is comparable to the shift in temperature which occurred over the past 5000–10 000 years following the Last Glacial happening in only 100 years (Steffen *et al.* 2009). This magnitude of change is expected to result in massive numbers of species extinctions (Thomas *et al.* 2004).



Rural tree decline in the Fingal Valley

Land Tenure

The North-East and East Coast region considered here covers an area of around 19 000 km².

Reserves

Numerous, mostly small, reserves occur on public and private land in eastern Tasmania. These include State Reserves, Public Reserves, Forest Reserves, Nature Recreation Areas and other classifications. There are six National Parks: Ben Lomond, Mount William, Douglas-Apsley, Freycinet, Maria Island and Tasman. The majority of reserves are under the *Nature Conservation Act 2002* and therefore managed by the Parks and Wildlife Service. Forest Reserves are managed by Forestry Tasmania and council reserves are managed by local government.

Tasmania has a relatively high proportion of reserved land, with formal reserves covering 38% of the landmass. However reservation is biased toward the west, southwest and highlands. The four bioregions in eastern Tasmania have much lower reservation levels (McQuillan *et al.* 2009):

- Ben Lomond (15%),
- Flinders (23.9%),
- Northern Midlands (4.2%),
- South East (11.8%).

Furthermore, in contrast with the wilderness areas of western Tasmania, most of the reserve estate in the east is not strict nature reserves but is instead IUCN category V or VI (McQuillan *et al.* 2009).

Around 2760 km² of the East Coast region is in the National Reserve System, including 230 km² on private land (DSEWPAC 2010).

State Forest and Crown Land

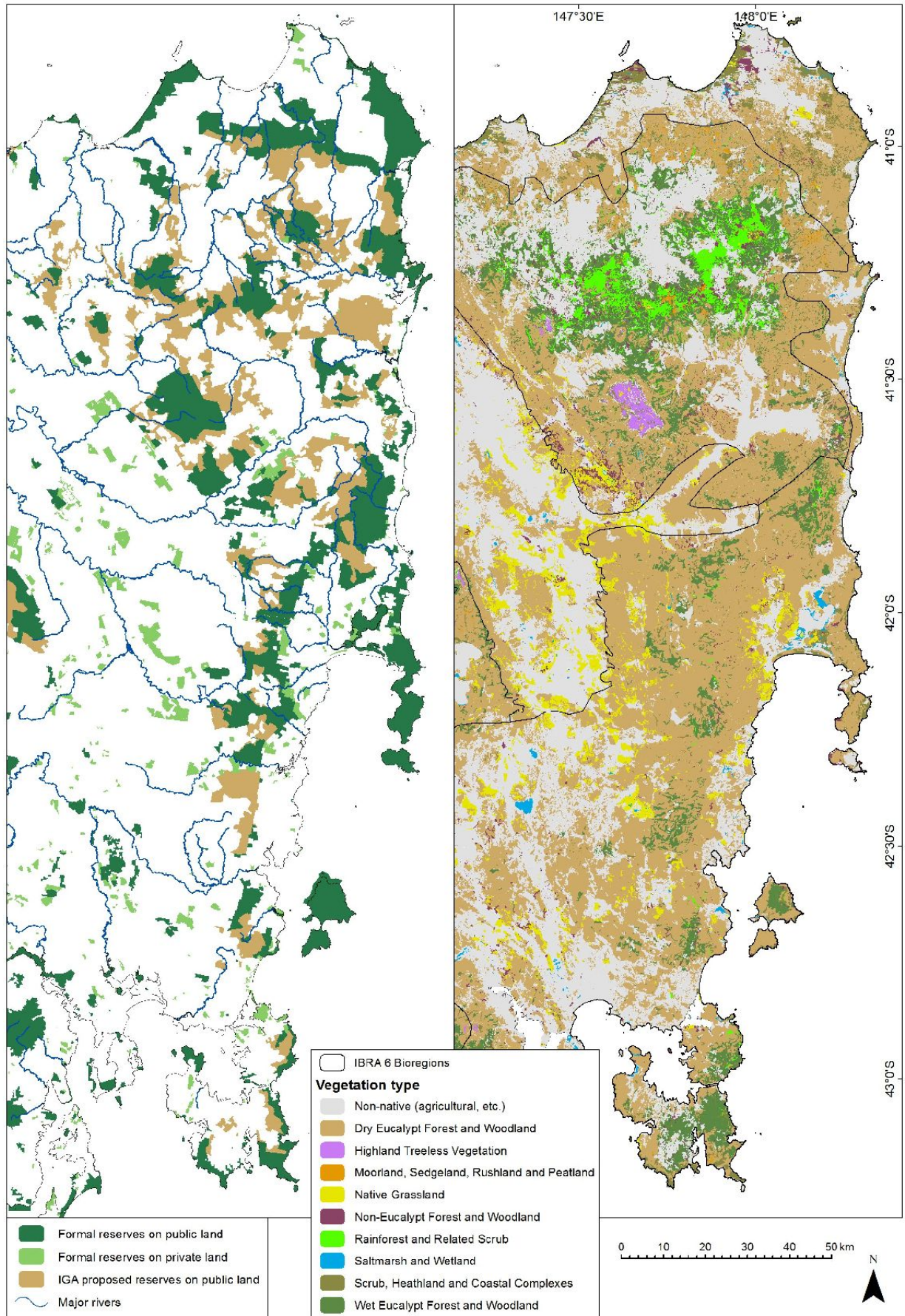
State Forest covers around 4080 km² including areas designated as 'informal reserves'. Most Crown Land has been or will be reallocated to other land tenures following the Crown Land Assessment and Classification process.

Private Land

Private land accounts for around 5500 km² of which 250 km² is protected land in the form of conservation covenants and private reserves. In addition to formally protected private land there are more than 150 registered Land for Wildlife properties in the region, which demonstrates a significant contribution to nature conservation by private landholders.



Cape Hauy, Tasman Peninsula



Land Use

The native vegetation of the North-East and East Coast is largely intact and is less fragmented than many settled parts of Tasmania (Michaels *et al.* 2010). However some local areas have been subject to extensive land clearing and fragmentation, particularly the lowlands of the Great Northern Plain, the basalt country at Scottsdale and the alluvial valleys of the major rivers (e.g. South Esk). Highland areas and lowlands with poor soils tend to retain native vegetation, although extensive areas are subject to modification by forestry.

Much of the native forest on public and private land has a history of logging, with clearfell logging practised in wet forests and selective logging in dry forest. Extensive areas of tree plantations (eucalypt and softwood) have been established in some districts, particularly in the moderate to high rainfall zones of the North-East.

Intensive land uses such as cropping and dairying occur in specific areas such as Pyengana and Scottsdale. Grazing land is more widespread and is common through the Great Northern Plain, South Esk Valley and East Coast.

Human settlement in the region is relatively low density and extensive areas are uninhabited. The largest towns, Scottsdale and St Helens, each have a population of around 2000. Most towns are located on the coast with ribbon development occurring in places (e.g. Beaumaris/Scamander).

Clearing of native vegetation is the single largest pressure on biodiversity, and human adaptation to climate change will see a continuation of land use change in areas of high productivity (DPIPWE 2010a).

Conservation Values

Ecosystems

Eucalypt Forest

Eucalypt forest is the most widespread land cover in eastern Tasmania, covering 60% of the region and comprising 40 eucalypt forest communities according to the Tasmanian vegetation map (TASVEG 2.0). Eucalypt forest communities are broadly classified as dry eucalypt forest or wet eucalypt forest, which tend to be differentiated by an annual rainfall of around 1000 mm, although localised landscape factors often create a more complex mosaic with wet forest in gullies amongst a matrix of dry forest. Eucalypt communities range from coastal to subalpine, and from open grassy woodland to tall wet forest.

Eastern Tasmania is the centre of diversity for dry eucalypt forest communities. The extensive tracts of dry forest provide a basis for maintaining varied fire regimes, migration and evolution of eucalypt ecosystems. Eucalypt communities endemic to eastern Tasmania include two *Eucalyptus sieberi* forest types (although similar communities occur in Victoria), *E. barberi* forest and woodland and *E. tenuiramis* forest on granite (Harris & Kitchener 2005). The East Coast is also the stronghold for several communities which are not confined to the region such as *E. amygdalina* coastal forest, *E. amygdalina* on dolerite, *E. amygdalina* on sandstone, *E. amygdalina* on mudstone, *E. pulchella* forest and *E. tenuiramis* forest on dolerite (Harris & Kitchener 2005).



Dry forest dominated by black peppermint (Eucalyptus amygdalina) near Gladstone

The Ben Lomond bioregion in the North-East has been subject to the most substantial losses of native forest communities since monitoring was established under the Permanent Native Forest Estate (FPA 2011). Forest communities associated with relatively fertile sites, such as damp sclerophyll forest, *E. viminalis* wet forest, *E. regnans* forest and blackwood forest on slopes in this bioregion have amongst the highest rates of clearing for agriculture and plantation (FPA 2011). For example, *Eucalyptus regnans* forest in the North-East has one of the highest rates of forest clearing in Tasmania since 1996, with one third (9150 ha) of the 1996 extent having been cleared over 15 years (FPA 2011), which is almost as much as the estimated 11 200 ha cleared over many decades prior to 1996. This understates the loss of mature forest since it does not include logging and regeneration of native forest which is also commonplace in this forest type, nor does it consider pre-1996 clearing. Statewide, wet forest dominated by *Eucalyptus regnans* is relatively poorly reserved compared to other eucalypt communities (Potts & Tilyard 2012).

A specific type of wet forest occurs on elevated sites close to the coast where additional precipitation and humidity is provided by frequent cloud cover. These rare and localised 'cloud forests' are poorly conserved in Tasmania and therefore a representative sample of this ecosystem should be included in an expanded reserve system (McQuillan 2012). Cloud forests are largely restricted to high hills close to the East Coast, including Mount Elephant, South Sister, Mount Maria and Tatnells Hill (Fitzgerald 1999, McQuillan 2012).

Rainforest

Rainforest occurs in areas of high rainfall and low fire frequency. Substantial areas of rainforest dominated by myrtle beech (*Nothofagus cunninghamii*) and sassafras (*Atherosperma moschatum*) occur in the North-East Highlands where rainfall is greater than 1000 mm per annum. Elsewhere in eastern Tasmania the climate is at best marginal for rainforest and fire frequency is relatively high; consequently rainforest is limited to small relict patches, typically in topographically protected sites (Neyland 1991). Myrtle beech is not always present due to its relatively poor dispersal ability, compared to the wind-dispersed sassafras (Neyland 1991).

Keystone rainforest species such as myrtle beech and sassafras survived previous glacial cycles in isolated refugia from which they underwent local range expansions. Consequently populations in eastern Tasmania are genetically distinct from those in the extensive rainforests of western Tasmania, and from mainland Australia (Shapcott 1994, Worth *et al.* 2009). The rainforests of North-East Tasmania, as a geographic outlier from the western rainforests, are likely of National Heritage significance (Hitchcock 2012).



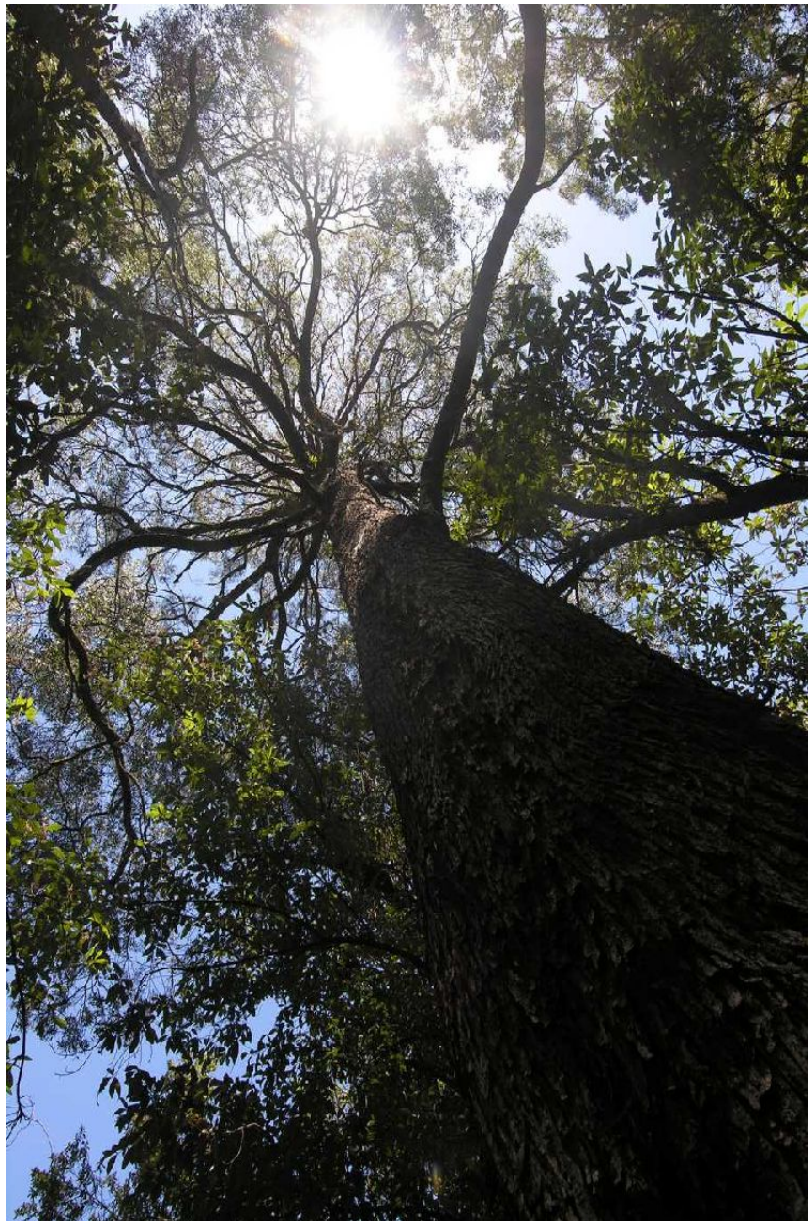
Myrtle beech (Nothofagus cunninghamii) and ferns in rainforest, Douglas-Apsley National Park

Other Forest

Other forest communities include those dominated by blackwood (*Acacia melanoxylon*), silver wattle (*A. dealbata*), tea trees (*Leptospermum* spp.), she-oaks (*Allocasuarina* spp.) and paperbark (*Melaleuca ericifolia*). Oyster Bay pine (*Callitris rhomboidea*) forest is restricted to the East Coast and Furneaux Islands. Twelve non-eucalypt forest Tasveg communities occur in the region, occupying a variety of habitats, and many are relatively rare. Because they differ in structure and species composition from the much more widespread eucalypt forest communities these non-eucalypt forest types are important for maintaining biodiversity at the landscape scale.

Grassland

Native grasslands dominated by species of *Poa*, *Themeda*, *Austrodanthonia* and *Austrostipa* are uncommon in Eastern Tasmania. The most extensive native grasslands are in the Fingal Valley and the central East Coast. The most widespread community 'lowland grassland complex' is often a semi-natural grassland with a mix of native and exotic species. Two Tasveg grassland communities are rare, having undergone a massive reduction in their extent across Tasmania, and together these are recognised as a Critically Endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2010).



Blackwood (Acacia melanoxydon) in damp sclerophyll forest at Siamese Ridge

Heathland, Scrub and Moorland

Several heathland and moorland communities occur in eastern Tasmania, typically associated with nutrient-poor and waterlogged soils. Heath communities typically characterised by tea-tree (*Leptospermum* spp.) and paperbark (*Melaleuca* spp.) occur along watercourses and in swampy areas. Buttongrass (*Gymnoschoenus sphaerocephalus*) moorland occupies similar situations and reflects a high fire frequency. The relatively small patches of buttongrass moorland in Eastern Tasmania are ecologically similar to the extensive moorlands of southwest Tasmania but are floristically distinct. Moorland, heath and forest tend to form a mosaic across the landscape in areas of low relief and several distinct vegetation types can coexist in a small area primarily due to differences in soil moisture.

The formerly extensive heathlands of the Great Northern Plain have been largely cleared for grazing land (Kirkpatrick & Wells 1987) and the remnant heathland here has “extremely high biological significance” (Kirkpatrick & Harris 1999). Land clearing, inappropriate fire regimes, nutrient enrichment and the plant pathogen *Phytophthora cinnamomi* pose a threat to heathlands (Kirkpatrick & Harris 1999).

Scrub communities are mostly confined to coastal and highland sites where conditions are poor for tree growth, or they are intermediate successional stages in the development of forest.



Moorland, scrub and dry forest mosaic at Mt Pearson

Alpine

Alpine ecosystems in the North-East comprise several vegetation communities with affinities to alpine vegetation of the Central Plateau, however there are some differences such as the absence of Tasmania's endemic montane conifers from the North-East (Kirkpatrick 1997). The alpine vegetation also has significant structural and floristic differences from the treeless

highland vegetation of mainland Australia (Davies 1996). Mount Arthur and Mount Victoria represent the northern and eastern limits, respectively, of Tasmania's alpine environment (Kirkpatrick 1997).

Riparian Vegetation

Vegetation of riverbanks is rarely mapped separately because it tends to be narrow and intergrades with the surrounding vegetation. Riparian vegetation has a high proportion of threatened plant species and comprises a wide variety of floristic and structural communities, several of which are poorly reserved or unreserved in eastern Tasmania (Daley & Kirkpatrick 2004).

Freshwater Ecosystems

Most catchments in eastern Tasmania are relatively small and typically have low flows in summer, although flooding can occur in any season. The largest river is the South Esk which arises in the North-East Highlands. Wetlands are uncommon but are important habitat for birds and other fauna. Most wetlands in the region are coastal lagoons. Freshwater ecosystems vary in condition from intact to highly degraded (DPIW 2008) and provide habitat for a variety of threatened fauna species including galaxiid fish and hydrobiid snails (Bryant & Jackson 1999). The region contains 21 of Tasmania's 89 sites listed on the Directory of Important Wetlands Australia (Environment Australia 2001). However a more recent assessment has identified over 1000 wetlands which potentially meet criteria for listing in DIWA (NRM South 2007). Five of Tasmania's ten listed Ramsar wetlands are on the East Coast, on public and private land (Prahalad & Kriwoken 2010).



Coastline near Swansea looking toward Freycinet Peninsula

Coastal, Saltmarshes and Estuaries

The East Coast is notable for a relatively undeveloped coastline, with many areas in a largely natural state with minimal infrastructure or weeds. The coastline is diverse, with high and low-energy environments including long sandy beaches, coastal lagoons, massive headlands and sea cliffs.

Some of Tasmania's largest and most significant estuaries occur on the East Coast, such as Georges Bay, Moulting Lagoon and Little Swanport. Estuaries are important because they have high productivity and are an interface between terrestrial, freshwater and marine realms.

Saltmarshes are unique habitats with distinctive ecology and biodiversity. They are small and localised and are vulnerable to environmental change. Observed changes in Tasmanian saltmarsh ecosystems, including a net reduction in area and shifts in plant species composition, have occurred in response to human impact, recent climatic change and sea level rise (Prahald *et al.* 2011).



Georges Bay estuary near Humbug Point

Threatened Communities

Twenty-three vegetation communities listed as threatened on the Tasmanian *Nature Conservation Act 2002* occur in eastern Tasmania (Table 1).

Table 1. Extent of threatened vegetation communities in Eastern Tasmania (not including EPBC listed communities).

Group	TASVEG 2.0 community	Hectares	Approx. % of Tas extent
Dry Eucalypt Forest and Woodland	<i>Eucalyptus amygdalina</i> forest and woodland on sandstone	13587	30.8
	<i>Eucalyptus amygdalina</i> inland forest and woodland on Cainozoic deposits	2910	11.6
	<i>Eucalyptus globulus</i> dry forest and woodland	6153	36.9
	<i>Eucalyptus ovata</i> forest and woodland	3472	25.1
	<i>Eucalyptus risdonii</i> forest and woodland	2	0.3
	<i>Eucalyptus tenuiramis</i> forest and woodland on sediments	805	1.7
	<i>Eucalyptus viminalis</i> - <i>Eucalyptus globulus</i> coastal forest and woodland	938	31.8
Highland Treeless Vegetation	Cushion moorland	107	3.4
Moorland, Sedgeland, Rushland and Peatland	Highland grassy sedgeland	137	0.7
	<i>Sphagnum</i> peatland	19	0.6
	Subalpine <i>Diplarrena latifolia</i> rushland	2	0.2
Native Grassland	Highland <i>Poa</i> grassland	1106	4.6
Non-Eucalypt Forest and Woodland	<i>Allocasuarina littoralis</i> forest	733	48.2
	<i>Callitris rhomboidea</i> forest	697	80.7
	<i>Melaleuca ericifolia</i> swamp forest	1326	16.8
	Notelaea - Pomaderris - Beyeria forest	130	45.2
Rainforest and Related Scrub	Rainforest fernland	1162	68.9
Saltmarsh and Wetland	Wetland (undifferentiated)	1410	24.4
Scrub, Heathland and Coastal Complexes	<i>Banksia marginata</i> wet scrub	26	0.8
	<i>Melaleuca pustulata</i> scrub	330	100.0
	Riparian scrub	1493	37.6
	Seabird rookery complex	22	3.1
Wet Eucalypt Forest and Woodland	<i>Eucalyptus brookeriana</i> wet forest	100	1.6
	<i>Eucalyptus viminalis</i> wet forest	1701	22.7
Total		38371	12.6

The three Tasmanian ecosystems listed as threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* all occur in eastern Tasmania.

The *Eucalyptus ovata* – *Callitris oblonga* community is endemic to eastern Tasmania and is classified as Vulnerable due to massive reduction in extent and ongoing loss and degradation from weed invasion and changed fire and flood regimes (TSU 2004).

Tasmanian lowland native grasslands (dominated by *Poa* or *Themeda*) are a Critically Endangered ecological community which mostly occur in the Midlands, with some patches in eastern Tasmania (DEWHA 2010).

Alpine *Sphagnum* peatlands are listed as Endangered and, in Tasmania, occur mostly in the Central Highlands with outlying examples in the North-East Highlands (Commonwealth of Australia 2009).

Fauna

Predators

Following the extinction of the thylacine (*Thylacinus cynocephalus*), the largest terrestrial carnivores are the Tasmanian devil (*Sarcophilus harrisi*), the spotted-tail quoll (*Dasyurus maculatus*) and wedge-tailed eagle (*Aquila audax fleayi*). All of these apex predators are listed threatened species in Tasmania. Apex predators play a critical ecosystem function in the top-down regulation of food webs (Soulé *et al.* 2004) and can also suppress feral predators such as cats and foxes (Johnson *et al.* 2012). Tasmania is globally significant for having the largest guild of marsupial carnivores (Jones 2003).

Species distribution models for the three largest marsupial carnivores (Tasmanian devil, spotted-tail quoll, eastern quoll) identifies three distinct hotspots for these species, one of which is “the north-east (bounded by the Tamar River and Fingal Valley but excluding highest altitude and coastal areas) and spreading down the Eastern Tiers to as far south as [Little Swanport]” (Johnson *et al.* 2012). This analysis also used weather stability maps to identify refugia, defined as areas where these species are likely to persist in times of climatic variation.

“These refugia based on concurrent distributions capture the distribution strongholds for the Tasmanian devil and eastern quoll well. Connectivity of reserved habitats for these two species could be enhanced with additional reserves along the full length of the Eastern Tiers to as far south as Sorell, both capturing the core refugia and distribution strongholds and providing north-south latitudinal connectivity” (Johnson *et al.* 2012).

Specific refugia indicated by the model for the Tasmanian devil include the lower slopes of the Ben Lomond Plateau, the northern portion of the Eastern Tiers and the St Marys region. For the spotted-tail quoll, likely refugia comprise the sub-coastal lowlands of the north coast (Johnson *et al.* 2012). The formal establishment of ENGO reserves in the northeast of Tasmania and along the Eastern Tiers would greatly improve reservation/protection status and connectivity for the sympatric carnivore guild (IVG 2012a).

The largest raptor in Australia, the Tasmanian subspecies of the wedge-tailed eagle ranges across eastern Tasmania and relies on mature forest for nesting. Populations of this endangered subspecies in North-East Tasmania are affected by loss of nesting habitat associated with native forest logging and plantation conversion, with populations predicted to decline by at least half within the next 40 years due to a continuing loss of mature forest (Bekessy *et al.* 2009).

The Tasmanian masked owl (*Tyto novaehollandiae castanops*), the world's largest barn owl,

prefers dry sclerophyll forest (Bell *et al.* 1997) and requires old growth trees for nesting hollows (Bell *et al.* 1997). Like other medium to large predators it has a large home range, which may be more than 1000 hectares (Bell *et al.* 1997). Important breeding areas for this species include the east coast between St Marys and the Tasman Peninsula and mature forest remnants in the near-coastal lowlands in the northeast (Bell *et al.* 1997).

With regard to the masked owl, McQuillan (2012) notes: “In the absence of critical habitat being defined for this functionally important and globally unusual subspecies, a wide geographical cross section of old growth forests rich in potential nesting sites and prey should be recommended in order to support as many occupied home ranges as possible”.

Birds

Eastern Tasmania includes eight Important Bird Areas, which are sites of international importance for bird conservation (Birds Australia 2009). The Cape Portland IBA supports significant populations of coastal birds, such as Cape Barren Geese and Hooded Plover. The Moulting Lagoon IBA is a large estuarine area with thousands of black swans. IBAs at Marion Bay and Orford recognise habitat for coastal birds such as oystercatchers and the vulnerable fairy tern. The Douglas Apsley IBA is recognised for forest birds, and is representative of the widespread eucalypt forest habitat of the Eastern Tiers.

Invertebrates

While western Tasmania is particularly notable for invertebrate diversity and ancient species, the North-East Highlands is also a hotspot of invertebrate diversity (Richardson 2012). The distribution of Tasmanian invertebrates sometimes exhibits fascinating patterns of biogeographic interest. North-East Tasmania appears to be particularly rich in these phenomena, including 'faunal breaks' where a sharp change in invertebrate species assemblages occur, and parapatric boundaries between related species of velvet worms and burrowing crayfish (Richardson 2012).

Ancient and Refugial Species

Tasmania's relictual (or ancient) groups of invertebrates are globally significant. The velvet worms (Phylum: Onychophora) have evolutionary significance as the link between worms and arthropods. The Tasmanian onychophorans are notable for their particularly ancient lineage, Gondwanan relationships and their endemism (Richardson 2012). Velvet worms rely on mature wet or damp forest habitat. The two rarest species in Tasmania are endemic to the North-East and are listed threatened species.

Freshwater crayfish (Family: Parastacidae) are another ancient group with Gondwanan origins. Tasmania has a rich crayfish fauna with 37 species of which 35 are endemic (Richardson 2012). Two of the 3 Tasmanian species of riverine crayfish (*Astacopsis* spp.) occur in eastern Tasmania and six species of burrowing crayfish (*Engaeus* spp.) occur in the North-East (Richardson *et al.* 2006). Of these 8 species, three are threatened (see Table 2) and four of the *Engaeus* species are locally endemic in the North-East. The giant freshwater crayfish (*A. gouldi*), the largest freshwater crustacean in the world, is a threatened species due to declining populations and local extinctions; the north-eastern Tasmanian populations are genetically distinct from north-western Tasmania and therefore may be of extremely high conservation value (McQuillan 2012).

Tasmania has a diverse lucanid or stag beetle (Family: Lucanidae) fauna with Gondwanan origins, including three *Hoplogonus* species all endemic to restricted areas of the North-East which probably represent glacial refugia for these flightless forest-dependent beetles (McQuillan 2012).

Threatened Fauna

Fifty threatened terrestrial and freshwater fauna species have been recorded from the region. Areas of high value for threatened species habitat, including extensive mature forest habitat, occur on the northern and eastern slopes of the Blue Tier and the adjoining lowlands (IVG 2012a). Significant unreserved habitat for hollow-nesting birds occurs in this area, and also in the catchments of Constable Creek and Little Swanport River (IVG 2012a).

Some of the many threatened fauna species with core habitat occurring in eastern Tasmania are listed in Table 2.



Tasmanian devil
(*Sarcophilus harrisi*)

Table 2. Some threatened fauna species of eastern Tasmania (not a comprehensive list).

Common name	Scientific name	Tasmanian status	National status	Key locations
Grey goshawk	<i>Accipiter novaehollandiae</i>	e		Blue Tier
Swift parrot	<i>Lathamus discolor</i>	e	EN	Binalong Bay, St Marys region, Maria Island, Wielangta, Forestier and Tasman peninsulas ²
Forty-spotted pardalote	<i>Pardalotus quadragintus</i>	e	EN	Maria Island
Masked owl	<i>Tyto novaehollandiae</i>	e	VU	Southern and central East Coast, Great Northern Plain
Wedge-tailed eagle	<i>Aquila audax fleayi</i>	e	EN	Tall forest on south and SE-facing slopes – Eastern Tiers, North-East Highlands, Forestier and Tasman Peninsulas
Tasmanian devil	<i>Sarcophilus harrisii</i>	e	EN	Eastern Tiers, St Marys region, foothills of North-East Highlands
Spotted-tail quoll	<i>Dasyurus maculatus</i>	v	VU	Lowland North-East Tasmania
New Holland mouse	<i>Pseudomys novaehollandiae</i>	e	VU	Coastal heathland and heathy forest in the North-East
Glossy grass skink	<i>Pseudemoia rawlinsoni</i>	r		Unknown but recorded from Coles Bay, South Esk Valley and Binalong Bay.
Green and gold frog	<i>Litoria raniformis</i>	v	VU	Coastal wetlands on the north and east coasts
Swan galaxias	<i>Galaxias fontanus</i>	e	EN	Headwaters of the Swan and Macquarie rivers
Dwarf galaxiid	<i>Galaxiella pusilla</i>	v	VU	Wetlands in the North-East lowlands
Giant freshwater crayfish	<i>Astacopsis gouldi</i>	v	VU	Great Forester, Ringarooma, Musselroe rivers
Mt. Arthur burrowing crayfish	<i>Engaeus orramakunna</i>	v	VU	Mount Arthur
Scottsdale burrowing crayfish	<i>Engaeus spinicaudatus</i>	e	EN	East of Scottsdale
Blind velvet worm	<i>Tasmanipatus anophthalmus</i>	e	EN	St Marys region
Giant velvet worm	<i>Tasmanipatus barretti</i>	e	EN	Avenue and Scamander river catchments
Bornemissza's stag beetle	<i>Hoplogonus bornemisszai</i>	e	CR	Restricted to a small area of wet forest at Goulds Country
Simson's stag beetle	<i>Hoplogonus simsoni</i>	v	VU	Blue Tier
Vanderschoor's stag beetle	<i>Hoplogonus vanderschoori</i>	v	VU	Mount Victoria

² These are all 'Swift Parrot Important Breeding Areas' (FPA 2010)

Broad-toothed stag beetle	<i>Lissotes latidens</i>	e	EN	Restricted to wet forest in the Wielangta area
Burgundy Snail	<i>Helicarion rubicundus</i>	r		Forestier Peninsula

Flora

The eastern Tasmanian flora has close affinities with mainland south east Australia, with a dominance of fire and drought adapted species. It is distinct from the western Tasmanian flora which has a prominent Gondwanan element. Many of Tasmania's rarest, most threatened and under-reserved plant species occur in the east.

Eucalypts

A diversity of climates and soils combined with glacial history and ongoing evolution contribute to the greater diversity of eucalypts in eastern Tasmania than elsewhere in the state. Several restricted endemics occur in the South-East in addition to the more widespread species.

Particularly high eucalypt species richness (12 or more species per 100km²) occurs throughout the Eastern Tiers, especially in the north, and near St Marys and Wielangta (Potts & Tilyard 2012, Williams & Potts 1996). These areas are likely to contain a high diversity of habitats and are important for eucalypt evolution. Significant intraspecific genetic variation occurs within many eucalypt species, and eastern Tasmania contains genetically distinct populations of several species, sometimes reflecting a history of glacial refugia (McKinnon *et al.* 2004).



Davies waxflower (*Phebalium daviesii*), an endangered shrub from near St Helens

Proposed new reserves on public land will substantially increase the reservation of *Eucalyptus regnans* in the North-East, Eastern Tiers and Tasman Peninsula, and *E. sieberi* in the North-East (Potts & Tilyard 2012).

Unusual and significant eucalypt occurrences in eastern Tasmania include a disjunct inland population of a rare race of *E. globulus* at Pepper Hill, an outlying population of *E. aff. subcrenulata* at the Blue Tier, an ecologically marginal population of *E. archeri* in the North-East Highlands, low elevation outlying populations of *E. gunnii* at Mt Arthur and Fingal Tier, small disjunct stands of *E. regnans* in the Eastern Tiers (Potts & Tilyard 2012). Important populations of the rare species *E. barberi* occur on public forest in the Little Swanport and Wielangta areas (Potts & Tilyard 2012).

Wielangta has a high diversity of eucalypt species and also is the range limit for several species (e.g. *E. barberi*, *E. delegatensis*, *E. urnigera*) and contains rare, relictual and hybrid populations including *E. cordata*, *E. coccifera* and *E. delegatensis* (Potts & Tilyard 2012).

Tasmania is a global hotspot for giant trees, with four of the ten tallest tree species on Earth, including the tallest angiosperms (Tng *et al.* 2012). Furthermore the tall mixed forest ecosystem in which giant eucalypts are emergent over a rainforest canopy is globally unique:

“The resulting syndrome of a fire-dependent forest above a fire-intolerant forest is only known in the associations between eucalypts and Australian rain forest. These unique ecosystems are of high conservation value, in light of substantial clearing and logging over the last 150 years” (Tng *et al.* 2012).

North-East Tasmania has suitable conditions for giant trees and several giant eucalypts are known, the tallest at 89 metres are a *Eucalyptus viminalis* and a *E. regnans* in the upper South Esk catchment. The Blue Tier Giant is the most massive tree in eastern Tasmania with an estimated volume of 290m³ (Giant Trees Consultative Committee 2011).



Highland eucalypt forest in State Forest at Ben Lomond

Threatened Flora

More than 270 threatened vascular plant and lichen taxa are known from the region. There is much potential for improving the reservation status of threatened flora species by protecting forests on public land in eastern Tasmania (IVG 2012b). Much of the unreserved public forests of the North-East, Wielangta and the Tasman Peninsula contain high to extremely high priority flora values (IVG 2012b).

An area of unreserved forest comprising the Fingal Tier and forests directly west of the Douglas-Apsley National Park “is outstanding in its high threatened flora values, capturing important populations of 12 priority threatened flora species. In addition a number of species of high conservation significance are known to occur in this proposed reserve but have not been assessed in this analysis as they are not currently listed as threatened due to their recent description or insufficient knowledge of their extinction risk.” (IVG 2012b).

A number of threatened flora species with very small populations or geographic extent occur in eastern Tasmania. These include the Mount Arthur boronia (*Boronia hemichiton*), brown guineaflower (*Hibbertia rufa*), Davies waxflower (*Phebalium daviesii*), shiny cliff eyebright (*Euphrasia amphisysepala*) and hairy cliff eyebright (*E. phragmostoma*).



Tiny triggerplant (Stylidium perpusillum), listed as rare in Tasmania

Marine

The marine realm is not considered in this report, however it is noted that there are considerable conservation values in Tasmania's East Coast marine environment including (Parsons 2011):

- Schouten Island and Passage – giant kelp beds, seagrass meadows and sponge gardens;
- Endangered Southern Right Whales use the waters during seasonal migration;
- Georges Bay has the last consolidated reef of native flat oysters;
- Governor Island (Bicheno) – deep reefs, one of Australia's top diving sites;
- Tasman Peninsula – unique cave systems, giant kelp forests and diverse marine life.

There is clearly potential for integrating terrestrial conservation planning with complementary marine protected areas, e.g. linking reserves from Maria Island to the mainland and protecting the marine environment at the Bay of Fires.

Conservation Planning

Comprehensive, Adequate and Representative reserve system

The Regional Forest Agreement for Tasmania attempted to implement a CAR system for forests with some success. However there are a number of issues with the CAR approach:

1. science-based targets were compromised by politically motivated goals (Mendel & Kirkpatrick 2002),
2. some targets have not been achieved after more than 10 years of conservation programs targeting private land (McQuillan 2012),
3. target-based conservation has inherent limitations given the difficulties of classifying and quantifying biodiversity, and the setting of actual targets (e.g. the RFA target of 15% for comprehensiveness is lower than the range of 25-75% suggested by a review of scientific studies; Mackey 2012),
4. while comprehensiveness is relatively easy to determine, it is difficult to quantify adequacy, and adequacy is context dependent, requiring detailed knowledge of the ecosystems and species in question (Watson *et al.* 2008),
5. representativeness was originally assessed simply on the basis of bioregional occurrences of each forest community, however other methods may be employed to improve assessment representativeness (Mackey *et al.* 2007, Mackey 2012; and see below),
6. landscape condition was not included,
7. although they can be considered under 'Adequacy', the RFA has given limited consideration to ecological processes, connectivity and resilience, concepts which are increasingly being incorporated in conservation planning in the context of rapid climate change.

Three additional approaches to assessing representativeness were recently conducted as part of the IVG process.

Firstly, relative biological productivity for eucalypt forests was considered by identifying the highest classes of potential tree height within each of four rainfall zones. Considerable areas of relatively high productivity forest occur on unreserved public land in eastern Tasmania, particularly in the North-East Highlands, parts of the western slopes of the Eastern Tiers and the Tasman Peninsula (Knight 2012). McQuillan (2012) notes that high productivity sites, such as basalt soils and downslope areas which accumulate nutrients and moisture, tend to support higher animal populations and greater species richness and are often poorly represented in the reserve system.

Secondly, land components – which are relatively homogeneous units defined by landform, geology, soils and climate in the Land Systems of Tasmania classification – were used as to represent abiotic environmental variation as a surrogate for biodiversity. This allowed analysis of 'clearing bias', i.e. the proportion of each land unit which has been converted to non-native vegetation. Extant forest on land components with high clearing bias occurs in the upper South Esk Valley, Constable Creek, and the lowlands of the north coast (Knight 2012).

Thirdly, a comprehensive grid-based spatial analysis of native plant species records has modelled the similarity of species composition across Tasmania, giving an indication of which floral assemblages are well represented in reserves (Harwood *et al.* 2012). This analysis indicates that unreserved public forests in eastern Tasmania, including the Tasman Peninsula and the North-East, contain relatively poorly reserved floras. New reserves proposed under the IGA would significantly improve reservation of plant species, particularly dry forest flora in the Eastern Tiers and wet eucalypt forest and rainforest in the North-East (Harwood *et al.* 2012).

Notwithstanding these issues, the CAR approach has made significant progress in reservation of Tasmania's biodiversity and the resulting reserve system provides a solid foundation for an integrated landscape conservation approach which incorporates strategic additions to the reserve system for connectivity and improved representativeness along with off-reserve conservation and restoration.

Connectivity

Connectivity is about the degree of movement of organisms and ecological processes, involving concepts of barriers, dispersal distances and 'landscape permeability', which are highly scale-dependent (Crooks & Sanjayan 2006). Connectivity is important because it allows the continuity of native habitats along environmental gradients (e.g. in altitude and distance from the coast) and provides a corridor for animals and plants to move through the landscape over short and long time scales (McQuillan *et al.* 2009).

A CSIRO report offers these principles in regards to the challenge of conserving biodiversity and planning protected areas in a rapidly changing climate (Dunlop & Brown 2008):

“Protecting habitat is probably the best way to conserve species under climate change. While the species and ecosystems in any one area will change over time, the greater the total area of habitat available, and the more diverse that habitat, the greater the number of ecosystems and species that will be able to survive. ... Connectivity of habitat at various scales can be important for facilitating the movement of different species, which may increase their viability and ability to respond to climate variability and change.”

Environmental Gradients

Apart from the large latitudinal gradient, the East Coast and North East region also contains major elevation and climatic gradients. Altitudinal variation, with consequent temperature and precipitation gradients, should be secured in nature reserves to allow adaptation to climate change (Busby 1998). Gradients and ecotones are important in planning for climate change because they are relatively resilient to change (Lovejoy 2005).

“Extensive elevational gradients and corridors of vegetation connecting populations and maintaining pathways from sea level to the mountains, are an essential buffer against the impacts of both natural and human-enhanced climate change on native species.” McQuillan (2012). Hitchcock (2012) notes the “impressive altitudinal range of more than 1500 metres” in North-East Tasmania as contributing to heritage values for landscape diversity and biodiversity.

The importance of elevation gradients for capturing biodiversity is also evident at a relatively small scale (Baker *et al.* 2006), so it is necessary to include gradients of different types and at multiple scales to maximise representation and resilience.

Refugia

Refugia (or refuges) are places where biodiversity is more likely to persist during periods of environmental stress or change. For example, glacial refugia are sites where species survived the cold and aridity of glacial maxima, providing for later recolonisation as the climate warmed (Kirkpatrick & Fowler 1998). However it is unclear if these areas would also function as refugia for cool-climate species under a warmer climate, considering that they may have maintained a wet forest ecosystem relatively unchanged for tens of thousands of years.

“On the east coast rainforest or mixed forest occurring below 440m above current sealevel, the approximate height of the last glacial treeline, on the slopes of Blue Tier, deserve secure reservation. This area seems likely to be the source of the rainforest reinvasion of the Northeastern Highlands, and may also be the source for reinvasion of *Eucalyptus regnans*. The Elephant Pass-St Marys Pass-Douglas River area seems to have maintained climates suitable for rainforest and wet eucalypt forest from the height of the last glacial to the present. Not surprisingly, the area is the location for many rare species of invertebrates and plants. This mid-east coast area should be reserved where possible, especially wet valleys below 370m” (Kirkpatrick & Fowler 1998).

Fire refugia are sites which are topographically protected from fire and therefore likely to have a much lower frequency of fire than the surrounding landscape. Given the increased incidence of fire in Tasmania over the past century and the predicted increase in wildfire with climate change in the future (DPIPWE 2010a), fire refugia are very important for maintaining elements of biodiversity that are fire sensitive, such as remnant rainforest in eastern Tasmania. A fire refugia index based on topographic features and historical records of fire ignitions indicates that likely fire refugia in eastern Tasmania are limited to the North-East Highlands and small areas in the Douglas-Apsley, Eastern Tiers, Wielangta and Tasman Peninsula (IVG 2012c). At a bioregional scale these sites may be critically important for the persistence of rainforest species in the future. 'Microrefugia' may occur where topographic influences create a local microclimate which differs from the prevailing climate (Dobrowski 2011). In Tasmania these are expected to occur on near coastal hills where fog precipitation is

important ('cloud forests'), deep valleys and south-facing slopes where evapotranspiration is low, and areas with ground water supply such as riparian zones (McQuillan 2012).

Although some refugia have been mapped, much more research and analysis is needed to identify various types of refugia for a range of biodiversity elements in Tasmania (Brown 2010). Australia's *Strategy for the National Reserve System* notes that refugia, as critical areas for climate change resilience, should form the core areas of landscape-scale approaches to conservation (Australian Government 2009).



Puffball fungus in remnant rainforest, Douglas-Apsley National Park

Ecological Processes

A framework for incorporating ecological processes in conservation planning has been developed by Mackey *et al.* (2007). This attempts to go beyond the simple asset-based approach of the CAR system. McQuillan *et al.* (2009) considered these ecological processes in a Tasmanian context. A landscape-scale corridor in eastern Tasmania would help protect and maintain many of these processes including maintaining functional populations of predators and hence trophic processes, and allowing long-distance biological movement.

Terrestrial and freshwater environments tend to be treated separately in conservation projects and it remains a conservation planning challenge to capture ecological processes which integrate across these realms (Beger *et al.* 2010).

Geoconservation

Nearly 200 sites of geological, geomorphological (landform), and pedological (soil) significance are recorded in eastern Tasmania, including 11 of national significance and 6 of global significance (DPIPWE 2010b).

Restoration

Strategic habitat restoration is a key part of the climate change adaptation challenge. According to acclaimed conservation biologist Thomas Lovejoy, “Restoration of connections in landscapes between protected areas, always important for various migratory species, is central to conservation under climate change” (Lovejoy 2005).

The potential for restoration of native vegetation in the region has been demonstrated by the Skyline Tier Restoration Project which is practising fire management and weed control to restore inappropriately located pine plantations to native eucalypt forest (Bushways 2009). This project has multiple benefits including local employment and training, reducing wildfire risk, improving habitat value for threatened and common species, and carbon sequestration (Bushways 2011). A strategic plan for eucalypt and pine plantations in eastern Tasmania would be useful to identify areas suitable for plantations and to plan for ecological restoration of plantations which are inappropriately sited (e.g. steep slopes, water catchments, barriers to connectivity). For example, a small area of plantation at Wielangta merits restoration and inclusion in the proposed Wielangta Reserve (North 2011). In higher rainfall regions there are opportunities for restoration of *Eucalyptus regnans* forest which has been converted to plantation.

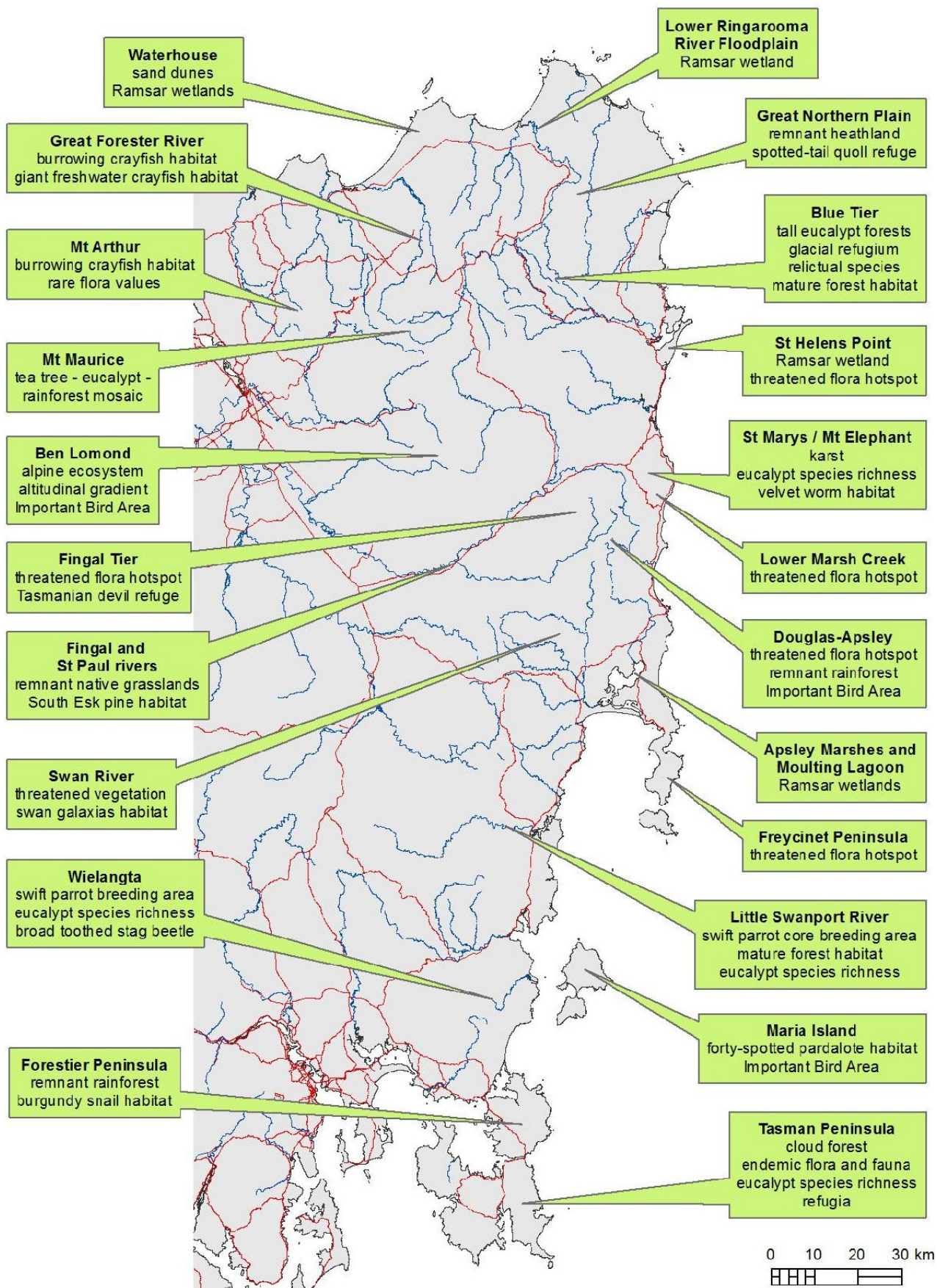
There is considerable potential for improved catchment management in the middle and upper South Esk catchment where invasive weeds, habitat fragmentation and tree decline are major issues. Strategic restoration of plantations, weed control, habitat restoration and riparian revegetation would improve catchment health, hydrological function and habitat value in this important catchment. This would be a flagship project for ecological restoration in Australia. Establishment of corridors or 'stepping stones' of native vegetation across the Fingal Valley would improve connectivity between the Eastern Tiers and North-East Highlands.

The South Esk pine (*Callitris oblonga* subsp. *oblonga*) once grew along the length of the river and is now largely restricted to parts of the upper reaches of the South Esk and its tributaries (TSU 2004). This species is listed as vulnerable in Tasmania and endangered under Commonwealth legislation. South Esk pine and black gum forest is one of the most threatened ecological communities in Tasmania. Re-establishment of South Esk pine and other native



riparian vegetation is a suitable goal for a long-term landscape restoration plan. Most of the riparian land is privately owned and therefore the plan will require successful partnerships between groups, plus landowner engagement and incentives for works such as fencing and weed control (Koehn *et al.* 2001).

Harvested pine plantation at Skyline Tier



National Heritage

Expanding and connecting the existing reserves in the North-East as proposed in the 'Linking Landscapes' plan (NEBN 2007) would capture values of National Heritage significance (Hitchcock 2012). National Heritage values also occur in a more-or-less linear corridor along the Eastern Tiers and on the Tasman and Forestier peninsulas (Hitchcock 2012). Core areas with high integrity and conservation value are centred on Ben Lomond, Mount Maurice, Mount Victoria and Douglas-Apsley with critical long-distance connectivity between these and other areas (e.g. Mount Cameron in the north and Wielangta in the south) greatly adding to the heritage value (Hitchcock 2012). Numerous places in Eastern Tasmania are listed on the National Heritage List for cultural, ecological and geomorphological values (DSEWPAC 2012).

Carbon Economy

Projections of future carbon stocks and fluxes in Tasmanian forests under scenarios of reduced logging and longer plantation rotations on public and private land could generate tens of millions of dollars in carbon credits, particularly if these activities are determined to be Kyoto eligible under Commonwealth Government policy (May *et al.* 2012). Significant areas of public and private forest in Eastern Tasmania are potentially eligible with a consequent income for land managers which could aid forest management.

Conclusion

Large-scale connectivity as proposed here for eastern Tasmania provides the best opportunity to capture large environmental gradients, viable and functional populations of carnivores and a representative variety of habitats. This requires a long-term, cross-tenure conservation plan, preferably using the systematic approach to conservation planning outlined by Margules & Pressey (2000). Although further research is needed to identify refugia there is sufficient knowledge of most biodiversity values and conservation planning principles to undertake a comprehensive regional strategy now.

A focal species approach (Huggett 2007; Lambeck 1997) would help inform appropriate levels of reservation, connectivity and off-reserve conservation actions for a long-term regional conservation strategy. A number of species could be useful indicators and icons for the conservation and restoration of terrestrial and freshwater habitats in the region, e.g. the South Esk pine, giant freshwater crayfish, masked owl.

Strategic restoration projects and off-reserve conservation initiatives are needed to complement reserves. An East Coast Corridor does not mean no economic activity. Sustainable agriculture, ecotourism and forestry, for example, can coexist with conservation. Carbon credits produced from the land use sector, including avoided deforestation and afforestation, have significant potential to provide an ongoing income stream in the region.

This would build on the valuable contribution that existing reserves and conservation projects deliver in eastern Tasmania. An eastern Tasmania connectivity corridor would address the priorities and actions in *Australia's Biodiversity Conservation Strategy*, including 'building ecosystem resilience in a changing climate' (NRMMC 2010). Expanding and connecting existing reserves to include areas of documented National Heritage value would make a notable contribution to the National Reserve System.

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Appendix:

Landscape Conservation Initiatives in Eastern Tasmania

Linking Landscapes

This project undertaken by the North East Bioregional Network identified areas of unreserved public land (i.e. State Forest and Crown Land) with high conservation values for potential inclusion in the national reserve system. Proposed new reserves were designed using a landscape scale approach with a strong emphasis on improving the integrity and connectivity of the reserve system by buffering and connecting the existing mosaic of reserves. Proposed reserves capture important and under-reserved values including threatened species, old growth forests and rare vegetation communities.

<http://www.northeastbioregionalnetwork.org.au/wldcntry.htm>

North East Highlands National Park (proposed)

This proposal for a National Park in the Blue Tier – Mount Victoria region would connect existing reserves and protect the landscape mosaic of wet sclerophyll forests and rainforest, including the tallest forests in the North East.

<http://www.bluetier.org/articles4/nehpark.pdf>

Bay of Fires National Park (proposed)

The Tasmanian Government has earmarked the upgrading of existing reserves in the Bay of Fires area to National Park status in recognition of the natural, cultural and ecotourism values of the area. This alternative proposal expands the area of the proposed National Park to include adjoining State Forest so as to ensure east-west connectivity between the coast and the Blue Tier Reserve and north-south connectivity.

<http://www.et.org.au/system/files/userfiles/Bay%20of%20Fires%20A%20New%20National%20Park%20for%20North%20East%20Tasmania.pdf>

Break O' Day National Park (proposed)

The proposed Break O'Day National park aims to improve the integrity, viability and recognition of the ecological and landscape values of the St Marys region by connecting several existing reserves.

This proposal is notable for excellent coverage of environmental gradients (elevation range and from the coast to inland) and protection of 'cloud forest' environments (McQuillan 2012).

<http://www.netlandtrust.org.au/download/Break%20O%27Day%20Report.pdf>

Constable Creek – Loila Tier reserve (proposed)

A relatively unknown and undeveloped area of 13,200 hectares in the St Helens hinterland with extensive dry forest ecosystems is proposed for reservation.

<http://www.northeastbioregionalnetwork.org.au/docs/Constablereserve.pdf>

Wild Wielangta

Wielangta is “ a hotspot of conservation values, including important swift parrot breeding habitat, a variety of narrow range endemic species and a likely climate refugium” (McQuillan

2012).

The area contains 30% of Tasmania's flora species in a relatively small area and is a key habitat for several threatened fauna species (North 2011). A proposed reserve extension consolidates several existing reserves into a new 10,900 hectare reserve so as to protect the significant natural values (North 2011).

<http://wildwielangta.edublogs.org/>

North East Tasmania Land Trust (NETLT)

This not-for-profit organisation acquires and manages private land for conservation in the North East. Private land conservation is vital for protection of important values that are under-represented on public land and for maintaining habitat and connectivity in areas such as the coastal zone where land tenure is predominantly private. The NETLT is well positioned to undertake strategic acquisition of private land parcels which occur as gaps within existing reserves or connectivity zones.

<http://www.netlandtrust.org.au>

Tasmanian Land Conservancy (TLC)

Like the NETLT, the TLC acquires land for conservation, but with a statewide rather than a regional focus. The TLC's portfolio includes Long Point Nature Reserve on the East Coast.

<http://www.tasland.org.au>

Conservation covenants on private land

Numerous conservation covenants and private nature reserves occur in the region, resulting from government initiatives such as Protected Areas on Private Land and the Forest Conservation Fund. These represent a major contribution to nature conservation by private landowners. A landscape-scale conservation initiative would add value to these by integrating conservation management across land tenures.

North East Land Use Plan

This project utilised the widely used Conservation Action Planning framework to identify and assess conservation assets, threats, strategies and objectives. The project area comprises several catchments on the East Coast. Several of the strategies recommended in this report relate to landscape- or catchment-scale planning and connectivity.

<http://www.northeastbioregionalnetwork.org.au/docs/North%20east%20Bioregional%20report%20-%20Land%20use%20plan%20for%20email.pdf>

Break O'Day Priority Habitat Mapping

In 2011 the North East Bioregional Network produced a map of 'priority habitat' areas in the Break O'Day Municipality. Spatial analysis was conducted using GIS and Marxan conservation planning software in order to capture multiple habitat values including connectivity.

Skyline Tier Restoration

Post-harvest restoration of former radiata pine plantation at Skyline Tier has been undertaken since 2007. Native forest regeneration has been highly successful in the project area, proving the efficacy of restoring biodiverse native vegetation on a site which was previously an

extensive monoculture of potentially invasive exotic trees. This provides a model for other restoration projects to provide local employment and long-term ecological benefits.

<http://www.northeastbioregionalnetwork.org.au/docs/skyli911.pdf>

Swan-Apsley

The Swan-Apsley catchment region on the central East Coast is a priority area for NRM South, with planning and funding to address land management issues such as weed and fire management. The region has the highest proportion of threatened plant species in Southern Tasmania and contains important water catchments for East Coast settlements.

http://www.nrmsouth.org.au/programs_activities/view_healthy_catchments_coasts_15130682/view_swan_apsleylittle_swanport_priority_area_15130749/

Conclusion

All of these proposals and projects are complementary and contribute to the long-term protection of the significant natural heritage of the North East and East Coast. Given the mix of land tenures and land use history, achieving landscape-scale connectivity conservation will require a range of complementary approaches such as these. A large-scale habitat corridor in eastern Tasmania would be achievable with relatively limited resources since there is substantial connected habitat which requires minimal management and there are a number of existing initiatives which contribute to the aim.

Clearly there is considerable opportunity for consolidation of existing reserves, particularly through the IGA process. Since the focus has largely been on intact public land, the next stage is to identify degraded land or intact private land which would fill critical gaps in the landscape. Established processes such as voluntary conservation covenants and biodiverse revegetation can achieve these aims, particularly when conducted as part of a broad landscape scale plan.

Strategic restoration of wildlife corridors in the heavily cleared Fingal Valley and Great Northern Plain is a conservation priority in the region. Likewise, restoration of the weed-infested riparian zone of the South Esk River would provide habitat, connectivity and ecological services. Retaining corridors from the coast to the Eastern Tiers is a priority on the East Coast.

