Mapping to underpin management of Littoral rainforest

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CSIRO

Northern Australia Environmental Resources Hub

National Environmental Science Programme

Why did we do this project?

- NESP Research Priority – Develop management practices for rainforests which minimise the impact of extreme weather events
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
  - EPBC listed critically endangered ecological community



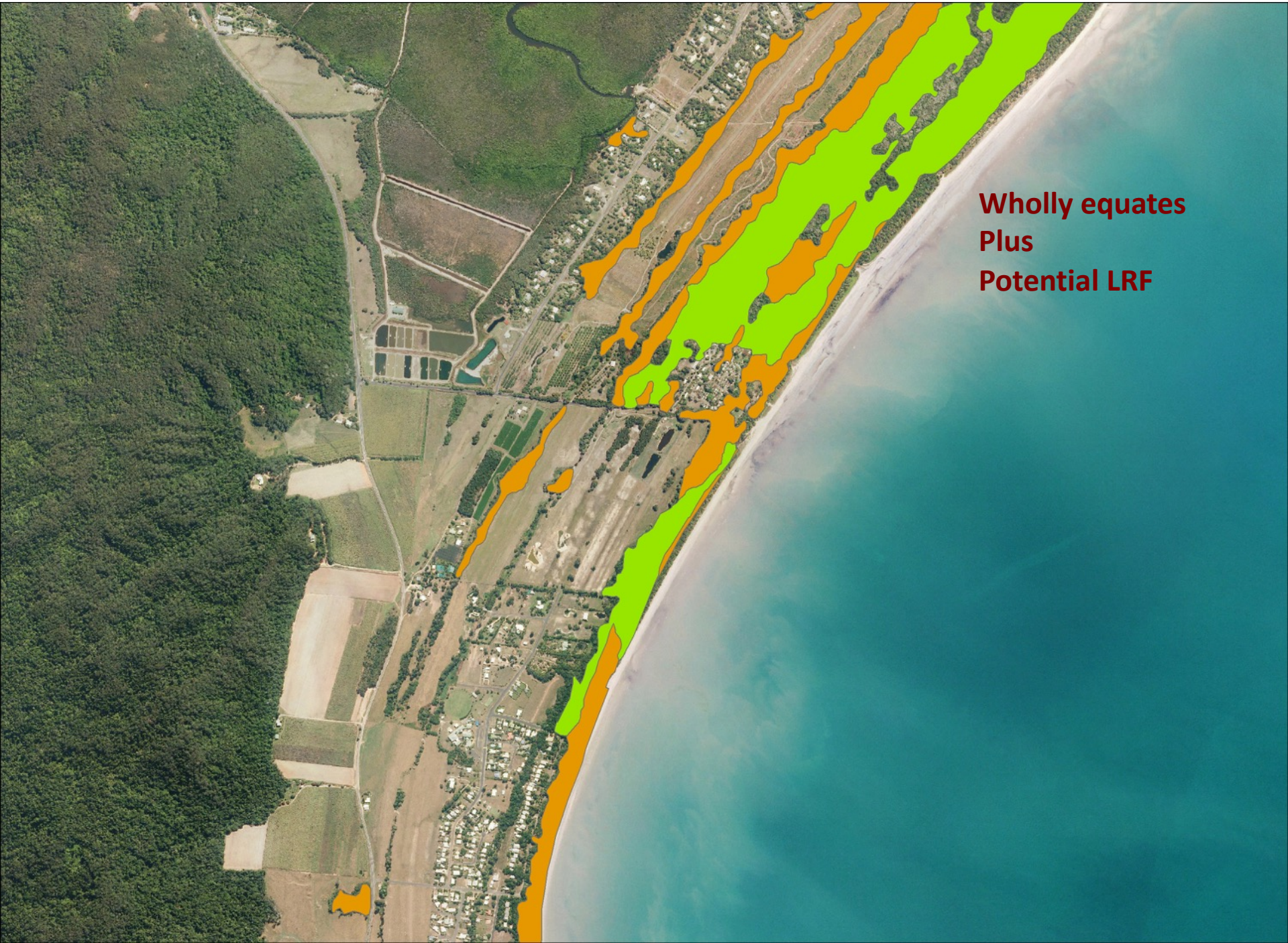
Lavorel et al. 2015 Ecological mechanisms underpinning climate adaption services. Global Change Biology, 21: 12-31.

How did we do it?

- Mapping of LRF
  - Based on a methodology established in MTSRF (I year) and NERP projects (3 years)
  - Listing advice criteria e.g. 'wholly compliant' RE's, floristic composition and other characteristics, geology
  - Ground-truthing – 156 site assessments

Expert Advisory Committee – DotE, WTMA, Terrain NRM, Traditional Owners, QLD Herbarium, QPWS, FNQ ROC, Local Councils – met 3 times, field work, expert opinion


Wholly equates


Wholly equates
Plus
Potential LRF

How did we do it?

- Modelling of storm-surge, inundation and sea-level rise impacts on littoral rainforest
  - DSITIA report on Average Recurrence Intervals (ARI) for each coastal Qld LGA (June 2014)
  - Using high-res coastal LiDAR
  - 20 yr, 50, 100, 200, 500, 1000, 10K ARI and TMST with and without an 80 cm sea-level rise

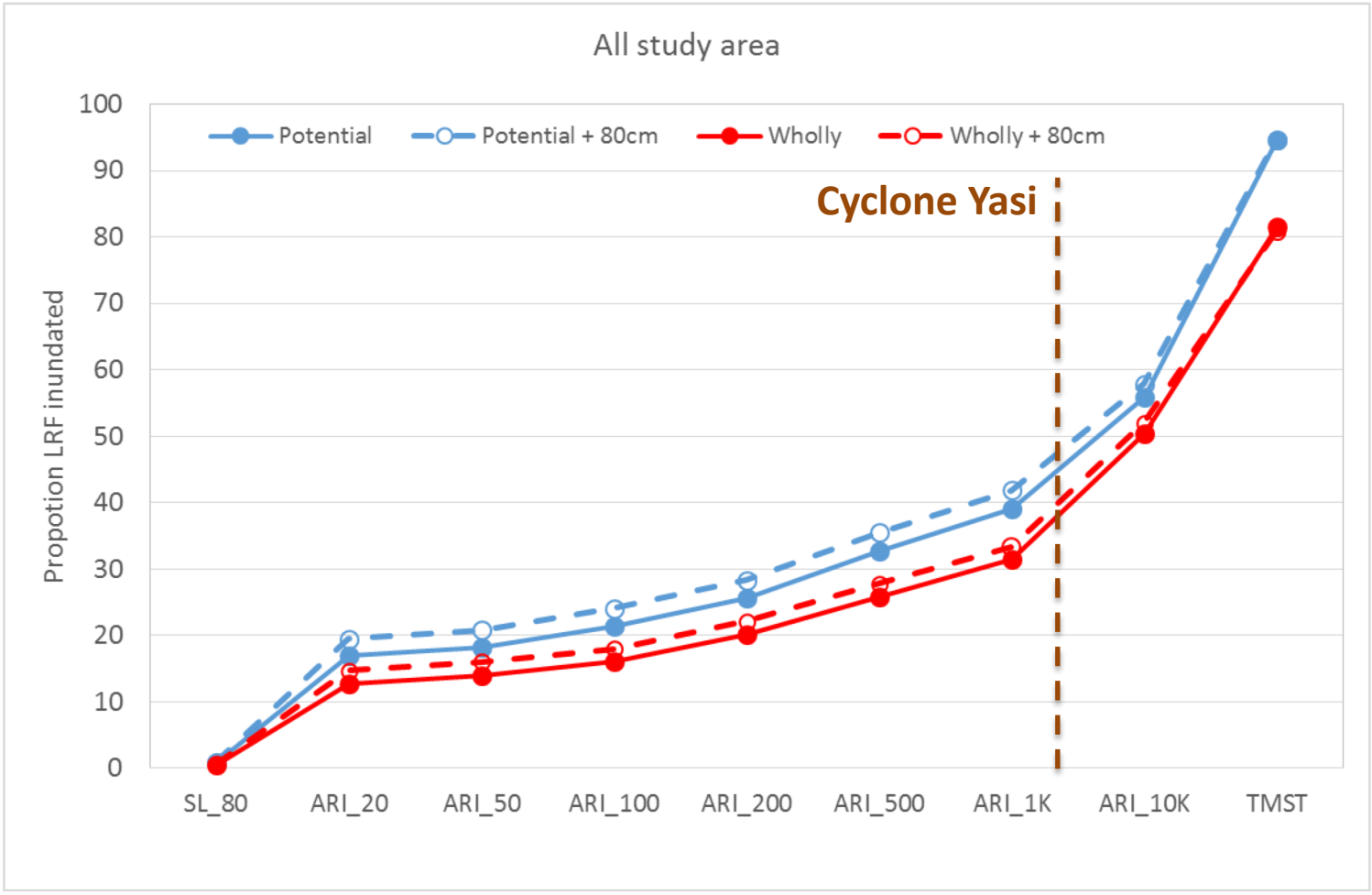

50 Yr
Inundation
< 20%
20 - 50%
> 50%

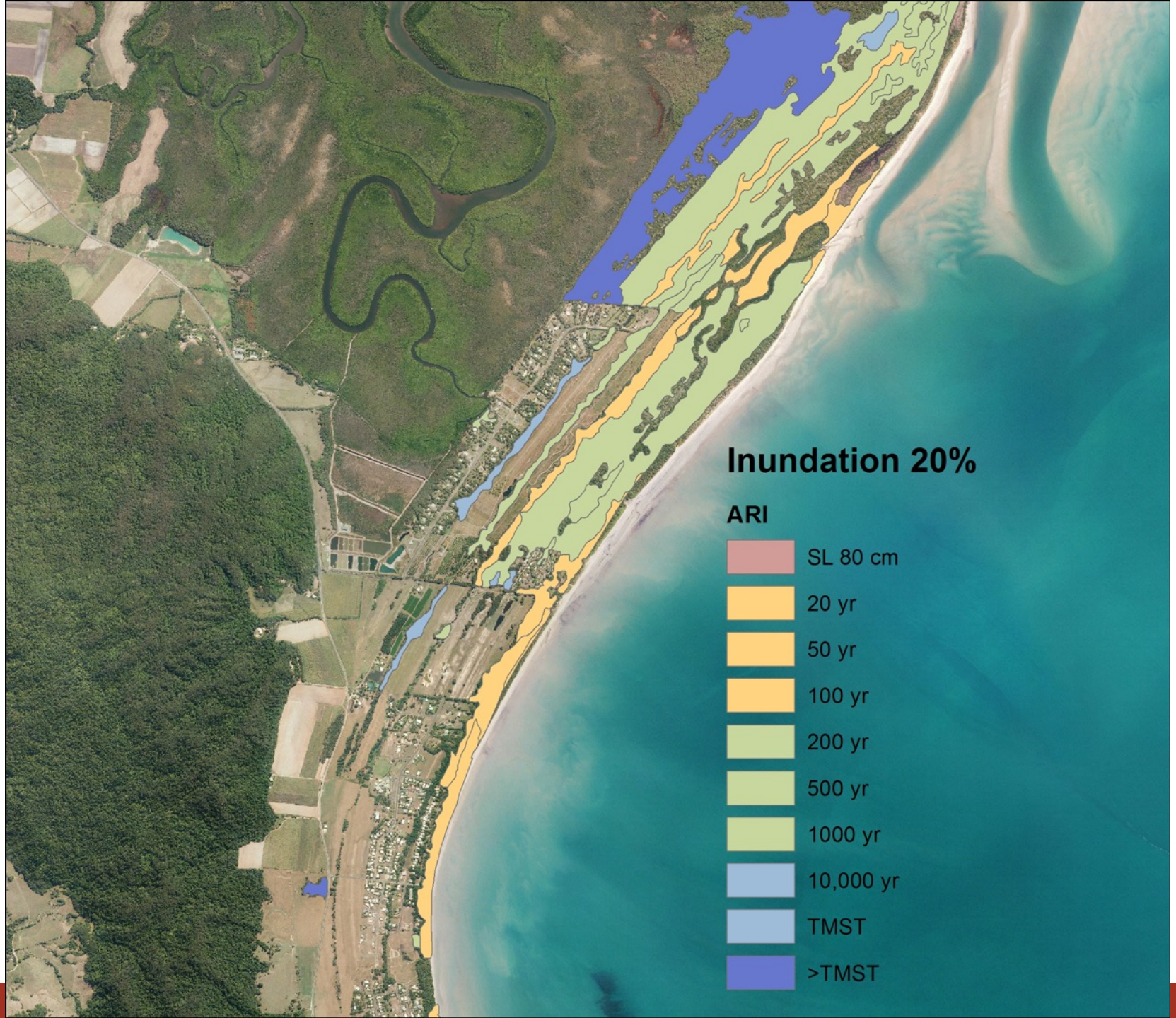

200 Yr
Inundation
< 20%
20 - 50%
> 50%

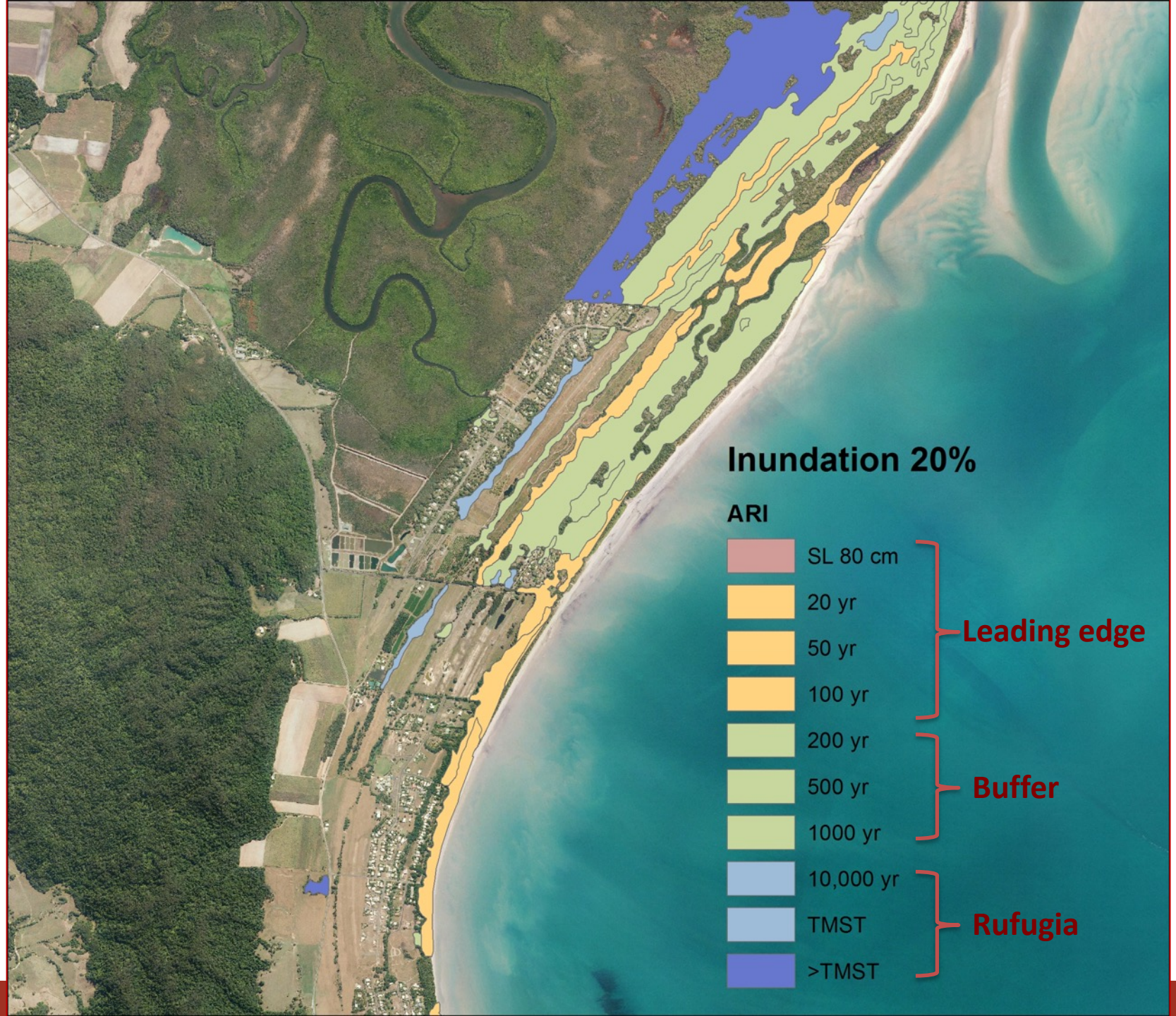

1000 Yr
Inundation
< 20%
20 - 50%
> 50%


TMST
Inundation
< 20%
20 - 50%
> 50%

Storm surge and inundation

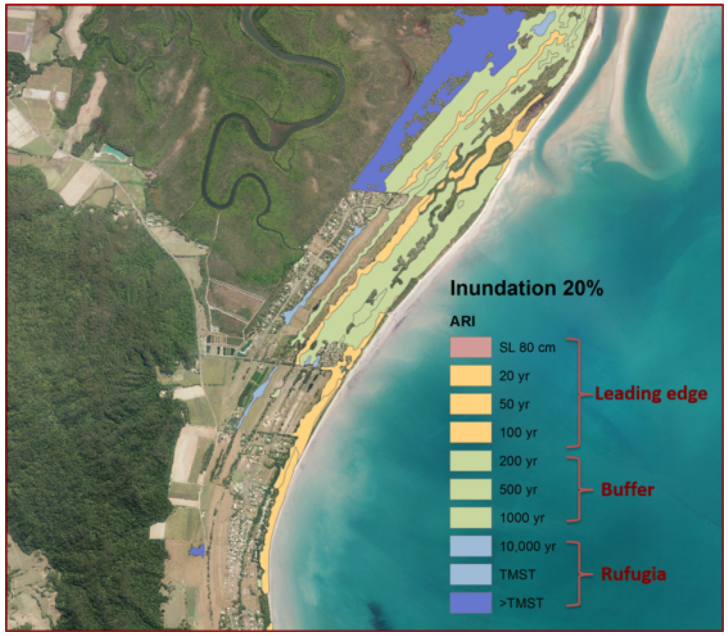


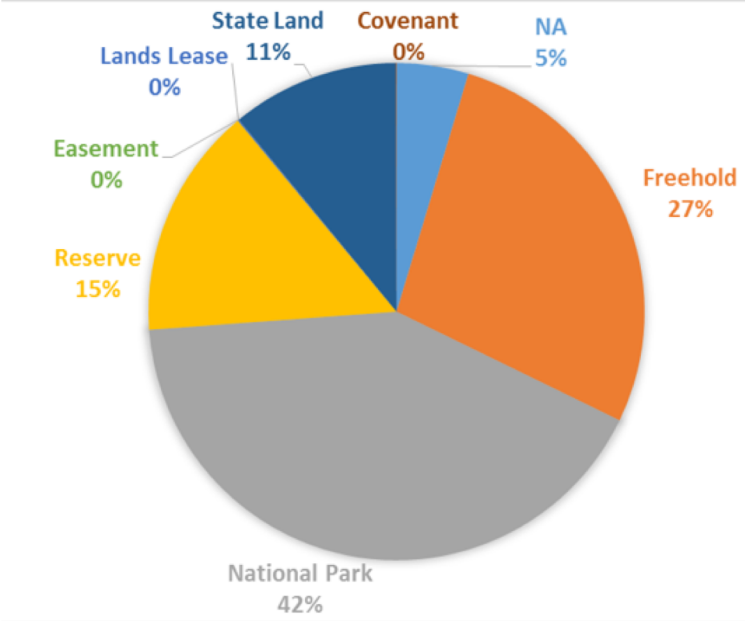

Inundation 20%
ARI
SL 80 cm
20 yr
50 yr
100 yr
200 yr
500 yr
1000 yr
10,000 yr
TMST
>TMST


Inundation 20%
ARI
SL 80 cm
20 yr
50 yr
100 yr
200 yr
500 yr
1000 yr
10,000 yr
TMST
>TMST
Leading edge
Buffer
Rufugia

Management

LRF role	Characteristics	Management actions
Refugia	Exposed infrequently	• Consider enhanced/formal protection status for areas not in the Protected Area Estate • Rehabilitate degraded patches and enhance size and connectivity of patches • Reduce pressures (e.g. invasive species, access impacts)
Buffer	Exposed moderately to infrequently	• Consider enhanced/formal protection status for areas not in the Protected Area Estate that are critical for connecting leading-edge and refugial areas • Manage pressures (e.g. invasive species, access impacts) • Prioritise restoration in areas where buffer vegetation provides connectivity between leading-edge and refugial vegetation or where it provides critical services
Leading-edge	Exposed frequently	• Prioritise management in areas where critical services are provided • Stabilisation and/or facilitated natural colonisation to speed recovery following inundation impacts in areas providing critical services • Formalise planning mechanisms to allow retreat in areas not already developed





Recovery Plan

Australian Government
Department of the Environment and Energy

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Ecological Community

Draft National Recovery Plan

February 2017

Action 3.3 ***High priority***	**Increase the resilience of Littoral Rainforest** ***Research/Information*** a. Classify patches of Littoral Rainforest at local and regional scales in terms of their leading edge, buffer and refugial zones (see Murphy et al., 2016). ***On-ground*** b. Prioritise management within patches of Littoral Rainforest as follows: ○ prioritise protection of leading edge zones which provide critical services; ○ prioritise restoration in areas where buffer vegetation provides connectivity between leading edge and refugial vegetation or where it provides critical ecosystem services; ○ prioritise protection of refugial vegetation wherever possible. c. Support local councils to include Littoral Rainforest in conservation zones. d. Identify and implement methods to protect refugial zones of Littoral Rainforest. e. Collect and store seeds in appropriate regional seedbanks to ensure the long-term conservation of key species. f. Propagate seeds of key species for use in restoration plantings.

Action 5.2: ***High priority***	**Improve knowledge of the extent and condition of Littoral Rainforest** ***Research/Information*** a. Finalise and distribute protocols for the fine-scale mapping of Littoral Rainforest. b. Establish a baseline against which to measure condition and patch quality. c. Assess whether conditions exist for Littoral Rainforest to extend inland further than the recognised 2 km limit in particular bioregions, such as Cape York Peninsula where the ecological community may extend up to 10 km inland. ***On-ground*** d. Undertake local and regional level fine-scale mapping of Littoral Rainforest to confirm the extent and condition of the ecological community across its range. e. If there are circumstances in which Littoral Rainforest is found to extend further than 2 km inland, update the key diagnostic characteristics to reflect this.

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Ecological Community - Draft National Recovery Plan

CASE STUDY

Succession and Littoral Rainforest in the Wet Tropics Bioregion*

***Information provided by Andrew Ford, CSIRO Land and Water, Atherton**

Succession in vegetation is generally regarded as a time-related progression from one type of vegetation to another through a series of frequently identifiable events. Change in vegetation is initiated by the reduction or addition of a number of underlying factors which have the potential to drive the current vegetation along a gradient of transition towards another type of vegetation. This gradient can vary dramatically, and is often a reflection of altitude, substrate, rainfall patterns or soil types.

The expected and classical rainforest successional theory proposes that a system initially has no vegetation. Over time small herbs and grasses colonise this vacant space, and with more time small shrubs begin to appear. Larger plants can only colonise these herb dominated areas once sufficient organic matter and soil (with sufficient minerals and nutrients) accumulates. Once larger shrubs and small trees become established they offer habitat to fruit-eating animals which then disperse many and varied species throughout the new ecosystem. The general pattern in tropical areas is for large-leaved and fast growing shade intolerant tree species to appear first, followed by slower growing and smaller leaved shade tolerant species. This is a very simplistic version of events, which theoretically holds for the majority of lowland to mid-elevation rainforest vegetation types.

Littoral Rainforest occurs in close proximity to the ocean and is influenced by maritime processes. Sands deposited from the ocean over millennia have created ideal conditions for the development of Littoral Rainforest, which follows a similar trajectory to that of classical rainforest succession. Colonisation of sand deposits starts with herbs, which initially stabilise the sand with root growth and later aid in the accumulation of organic matter which then supports woody species recruitment. Fire is crucial to the maintenance of sclerophyll vegetation on sand, reducing fire frequency will aid the transition towards rainforest.

The transition process on sand takes a slightly different trajectory to that encountered on other substrates. Invading rainforest species tend to be future long-lived canopy species, rather than the truly successional

during this period (DELWP, 2016). Major population centres in East Gippsland (likely to be impacted) include Lakes Entrance, where Littoral Rainforest occurs, Bairnsdale and Orbost (DELWP, 2016).

In addition to the direct impacts of land clearing, coastal development can also result in a wide range of other indirect impacts to Littoral Rainforest, such as increased weed invasion, dumping of garden waste and other rubbish, and disturbance to native fauna from domestic pets (BAAM, 2013).

***Figure 3:** Clearing of vegetation for a residential development adjacent to Littoral Rainforest. The patch was incorrectly defined in Regional Ecosystem mapping but following ground surveys was identified as Littoral Rainforest. (© Helen Murphy).*

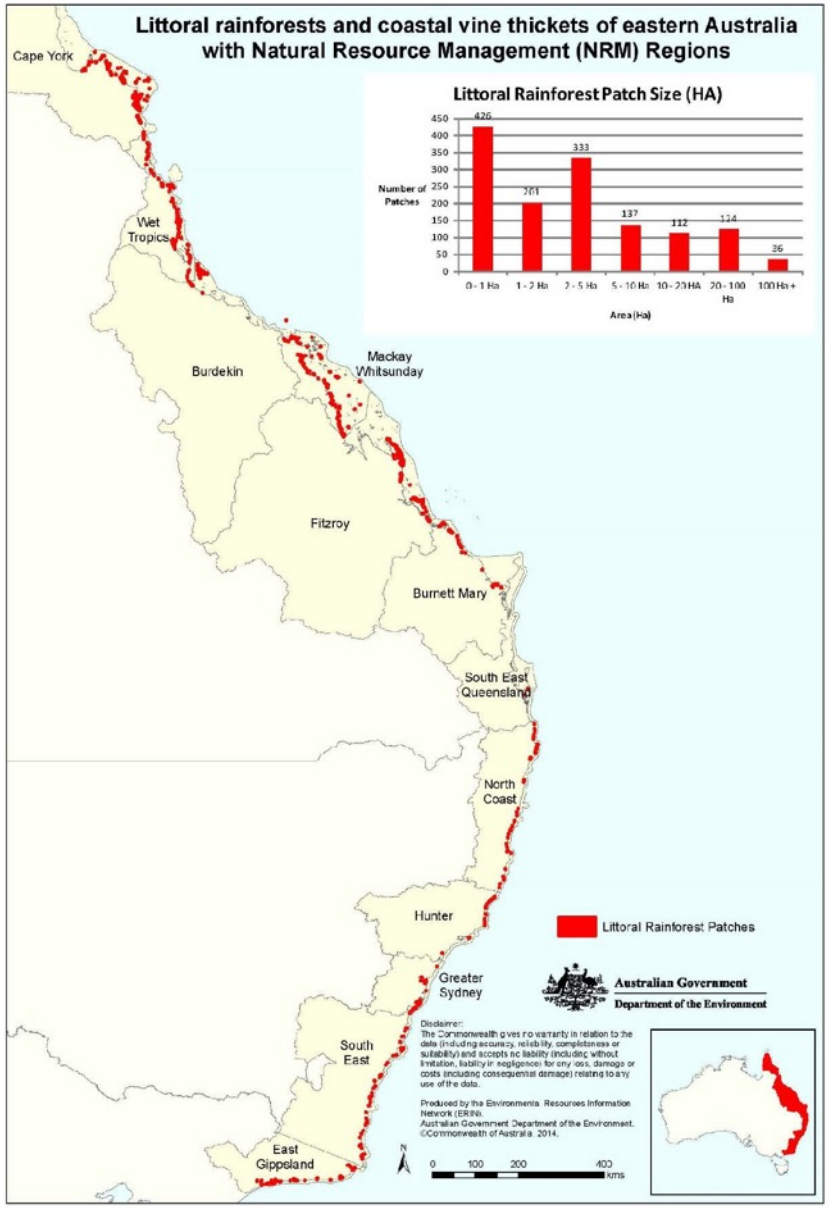
2.2.2 Tourism and vector disturbance

In addition to coastal development, tourism and vector disturbance within Littoral Rainforest pose an ongoing threat. According to the Bureau of Tourism Research (DISR, 2001), 50% of international visits and 42% of domestic visits are to coastal areas. Due to the ongoing demand for tourism and recreational facilities to cater for users of coastal and marine ecosystems (Ward & Butler 2006), this trend is likely to increase over time. Such pressure is likely to result in more development on coastal

Recovery Plan

Performance criteria: The current known extent of Littoral Rainforest has been maintained or extended and the condition of the ecological community has been maintained or improved.

- No further decline in Littoral Rainforest



Establishing a baseline

Of 101 on-ground site assessments where LRF occurrence was confirmed:

- 65% of sites were not in wholly-equate Regional Ecosystems, and
- a further 11% of sites were in areas not covered by any Regional Ecosystem mapping (primarily on islands of the Great Barrier Reef).

Thus, more than 75% of sites where Littoral Rainforest occurs would not have been captured by simply mapping Regional Ecosystems that wholly-equate with the Listing Advice.

Including Potential LRF accounted for 67% of sites (11% unmapped). Much of the remaining 29% included errors in RE mapping.

The current extent of LRF is probably greater than the existing baseline suggests

Refining Regional Ecosystem mapping in Queensland

- Correcting errors and new linework
- Accounting for heterogeneous polygons
- Adding an attribute to REs noting that LRF may occur
- 60 Herbarium vouchers (EPBC/NCA species, range expansions, unusual occurrences)

Ochrosia elliptica

Cerbera manghas

Local and Regional impacts

Qld Parks and Wildlife (Marine Parks) - Mapping LRF where RE mapping is absent

Local and Regional impacts

Working (and training) local government employees to identify LRF

NCCARF CoastAdapt Snapshot

Littoral rainforest: Understanding the distribution and resilience of frontline coastal forests

Summary

Littoral rainforests and coastal vine thickets of Eastern Australia are critically endangered ecological communities. This unique vegetation exists within the dynamic fringe of the coastal zone: they face landward pressure from human settlement and land use but also seaward pressure from extreme weather events and sea-level rise. A detailed study in the Wet/Dry Tropics of Far North Queensland is refining our knowledge of the region's littoral rainforests, their distribution, vulnerability and resilience. One project incorporates the potential forces of sea-level rise and storm surge on the distribution and persistence of this key natural asset which will help to guide its management into the future.

Keywords

Littoral rainforest, extreme weather, mapping, coastal eco-systems

Littoral rainforests are situated in the coastal zone and are defined by the regular actions of sea (salt spray, coastal winds, tides and sediments) as well as extreme weather events (cyclones and storm surge). They play an important ecological role (habitat for endangered species) and deliver significant ecosystem services (protecting foreshores, human settlement and infrastructure). As such, they are an important ecological resource as well as an essential element of the tropical lifestyle and tourism values which attract so many to the shores of the Far North Queensland region (see Figures 1 and 2).

Figure 1: Littoral Rainforest on High Island National Park. © Andrew Ford, CSIRO.

coastadapt.com.au

Protected. National Parks Association of Queensland

Dr Helen Murphy
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Atherton

Littoral rainforests and coastal vine thickets of eastern Australia (hereafter littoral forests) are a critically-endangered ecological community listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Coastal processes such as salt spray, tidal inundation and storm tides, salt-laden on-shore winds and unstable and dynamic substrates derive this distinct ecological community.

Already highly fragmented and subject to many landward pressures such as coastal development, weeds and feral animals, littoral forest in the tropics and subtropics of eastern Queensland is also very susceptible to severe storms and cyclones.

Cyclones can bring storm surges in the form of both higher-than-usual high tides and destructive wave action, which causes beach erosion but also deposits vast volumes of beach sands in other places.

Cyclone Yasi crossed Cardwell as a category 5 cyclone in 2011 and was considered to have created between a one-in-1000-years and a one-in-3000-years storm surge event.

The impact on littoral forest in this area was visually dramatic. However, by bearing the brunt of the storm, the coastal vegetation served a vital purpose in protecting other habitat.

Littoral vegetation helps moderate the effects of waves, wind and inundation associated with cyclones, protecting other vegetation, infrastructure and human communities from the most severe effects.

In the Wet Tropics bioregion, where the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has done extensive surveys, the majority of littoral forest occurs in land classed as conservation area and natural environments (more than 90 per cent), with a considerable amount within the national park estate (more than 40 per cent).

Access tracks through littoral rainforest (above) and (below) severe impacts to littoral rainforest caused by Cyclone Yasi at Tully Heads in 2011. PHOTOS: ANDREW FORD & DAN METCALFE

This is likely true for much of the Queensland east coast, as littoral forest has been largely removed or become heavily fragmented in developed areas.

Littoral forest in national parks are generally subject to fewer human-induced threats and these threats are often managed.

In the Wet Tropics, it is common for national park campground areas to be established in littoral forest because shady beachfront locations with relatively open understorey and sand underfoot make for attractive and comfortable camping.

A critical first step in managing

littoral forest is understanding exactly where it is. In the Wet Tropics bioregion this is not as straightforward as it might seem, as although the EPBC listing advice describes the broad characteristics of the community, there is considerable variation in floristic composition and structure. A reliance on regional ecosystem mapping alone can lead to some littoral forests not being recognised, particularly on islands.

Following cyclones, most of the damage to littoral forest is in the form of uprooted and severely damaged trees, as well as sand deposition or erosion. Occasionally littoral forest appears completely destroyed, however in many affected areas post-Yasi and also after Cyclone Larry (2006) we have seen significant recruitment and regrowth.

Littoral forests are naturally highly dynamic and generally resilient to extreme events; of course, managing existing pressures that undermine the natural capacity of the vegetation to recover – such as weeds, feral animals and uncontrolled access – is critical for enhancing their resilience.

In some cases, restoration actions may be necessary to speed recovery and restore diversity where the natural capacity to recover is slow.

The full report 'Mapping to Underpin Management of Tropical Littoral Rainforest' is online: http://bit.ly/tropical-littoral-rainforest

Spatial layers produced by the project are available at the CSIRO Data Portal (search for Littoral rainforest): https://data.csiro.au

Northern Australia Environmental Resources Hub

National Environmental Science Programme

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