Coastal lowland rainforests, Australia

Assessment by: Metcalfe, D J., & Lawson, T J.

Overall risk category **EN**

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	COLLAPSED
NE	DD	LC	NT	VU	EN	CR	CO

View on www.iucnrle.org

Citation:

Metcalfe, D.J., & Lawson, T.J 2015. Coastal Lowland Rainforest. Austral Ecol. 40, 373-385. https://doi.org/10.1111/aec.12263.

if you see any errors or have any questions or suggestions on what is shown in this document, please provide us with feedback so that we can correct or extend the information provided.

Scope of assessment: Sub-global / National

Coastal lowland rainforests, Australia

Overall risk category EN

Assessment Type

Citation:

Metcalfe, D.J., & Lawson, T.J 2015. Coastal Lowland Rainforest. Austral Ecol. 40, 373-385. https://doi.org/10.1111/aec.12263.

Link:

https://onlinelibrary.wiley.com/doi/abs/10.1111/aec.12263

Keywords:

Agriculture, Biodiversity, Casuarius-casuarius-johnsonii, Climate change, Community, Conservation, Cyclone, Fragmentation, Invasive species, North Queensland, Protected areas, Southern cassowary

Ecosystem Description

The coastal lowland rainforest ecosystems are recognized as being higher rainfall closed-canopy forest communities on the eastern side of the coastal ranges, at less than 100 m.a.s.l., and bounded to the east by mangroves, littoral rainforest or non-rainforest coastal complexes including native grasslands, Melaleuca sp. woodlands and vegetated swamps (DoE 2014). These ecosystems consist of a complex mosaic of landforms and soil types reflecting a highly dynamic recent geological history. Rainfall within the Wet Tropics bioregion varies from very wet and effectively aseasonal to highly seasonal in drier areas. In mature coastal lowland rainforest, recruitment is by shade-tolerant species that grow slowly towards the canopy. The area now occupied by rainforests in Australia is estimated to be c. 25% of what was present at European settlement 200 years ago (Webb and Tracey 1981). The area of the Wet Tropics still covered by native vegetation is nearer 70%, however, most of the lowland area has been cleared, primarily for agriculture.

Classification

IUCN Habitats Classification Scheme

- 1. Forest
  - 1.6. Forest - Subtropical/tropical moist lowland

IUCN Global Typology

- Terrestrial
  - T1. Tropical-subtropical forests
    - T1.1 Tropical-subtropical lowland rainforests

Distribution

Tropical coastal lowland rainforests are located at Australia between Mackay (21 °S) and Iron Range (12 °S) on the east coast of northern Queensland. The greatest extent of this ecosystem is in the lowlands of the Mcwraith and Iron Range landscapes on Cape York Peninsula (Metcalfe et al. 2014) and in the Wet Tropics Bioregion (DoE 2013). The Wet Tropics Bioregion is a narrow belt of coastal plains and ranges, including the adjacent section of the

Great Dividing Range and its associated tablelands; this area covers 450 km from Black Mountain (15°40'S), south of Cooktown to Bluewater (19°15'S), north of Townsville.

System

Terrestrial

Biogeographic Realm

Australasian

Countries

Australia

Geographic Region

Northeast Australia

Characteristic Native Biota

The coastal lowland rainforest ecosystem is characterized by a high species diversity of plants with predominantly large leaves including a high representation of the families Myrtaceae and Lauraceae. Of the 2,145 plant species in the rainforests of the Wet Tropics bioregion (Metcalfe and Ford 2008), over 1,100 species have the potential to exist in coastal lowland rainforest. However, few species are restricted to this ecosystem; rather, they extend into littoral or upland rainforest types. In this sense, a large number of species resident in these forests are recognized as being of conservation concern. The vertebrate community within this bioregion is also not restricted to coastal lowland rainforest; nevertheless, the lowlands provide a stronghold for many species such as the southern cassowary, Bennett's tree-kangaroo and migratory birds such as the buff-breasted paradise kingfisher (Williams 2006). The streams running through coastal lowland rainforest contains a distinct freshwater fish community. These streams support iconic species such as the freshwater moray eel (Ebner et al. 2011) and a large number of recently described habitat specialists such as cling gobies (Ebner and Thuesen 2010). The invertebrate communities are poorly known, though intensive studies in the lowlands at sites such as the Australian Canopy Crane research facility are beginning to uncover the diversity present.

Taxa

Acriopsis emarginata, Actephila foetida, Aponogeton bullosus, Aponogeton proliferus, Archontophoenix spp., Asplenium wildii, Backhousia spp., Canarium acutifolium var. acutifolium, Carronia pedicellata, Chingia australis, Cyclophyllum costatum, Dasyurus hallucatus, Diplazium cordifolium, Durabaculum mirbelianum, Durabaculum nindii, Endiandra cooperana, Erythrotriorchis radiatus, Gardenia actinocarpa, Hipposideros semoni, Idiospermum australiense, Licuala spp., Lindsayomyrtus spp., Litoria dayi, Litoria nannotis, Litoria rheocola, Melanotaenia eachamensis, Phaius pictus, Phaius tancarvilleae, Phalaenopsis rosenstromii, Plesioneuron tuberculatum, Pteropus conspicillatus, Rhinolophus philippinensis, Saccolaimus saccolaimus nudicluniatus, Stiphodon semoni, Syzygium spp., Toechima pterocarpum, Uromys caudimaculatus, Vrydagzynea grayi, Xanthostemon formosus

Abiotic Features

The coastal lowlands consist of a complex mosaic of landforms and soil types reflecting a highly dynamic recent geological history. Landforms and substrates include prograding dune systems and riverine alluvia, granite outcrops associated with the coastal ranges, small but significant areas of very high fertility basalt soils (Whitehead et al. 2007), which support a characteristic flora, and metamorphosed granites and sediments associated with the volcanic intrusions. Soil fertility alone is implicated in explaining the distribution of remarkably few species, though edaphic considerations are important in determining location and stability of rainforest/tall open forest boundaries. Rainfall within the bioregion varies from very wet and effectively aseasonal (e.g. Cape Tribulation, Babinda and Tully more than 3,500 mm per year) to highly seasonal in drier areas (e.g. Bluewater less than 1,300 mm per year). Except in the areas of highest rainfall, most of the Wet Tropics rainforests have a distinct 5-6-month dry season, the extent of which affects species and structural composition, with peak endemism in the wettest areas and the drier areas supporting communities more akin to the rainforests of Cape York Peninsula (Costion et al. 2015). Temperature varies with seasonality, the annual temperature range being greatest in the drier areas where temperature fluctuations are least buffered by high humidity. Highest daily temperatures may reach 44°C, but seldom for more than a day or two (Commonwealth Bureau of Meteorology 2011). Drainage of cool air down from the mountains in sheltered valleys leads to disjunct mountaintop species being found in the lowlands in exceptional circumstances (DJ Metcalfe and AJ Ford, unpubl. data, 2014). Prevailing winds are from the southeast, although wind appears to have limited effect on community structure except when tropical cyclones irregularly cross the coast, when high wind speeds, gusting, very high rainfall events and storm surges may cause damage.

Biotic Processes

In mature coastal lowland rainforest, recruitment is by shade-tolerant species that grow slowly towards the canopy. Natural mortality through disease or herbivore pressure create small gaps which are rapidly filled by this advanced regeneration, or by rapid recruitment of more light-demanding species in the case of larger treefall gaps (Grubb and Metcalfe 1996). Differences in phenology (Westcott et al. 2005), dispersal (Grubb et al. 1998) and requirements for successful establishment (Connell et al. 2005) largely determine pattern at local scales. Availability of seeds and other drivers of recruitment success and occasional impacts by tropical cyclones are the greatest environmental drivers of change in the coastal lowland rainforest. Impacts of cyclones include canopy shredding, leading to removal of most of the leaves and exposure of the understorey to high light levels (Metcalfe and Bradford 2008; Metcalfe et al. 2008; Metcalfe and Ford 2008). This can result in massive recruitment of short-lived light-demanding species as well as slow-growing disturbance-responsive species (Metcalfe et al. 2014). Cyclones may also trigger a mass flowering of understorey shrubs and small trees, possibly through increased light levels to the understorey. Laidlaw et al. (2007) note, however, a high degree of temporal stability within stands despite frequent catastrophic disturbances. Human activity has also influenced forest dynamics. From about 2000 years ago, the archaeological record shows a sudden increase in aboriginal habitation in rainforest tied to an increase in the use of toxic, though nutritious, tree nuts (Cosgrove et al. 2007). Early European explorers record fire being used as a modifier of plant community structure (Hallam 1975), while Hill et al. (1999) document contemporary use of fire to prevent rainforest incursion into clearings maintained as cycad gardens.

Threatening Processes

Natural perturbations through cyclonic disturbance cause significant structural change and some impacts on species persistence or turnover (Metcalfe and Bradford 2008; Metcalfe et al. 2008; Metcalfe and Ford 2008; Murphy et al. 2014) but these are stochastic events and are normally followed by rapid regrowth and recruitment, resulting in highly complex structural environments. However, in disturbed environments, canopy opening may also be linked to weed infestation following cyclone damage and proliferation of vines (Catterall et al. 2008; Murphy et al. 2008). Most of the remaining coastal lowland rainforest is also threatened by direct anthropogenic impacts. Increased fragmentation and the amount and proportion of edge habitat can also impact on forest microclimate. Introduced diseases, herbivores and predators may also affect forest community functioning, influencing the complex array of interactions which sustain rainforest communities (Taylor et al. 2011; Metcalfe and Bradford 2008). Human activity has influenced forest dynamics including changes to natural fire regimes, with land management resulting in less frequent but more intense fires in some areas and more frequent less intense fires in others (Stanton et al. 2014). Changes to hydrological regimes may also impact coastal lowland rainforest, mainly through draining of wetlands (McJannet et al. 2012). Climate change may exacerbate many of these factors; it has the potential to increase the severity of cyclones and lengthen dry seasons (Suppiah et al. 2010), potentially increasing fire risk.

Collapse

Collapse was defined as when the rainforest canopy is predominantly open and simplified in structure, and recruitment of closed forest species has ceased.

Ecosystem Risk Assessment

Assessment Protocol	IUCN Red List of Ecosystems Category and Criteria	Last Assessed
IUCN RLE v2.0	Endangered A3+B1aiii	2015

Justification

The coastal lowland rainforest ecosystem exists in protected areas, but fragmentation continues through road, rail and power corridor expansion, having significant impacts on biodiversity and ecosystem function. Comparison of the extent of coastal lowland rainforest using current RE mapping (75,796 ha) with the inferred pre-clearance RE rainforest extent (190,006 ha) suggests a decline in extent of at least 60% since the late nineteenth century with estimates as high as 75% of the original coastal lowland rainforest on alluvial soil being cleared. The subtype coastal lowland rainforest on alluvial soils would be encompassed by a minimum convex polygon of 10,241 km2, 38% smaller than the equivalent polygon encompassing all coastal lowland rainforest, and the evidence suggests that there are continuing declines in the biotic function as well as clearance as the main threatening processes. Therefore, coastal lowland rainforests were assessed as Endangered under subcriteria A3 and B1aiii.

Criterion A EN

Summary

Remaining coastal lowland rainforest exists in protected areas, but fragmentation continues through road, rail and power corridor expansion, having significant impacts on biodiversity and ecosystem function. Evidence from reduction of geographic distribution in the coastal lowland rainforest suggests a decline in extent of 60% since the late nineteenth century with estimates as high as 75% of the original coastal lowland rainforest on alluvial soil being cleared. Therefore, the ecosystem was assessed as Endangered under subcriterion A3.

Risk Category EN

Subcriterion	Category	Justification
A1	DD	Historical data for coastal lowland forests, particularly from southern parts of the bioregion for the past 50 years, is not available. Considering no reliable information is accessible to assess the decline of the geographic distribution of the ecosystem in the past 50 years, it is classified as Data Deficient under subcriterion A1. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
A2a	DD	There are limited published data about future scenarios for the coastal lowlands, particularly from southern parts of the bioregion. Considering no reliable information is available to assess the decline of the geographic distribution of the ecosystem in the next 50 years, it is classified as Data Deficient under subcriterion A2a. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
A2b	NE	This subcriterion was not assessed. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
A3	EN	Comparison of the extent of coastal lowland rainforest using current RE mapping (75,796 ha) with the inferred pre-clearance RE rainforest extent (190,006 ha) suggests a decline in extent of 60% since the late nineteenth century. However, of the 60% of the coastal lowland rainforest cleared, 73% of that was on alluvial soils, in which as analysis of pre-clearing data suggests that coastal lowland rainforest only represented 58% of the original total resource. This means that 75% of the original coastal lowland rainforest on alluvial soil has been cleared, and only 27,068 ha remain. Therefore, as a distinct subtype, coastal lowland rainforest on alluvial soil is assessed as Endangered under subcriterion A3. **Key Indicators in detail** Evidence of Continuing Decline: Decreasing Evidence of Threatening Processes: Yes **Indicator Variable:** Change in distribution Extent (%): 75 Mapped distribution Year: 1750 Mapped distribution (ha): 190,006 Year: 2013 Mapped distribution (ha): 27,068

Criterion B EN

Summary

All occurrences of coastal lowland rainforest are encompassed by a minimum convex polygon of 16,476 km2 and there is evidence of disruption of biotic interactions due to urban or agricultural development, chronic depletion through impacts of invasive species, the effects of cyclones and habitat modification by anthropogenic disturbance. Habitat modification by anthropogenic and pig disturbance disrupts seed dispersal and establishment regimes; thus, the status of the ecosystem is Endangered under subcriterion B1aiii.

Risk Category EN

Subcriterion	Category	Justification
B1	EN	The extent of a minimum convex polygon enclosing all occurrences of the coastal lowland rainforest encompasses an area of 16,476 km2 and there is evidence of disruption of biotic interactions due to urban or agricultural development, chronic depletion through impacts of invasive species, the effects of cyclones and habitat modification by anthropogenic disturbance. Thus, the status of the ecosystem is Endangered under subcriterion B1aiii. **Key Indicators in detail** Number of Threat-defined Locations: more than 5 Evidence of Continuing Decline: Decreasing Evidence of Threatening Processes: Yes **Indicator Variable:** EOO Mapped distribution Year: 2015 Mapped distribution (km2): 16,476
B2	LC	Coastal lowland rainforest occupies 114 10 × 10 km grid cells within the Wet Tropics bioregion, excluding cells with less than 1% of cell area occupied. The subtype coastal lowland rainforest on alluvial soils occupies 72 grid cells. Both of these estimates exceed the threshold value of 50 locations for threatened categories. Therefore, the status of the ecosystem is Least Concern under subcriterion B2. **Key Indicators in detail** Number of Threat-defined Locations: more than 5 Evidence of Continuing Decline: Decreasing Evidence of Threatening Processes: No **Indicator Variable:** AOO Mapped distribution Year: 2015 Mapped distribution (10x10-km grid cells): 114
B3	LC	Coastal lowland forest expands across six discrete river catchment units (from north to south) in which a single threatening event can rapidly affect the whole ecosystem: the Bloomfield River, the Daintree/Mossman system, the Barron north of Cairns, the Russell/Johnstone catchments south of Cairns, the Tully/Murray system and the rivers around Cardwell and Ingham. This ecosystem thus exists at more than five threat-defined locations and is assessed as Least Concern under subcriterion B3. **Key Indicators in detail** Evidence of Continuing Decline: Decreasing Evidence of Threatening Processes: No

Criterion C DD

Summary

No reliable information is available to assess the environmental degradation of the ecosystem; thus, it is classified as Data Deficient under criterion C.

Risk Category DD

Subcriterion	Category	Justification
C1	DD	No reliable information is available to assess the environmental degradation of the ecosystem in the past 50 years; thus, it is classified as Data Deficient under subcriterion C1. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
C2a	DD	No reliable information is available to assess the environmental degradation of the ecosystem in the next 50 years; thus, it is classified as Data Deficient under subcriterion C2a. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
C2b	DD	No reliable information is available to assess the environmental degradation of the ecosystem in a 50-year period; thus, it is classified as Data Deficient under subcriterion C2b. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No
C3	DD	No reliable information is available to assess the environmental degradation of the ecosystem historically; thus, it is classified as Data Deficient under subcriterion C3. **Key Indicators in detail** Evidence of Continuing Decline: Unknown Evidence of Threatening Processes: No

Criterion D DD

Summary

No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem; thus, it is classified as Data Deficient under criterion D.

Risk Category DD

Subcriterion	Category	Justification
D1	DD	No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem in the past 50 years; thus, it is classified as Data Deficient under subcriterion D1. **Key Indicators in detail** Evidence of Threatening Processes: No
D2a		No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem in the next

DD 50 years; thus, it is classified as Data Deficient under subcriterion D2a.

Key Indicators in detail

Evidence of Threatening Processes: No

D2b DD No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem in a 50-year period; thus, it is classified as Data Deficient under subcriterion D2b.

Key Indicators in detail

Evidence of Threatening Processes: No

D3 DD No reliable information is available to assess the disruption of biotic processes or interactions in the ecosystem historically; thus, it is classified as Data Deficient under subcriterion D3.

Key Indicators in detail

Evidence of Threatening Processes: No

Criterion E DD

Summary

No quantitative analysis has been carried out to assess the risk of ecosystem collapse for coastal lowland rainforests. Therefore, the ecosystem is classified as Data Deficient under criterion E.

Risk Category DD

Cited References

Bohnet IC, 2010, LANDSCAPE URBAN PLAN, V97, P239, DOI 10.1016/j.landurbplan.2010.06.007.
Bruce C, 2008, AUSTRAL ECOL, V33, P516, DOI 10.1111/j.1442-9993.2008.01906.x.
Campbell Hamish A., 2012, Endangered Species Research, V17, P53, DOI 10.3354/esr00397.
Carnegie AJ, 2012, AUSTRALAS PLANT PATH, V41, P13, DOI 10.1007/s13313-011-0082-6.
Catterall CP, 2008, AUSTRAL ECOL, V33, P471, DOI 10.1111/j.1442-9993.2008.01902.x.
Catterall C. P., 2008, LIVING DYNAMIC TROPI, P510.
Colwell RK, 2008, SCIENCE, V322, P258, DOI 10.1126/science.1162547.
Commonwealth Bureau of Meteorology, 2011, CLIM STAT AUSTR SIT.
Connell J. H., 2005, Tropical rainforests: past, present and future, P486.
Cosgrove R, 2007, PALAEOGEOGR PALAEOCL, V251, P150, DOI 10.1016/j.palaeo.2007.02.023.
Costion CM, 2015, DIVERS DISTRIB, V21, P279, DOI 10.1111/ddi.12266.
Curran LM, 2004, SCIENCE, V303, P1000, DOI 10.1126/science.1091714.
Deh, 1999, LOWL RAINF FLOODPL N.
Dehp, 2012, REG ECOS FRAM.
Dewr, 2007, AUSTR NAT VEG SUMM A.
DoE, 2013, INT BIOG REG AUSTR I.
DoE, 2014, LITT RAINF COAST VIN.
Ebner BC, 2010, AUST J ZOOL, V58, P331, DOI 10.1071/ZO10061.
Ebner BC, 2011, J FISH BIOL, V79, P70, DOI 10.1111/j.1095-8649.2011.02987.x.
Garnett S, 2011, ACTION PLAN AUSTR BI.
Goosem M, 2007, CURR SCI INDIA, V93, P1587.
Grubb PJ, 1996, FUNCT ECOL, V10, P512, DOI 10.2307/2389944.
Grubb PJ, 1998, OIKOS, V82, P467, DOI 10.2307/3546368.

Hallam S. J., 1975, FIRE AND HEARTH.
Harrington Graham N., 1997, P292.
Hill R, 1999, SOC NATUR RESOUR, V12, P205, DOI 10.1080/089419299279704.
Hill R, 2010, ENVIRON CONSERV, V37, P73, DOI 10.1017/S0376892910000330.
Hopkins MS, 1993, J BIOGEOGR, V20, P357, DOI 10.2307/2845585.
Hosonuma N., 2012, ENVIRON RES LETT, V7, P1, DOI DOI 10.1088/1748-9326/7/4/044009.
IUCN, 2001, RED LIST CAT CRIT.
IUCN, 2013, IUCN RED LIST THREA.
Keith D. A., 2013, PLOS ONE, V8.
Laidlaw M, 2007, AUSTRAL ECOL, V32, P10, DOI 10.1111/j.1442-9993.2007.01739.x.
Laliberte E., 2009, ECOL LETT, V13, P76.
Laurance WF, 2008, CONSERV BIOL, V22, P1154, DOI 10.1111/j.1523-1739.2008.00981.x.
Lavorel S, 2015, GLOBAL CHANGE BIOL, V21, P12, DOI 10.1111/gcb.12689.
Lawrence D, 2015, NAT CLIM CHANGE, V5, P27, DOI {[}10.1038/nclimate2430, 10.1038/NCLIMATE2430].
Le Saout S, 2013, SCIENCE, V342, P803, DOI 10.1126/science.1239268.
Martin Keith C., 2013, Aqua, V19, P155.
Mcinnes KL, 2003, NAT HAZARDS, V30, P187, DOI 10.1023/A:1026118417752.
McJannet D, 2012, HYDROL PROCESS, V26, P53, DOI 10.1002/hyp.8111.
Metcalfe D., 2014, BIODIVERSITY ENV CHA, P111.
Metcalfe DJ, 2008, AUSTRAL ECOL, V33, P432, DOI 10.1111/j.1442-9993.2008.01898.x.
Metcalfe DJ, 2008, FOREST ECOL MANAG, V256, P2073, DOI 10.1016/j.foreco.2008.07.040.
Metcalfe D. J., 2008, LIVING DYNAMIC TROPI, P123.
Metcalfe D. J., 2014, MAPPING LITTORAL RAI.
Moore LA, 2007, J ORNITHOL, V148, P357, DOI 10.1007/s10336-007-0137-1.
Murphy HT, 2008, AUSTRAL ECOL, V33, P495, DOI 10.1111/j.1442-9993.2008.01904.x.
Murphy HT, 2008, BIOL INVASIONS, V10, P925, DOI 10.1007/s10530-008-9246-x.
Murphy H. T., 2011, WEED RESPONSES CYCLO.
Murphy HT, 2014, AUSTRAL ECOL, V39, P696, DOI 10.1111/aec.12133.
Pert PL, 2012, ECOL INDIC, V18, P191, DOI 10.1016/j.ecolind.2011.11.018.
Pohlman CL, 2007, BIOTROPICA, V39, P62, DOI 10.1111/j.1744-7429.2006.00238.x.
Sam K, 2014, J FIELD ORNITHOL, V85, P152, DOI 10.1111/jofo.12057.
Setter M., 2002, P 13 AUSTR WEEDS C, V13, P173.
Sodhi NS, 2004, TRENDS ECOL EVOL, V19, P654, DOI 10.1016/j.tree.2004.09.006.
Sonter Laura J., 2011, Pacific Conservation Biology, V16, P274.
Stanton P, 2014, AUST FORESTRY, V77, P51, DOI 10.1080/00049158.2014.881702.
Stibig HJ, 2014, BIOGEOSCIENCES, V11, P247, DOI 10.5194/bg-11-247-2014.
Sumner J, 2005, CONSERV GENET, V6, P333, DOI 10.1007/s10592-005-4959-1.
Suppiah R., 2010, CLIMATE CHANGE PROJE.
Taylor DL, 2011, WILDLIFE RES, V38, P437, DOI 10.1071/WR08138.
Thuesen PA, 2011, PLOS ONE, V6, DOI 10.1371/journal.pone.0026685.
Wallace Jim, 2008, Ecohydrology \and Hydrobiology, V8, P183, DOI 10.2478/v10104-009-0014-z.
Wardhaugh CW, 2012, PLOS ONE, V7, DOI 10.1371/journal.pone.0045796.
Webber BL, 2010, AUSTRAL ECOL, V35, P423, DOI 10.1111/j.1442-9993.2009.02054.x.
Webb L. J., 1958, AUSTRALIAN JOUR BOT, V6, P220, DOI 10.1071/BT9580220.
Webb LJ, 1981, ECOLOGICAL BIOGEOGRA, P605.
Westcott DA, 1999, WILDLIFE RES, V26, P61, DOI 10.1071/WR98012.
Westcott DA, 2005, OECOLOGIA, V146, P57, DOI 10.1007/s00442-005-0178-1.
Westcott DA, 2005, TROPICAL FRUITS AND FRUGIVORES: THE SEARCH FOR STRONG INTERACTORS, P237, DOI 10.1007/1-4020-3833-X_12.
Whitehead PW, 2007, AUST J EARTH SCI, V54, P691, DOI 10.1080/08120090701305236.
Wilcove DS, 2013, TRENDS ECOL EVOL, V28, P531, DOI 10.1016/j.tree.2013.04.005.
Williams K.J., 2011, BIODIVERSITY HOTSPOT, P295.
Williams SE., 2006, VERTEBRATES WET TROP.