Forestry Department

Food and Agriculture Organization of the United Nations

Mangroves of Oceania 1980-2005:
Les mangroves d'Océanie 1980-2005:

COUNTRY REPORTS

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The purpose of these papers is to provide early release of information on ongoing activities and programmes and to stimulate discussion.

Comments and feedback are welcome.

For further information, please contact fra@fao.org or

Mette Løyche Wilkie
Senior Forestry Officer
FAO Forestry Department
Viale delle Terme di Caracolla
00153 Rome, Italy
e-mail: Mette.LoycheWilkie@fao.org

CONTENTS

Acknowledgements

The Global Forest Resources Assessment 2005 (FRA 2005) represents a major effort of FAO's Forestry Department, FAO member countries, donors, partners and individual experts. More than 800 people have been directly involved in the process. National correspondents and their teams provided detailed country reports for the assessment. In addition to a detailed report from each country and the main report (FAO, 2006a), several thematic studies were prepared. One of these is *The world's mangroves 1980–2005*. In addition to the main report (FAO, 2007) five regional working papers have been produced providing more detailed information on the mangroves in the 124 countries and areas in which they are found. This document is one of these working papers.

FAO is grateful for the support of all countries, organizations and experts inside and outside the organization that have made this study possible. More than 150 people have been involved, including 107 national correspondents to FRA 2005 and their colleagues, national and international experts.

Institutional and individual contributors are listed in Annex 1. FAO also recognizes the important collaboration, support and financial resources provided by ITTO in the framework of the interagency initiative for a revised *World Atlas of Mangroves*.

FAO also thanks colleagues in the International Society for Mangrove Ecosystems (ISME), the United Nations Environment Programme World Conservation Monitoring Centre, the Man and Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization and the International Network on Water, Environment and Health of the United Nations University for their collaboration in the data gathering process and remote sensing interpretation; and Spacedat s.r.l. for assistance with the distribution map.

Serena Fortuna was responsible for compiling and analysing the data and preparing this working paper; Mette Wilkie initiated the study and provided technical guidance when needed.

Introduction

Mangroves are commonly found along sheltered coastlines in the tropics and subtropics where they fulfil important socio-economic and environmental functions. These include the provision of a large variety of wood and non-wood forest products; coastal protection against the effects of wind, waves and water currents; conservation of biological diversity, including a number of endangered mammals, reptiles, amphibians and birds; protection of coral reefs, sea-grass beds and shipping lanes against siltation; and provision of habitat, spawning grounds and nutrients for a variety of fish and shellfish, including many commercial species.

High population pressure in coastal areas has, however, led to the conversion of many mangrove areas to other uses, including infrastructure, aquaculture, rice and salt production. Numerous case studies describe mangrove losses over time, but information on the status and trends of the extent of mangroves at the global level has, so far, been scarce.

The first attempt at estimating the total mangrove area in the world was undertaken as part of the FAO/United Nations Environment Programme (UNEP) Tropical Forest Resources Assessment in 1980, where the world total was estimated as 15.6 million hectares. More recent estimates have ranged from 12 to 20 million hectares. Countries with small areas of mangroves have been excluded from many studies because of lack of information and because their combined area of mangroves would not significantly affect the world total.

The world's mangroves 1980–2005 is a thematic study undertaken within the framework of the Global Forest Resources Assessment 2005. It was led by FAO in collaboration with mangrove specialists throughout the world, and was co-funded by the International Tropical Timber Organization (ITTO). It builds on the 1980 assessment, on the FAO Global Forest Resources Assessment 2000 (FRA 2000) and 2005 (FRA 2005), and on an extensive literature search and correspondence with mangrove and forest resources assessment specialists.

The main aim of this study is to facilitate access to comprehensive and comparable information on the current and past extent of mangroves in the 124 countries and areas where they are known to exist, highlighting information gaps and providing updated information that may serve as a tool for mangrove managers and policy- and decision-makers worldwide.

Some 2 900 national and subnational data sets on the extent of mangrove ecosystems were collected during this process, permitting the compilation of an updated list of the most recent reliable estimate for each country. Regression analyses based on historical data provided revised estimates for 1980, 1990, 2000 and a forecast for 2005. The extrapolation to 2005 was constrained by the lack of recent information for a number of countries. This estimate is thus indicative and is likely to change when results from ongoing and future assessments become available.

The main report entitled *The world's mangroves 1980–2005* (FAO, 2007) presents a global overview of mangrove vegetation, species composition and distribution, together with an indication of the main uses and threats in each region. The results indicate that global mangrove area is currently about 15.2 million hectares, with the largest areas found in Asia and Africa, followed by North and Central America. An alarming 20 percent of the global mangrove area, or 3.6 million hectares, has been lost since 1980. More recently, the rate of net loss appears to have slowed down, reflecting an increased awareness of the value of mangrove ecosystems. However, the annual rate of loss is still disturbingly high.

The report also highlights that regular updating of information on the extent and condition of mangroves is needed as an aid to policy- and decision-making for the conservation, management and sustainable use of the world's remaining mangrove ecosystems.

Detailed qualitative and quantitative information for each country is reported in five regional working papers as a complement to the information in the main report. This document is one of those regional working papers. It is an unedited compilation of country profiles providing more detailed information on the extent of mangroves and changes over time, a vegetation description and an indication on major threats and uses of these coastal forests.

The country profiles are the result of an intense cooperation between FAO staff at Headquarters and in our Regional Offices and national experts. Each country profile is presented in the official UN language of communication and is structured - with some exceptions for those countries where insufficient information is available - according to six sections:

- Vegetation description, uses and threats;
- Mangrove species checklist;
- National level mangrove estimates;
- Trends in mangrove area extent over time;
- Summary status of mangrove area extent over time;
- Formulas used for the trend analysis.

Following the classification used by Tomlinson 1987, mangroves may be divided into three groups according to their features: major elements (strict or true mangroves), minor elements and mangrove associates. During this assessment Tomlinson's list of true mangrove species was modified by adding some species commonly found as exclusive mangrove species (Saenger *et al.* 1983). Information on minor elements and mangrove associates is not included in this report.

All the national level mangrove area estimates collected during the preparation of this assessment are presented in each country profile. However, differences in methodologies, classifications, mapping scales etc. make a direct comparison of the estimates difficult. Consequently only the estimates considered as the most accurate and reliable were used for the analysis of the area changes over time. These are clearly marked in the tables. Detailed information on the formula used for the trend analysis is available for each country, with the exception of those countries/territories where related information was not available.

The findings of this study will also contribute to the revised edition of the *World Atlas of Mangroves*, first published in 1997 by the International Society for Mangrove Ecosystems (ISME) in collaboration with the International Tropical Timber Organization (ITTO) and the UNEP World Conservation Monitoring Centre (UNEP-WCMC). The second edition is being developed as a joint initiative of ISME, ITTO, the Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO), UNEP-WCMC, the International Network on Water, Environment and Health of United Nations University, and FAO. The atlas will promote conservation, restoration, management and sustainable use of mangrove ecosystems. Further information on and contacts for this initiative are available at www.fao.org/forestry/site/mangrove-atlas.

American Samoa

Vegetation description, uses and threats

Mangroves are found along the coasts of Tutuila and Aunu'u islands, distributed in eight villages. They cover a significant extent in five of these (i.e. Leone, Aoa, Pala Lagoon, Masefau, and Aunu'u), while the combination of Aua, Vatia, and Alofau stands, cover less than one hectare; no mangroves are found on Ofu, Olosega or Ta'u

Bruguiera gymnorrhiza often dominates the stands, and they occur mainly in protected coastal bays and estuaries where fresh waters enter the ocean, with trees reaching 12 to 15 m in height. These habitats are inundated by saline or brackish water at high tide and are often flooded by fresh water. The closed canopy allows only *Bruguiera sp*. seedlings in the understory, but the swamp fern *Acrostichum aureum* and trees of the species *Rhizophora samoensis* occupy openings. Often on the south-central coast of Tutuila mangrove, scrub communities dominated by *Rhizophora samoensis* or *Bruguiera gymnorrhiza* are found along the shores.

Mangrove areas in the Pacific have been traditionally used for fishing and collecting crabs, while timber is extensively used for firewood and construction of houses and boats. As in other parts of the world, development pressure (filling, seawall construction, pollution, dumping of waste, oil and garbage) represents a big threat to mangroves. In 2003 a first attempt of reforestation was undertaken in a small patch of mangroves (around one ha) in Nu'uli, however the experience was not successful. Legislation to control their use exists, however it is not always exercised.

Reference:

Cole, T.G., Whitesell, C.D., Whistler, W.A., McKay, N. & Ambacher, A.H. 1988. *Vegetation survey and forest inventory, American Samoa.* Pac. Southwest Forest and Range Exp. Sta. Resource Bull. USDA Forest Service, Berkeley, CA.

Curry, T. 2005 Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Spalding, M.D., Blasco, F. & Field, C.D. *eds*. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

Whistler, A.W. 1976. *Inventory and Mapping of Wetland Vegetation in the Territory of American Samoa.* U.S. Army Corps of Engineers. Fort Shafter, Hawaii. 94 pp.

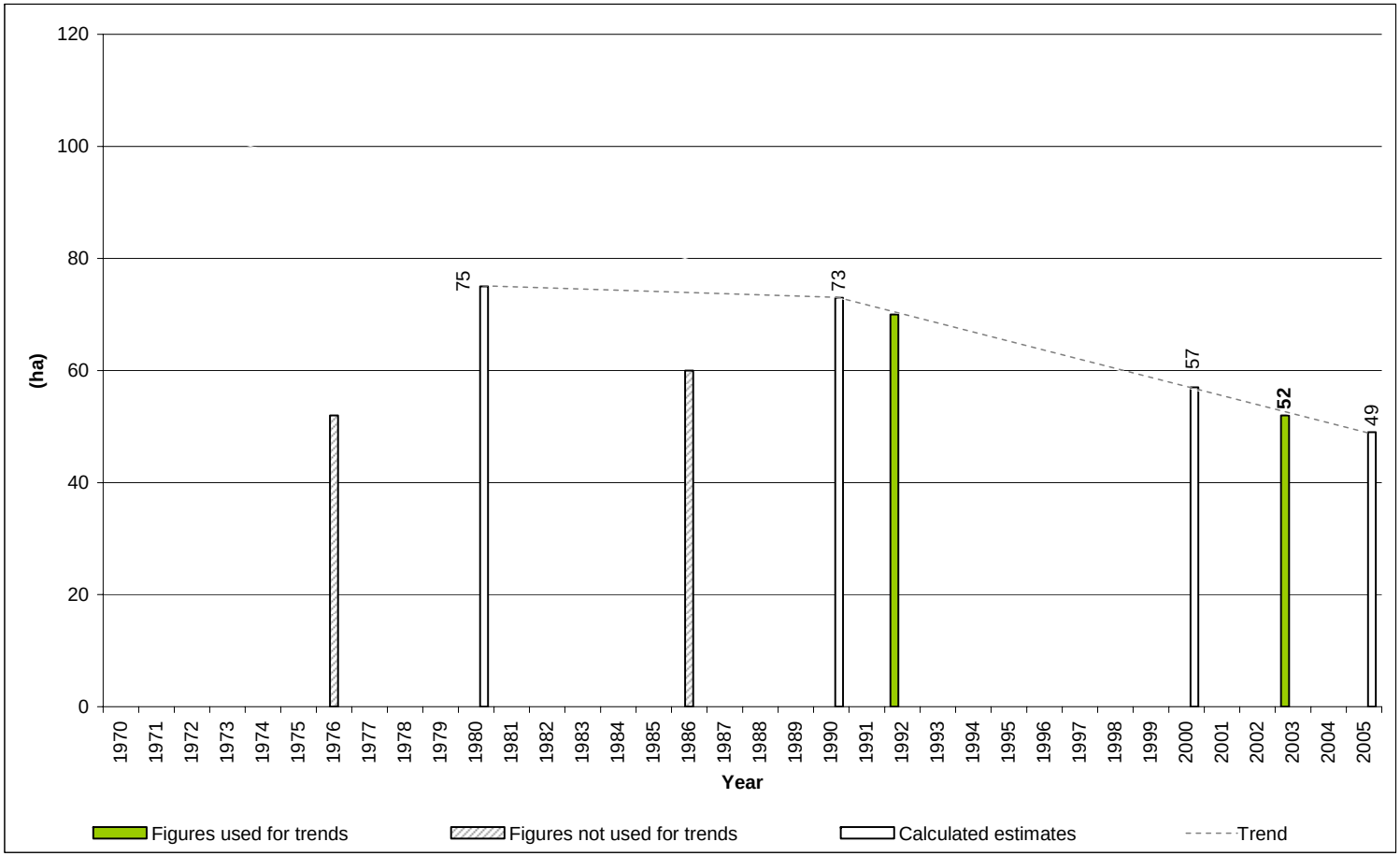
True mangrove species checklist

Acrostichum aureum	
Bruguiera gymnorrhiza	
Rhizophora mangle	
Xylocarpus mekongensis	(syn. *Xylocarpus molucensis*) found at Nu'uli and Aunu'u

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1976	52	**Whistler, A.W.** 1976. *Inventory and Mapping of Wetland Vegetation in the Territory of American Samoa.* U.S. Army Corps of Engineers. Fort Shafter, Hawaii. 94 pp.		Aerial photos. Scale 1:10 000. This inventory may have left aside some stands of mangroves, thus reporting a lower estimate than the extent actually present in the country in 1976..
1985	60	**Donnegan, J. A., Mann, S. S. Butler, S. L. && Hiserote, B. A**. 2004. *American Samoa's forest resources, 2001*. Resour. Bull. PNW-RB-244. Portland		Historic land cover maps (**Cole, T.G., Whitesell, C.D., Whistler, W.A., McKay, N. & Ambacher, A.H.** 1988. *Vegetation survey and forest inventory, American Samoa.* Pac. Southwest Forest and Range Exp. Sta. Resource Bull. USDA Forest Service, Berkeley, CA.) scanned, digitized, and assembled in a GIS in 2002. In Cole et al. 1988 American Samoa's vegetation types were identified and delineated on black and white photographs taken in 1984 at a nominal scale of 1:10 000, the ground checking however was not intensive.
1992	70	**BioSystems Analysis Inc**. 1992. *A Comprehensive Wetlands Management Plan for the Islands of Tutuila and Aunu'u.* American Samoa Pago Pago: Economic Development Planning Office, 1992.	X	Cited in: **Bardi, E. & Sheri Mann, S.** 2004. *Mangrove inventory and assessment project in American Samoa. Phase 1: Mangrove delineation and preliminary rapid assessment.* Technical Report No. 45. American Samoa Community College, Pago Pago, American Samoa. Total extent of wetlands was reported to be 187 ha (463 acres) among which around 70 ha of mangroves. It should be noted however that this figure may provide an slightly higher estimate than the real extent of mangroves, since in some sites non-mangrove wetlands areas may have been taking into account.
2003	52	**Bardi, E. & Sheri Mann, S.** 2004. *Mangrove inventory and assessment project in American Samoa. Phase 1: Mangrove delineation and preliminary rapid assessment.* Technical Report No. 45. American Samoa Community College, Pago Pago, American Samoa	X	GPS delineation of mangrove boundaries. The breakdown in sites is provided. In Aoa (2.5 ha) and Vatia (0.3 ha) the true mangrove species do not represent the main vegetation type.

Trends in mangrove area extent over time



The 1980 estimate is based on qualitative information (Bardi, E. & Sheri Mann, S. 2004)

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
American Samoa	52	2003	75	73	57	49

Formulas used for the trend analysis

Linear:
$y = mx + b$ where m is the slope and b is the intercept.

Australia

Vegetation description, uses and threats

The mangrove flora of Australia, with its 36 mangrove species, is one of the richest in the world. Mangrove stands are most abundant, most diverse and most extensive in the tropical, high rainfall areas of northern and north-eastern Australia where the water temperature is greater than 24ºC in the warmest month, and they are especially well developed where the annual rainfall exceeds 1 250 mm. There is a progressive decline in species richness southwards to the subtropical coastlines of the east coast (eight species in Moreton Bay, 27° 30' S) compared with four species on the west coast at Shark Bay (26° 30' S). The most common species, *Avicennia marina*, has the most widespread distribution which includes some relic temperate populations in Victoria (Western Port Bay), South Australia (Gulf of St Vincent and Spencer Gulf) and southwest Western Australia (Leschenault Inlet). This Western Port Bay population is at the highest latitude of any mangrove community in the world at 38° 22' South latitude, which is substantially further south than the mangroves of Auckland harbour, New Zealand (37° 01' S). The structure of mangrove stands in Australia varies considerably around the coast: in high rainfall tropical north Queensland, they may occur as closed forests up to 30 metres in height, while on lower rainfall coasts they vary in height between 10 and 20 metres. The *Ceriops* sp. open woodlands on the landward margin of the lower rainfall mangrove stands are generally 1-3 metres in height, as are the temperate outliers of *Avicennia* sp. referred to previously.

Direct use of mangroves in Australia is not large, and vast areas remain in a relatively pristine state. The Aboriginal inhabitants of this country used, and in some places still use, many mangrove products; however, this sustainable use of the resources is only at small scale because of the small size of the Aboriginal population. Following settlement of Australia by Europeans in 1788, the pattern of exploitation changed, and substantial areas of mangroves began to be cleared for the construction of port facilities and for other developments. Later, substantial areas of mangroves were cleared for farming, for construction of canal estates and tourist developments. There has been very little utilization of for timber because there is a plentiful supply of hardwood timber from terrestrial forests. Today, most Australian States and Territories have laws which prevent or tightly control clearing of all natural vegetation, so little clearing of mangroves occurs. In addition, large areas of mangroves are within protected areas. There is some evidence that mangroves are expanding slightly in eastern Australia, possibly as a result of erosion in coastal catchments resulting in sedimentation of coasts. There is also evidence of large stands of mangroves being killed by major cyclones e.g. Coburg Peninsula, Northern Territory in 2005; however, there is a reasonable expectation that these stands will regenerate.

Reference:

Hopkins, A.J.M. 2005. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997 *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

The National Forest Inventory 2003. *Australia's State of the Forests Report 2003*. The Bureau of Rural Sciences.382 pp

True mangrove species checklist

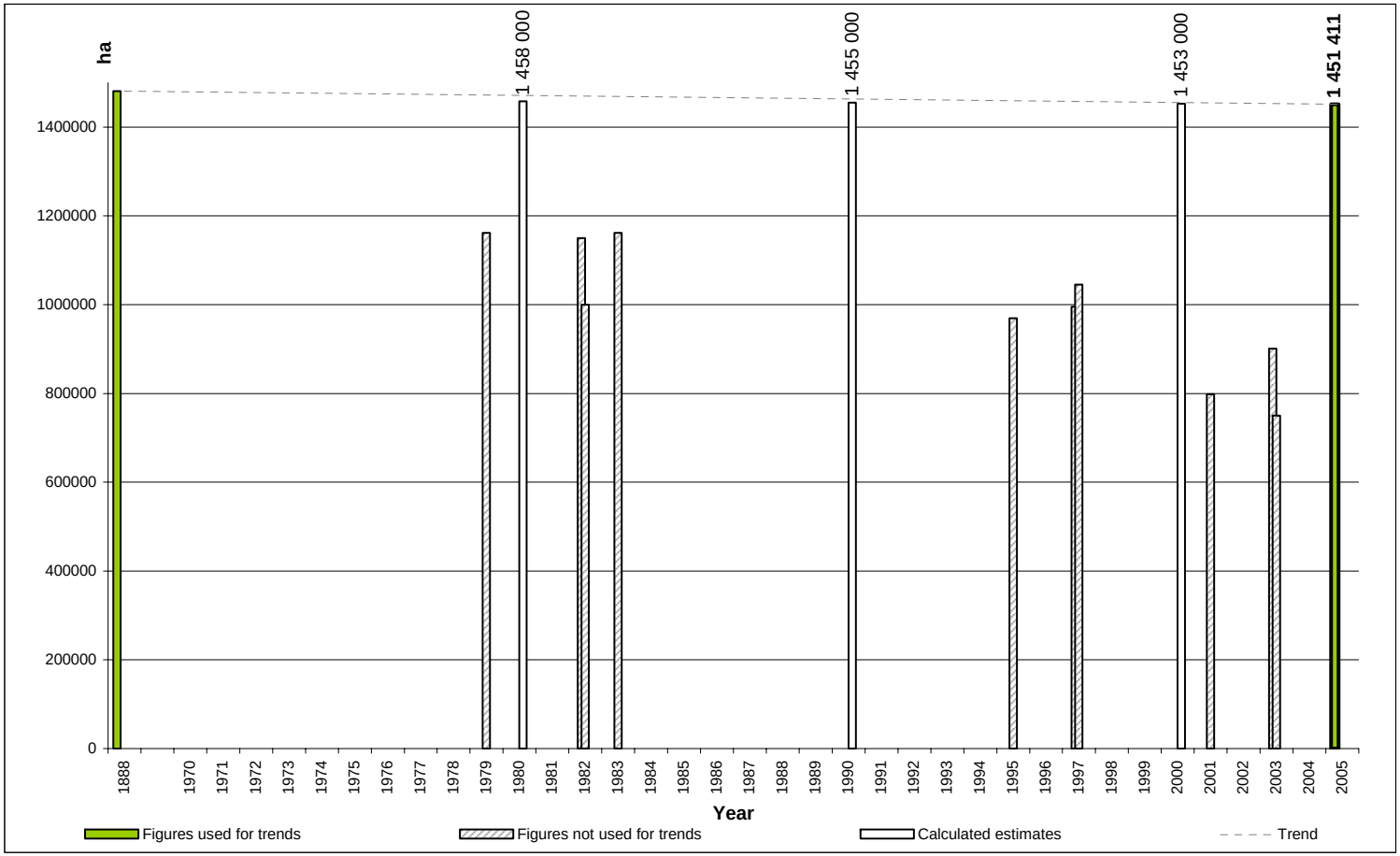
Species	Species
Acanthus ebracteatus	*Rhizophora stylosa*
Acanthus ilicifolius	*Rhizophora x lamarckii*
Acrostichum speciosum	*Scyphiphora hydrophyllacea*
Aegialitis annulata	*Sonneratia alba*
Aegiceras corniculatum	*Sonneratia caseolaris*
Avicennia integra	*Sonneratia x gulngai*
Avicennia lanata	*Sonneratia x urama*
Bruguiera cylindrica	*Xylocarpus granatum*
Bruguiera exaristata	*Xylocarpus mekongensis*
Bruguiera gymnorrhiza	
Bruguiera parviflora	
Bruguiera sexangula	
Camptostemon schultzii	
Ceriops australis	
Ceriops decandra	
Ceriops tagal	
Cynometra iripa	
Excoecaria agallocha	
Heritiera littoralis	
Lumnitzera littorea	
Lumnitzera racemosa	
Lumnitzera x rosea	
Nypa fruticans	
Osbornia octodonta	
Pemphis acidula	
Rhizophora apiculata	
Rhizophora mucronata	

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1888	1 480 900	**Hopkins, A.J.M.** 2005 *Personal communication*	X	Estimate of pre-European extent of mangrove vegetation collated from data provided by key vegetation mapping personnel in each State and Territory of Australia. Cited in: **Hopkins, A.J.M.** 2005. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.
1979	1 161 700	**Galloway, R.W.** 1979. *Distribution and patterns of Australian mangals.* Presented at the Australian National Mangrove Workshop, 18-20 April 1979		Cited in: **FAO.** 1982. *Management and utilization of mangroves in Asia and the Pacific.* FAO environment paper 3. FAO, Rome, 160 pp.
1982	1 000 000	**Robertson, A.J.** 1991. Plant-animal interactions and the structure and function of mangrove forest ecosystems. *Australian Journal of Ecology* Vol. 16: 433-443		Secondary reference, no primary source provided.
1982	1 150 000	**Galloway, R.W.** 1982. Distribution and physiographic patterns of Australian mangroves. *In:* Clough, B.F., ed. *Mangrove ecosystem in Australia: Structure, Function and Management*, pp. 31-54. Australian Institute of Marine Science and Australian National University Press, Canberra.		Cited in: **Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp. It could be an approximate estimate based on Galloway, R.W. 1979 (see above).
1983	1 162 000	**Wacharakitty, S.** 1983. Mangrove Ecosystem in General. *In: ESCAP/UNESCO/NRCT Regional Remote Sensing Training Course of Mangrove Ecosystem.* p. 22-33. Bangkok, Nov. 28-Dec. 16 1983		Cited in **FAO.** 1994. *Mangrove forest management guidelines*. FAO Forestry Paper 117. Rome, 319 pp. It could be an approximate estimate based on the 1979 figure (see above)
1995	969 500	**Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.		Map analysis. The Australia mangrove mapping information in this reference is © Commonwealth Copyright, AUSLIG: Australia's national mapping agency. 1995 All rights reserved. These data are derived from the 1:250 000 National Topographic Map Series and are thus from various sources and ages. **AUSLIG.** 1995. 1:250 000 digital coverage of mangroves from: *TOPO250K GEODATA.* The Australian Geographic Database Program: GEODATA. Australian Surveying and Land Information Group, ACT Australia.

Year	Area (ha)	Source	Trend	Methodology/Comments
1997	1 045 000	**National Forest Inventory.** 1997.		Cited in: **Bureau of Rural Sciences (BRS).** 1998. *Australia's State of the Forest Report 1998.* http://www.affa.gov.au/content/publications.cfm?Category=Forest%20and%20Vegetation%20Sciences&ObjectID=3D3475D7-AA51-493F-90C186929E909302
1997	995 300	**Field, C.** 2003. *Personal communication*		Modified Forest Inventory 1997
2001	798 000	**Field, C.** 2003. *Personal communication*		National Forest Inventory 2001
2003	750 000	**Field, C.** 2003. *Personal communication*		National Forest Inventory 2003
2003	901 000	**Wood, M.** 2004. *Personal communication*.		Map analysis 1:250 000 and 1:100 000. Data based on: **The National Forest Inventory** 2003. *Australia's State of the Forests Report 2003*. The Bureau of Rural Sciences.382 pp.
2005	1 451 411	**Hopkins, A.J.M.** 2005 *Personal communication*	X	Estimate of present extent of mangrove vegetation collated from data provided by key vegetation mapping personnel in each State and Territory of Australia. Cited in: **Hopkins, A.J.M.** 2005. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished. Previous assessments cannot be compared with this one, which is considered as the most recent reliable estimate, as the definitions and the mapping methods used may be different.

Trends in mangrove area extent over time



Only minor changes have occurred in this country, mangrove area extent may be considered as relatively constant. The estimates for 1980, 1990, 2000 and 2005 are based on linear regression between the 1888 data and the 2005 one, taking into account the qualitative information provided in the framework of the thematic study.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Australia	1 451 411	2005	1 458 000	1 455 000	1 453 000	1 451 000

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Christmas Island

Vegetation description, uses and threats

Christmas Island consists of a cap of limestone in the Indian Ocean. Mangroves do not occur on the coasts, but a stand of unusually tall trees of *Bruguiera gymnorrhiza* and *Bruguiera sexangula* (locally called tumu merah and tumu barau) is found about 50 m above sea level at Hosnie's Spring, which was designated Ramsar site in 1990. On the east coast two more species are found, *Heritiera littoralis* (dungun), above Greta Beach and towards Dolly Beach, and *Cynometra ramiflora* (puki anjing), which can reach 20 m in height, and occurs in a single stand south of Ross Hill summit, at 220-300 m altitude; another example of coastal mangrove species living far from the sea.

Besides the minor threat represented by the tourism activities, no other major threats are currently present on the island. Part of the territory was declared National Park in 1980 and thanks to following extensions, around the 63 percent of the territory is now protected within the park. Hosnie's Spring was incorporated in the Park in 1989 and it was declared a wetland of international importance in 1990, the smallest in the world. This wetland had little human impact and it is in relatively undisturbed condition, probably also due to the isolation of the site.

Reference:

Department of the Environment and Heritage, Australian Government. 2004. *Christmas Island National Park.* http://www.deh.gov.au/parks/christmas/index.html

The Ramsar Convention on Wetlands 2003. *The Annotated Ramsar List of Wetlands of International Importance – Australia*. http://www.ramsar.org/profile/profiles_australia.htm#nsw

Ramsar Bureau. *A Directory of Wetlands of International Importance.* http://www.wetlands.org/RDB/Ramsar_Dir/Australia/au040D02.htm

Mangrove species checklist

Bruguiera gymnorrhiza
Bruguiera sexangula
Cynometra ramiflora
Heritiera littoralis

National level mangrove estimates

No quantitative information is currently available for this territory. The stand found at Hosnie's Spring is however very small in extent, comprising between 300 and 600 *Bruguiera sp* trees

Fiji

Vegetation description , uses and threats

Mangroves are found all along the west and east coast of Fiji, with the biggest stands occurring at the mouths of major rivers deltas around mud-covered stream banks in the tidal zone. Nearly 60 per cent of the total mangrove area is found on Viti Levu – especially in Ba, Rewa and Labasa Delta areas – and on Vanua Levu. Among the nine mangrove species present in the country, *Rhizophora stylosa* and *Rhizophora x selala* form a scrubby seaward fringe, replaced further inland by a mixed forest of *Bruguiera gymnorrhiza, Excoecaria agallocha, Lumnitzera littorea* and *Xylocarpus granatum*. *Rhizophora samoensis* is scattered throughout.

Mangroves have been traditionally used for fishing and collecting crabs, which together with timber extraction for firewood, houses/boats construction and removal of trees for coastal and urban development led to some decline in mangrove extent. Fiji had a long history of mangroves being considered as part of the national forest reserve till 1975 when they were placed under the jurisdiction of the Department of Lands and Survey and their usage was not regulated in a systematic way. Today, mangroves have little legal protection in Fiji and significant areas have been degraded especially due to conversion to agriculture land and sugar cultivation; increased sediment loads from upland logging, agricultural operations and local pollution current threaten this ecosystem.

Reference:

Maharaj, R. J. 2002. Pacific islands at risk: foreshore development and their vulnerability and implications for adaptation strategies to climate change. *In*: Mimura, N. & Yokoki, H. (ed). *Proceedings of the APN/SURVAS/LOICZ Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia-Pacific Region.* Kobe, Japan. November 14-16 2000. APN Environment Agency, Japan.

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

True mangrove species checklist

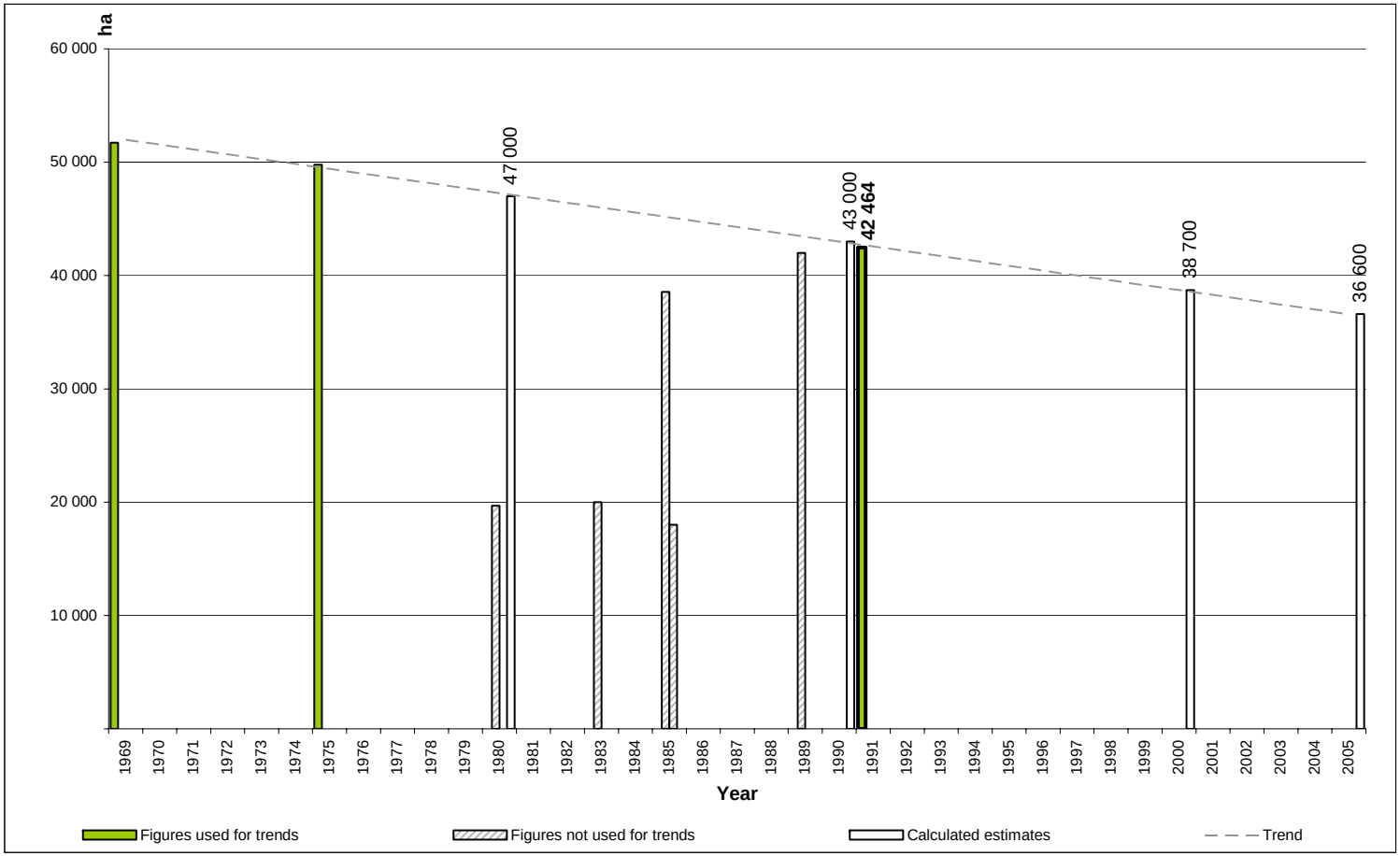
Bruguiera gymnorrhiza
Excoecaria agallocha
Heritiera littoralis
Lumnitzera littorea
Rhizophora samoensis
Rhizophora stylosa
Rhizophora x selala
Xylocarpus granatum
Xylocarpus mekongensis

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1969	51 700	**Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.	X	Map analysis. The remaining indigenous forest in Fiji was digitised from a 1:500 000 scale forest cover map, prepared by the Ministry of Forests, Fiji, from a 1985 survey. Forest types were added with the help of the Maruia Society, Auckland, New Zealand, whose staff generously prepared a summary forest map based on the Fiji Forest Inventory carried out in 1966-9 and published in 1972, in 29 map sheets at 1:50 000 by the Directorate of Overseas Surveys, London.
1975	49 777	**Richmond, T. de A. and Ackerman, J.M.** 1975. Flora and Fauna of Mangrove formations in Viti Levu and Vanua Levu - Fiji. *In:* Walsh, G.E., Snedaker, S.C. and Teas, M.J., ed. *Proceedings of International Symposium of Biology and Management of Mangroves*, p.147-152. University of Florida.	X	Cited in: **Senibulu M.** 2000. The Role of the National Government in the Economic Development of Mangrove in Fiji. *In International Workshop Asia-Pacific Cooperation on Research for Conservation of Mangroves* 26-30 March, 2000 - Okinawa, Japan. http://landbase.hq.unu.edu/Workshops/OkinawaMarch2000/Papers/Senibulupaperma r2000.htm
1980	19 684	**Marshall.** nd.		Cited in: **Snedaker, S.C.** 1984. The mangroves of Asia and Oceania: status and research planning. *In: Proceedings of the Asian Mangrove Symposium.*, eds. Soepadmo,E; Rao,AN; McIntosh,DJ. p. 5-15 Percetakan Ardyas Sdn Bhd., Kuala Lumpur. 25-29 August 1980, Kuala Lumpur, Malaysia.
1983	20 000	**Wacharakitty, S.** 1983. Mangrove Ecosystem in General. *In: ESCAP/UNESCO/NRCT Regional Remote Sensing Training Course of Mangrove Ecosystem.* p. 22-33. Bangkok, Nov. 28-Dec. 16 1983		Cited in: **FAO.** 1994. *Mangrove forest management guidelines*. FAO Forestry Paper 117. Rome, 319 pp. Rough estimate probably based on Marshall, n.d. (see above)
1985	38 543	**Watling D.** 1985. *A mangrove management plan for Fiji Phase I Fiji.* South Pacific commission and Government Press. Suva. 67 pp.		1:50 000 aerial surveys by the Lands Department. It covers Fiji, Viti Levu and Vanua Levu but no information on smaller islands. This figure should be considered as an underestimate for the whole of Fiji group.
1985	18 000	**Yabaki.** 1985.		Cited in: **FAO.** 1989. *Forestry Sector Development Study - Fiji Environmental aspects of the sector*. Based on the work of Watling, D. Field document FO:DP/FIJ/88/006. FAO, Rome. 58 pp.
1989	42 000	**FAO.** 1989. *Forestry Sector Development Study - Fiji Environmental aspects of the sector.* Based on the work of Watling, D. Field document FO:DP/FIJ/88/006. FAO, Rome. 58 pp.		Rough estimate. The reference year is not provided.

Year	Area (ha)	Source	Trend	Methodology/Comments
1991	42 464	**Forestry Department.** 1991. Fiji National Forest Inventory (NFI). *In: Remote Sensing for Mangrove mapping in Fiji.* Samuela Lagataki, Forestry Department, Fiji	X	Remote sensing

Trends in mangrove area extent over time



Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Fiji	42 464	1991	47 000	43 000	38 700	36 600

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Polynésie Française

Végétation

La Polynésie française, territoire français d'outre-mer, est constituée d'environ 130 îles, se répartissant principalement en cinq archipels: les îles de la Société, les îles Marquises, les îles Australes, les îles Gambier et les atolls des Tuamotu. On s'interroge depuis longtemps sur l'existence de mangroves naturelles sur les îles de la Société. Bien que l'on ait des indices de la présence de mangroves qui remontent jusqu'à 1780, plusieurs sources plus récentes manquent d'informations à ce sujet. Toutefois, en 1975 la présence de *Rhizophora stylosa* a été documentée sur l'île de Moorea, en association avec *Acrostichum aureum*, qui atteint 3 mètres de haut. Les mangroves se trouvent essentiellement sur la côte ouest, à Haapiti et à Bora Bora. À Tahiti, la présence de mangroves est aussi attestée par des documents. On pense que ces espèces ne sont pas indigènes et qu'elles ont été introduites accidentellement à partir d'autres régions du Pacifique.

Reference:

Taylor, F.J. 1979. Rhizophora in the Society Islands. *Pacific Science*, 33(2): 173-176

UNEP-WCMC. 2001. French Polynesia. Protected Areas Programme. http://www.unep-wcmc.org/sites/wetlands/pyf_int.htm

Yonger, M. 2002. *Approche de la pêcherie récifo-lagonaire de Moorea (Polynésie Francaise): évaluation de la production halieutique et de la population de pêcheurs.* Mémoire de fin d'études pour l'obtention du diplôme d'Agronomie approfondie spécialisation halieutique. http://www.ird.nc/COREUS/stage.htm

Liste des espèces exclusives des mangroves

Acrostichum aureum
Rhizophora stylosa

Estimations au niveau national

Aucune information quantitative n'est actuellement disponible pour ce pays.

Guam

Vegetation description, uses and threats

Mangrove swamps are poorly represented on Guam; where they do occur, only a few of the typical western Pacific mangrove species are represented and swamps dominated by *Nypa fruticans* palms are not very common.

The main cause of mangrove reduction and degradation occurred over the last decades in Guam were caused by dredging.

Reference:

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

True mangrove species checklist

Acrostichum aureum
Avicennia alba
Avicennia marina
Bruguiera gymnorrhiza
Excoecaria agallocha
Heritiera littoralis
Lumnitzera littorea
Nypa fruticans
Rhizophora apiculata
Rhizophora mucronata
Rhizophora stylosa
Xylocarpus mekongensis

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1976	94	**Ellison, J.C.** 1995. Status report on Pacific Island Mangroves. *In:* Maragos, J.E.., Peterson, M.N.A., Eldredge, L.G., Bardach, J.E. and Takeuchi, H.F., eds. *Marine and Coastal Biodiversity in the Tropical Island Pacific Region. Volume 1: Population Development and Conservation Priorities.* East-West Center, Honolulu, USA	X	Secondary reference, no methodology provided.
1993	70	**Scott D.A.** 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm	X	Cited in: **Idechong, N., Ellison, J. and R. Jaensch.** 1995. *Regional Wetlands Action Plan for the Pacific Islands.* (Draft prepared for SPREP).

Trends in mangrove area extent over time

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Guam	70	1993	88	74	60	55

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Kiribati

Vegetation description, uses and threats

Mangroves occur in shallow parts of lagoons in several sites and islands of Kiribati. Relatively significant extents are found on Butaritari, Tarawa, Mwaiana and Aranuka islands. Trees of *Rhizophora mucronata, Bruguiera gymnorrhiza, Sonneratia alba* and *Lumnitzera littorea* are found in this country.

In Kiribati mangroves have been traditionally used for fuel, posts, poles, boats and houses construction and in the fishery sector to stake fish traps or to cultivate seaweeds. The health of these forests is not very good, as unfortunately some sites have been over-harvested for fuelwood and poles and some other have been highly damaged because of infrastructure development (especially at South Tarawa) and for the construction of fish ponds. Pollution has been also recorded in some stands, mainly caused by domestic and solid wastes. Mangroves in Kiribati are currently managed by the Environment and conservation, the agricultural and the fisheries divisions of the Ministry of Environment, Lands and Agricultural Development (MELAD).

Reference:

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

USDA Forest Service. 1998. *Mangroves of Kiribati. A priceless resource need protection.* By Ward, J.D. Northeastern Area State and Private Forestry. Pacific Islands Forests,and Trees Support Programme and Kiribati Ministry of Natural Resources Development, Division of Agriculture.
http://www.na.fs.fed.us/spfo/pubs/misc/mangroves/mangroves.htm

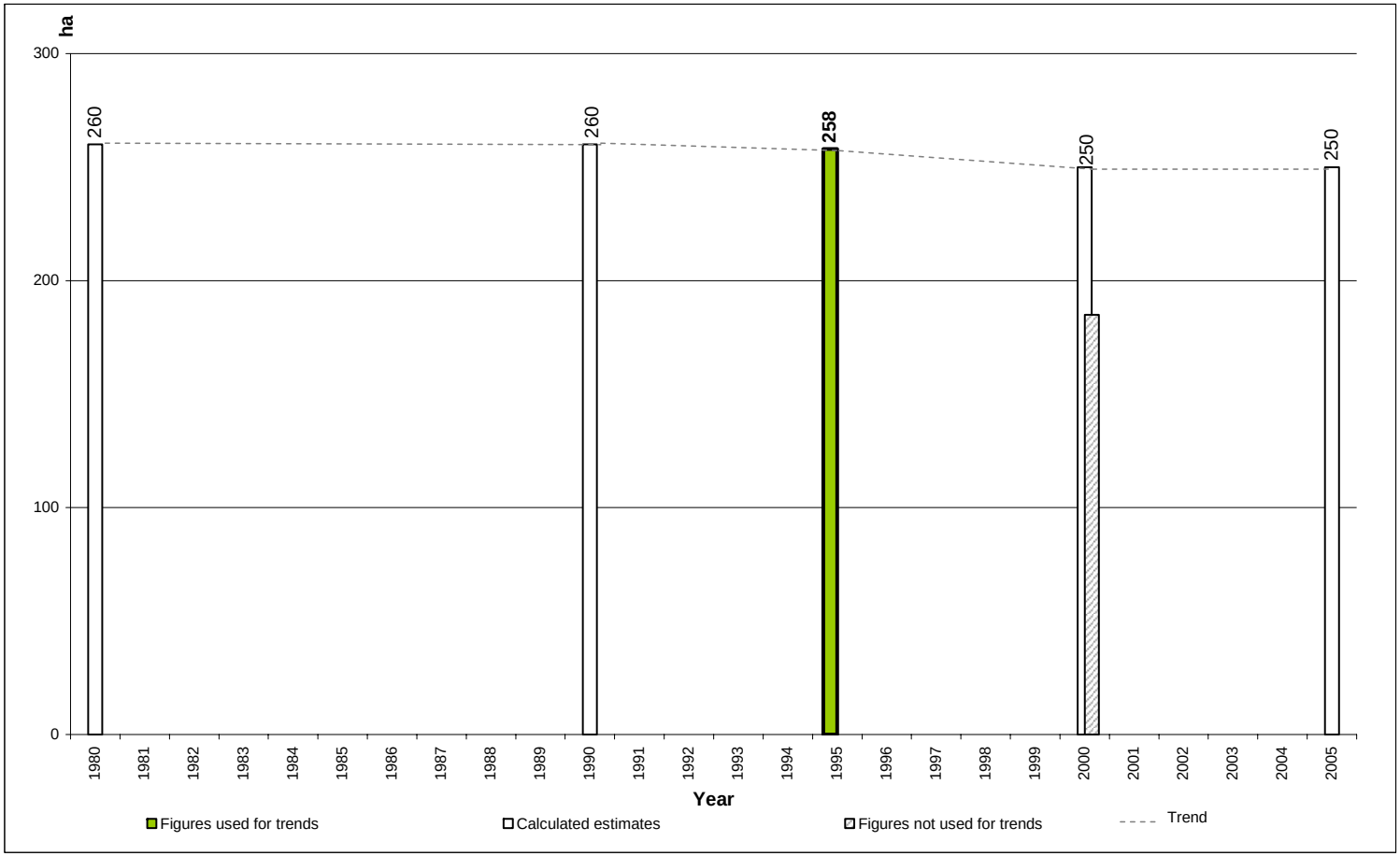
True mangrove species checklist

Bruguiera gymnorrhiza
Lumnitzera littorea
Rhizophora mucronata
Sonneratia alba

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1995	258	**South Pacific Forestry Development Programme and USDA Forest Service.** 1995. *Assessment of mangrove resources.*	X	Ground survey Cited in: **Ward, J.D. and Metz, W.D.** *Mangrove forests as modifiers of the impacts of climate change on high islands and atolls in the south pacific: mobilizing people and governments to act (atolls).* Pacific Islands Regional Forestry Programme. http://www.spcforests.org/Library/Mangroves/atolls/atolls.htm This figure may be slightly on the lower side, since the extent of mangroves found in many small islands is not available.
2000	185	**Emulate Me.** 2000. *Terms of Use & Privacy Policy.* Kiribati, Government, Economy, People, Geography, Related Links, Home Forum. EMULATEME		Estimation, no reference or methodology is provided.

Trends in mangrove area extent over time



Mangrove area extent has slightly decreased during the last twenty years, however no quantitative information is currently available.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**Year**	**ha**	**ha**	**ha**	**ha**
Kiribati	258	1995	260	260	250	250

Formulas used for the trend analysis

The figure for 1980, 1990, 2000 and 2005 are based on qualitative information.

Marshall Islands

Vegetation description

Mangrove forests are present on some of the islands of this archipelago however their extent is not large. In Lib Island, the largest one, they are found in large freshwater ponds, composed of *Bruguiera* sp. Other stands can also be found on Ailinglaplap and Jaluit, where the trees occur in small depressions, on Arno and on Mejit where they are found in a channel from a central pond to the sea.

Reference:

UN. 1988. *Islands of Marshall Islands*. Island directory. http://islands.unep.ch/ILL.htm#1382

True mangrove species checklist

Bruguiera sp.

National level mangrove estimates

No quantitative information is available for this country.

Federated States of Micronesia

Vegetation description, uses and threats

Mangroves are found all over the country, covering the coasts of Pohnpei, Chuuk Islands, Yap Islands, and Kosrae. They are extensive in tidally inundated areas and composed of 18 species, increasing in height and declining in species richness eastwards.

There is a considerable awareness of the importance of mangroves in this country. Currently they do not have to face any major threat and only very limited areas were degraded or changed to other uses over the years, mainly due to shoreline development.

Reference:

Ewel, K.C. 2005. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.

MacLean, C.D., Whitesell, C.D., Cole, T.G. & McDuffie, K.E. 1988. *Timber resources of Kosrae, Pohnpei, Truk, and Yap, Federated States of Micronesia.* USDA Forest Resource Bulletin PSW-24.

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

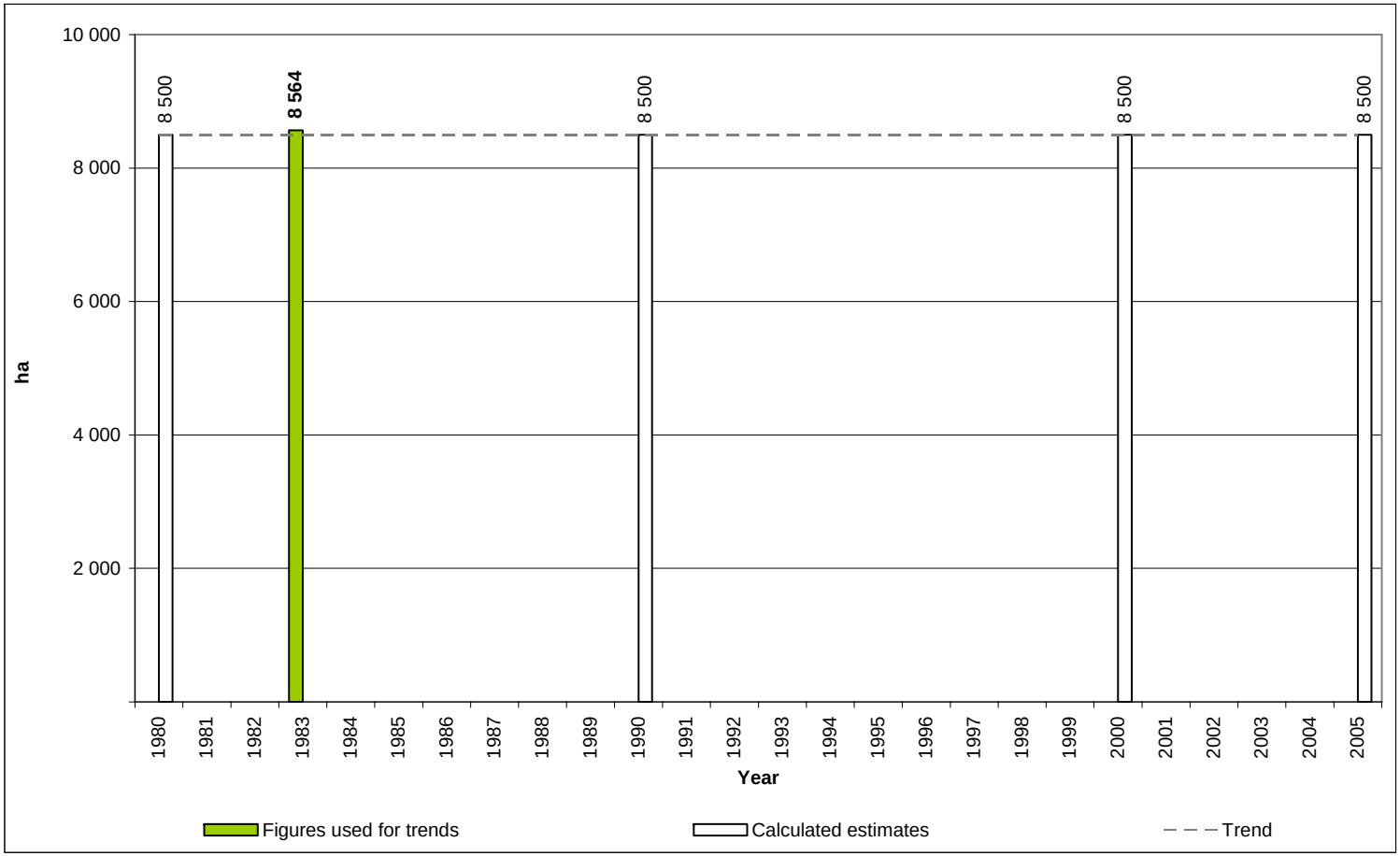
True mangrove species checklist

Acrostichum aureum	Uncertain
Acrostichum speciosum	
Avicennia alba	
Bruguiera gymnorrhiza	
Ceriops tagal	Introduced
Cynometra iripa	
Excoecaria agallocha	
Heritiera littoralis	
Lumnitzera littorea	
Nypa fruticans	
Pemphis acidula	
Rhizophora apiculata	
Rhizophora mucronata	
Rhizophora stylosa	
Rhizophora x lamarckii	
Scyphiphora hydrophyllacea	
Sonneratia alba	
Xylocarpus granatum	

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1983	8 564	**McLean, C. D., C. D. Whitesell, T. G. Cole, and K. E. McDuffie.** 1988. *Timber resources of Kosrae, Pohnpei, Truk, and Yap, Federated States of Micronesia.* Pac. SW Forest & Range Expt. Sta. Resource Bull. PSW-24. USDA Forest Service. 8 pp.	X	Compilation of previous studies based on aerial photos (dated 1976) combined with field sampling in 1983.

Trends in mangrove area extent over time



No significant changes appear to have occurred in this country over the last twenty years.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Fed. states of Micronesia	8 564	1983	8 500	8 500	8 500	8 500

Formulas used for the trend analysis

The trend analysis provided in this report is based on qualitative information currently existing.

Nauru

Vegetation description, uses and threats

Mangroves in Nauru are found in small patches of very limited extent on the northeast coast of the island. Only one species (*Bruguiera gymnorrhiza*) is currently reported for this country, *Rhizophora apiculata* was recorded in the past in association with *Thespesia populnea*, however its current presence is uncertain.

There are some reports of mangrove fruits being used as food by the Naruans.

Reference:

Saenger, P., Hegerl E.J. and J.D.S., Davie. 1983. *Global status of mangrove ecosystems.* Commission on ecology Papers No.3. IUCN. Gland, Switzerland. 88 pp.

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Scott D.A. 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm

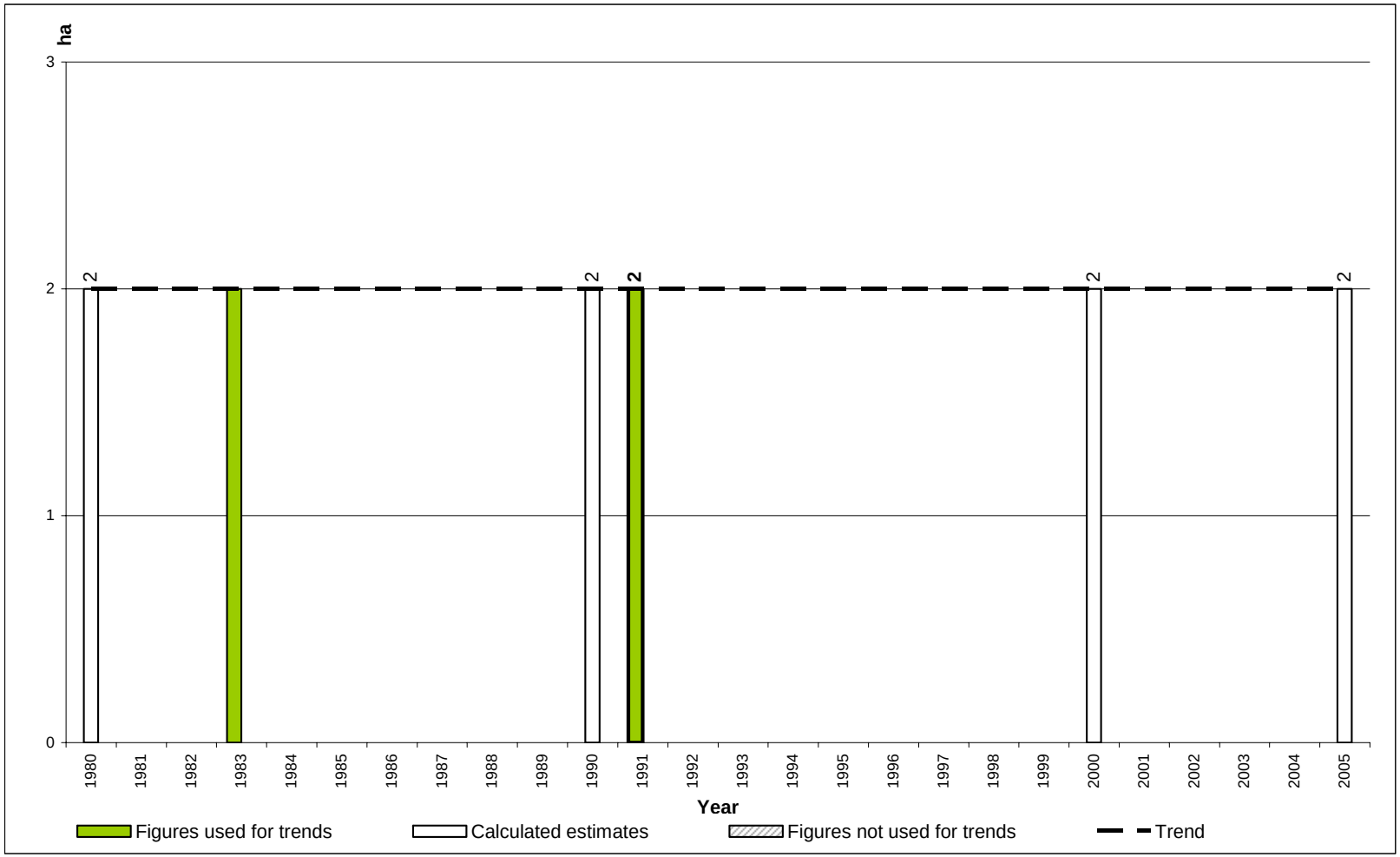
True mangrove species checklist

Bruguiera gymnorrhiza	
Rhizophora apiculata	Uncertain

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1983	2	**Saenger, P., Hegerl E.J. and J.D.S., Davie.** 1983. *Global status of mangrove ecosystems.* Commission on ecology Papers No.3. IUCN. Gland, Switzerland. 88 pp.	X	Secondary reference, no primary source provided. The "Year" is the publication year.
1991	2	**IUCN**. 1991. *IUCN Directory of Protected Areas in Oceania*. Prepared by the World Conservation Monitoring Centre. IUCN, Gland, Switzerland and Cambridge, U.K.	X	Less than two ha. Cited in: **Scott D.A.** 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm

Trends in mangrove area extent over time



No significant changes seem to have occurred in this country over the last twenty years.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Nauru	2	1991	2	2	2	2

Formulas used for the trend analysis

The trend analysis provided in this report is based on qualitative information currently existing.

Nouvelle Calédonie

Végétation, utilisations et menaces

Les mangroves se trouvent sur la côte occidentale et le long des cours inférieurs des rivières, à leur estuaire. Elles sont moins présentes sur la côte orientale, qui est particulièrement abrupte et n'est pas favorable à leur établissement. En général, la flore est relativement pauvre et ne présente pas d'espèces endémiques. *Rhizophora sp.* se trouve le long du littoral maritime où elle atteint une hauteur de deux à cinq mètre et forme des peuplements quasiment purs. Une forêt plus diversifiée et élevée (atteint huit mètres de hauteur), principalement composée de *Bruguiera gymnorrhiza, Rhizophora sp.*, *Lumnitzera racemosa* and *Sonneratia alba*, peut se trouver le long des biefs des fleuves sujets à la marée.

Les zones de mangrove du Pacifique sont traditionnellement destinées à la pêche de poissons et de crabes. Le bois est beaucoup utilisé comme bois de feu et la construction de maisons et d'embarcations. Comme dans d'autres parties du monde, les mangroves sont enlevées des côtes pour en faciliter le développement, as occurred in the surroundings of Noumea. Conséquences du développement urbain avec des rejets d'eaux usées plus important en fond de baie, contenant des éléments traces metalliques qui limitent la régénération des mangroves. Dernièrement, la mortalité des arbres est augmentée à cause de la pollution industrielle ce qui a contribué à la perte de mangroves. Actuellement, la côte ouest est la plus menacée, principalement par les activités humaines, l'urbanisation, la pollution et le développement de projets industriels miniers qui entraînent la création de nouvelles infrastructures portuaires sur des sites occupés par les mangroves. D'un autre côté, cependant, quelques activités de boisement et reboisement ont été enterprises en 1995 et 1999 à Mont Dore.

Reference:

Spalding, M.D., Blasco, F. et Field, C.D., eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japon. 178 pp.

Vedel, S. 2005. Information présentée dans le cadre de l'Étude thématique sur les mangroves destinée à l'Évaluation des ressources forestières mondiales 2005 (FRA 2005). Non publiée.

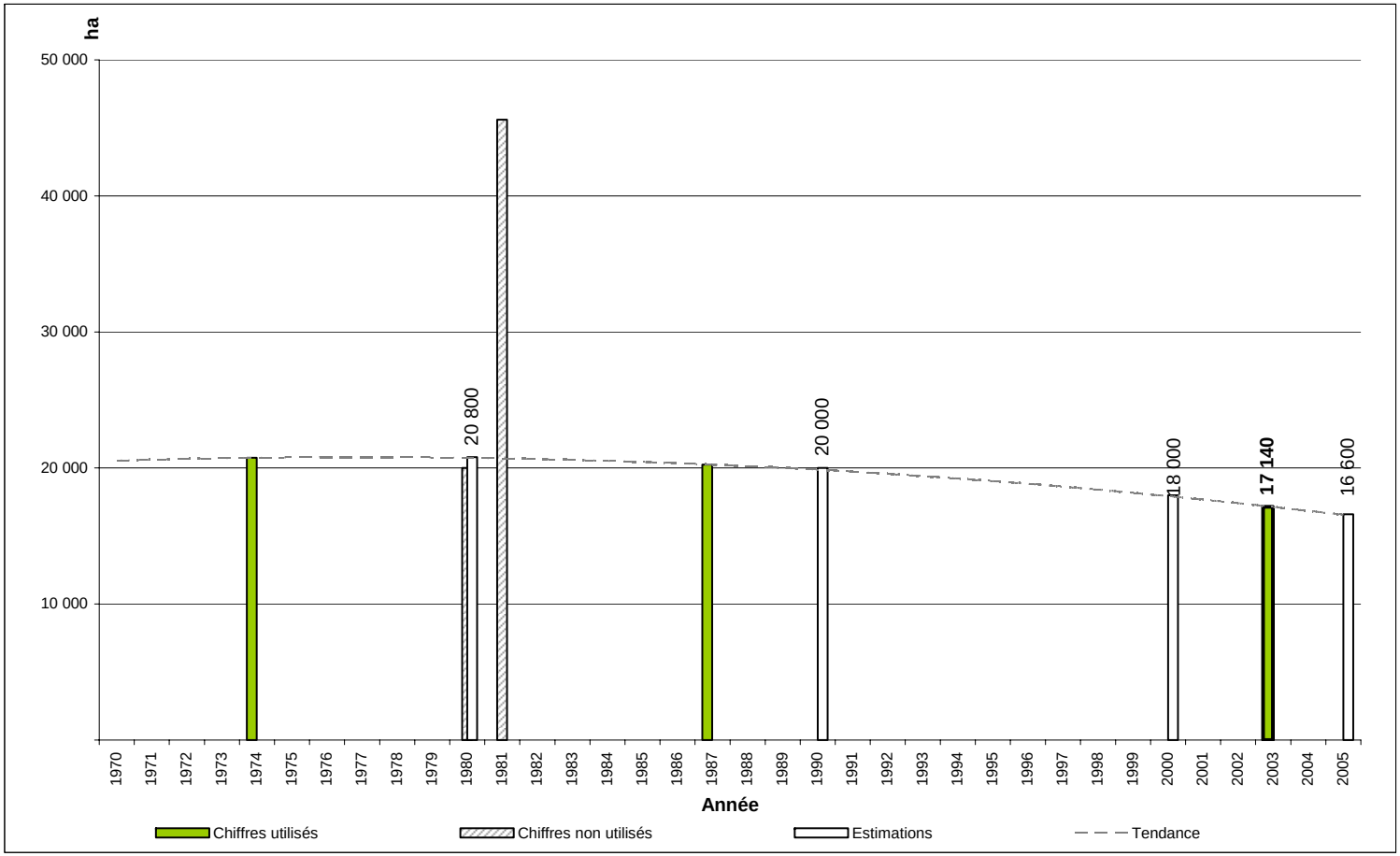
Liste des espèces exclusives des mangroves

Acanthus ilicifolius	*Acrostichum aureum*
Avicennia marina	*Bruguiera gymnorrhiza*
Bruguiera sexangula	*Ceriops tagal*
Cynometra iripa	*Cynometra ramiflora*
Excoecaria agallocha	*Heritiera littoralis*
Lumnitzera littorea	*Lumnitzera racemosa*
Lumnitzera x rosea	*Pemphis acidula*
Rhizophora apiculata	*Rhizophora samoensis*
Rhizophora stylosa	*Rhizophora x lamarckii*
Rhizophora x selala	*Scyphiphora hydrophyllacea*
Sonneratia alba	*Sonneratia caseolaris*
Xylocarpus granatum	*Xylocarpus mekongensis*

Estimations au niveau national

Année	Superficie (ha)	Référence	Tendance	Méthodologie/Commentaires
1974	20 756	**CTFT**. 1975. *Inventaire des ressources forestières de la Nouvelle Calédonie.* Reconnaissance générale et inventaire des blocs pilotes. V.1 : Méthode et réalisation. V.2 : Résultats et commentaires. Nogent sur Marne, France	X	Inventaire forestier Cité dans: **FAO.** 2005. *Évaluations des ressources forestières mondiales 2005* - Nouvelle-Calédonie. Par Dang, V.D. FRA 2005 Rapport national No. 193. Non publié.
1980	20 000	**Morat.** nd. Communication privée		**Cité dans: Snedaker, S.C.** 1984. The Mangroves of Asia and Oceania: Status and Research Planning. dans: proceedings of the Asian Symposium on Mangrove Environment Research and Management, Kuala Lumpur. p 5-15 August 25-29, 1980. Publié par E. Soepadmo, A.N. Rao et D.J. MacIntosh. 1984.
1981	45 600	**Spalding, M.D., Blasco, F. et Field, C.D.**, eds. 1997. World Mangrove Atlas. The International Society for Mangrove Ecosystems, Okinawa, Japon. 178 pp.		Analyse cartographique. Les données sur les mangroves ont été tirées de la carte *Atlas de la Nouvelle Calédonie et Dépendances* (1981) au 1:1 000 000, établie par l'Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) et publiée par ORSTOM, Paris, France.
1987	20 250	**Thollot, P.** 1987. Importance de la mangrove pour l'ichthyofaune du lagon de Nouvelle-Calédonie. Diplôme d'étude approfondie en Océanologie. Centre d'Océanologie de Marseille. ORSTOM, Nouméa, New Calédonie	X	Cité dans: **Idechong, N., Ellison, J., Jaensch, R.** 1995. A Regional Wetlands Action Plan for the Pacific Islands. (Version provisoire préparée pour SPREP) L' « année » se réfère à l'année de publication.
2000	22 210	Initiative « L'Atlas mondial des mangroves » www.fao.org/forestry/site/mangrove-atlas/fr		Interprétation des images LANDSAT pour l'année 2000 entrepris par UNEP-WCMC.
2003	17 140	**Gouvernement de la Nouvelle Calédonie**	X	Superficie calculée à partir de cartes différentes de tout le pays. Cité dans: **Vedel, S**. 2005. Information présentée dans le cadre de l'Étude thématique sur les mangroves destinée à l'Évaluation des ressources forestières mondiales 2005 (FRA 2005). Non publiée.

Tendances de l’étendue des zones de mangrove dans le temps



Synthèse de la situation de l'étendue de mangroves dans le temps

	Estimation fiable la plus récente de la surface de mangrove		Surface de mangrove 1980	Surface de mangrove 1990	Surface de mangrove 2000	Surface de mangrove 2005
	ha	**Année de réf.**	**ha**	**ha**	**ha**	**ha**
Nouvelle Calédonie	17 140	2003	20 800	20 000	18 000	16 600

Formules appliquées pour analyser les tendances

Tendance polynomiale :
Soit $y=b+c_1x+c_2x^2+c_3x^3+..+c_nx^n$ où b et $c_1 \ldots c_n$ sont des constantes données.

New Zealand

Vegetation description, uses and threats

The monospecific mangrove ecosystem (*Avicennia marina resinifera*) is of particular interest because of its close location with the southern limits of the world mangrove distribution (38° 22'S, in Australia and 37° 01' in Auckland harbour, New Zealand) and has a relatively simple structure. These forests occur in the harbours and estuaries of the northern third of the North Island.

Mangrove areas are used for fishing, shellfish collecting, recreation (kayaking) and boat mooring. Mangroves have occasionally been removed for coastal development and in the past there has been extensive loss of areas for agriculture and commercial land development; legislation now ensures that any significant clearance of mangroves are rarely approved. Nowadays it has been recorded that mangrove areas are increasing as they are colonizing sediment inputs from adjacent land uses which create new suitable habitat.

Reference:

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997 *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

Warren, P. 2004. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.

True mangrove species checklist

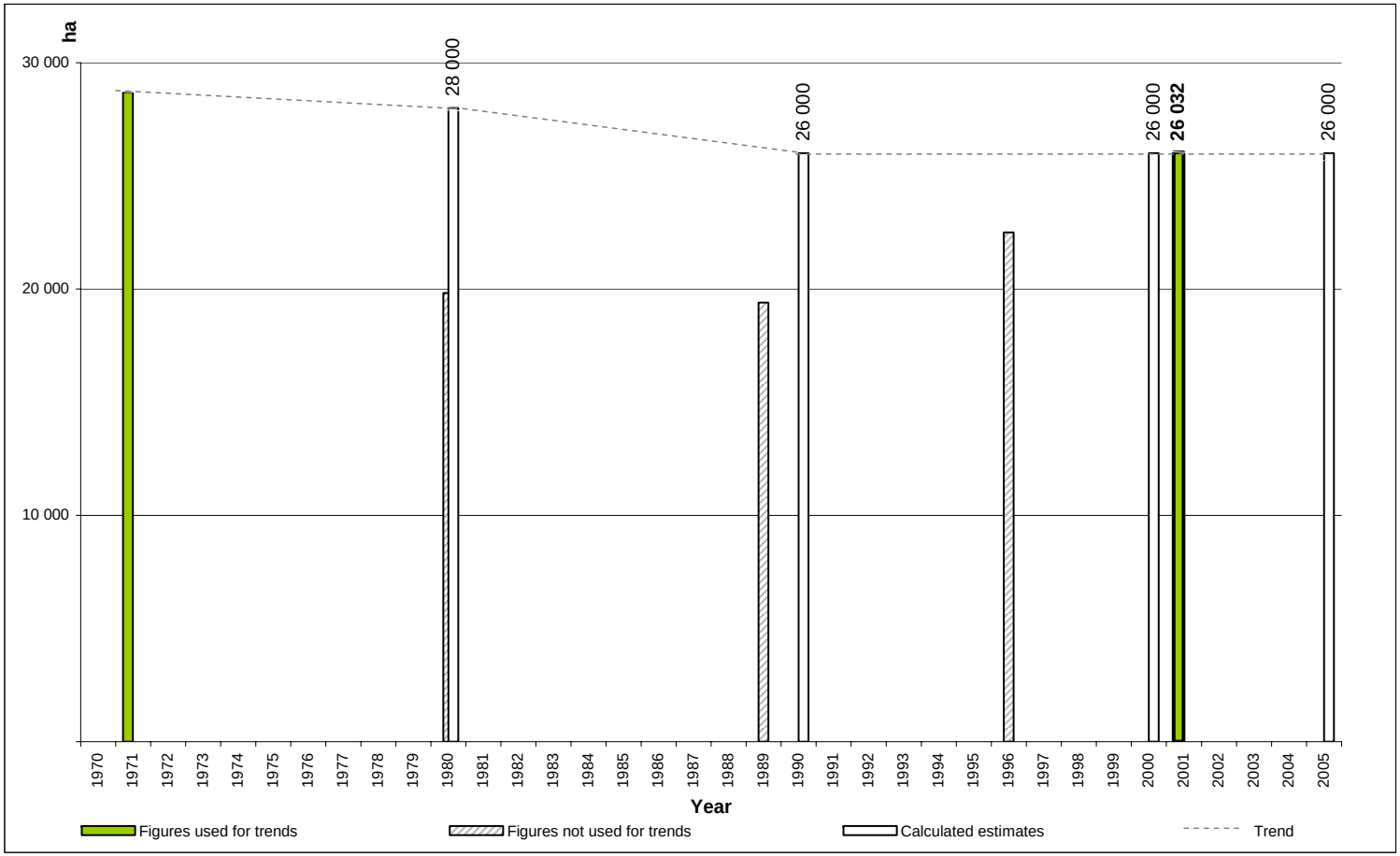
Avicennia marina resinifera

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1971	28 700	**Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.	X	Map analysis. Mangroves were copied from NZ topographic map series (Department of Lands and Survey) (various) onto a 1: 700 000 base map before digitising. Source data from these maps was aerial photography undertaken between 1960 and 1982. Department of Lands and Survey (1979-85) 1:50 000 NZMS 260. Department of Lands and Survey, New Zealand. Department of Lands and Survey (1968-85) 1:63 360 NZMS 1. Department of Lands and Survey, New Zealand.
1980	19 830	**Chapman.** 1980. Personal communication.		Cited in: **Snedaker, S.C.** 1984. The Mangroves of Asia and Oceania: Status and Research Planning. In: proceedings *of the Asian Symposium on Mangrove Environment Research and Management*, p 5-15 Kuala Lumpur, August 25-29, 1980. Edited by E. Soepadmo, A.N. Rao and D.J. MacIntosh. 1984. Secondary reference, no primary source provided. The "Year" is the year of the conference.

Year	Area (ha)	Source	Trend	Methodology/Comments
1989	19 400	**Hackwell.** 1989. *New Zealand Mangroves.* Department of Conservation, Wellington, New Zealand. 41 pp.		Cited in: **Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.
1996	22 500	**Ministry of Agriculture and Forestry.** 2001. *Land Cover Database 1*. Table compiled by Policy Information Group, Ministry of Agriculture and Forestry. http://www.maf.govt.nz/statistics/primaryindustries/landcover/tables/11-lc-nz.htm		Remote sensing. This study seems to be not comparable with the most recent data (LCDB version 2). The interpretation of the different images showed a slight increase in the resource, which is probably not corresponding to a real change.
2001	26 032	**Thompson, S. 2004.** *New Zealand Land Cover Database Version 2*. Ministry for the Environment	X	Cited in: **Warren, P.** 2004. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished. Remote Sensing. Database based on classification of LANDSAT 7TM, the majority of the image acquisition within 2000/2001. Differences in methodology do not allow the comparison of this data with the previous Land Cover Database 1

Trends in mangrove area extent over time



Several mangrove uses, and especially land reclamations, caused some losses in area till 1991. Thanks to the changes in the legislation came into force in that year, the process has been stopped, and since then only very small areas, probably less than one hectare in total, have been lost. On the contrary, in the last decade there has been a slight expansion of mangroves into new areas, generally replacing other natural ecosystem more than restoring past mangrove losses. (Warren, P. 2004). The extent for 1990, 2000 and 2005 are estimates based on the above cited information.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
New Zealand	26 032	2001	28 000	26 000	26 000	26 000

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Niue

Vegetation description

In the little coral atoll the coastal forest is low and tangled, dominated by trees and shrubs, including *Pemphis acidula* and *Excoecaria agallocha*. Mangroves are found in small patches and stands, and proper forests do not appear on this island.

Reference:

Gilman, E. 2005. Information provided for the Global Forest Resources Assessment (GFRA) 2005 thematic study on mangroves. Unpublished.

Mueller-Dombois, D. and F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

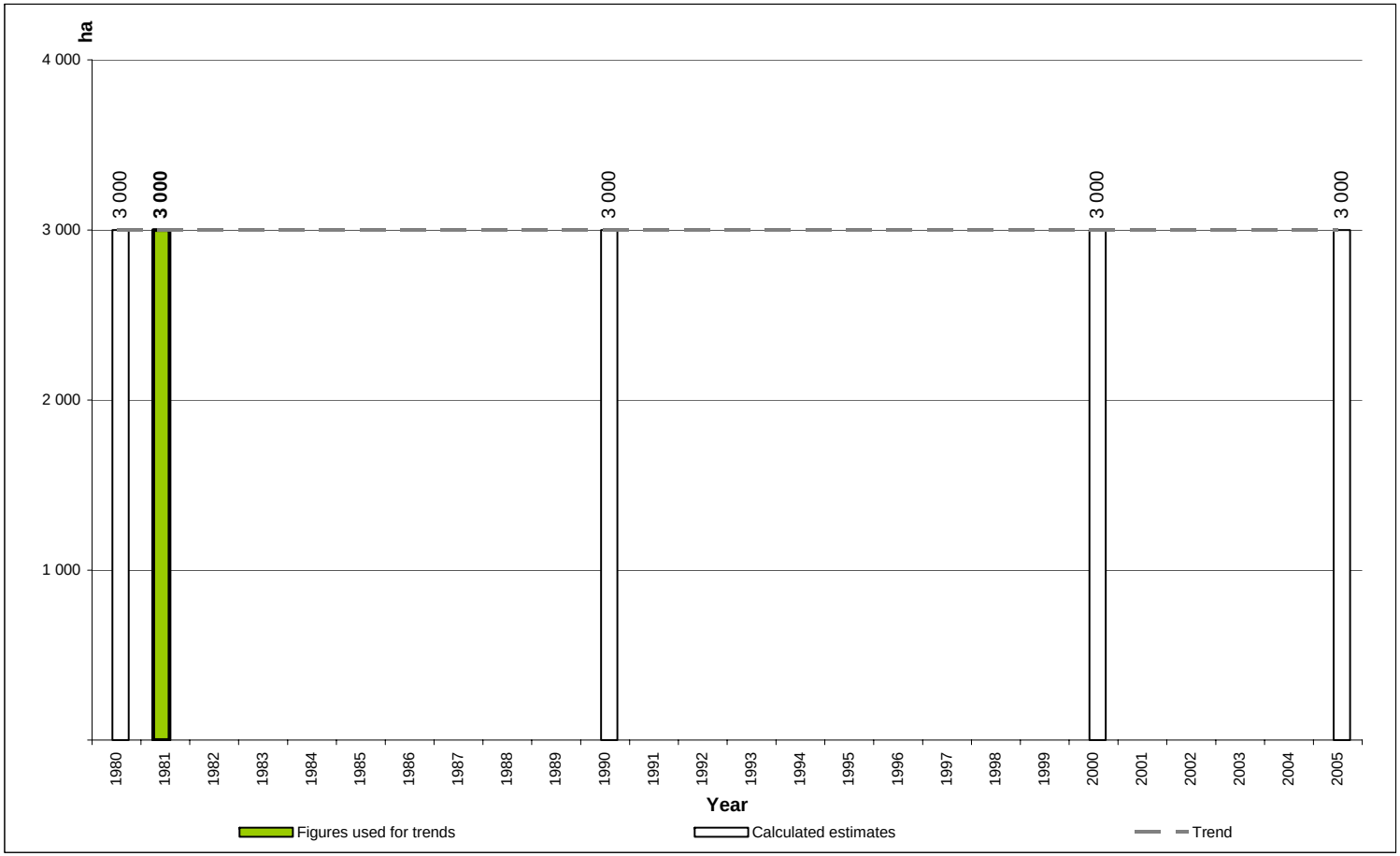
True mangrove species checklist

Excoecaria agallocha
Pemphis acidula

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1981	3 000	**Tamate, M.** 1993. Country Report. *In: proceedings of Heads of Forestry Meeting* 21-25 September 1992, Apia, Western Samoa.	X	Secondary reference, no primary source provided.

Trends in mangrove area extent over time



No significant changes appear to have occurred in this country over the last decades.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Niue	3 000	1981	3 000	3 000	3 000	3 000

Formulas used for the trend analysis

The trend analysis provided in this report is based on qualitative information currently existing.

Northern Mariana Islands

Vegetation description, uses and threats

Mangrove ecosystem in the Northern Mariana Islands is developed exclusively on Saipan Island, and it includes *Bruguiera gymnorrhiza, Heritiera littoralis* and *Xylocarpus moluccensis*. The majority of the mangroves are located in the wetland or adjacent areas to the Puerto Rico mudflats.

In the past mangroves probably covered a relatively extensive area, however nowadays this ecosystem is quite scarce. The main causes of destruction and degradation should be searched in the wetlands filling occurred during this century and in the consequences of the sugar cane and rice cultivations occurred during the Japanese period, from 1914 to 1944.
The Coastal Resources Management Act (PL 3-47) was introduced to protect the ecosystems, with regulations which also protect mangroves and critical wetland habitats. Most of the mangroves are included in the American Memorial Park, protected in the Wetland Mangrove Forested Sanctuary.

Reference:

Falanruw, M. C., T. G. Cole, & A. H. Ambacher. 1989. *Vegetation Survey of Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands*. Resource Bulletin PSW-RB-27, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

Mueller-Dombois, D. & F.R. Fosberg. 1998. *Vegetation of the tropical Pacific Islands.* Springer-Verlang, New York 733 pp.

The National Park Service. 2004. *American Memorial Park. Saipan, Northern Mariana Islands.* http://www.nps.gov/amme/main.htm

UNEP. 1998. *UN System-Wide Earthwatch Web Site. Island directory. Islands of Northern Mariana Islands* (United States). http://islands.unep.ch/ILY.htm

UNEP-WCMC. 2001. *Protected Areas Programme. Wetlands. Commonwealth of the Northern Mariana Islands.* http://www.unep-wcmc.org/sites/wetlands/mnp_int.htm

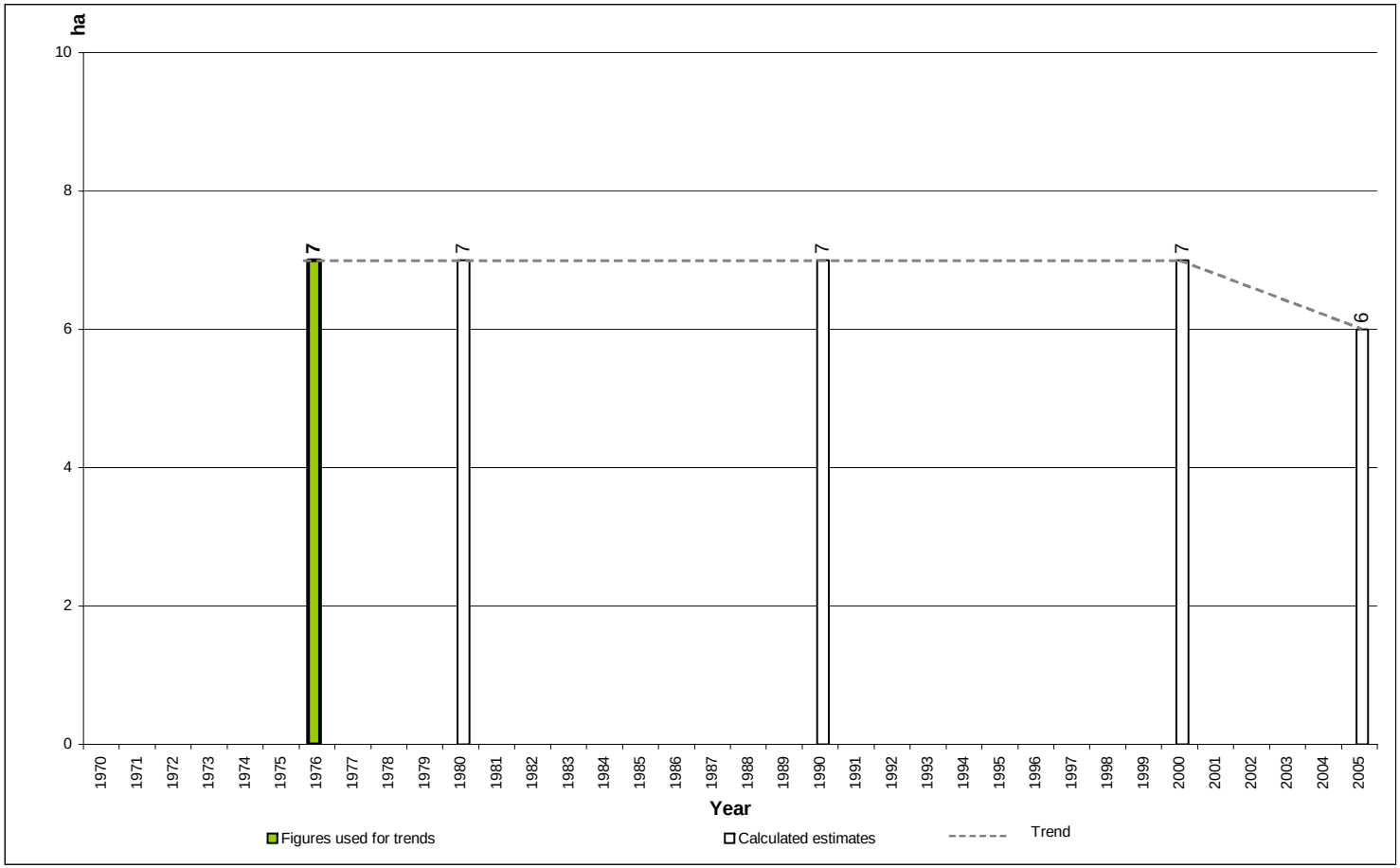
True mangrove species checklist

Bruguiera gymnorrhiza
Heritiera littoralis
Xylocarpus mekongensis

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1976	7	**Falanruw, M. C., T. G. Cole, & A. H. Ambacher.** 1989. *Vegetation Survey of Rota, Tinian, and Saipan, Commonwealth of the Northern Mariana Islands*. Resource Bulletin PSW-RB-27, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.	X	Aerial photographs and ground checking Maps derived from interpretation of 1976, 1:8 000 black and white aerial photography. Maps were partially field verified in 1984. Data are considered to be from 1976.

Trends in mangrove area extent over time



Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Northern Mariana Islands	7	1976	7	7	7	6

Formulas used for the trend analysis

The 1980, 1990, 2000 and 2005 estimates have been calculated applying the 1990-2000 and 2000-2005 forest cover annual change (-0.29 percent and -0.30 percent respectively; FAO. 2005)

Palau

Vegetation description

Found along the lower portions of rivers and on coastal mudflats, mangrove forests in Palau have a relatively high diversity, with 14 true mangrove species represented. Well-developed stands can reach 15 to 20 m tall. *Rhizophora stylosa* and *Sonneratia alba* dominate on the seaward side; at larger river mouths or bay indentations, *Rhizophora apiculata* and *R. stylosa* can become pure stands or occur with *Sonneratia alba* and *Bruguiera gymnorrhiza*; landward *Heritiera littoralis*, *Lumnitzera littorea* and *Xylocarpus granatum* are also found. Where the estuary becomes river-like *Bruguiera, Lumnitzera, Sonneratia* and *Xylocarpus* species are often found, but *Rhizophora sp.* becomes uncommon. The palm *Nypa fruticans* is fairly common along the lower portions and mouths of rivers. Other woody species include *Ceriops tagal* and *Scyphiphora hydrophyllacea.*

Reference:

Cole, G., Falanruw, M.C., MacLean, D.C, Whitesell, C.D, Ambacher, A.H. 1987. *Vegetation Survey of the Republic of Palau.* Resource Bulletin PSW-22. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture.

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

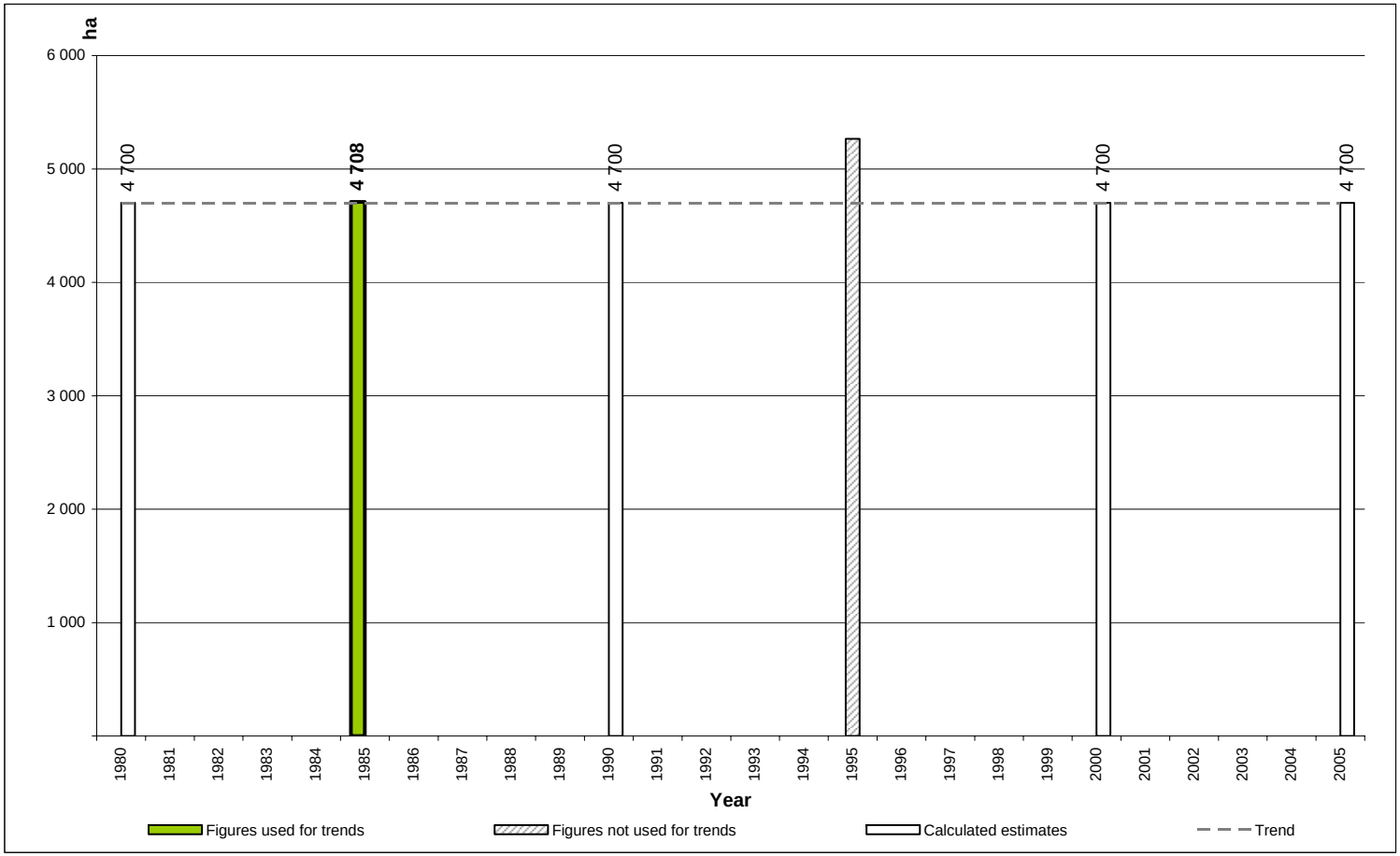
True mangrove species checklist

Avicennia alba	*Bruguiera gymnorrhiza*
Ceriops tagal	*Excoecaria agallocha*
Heritiera littoralis	*Lumnitzera littorea*
Nypa fruticans	*Rhizophora apiculata*
Rhizophora mucronata	*Rhizophora stylosa*
Scyphiphora hydrophyllacea	*Sonneratia alba*
Xylocarpus granatum	*Xylocarpus mekongensis*

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1985	4 708	**Cole, G., Falanruw, M.C., MacLean, D.C, Whitesell, C.D, Ambacher, A.H.** 1987. *Vegetation Survey of the Republic of Palau.* Resource Bulletin PSW-22. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture.	X	Remote sensing
1995	5 265	**FAO.** 1995. *Tropical Forests Action Programme; Information mission to Pacific Island countries* Based on the work of Desloges, C. Field document RAS/92/361. FAO, Rome. 69 pp.		The information was verbally reported to the author during a meeting. The reliability of the figure is uncertain

Trends in mangrove area extent over time



No significant changes appear to have occurred in this country over the last twenty years.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**Ha**	**ha**	**ha**	**ha**
Palau	4 708	1985	4 700	4 700	4 700	4 700

Formulas used for the trend analysis

The trend analysis provided in this report is based on qualitative information currently existing.

Papua New Guinea

Vegetation description, uses and threats

Papua New Guinea has undisturbed mangrove forests with high species diversity, extending over many thousands of kilometres along the shores and, penetrating quite deeply inland in many sites. Large stands of well structured mangroves are found especially on the mainland along the southern coast. Several stands also occur on the northern coast and on the islands but with less diversity in species. Fringing mangroves are widespread at most river mouths, on not too sandy, rocky or exposed localities. Important stands occur in the Gulf of Papua and along the coast of the Central Province, in the deltas of the Fly, Ramu and Sepik Rivers. *Rhizophora sp.* and *Bruguiera sp.* are the most common species in the Papuan Gulf, attaining large dimensions. Mangrove trees are often narrowly crowned, growing up to 20-30 metres in height, sometimes with extensive above-ground root systems without extensive undergrowth. A distinctive feature of mangroves in Papua New Guinea is their development in seasonally dry zones, such as around Port Moresby. Due to the climatic factors the height of trees in these regions is reduced, and species diversity is lower than in other PNG areas.

Most of the mangroves are sparsely populated and locally used for different purposes such as building materials, firewood, medicines and tannins. *Nypa fruticans* remains one of the most useful species being used for thatching, weaving and for the production of sugar and ethanol; commercial exploitation for timber is limited. The area changes occurred over the last two decades have been mainly caused by the human pressure for rural livelihood, for commercial activities and for the extraction of wood for poles for housing and carvings; the extraction of firewood for domestic cooking, and for drying of sea cucumbers for exports further contributed to the decline in the Western Province mangroves. On the other hand, aquaculture and tourism activities do not represent main threat to mangroves, which in several sites are still in good condition and health.

Reference:

Ambia, V. 2004. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.

FAO, UNEP. 1981. *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Asia.* FAO, UNEP, 475 pp.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

True mangrove species checklist

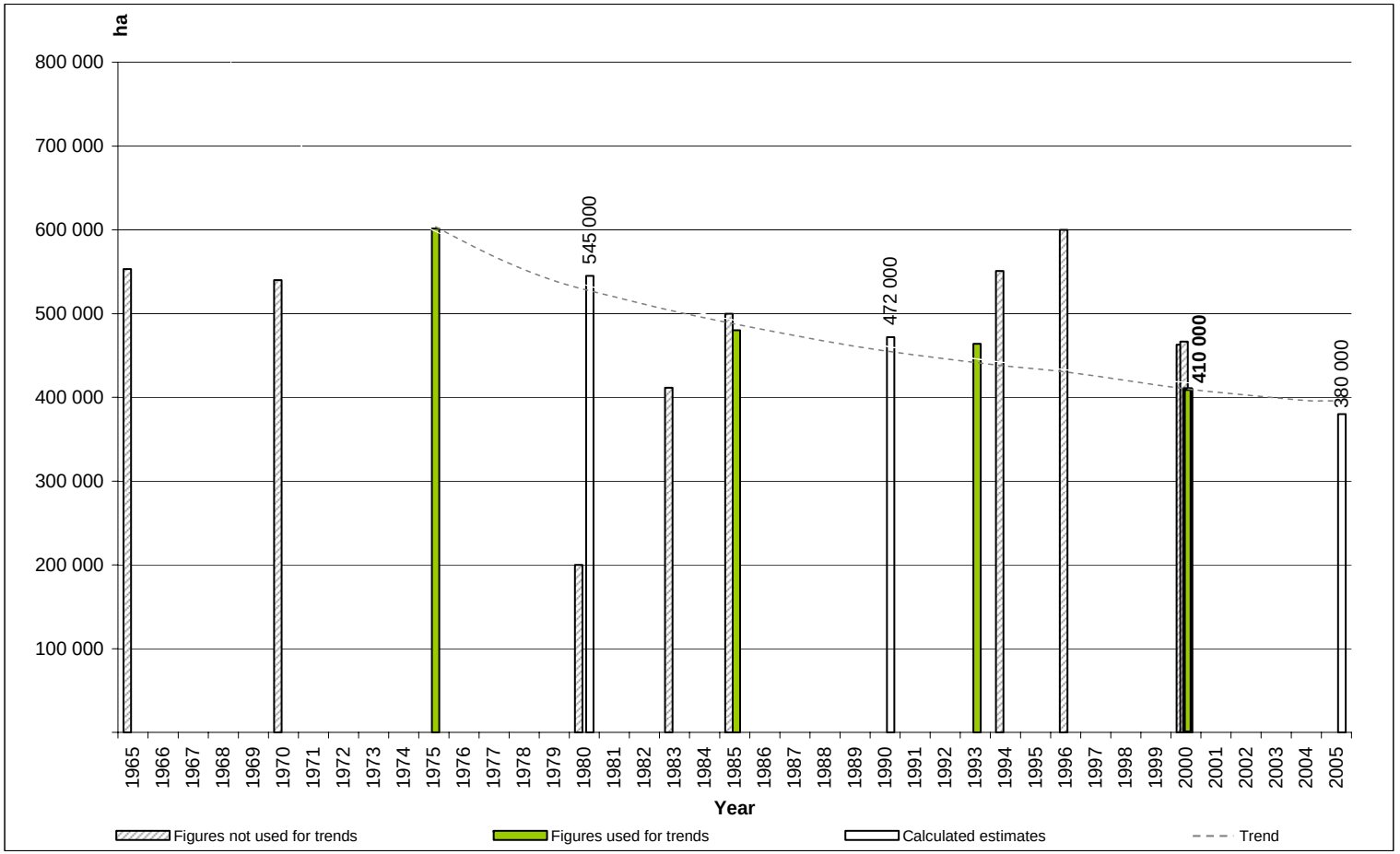
Acanthus ilicifolius	*Aegialitis annulata*	*Aegiceras corniculatum*
Avicennia alba	*Avicennia eucalyptifolia*	*Avicennia marina*
Avicennia officinalis	*Avicennia rumphiana*	*Bruguiera cylindrica*
Bruguiera exaristata	*Bruguiera gymnorrhiza*	*Bruguiera hainesii*
Bruguiera parviflora	*Bruguiera sexangula*	*Camptostemon schultzii*
Ceriops australis	*Ceriops decandra*	*Ceriops tagal*
Cynometra iripa	*Cynometra ramiflora*	*Excoecaria agallocha*
Excoecaria indica	*Heritiera littoralis*	*Kandelia candel*
Lumnitzera littorea	*Lumnitzera racemosa*	*Nypa fruticans*
Pemphis acidula	*Rhizophora apiculata*	*Rhizophora mucronata*
Rhizophora samoensis	*Rhizophora stylosa*	*Sonneratia alba*
Sonneratia caseolaris	*Sonneratia ovata*	*Xylocarpus granatum*
Xylocarpus mekongensis		

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1965	553 000	**FAO, UNEP.** 1981. *Tropical Forest Resources Assessment Project, Forest Resources of Tropical Asia.* FAO, UNEP, 475 pp.		Map analysis. 1:1 000 000 aerial photographs of years 1943 to 1972. The "Year" is the average year provided in the document.
1970	539 900	**Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.		Map analysis. Digital mapped data have kindly been provided by the Research School of Pacific and Asian Studies, Australian National University, with generous permission from the Department of Agriculture and Livestock, Papua New Guinea. These data are taken from the Papua New Guinea Resource Information System, developed by the Australian Commonwealth Scientific and Industrial Research Organisation. The source data have been generated from extensive field studies, extrapolated over the whole country by air photo interpretation of 1:50 000 and 1:80 000 images taken in the 1960s and 1970s, and mapped at a scale of 1:500 000. Although data are old, the authors believe that rates of change may not be large in this country, while these data are the most accurate available for this country. **Bellamy, J.A.** 1986. *Papua New Guinea Inventory of Natural Resources: Population Distribution and Land Use Handbook.* Natural Resource Series No. 6, CSIRO Division of Water and Land Resources, Canberra. **Paijmans, K.** *ed.* 1976. *New Guinea Vegetation.* Australian National University Press and CSIRO, Canberra
1975	601 600	**McAlpine, J. and J. Quigley.** 1998. *Forest Resources of Papua New Guinea. Summary of Statistics from the Forest Inventory Mapping (FIM) System.* Prepared by Coffey M.P.W.P. for AusAID and PNG National Forest Authority. Port Moresby.	X	The FIM provides maps and information for the whole of PNG on areas of forest and non-forest vegetation type, including land use, as at 1975. The figure reported in the table at the beginning of the book is 605 000 ha, while from the breakdown the extent resulted to be 601 600 ha.
1980	200 000	**Dahl, A.L.** 1980. *Regional ecosystem survey of the South Pacific Area.* SPC/IUCN Technical Paper 179. South Pacific Commission, Noumea, New Caledonia, 99pp.		Cited in: **Fisher, P and Spalding, M.D.** 1993. *Protected areas with mangrove habitat.* Draft Report World Conservation Centre, Cambridge, UK. 60 pp. The figure should be considered as an under estimate of the resources.
1983	411 600	**Saenger, P., Hegerl E.J. and J.D.S., Davie.** 1983. *Global status of mangrove ecosystems.* Commission on ecology Papers No.3. IUCN. Gland, Switzerland. 88 pp.		Secondary reference, no primary source provided. The "Year" is the publication year.

Year	Area (ha)	Source	Trend	Methodology/Comments
1985	480 000	**Beehler, B.** 1985. *Conservation of New Guinea Rainforest Birds*. ICBP Technical Publication 4:233-247.	X	Cited in: **UNU**. 1996. *Population, land management, and environmental change*. The UNU Global Environmental Forum IV, Population, Land Management, and Environmental Change. The United Nations University. Tokyo, Japan. http://www.unu.edu/unupress/unupbooks/uu03pe/uu03pe08.htm The "Year" is the publication year.
1985	500 000	**FAO.** 1985. *Mangrove forest study.* Based on the work of Ong, J.E. Field document PNG/84/001/A/01/12. FAO, Rome 23 pp.		Secondary reference, no primary source provided. The "Year" is the publication year. Rough estimate
1993	464 000	**Saunders, J.** 1993. *Agriculture land use of Papua New Guinea: Explanatory Notes to Map.* PNGRIS Publication No. 1. AIDAB, Canberra.	X	Cited in: **European Forest Institute**, 2000. Country Report - Papua New Guinea. http://www.efi.fi/cis/english/creports/papua_new_guinea.php
1994	550 942	**FIMS, NFS Papua New Guinea.** 1994		Cited by: **Sabuin, T.** 2001. Status of Mangrove Wetland protection and sustainable use in Papua New Guinea. *In: proceedings of the Regional Workshop Mangrove Wetland Protection & Sustainable Use.* Marine Studies Centre, USP Suva, June 12-16, 2001. The "Year" is the publication year.
1996	600 000	Mc.Alpine, Forest of PNG. Forest Inventory Mapping (FIM)		Aerial photo 1973/74 and 1996 LANDSAT imagery. Cited in: **Ambia, V.** 2004. Information provided for the Global Forest Resources Assessment (FRA) 2005 thematic study on mangroves. Unpublished.
2000	462 700	**World Resources Institute**. 2000. *World resources 2000-2001: people and ecosystem—the fraying web of life*. Washington, DC. UNDP. 400 pp.		Secondary reference, no primary source provided. The "Year" is the publication year.
2000	410 000	**Aizpuru, M., Achard, F., and Blasco, F.** 2000. Global Assessment of Cover Change of the Mangrove Forests using satellite imagery at medium to high resolution. *In EEC Research project n 15017-1999-05 FIED ISP FR* – Joint Research center, Ispra.		Estimation for the year 2000
2000	466 600	**Ibid**		LANDSAT imagery interpretation undertaken by UNEP-WCMC in the framework of the World Atlas of Mangroves initiative.

Trends in mangrove area extent over time



Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Papua New Guinea	410 000	2000	545 000	472 000	410 000	380 000

Formulas used for the trend analysis

Power:
$y=cx^b$ where c and b are constants.

Samoa

Vegetation description, uses and threats

Samoa is an archipelago composed of two main islands (Savai'i and Upolu) and seven islets; mangroves are found only on the two main islands, typically in protected coastal bays and estuaries where fresh water enters the ocean; the largest forest is found on Upolu. The riverine forest bordering the estuary of the Leaf River at Sa'anapu-Sataoa, in Upolu, represents the least disturbed mangrove forest in Samoa. The closed canopy allows only *Bruguiera* seedlings in the understory, but the swamp fern *Acrostichum aureum* and *Rhizophora samoensis* occupy openings. In a locality on the southern coast of Savai´i, a very small stand of *Xylocarpus mekongensis* (sin. *X. moluccensis*) is associated with *Bruguiera*. Often fronting mangrove forest is a mangrove scrub community dominated by small to medium-sized trees of *Rhizophora samoensis* (rarely exceeding 5 m in height). Where *Rhizophora samoensis* competes with the larger *Bruguiera gymnorrhiza*, the former is shaded out.

Mangrove areas have been extensively used and much of the forest is now degraded. The extensive deforestation occurred as a result of commercial timber operations (for the construction of houses and boats) and clearance of land for agriculture. Many areas have also been claimed for coastal and tourism development, such as Moata'a and Apia mangroves in Upolu; several other sites are degraded by human settlements.

Reference:

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Scott, D.A. ed. 1993. *A Directory of Wetlands in Oceania.* IWRB, Slimbridge, U.K. and AWB, Kuala Lumpur, Malaysia. http://www.wetlands.org/inventory&/OceaniaDir/WSamoa.htm

Whistler, W.A. 1992. Vegetation of Samoa and Tonga. *Pac. Sci.*, 46(2): 159-178.

True mangrove species checklist

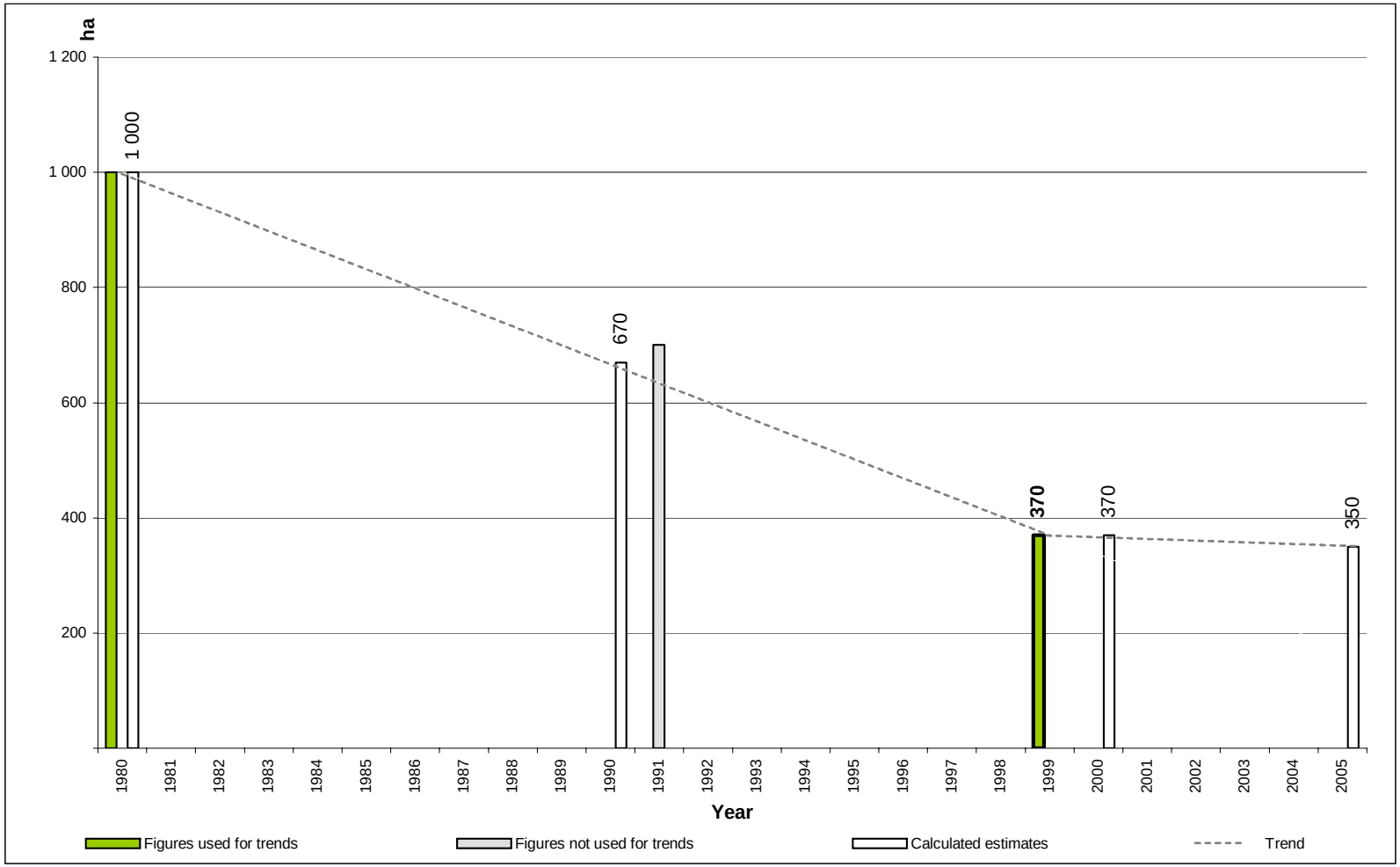
Acrostichum aureum
Bruguiera gymnorrhiza
Rhizophora samoensis
Xylocarpus mekongensis

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1980	1 000	**Dahl, A.L.** 1980. *Regional ecosystem survey of the South Pacific Area.* SPC/IUCN Technical Paper 179 South Pacific Commission, Noumea, New Caledonia. 99 pp	X	Cited in: **Fisher, P and Spalding, M.D.** 1993. *Protected areas with mangrove habitat.* Draft Report World Conservation Centre, Cambridge, UK. 60 pp.

1991	700	**Pearsall and Whistler.** 1991. *Terrestrial Ecosystem Mapping for Western Samoa.* Report prepared for the Government of Western Samoa. South Pacific Regional Environmental Programme, Noumea New Caledonia and East-West Center. Environment and Policy Institute.		Cited in: **Idechong, N., Ellison, J., Jaensch, R.** 1995. *A Regional Wetlands Action Plan for the Pacific Islands.* (Draft prepared for SPREP)
1999	370	SamFRIS (Samoa Forest Resource Information System) Database, Samoa Forestry Division, (2004)	X	GIS based database, utilize 1999 aerial photos for forest mapping. Cited in: **FAO.** 2005. *Global Forest Resources Assessment (FRA) 2005 country report - Samoa*. By Afamasaga Sami Lemalu FRA 2005 Working Paper No. 096. Unpublished.

Trends in mangrove area extent over time



The estimate for 2005 is an expert estimate.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Samoa	370	1999	1000	670	370	350

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Solomon Islands

Vegetation description, uses and threats

Mangroves are found on most of the Solomon Islands, occurring in sheltered coastal bays and along river mouths in two structural types: one is a low, stunted, 2.5 m tall forest dominated by *Rhizophora apiculata* while the other reach heights up to 25 m and it is composed of *Bruguiera parviflora*, *B. sexangula*, *Rhizophora apiculata* and *R. stylosa*. Other mangrove species include *Ceriops tagal* and *Lumnitzera littorea*, which sometimes forms pure stands. These differences in structure and composition are highly related to habitat features and to past disturbance. During the 1970s mangroves were the most extensive wetland type occurring in this country; significant extents were found on coastal areas on Isabel, New Georgia and Malaita islands

Freshwater wetlands and mangroves are of economic importance to the largely subsistence economy of Solomon Islanders. The leaf of Nypa palm are used as important building material, and it is also extensively used in traditional weaving, while other species supply important building materials and food resources ranging from fruits to a large variety of shells, crustaceans and fish. Mangroves have not been exploited on an industrial scale; however they are traditionally used for fishing and collecting crabs, the timber is extensively used for firewood and construction of houses and boats. As in other parts of the world, these forests are being removed for coastal development. Mangroves are ***protected from commercial logging and export under the Forest Resources and Timber Utilisation Act***, and however their degradation is still ongoing. Despite the deforestation still occurring due to over exploitation and conversion to other uses, some efforts are also made to regenerate the forest.

Reference:

Hansell, J.R.F. & Wall, J.R.D. 1976. *Land Resource of the Solomon Islands. Volume 1. Introduction and recommendations.* Land Resource study 18.

Scott, D.A. ed. 1993. *A Directory of Wetlands in Oceania.* IWRB, Slimbridge, U.K. and AWB, Kuala Lumpur, Malaysia.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997 *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

WWF South Pacific Programme. 2003. *WWF Solomon Islands Country Programme. Marine ecosystems of the Solomon Islands*. (Bismarck-Solomon seas ecoregion). http://www.wwfpacific.org.fj/marineresourcessolo.htm

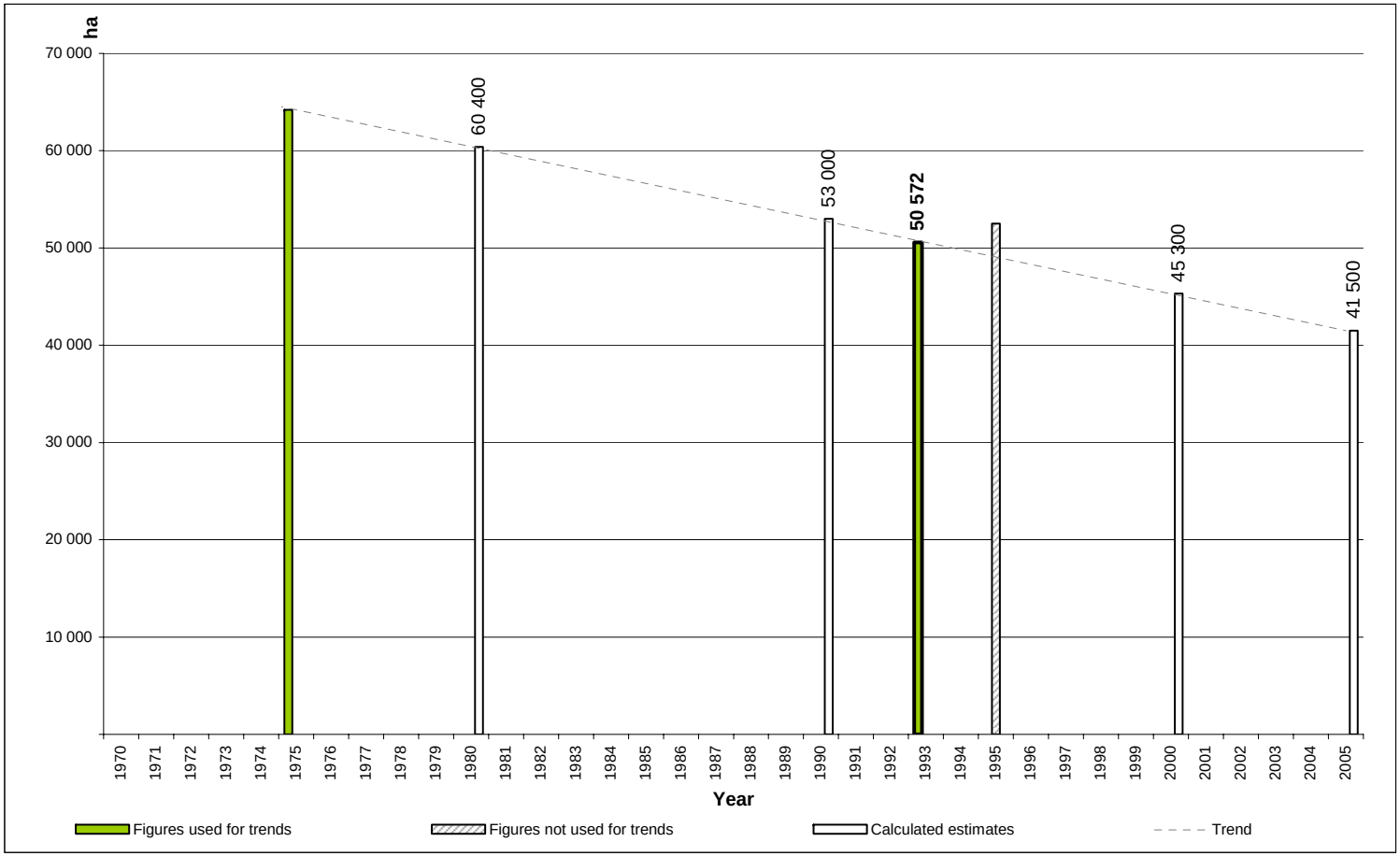
True mangrove species checklist

Aegiceras corniculatum	*Avicennia alba*
Avicennia marina	*Bruguiera gymnorrhiza*
Bruguiera parviflora	*Bruguiera sexangula*
Ceriops tagal	*Excoecaria agallocha*
Heritiera littoralis	*Lumnitzera littorea*
Nypa fruticans	*Osbornia octodonta*
Rhizophora apiculata	*Rhizophora mucronata*
Rhizophora stylosa	*Rhizophora x lamarckii*
Scyphiphora hydrophyllacea	*Sonneratia alba*
Sonneratia caseolaris	*Sonneratia x gulngai*
Xylocarpus granatum	*Xylocarpus mekongensis*

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1975	64 200	**Hansell, J.R.F., Wall, J.R.D.** 1976. *Land Resources of the Solomon Islands, Volume 1: Introduction and Recommendations.* Land Resources Div., Ministry of Overseas Development. Surbiton, Surrey (UK). 148 pp.	X	Remote sensing
1993	50 572	**ACIL Australia Pty Ltd, International Forest Environment Research and Management Pty Ltd, ERSIS Australia Pty Ltd.** 1995. *Solomon Islands National Forest Resources Inventory, Forests of the Solomon Islands* Australian International Development Assistance Bureau and Ministry of Natural Resources	X	Remote sensing. Area listed as forest type: Saline swamp (usually mangroves). Figure reported for each province. The figure excludes Rob Roy and Vaghena islands, small islands unlikely to significantly affect the total figure.
1995	52 500	**Solomon Islands National Forestry Inventory.** 1995.		Cited in: **WWF South Pacific Programme.** 2003. *WWF Solomon Islands Country Programme. Marine ecosystems of the Solomon Islands.* (Bismarck-Solomon seas ecoregion). http://www.wwfpacific.org.fj/marineresourcessolo.htm

Trends in mangrove area extent over time



Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Solomon Islands	50 572	1993	60 400	53 000	45 300	41 500

Formulas used for the trend analysis

Linear:
$y = mx + b$ where m is the slope and b is the intercept.

Tokelau

Vegetation description

Tokelau is a self-administering territory of New Zealand, which consists of three small atolls (Atafu, Fakaofo and Nukunonu) located in the South Pacific. A combination of coastal trees and shrubs grow in the littoral zone of the islands; *Pemphis acidula* is the only mangrove species found in this archipelago.

Reference:

CIA. 2005. *The online World Factbook.* http://www.cia.gov/cia/publications/factbook/geos/tl.html

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands*. Springer-Verlag, New York. 733 pp.

True mangrove species checklist

Pemphis acidula

National level mangrove estimates

No quantitative information is available for this country at the present stage.

Tonga

Vegetation description, uses and threats

Sheltered onshore mudflats, mainly on Tongatapu and in Vav'u, support a small mangrove swamp community dominated by *Bruguiera gymnorrhiza*, *Rhizophora samoensis* and/or *R. stylosa*. Farther inland, where the water changes from saline to brackish or fresh, the coastal swamp forests are dominated by *Excoecaria agallocha*, (locally called feta'anu) in association with *Xylocarpus granatum* (lekileki), *Heritiera littoralis* (ifi'ae kuma) and other not mangrove species.

Mangrove areas in the Pacific have been traditionally used for fishing and collecting crabs; on the other hand timber is extensively used for firewood and construction of houses and boats. Some clearance of coastal swamp have occurred (e.g. Nuku'alofa) and some areas have been cleared for coastal development. However awareness of mangrove importance is increasing; protection and management laws have been created over the past years, even though there are some difficulties in their implementation.

Reference:

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997 *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

Wiser, S. Burrows, L. Sykes, W. Drake, D. Savage, T. 1999. *A natural forest inventory of Tongatapu and nearby islands. Kingdom of Tonga* NZODA 1998/99 Forestry Project

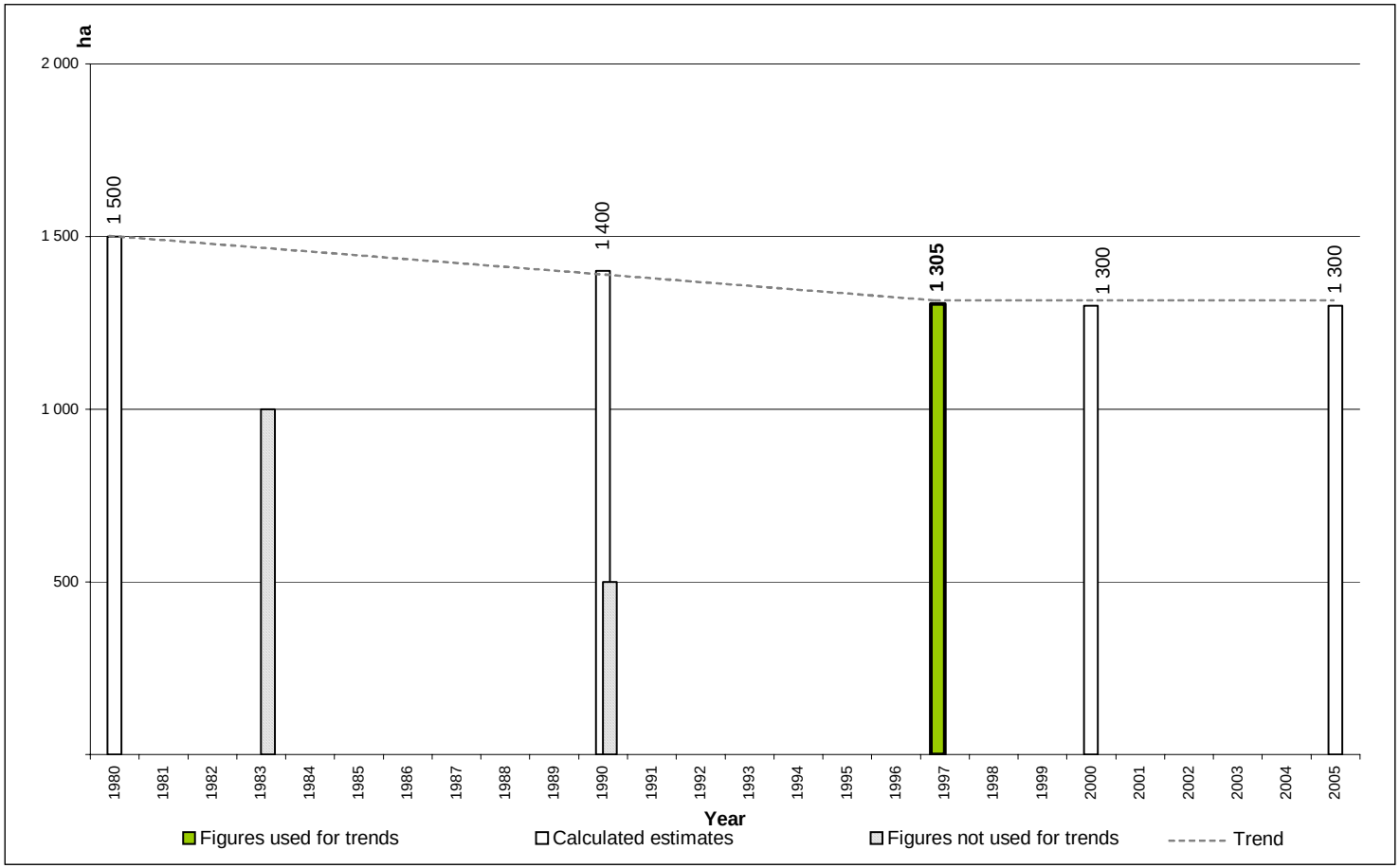
True mangrove species checklist

Acrostichum aureum	*Bruguiera gymnorrhiza*
Excoecaria agallocha	*Heritiera littoralis*
Lumnitzera littorea	*Rhizophora samoensis*
Rhizophora stylosa	*Xylocarpus granatum*
Xylocarpus mekongensis	

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1983	1 000	**Saenger, P., Hegerl E.J. and J.D.S., Davie.** 1983. *Global status of mangrove ecosystems.* Commission on ecology Papers No.3. IUCN. Gland, Switzerland. 88 pp.		Secondary reference, no primary source provided. The "Year" is the publication year.
1990	500	**Netatua, P, Department of Environment.** 2001. *Tonga Country Report.* Regional Workshop on mangrove wetlands protection and sustainable use. Marine Studies Centre, USP SUVA June 12-16, 2001		Aerial photographs
1997	1 305	**Wiser, S. Burrows, L. Sykes, W. Drake, D. Savage, T.** 1999. *A natural forest inventory of Tongatapu and nearby islands. Kingdom of Tonga* NZODA 1998/99 Forestry Project	X	Analysis of 1990 photographic coverage at scale 1:10 000 and 1:8 000 for the smaller islands plus ground assessment in 1997. This figure is providing information for Tongatapu only. Smaller stands are found also at Vav'u; therefore the national mangrove coverage could be slightly higher.

Trends in mangrove area extent over time



Some mangrove deforestation have occurred during the last two decades in Tonga, however the lack of historical information do not allow a proper trend analysis.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Tonga	1 305	1997	1 500	1 400	1 300	1 300

Formulas used for the trend analysis

The trend analysis provided in this report is based on qualitative information currently existing.

Tuvalu

Vegetation description, uses and threats

Tuvalu is an archipelago formed up of nine coral atolls, with mangroves covering the coasts of five of them, three limestone islands (Vaitupu, Nanumanga and Niutao) and two atolls (Funafuti and Nui). Funafuti has got a small mangrove swamp inside the main islet; some other inland mangroves also occur on Niutao and Nanumanga. Mangroves in Vaitupu are almost cut off from the sea and may reach six metres in height. The main true mangrove species found in this archipelago are *Lumnitzera littorea* and *Rhizophora stylosa*.

Mangroves in Tuvalu are threatened by various factors such as coastal erosion, pollution and on a long term basis the sea level rise due to global warming. Some activities and studies on the possible impact of sea level rise on these forests are currently on-going in the Pacific region.

Reference:

UN. 1998. *Tuvalu* http://islands.unep.ch/CLB.htm.

Scott D.A. 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm

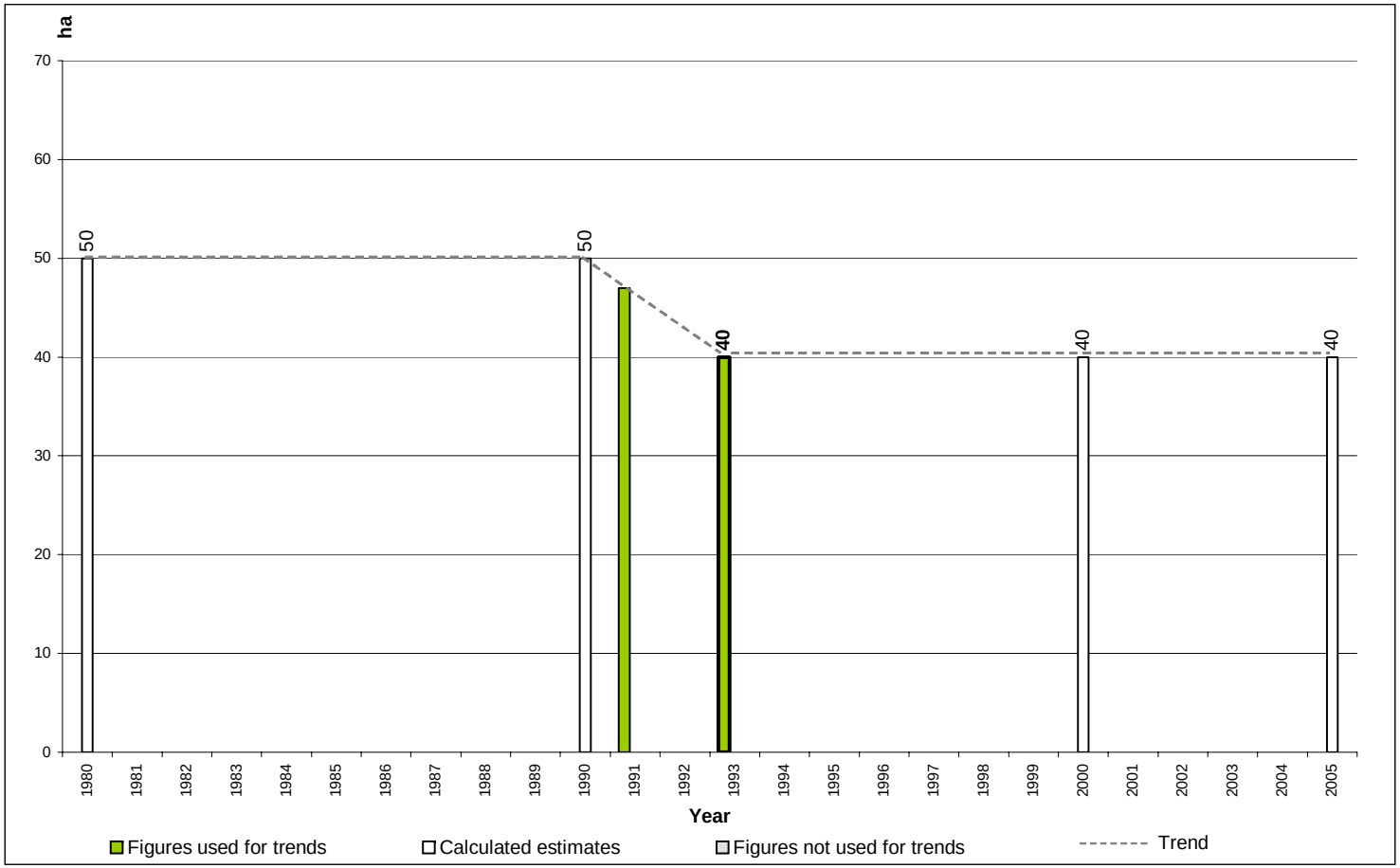
True mangrove species checklist

Lumnitzera littorea
Pemphis acidula
Rhizophora stylosa

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1991	47	**Teii, T.** 1991. Personal communication	X	Cited in: **Fisher, P and Spalding, M.D.** 1993. *Protected areas with mangrove habitat.* Draft Report World Conservation Centre, Cambridge, UK. 60 pp. The document provides also the breakdown.
1993	40	**Scott D.A.** 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm	X	Rough estimate, the total mangrove area extent could be slightly higher

Trends in mangrove area extent over time



Some mangrove deforestation have occurred in Tuvalu, however the lack of historical information do not allow a proper trend analysis; the estimates for 1980, 2000 and 2005 are rounded figures based on the limited information available and expert estimate.

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Tuvalu	40	1993	50	50	40	40

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Vanuatu

Vegetation description, uses and threats

Mangrove forests represent the most extensive wetland vegetation in Vanuatu but are found only on some of the islands in localized areas in sheltered coasts, mostly on Malekula; other stands are also found at the following localities Hiu, Efate, Emae, Epi, Vanua Lava, Ureparapara, Mota Lava and Aniwa. The only stands of significant extent are two large areas along the east coast of Malekula, The Port Stanley and the Port Sandwich, while elsewhere mangroves occur only as small stands or narrow belts along lagoons, sea shores and estuaries. Several tree species are growing in this country, distributed in four typical zones: a landward fringe, thickets of *Ceriops tagal* with the mangrove fern *Acrostichum aureum*, a *Rhizophora sp.* forest zone, and a seaward zone of *Avicennia marina*, occasionally with scattered *Sonneratia caseolaris* and *Bruguiera sp.*

Mangrove areas in the Pacific have been used traditionally for fishing and collecting crabs, however human impact on these ecosystems still appears to be slight and mainly limited to subsistence activities, as the exploitation of mangroves for these purposes is allowed. Mangrove timber is used for firewood and construction of houses and boats, and some trees are occasionally cleared for easier access to the sea. In few sites the landward fringe has been affected by the conversion to agriculture use, such as coconut plantations, while in other areas they have been removed for coastal development, as in the Maskelyne Islands and in the Port Vila area. Commercial logging is completely banned from the country.

Reference:

Department of Forest. 1998. *Vanuatu. Country report.* Port Vila

Scott, D.A. ed. 1993. *A Directory of Wetlands in Oceania.* IWRB, Slimbridge, U.K. and AWB, Kuala Lumpur, Malaysia.

Spalding, M.D., Blasco, F. & Field, C.D., eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.

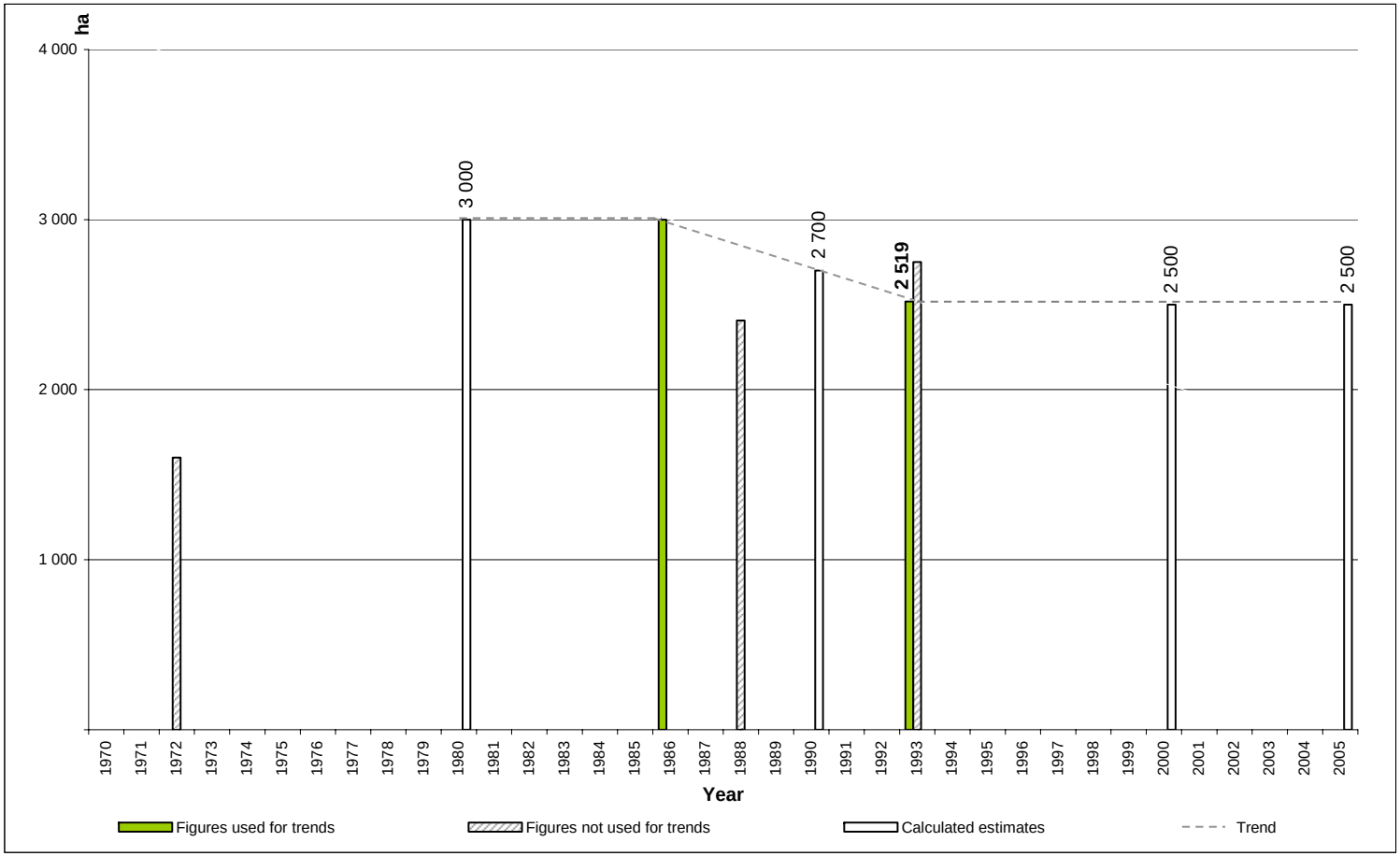
True mangrove species checklist

Acrostichum aureum
Avicennia marina
Bruguiera gymnorrhiza
Bruguiera parviflora
Ceriops tagal
Excoecaria agallocha
Heritiera littoralis
Lumnitzera littorea
Rhizophora apiculata
Rhizophora mucronata
Rhizophora stylosa
Sonneratia alba
Sonneratia caseolaris
Sonneratia x gulngai
Xylocarpus granatum
Xylocarpus mekongensis

National level mangrove estimates

Year	Area (ha)	Source	Trend	Methodology/Comments
1972	1 600	**Spalding, M.D., Blasco, F. and Field, C.D.**, eds. 1997. *World Mangrove Atlas.* The International Society for Mangrove Ecosystems, Okinawa, Japan. 178 pp.		Map analysis. Data extracted from relevant vegetation maps in Quantin, 1972. (Mangroves are only shown for Vaté (1:250 000), Ile Emaé (1:100 000), Malikolo (1:200 000), Épi (1:200 000), Iles Torrés (1:100 000), Iles Banks (1:100 000), Ile Aniwa (1:100 000)) **Quantin, P.** 1972. *Archipel des Nouvelles - Hébrides. Atlas des Sols et de Quelques donnes du Milieu Naturel.* 1:100 000-1:200 000. Office de la Recherche Scientifique et Technique Outre-Mer, Paris, France. .
1986	3 000	**David.** 1986.	X	**WCMC.** 2000. *Coral reefs and mangroves of the world.* http://www.wcmc.org.uk/marine/data/coral_mangrove/ .
1988	2 406	**David and Cilaurren.** 1988.		Cited in: **Tari, T. and Naviti, W.** 2001. Inventory of the status of mangrove wetlands in Vanuatu. *In proceedings of the Regional workshop: Mangrove Wetland Protection & Sustainable Use.* Marine Studies Centre, USP Suva, June 12-16, 2001.
1993	2 519	**Baldwin P. Hidson J. Siebuhr J. and F. Pedro** 1993. *Forest Resources of Vanuatu.* Queensland Department of Primary Industries/Department of Forestry, Port Vila.	X	Remote sensing and ground survey.
1993	2 750	**Scott D.A.** 1993. *A directory of wetlands in Oceania.* International Waterfowl and Wetlands research Bureau, Slimbridge, UK and Asian Wetlands Bureau, Kuala Lumpur, Malaysia. 444 pp. http://www.wetlands.org/inventory&/OceaniaDir/Contents.htm		Cited in: **Idechong, N., Ellison, J., Jaensch, R.** 1995. *A Regional Wetlands Action Plan for the Pacific Islands.* (Draft prepared for SPREP)

Trends in mangrove area extent over time



The estimate for 1980, 2000 and 2005 are expert estimates based on the qualitative information currently available

Summary status of mangrove area extent over time

	Most reliable, recent mangrove area estimate		Mangrove area estimate 1980	Mangrove area estimate 1990	Mangrove area estimate 2000	Mangrove area estimate 2005
	ha	**year**	**ha**	**ha**	**ha**	**ha**
Vanuatu	2 519	1993	3 000	2 700	2 500	2 500

Formulas used for the trend analysis

Linear:

$y = mx + b$ where m is the slope and b is the intercept.

Wallis et Futuna

Végétation

Sur Wallis, les mangroves se retrouvent dans quelques baies protégées tandis qu'il n'y en a pas sur Futuna et Alofi. Leur distribution est très limitée: on les retrouve seulement en franges étroites de 8 km (sur les 48 km totaux de l'île) surtout sur la côte sud-ouest de l'île, entre Mua Point et Malaetoli, et sur la côte ouest entre Ahoa et Utulea. De petits peuplements se trouvent également sur l'îlot de Faioa. Les forêts denses et bien structurées sont très rares : elles sont généralement floristiquement pauvres avec des arbres qui atteignent 3 ou 4 m de hauteur. Quelques bosquets d'*Acrostichum aureum* se retrouvent dans le sous-bois tandis que les peuplements sont formés de *Rhizophora samoensis* (très rare) et *Bruguiera gymnorrhiza*.

Reference:

CAREX environnement. 2002. *Inventaire et cartographie des ouvrages et aménagements du littoral de Wallis*. Service de l'Environnement de Wallis et Futuna.

Fourmy, J. 2005. Information présentée dans le cadre de l'étude thématique sur les mangroves destinée à l'Évaluation des ressources forestières mondiales 2005 (FRA 2005). Non publiée.

IFRECOR. nd. *État des milieux à Wallis et Futuna* http://www.ecologie.gouv.fr/article.php3?id_article=806

Mueller-Dombois, D. & F. R. Fosberg. 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

Ph Morat & J-M Veillon. 1985. *ORSTOM Contribution à la connaissance de la végétation et de la flore de Wallis et Futuna.* Bulletin du Musée National d'Histoire Naturelle, Paris

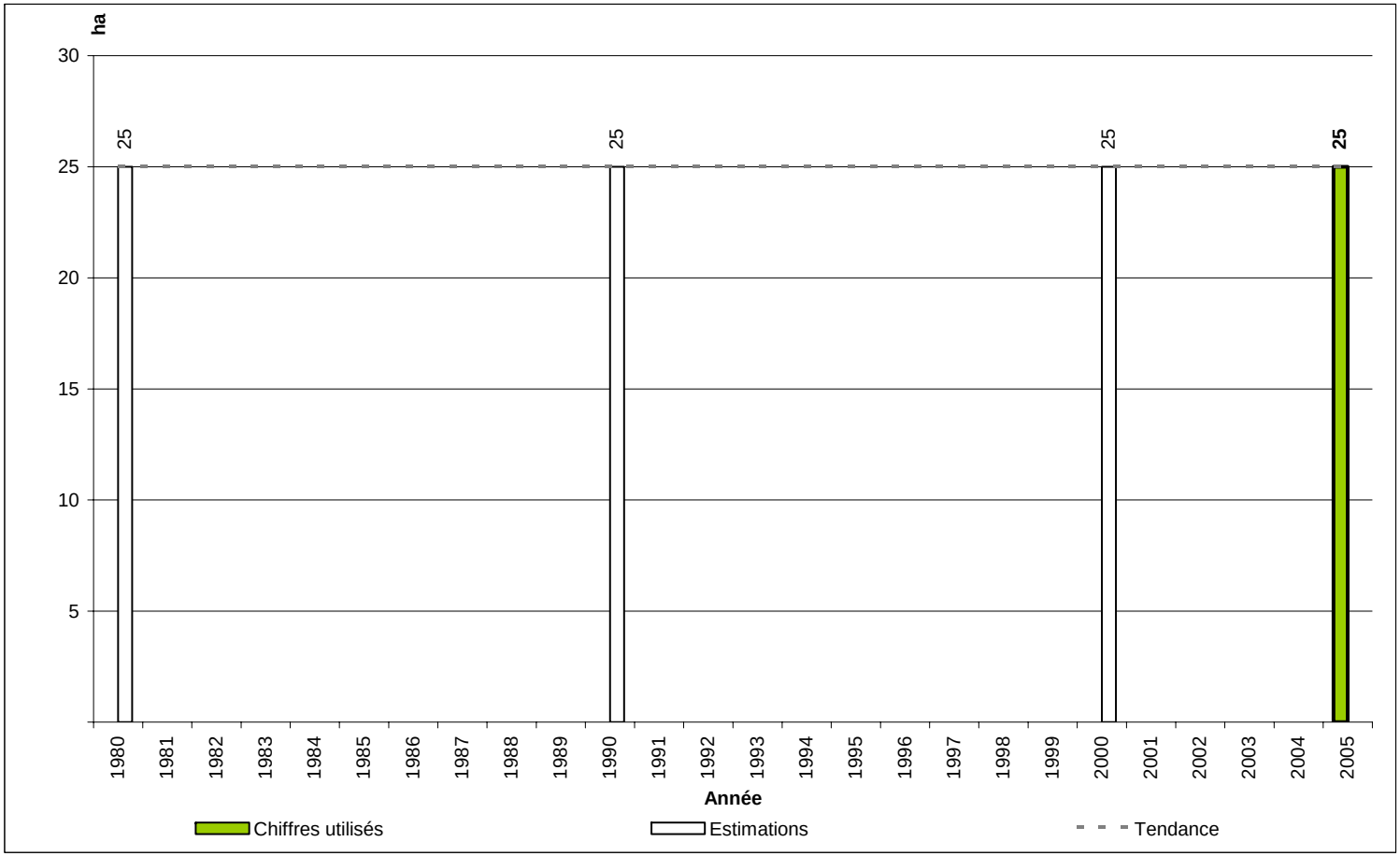
Liste des espèces exclusives des mangroves

Acrostichum aureum
Bruguiera gymnorrhiza
Rhizophora samoensis

Estimations au niveau national

Année	Surface (ha)	Source	Tendance	Méthodologie/Commentaires
2005	25	FAO. 2005. Évaluation des ressources forestières mondiales 2005 (FRA 2005) Rapport national - Wallis et Futuna. Par Fourmy, J. Document de travail de FRA 2005 No. 109. Non publié.	X	Informations préliminaires tirées d'une interprétation cartographique en cours.

Tendances de l’étendue des zones de mangrove dans le temps



Aucun changement significatif n’a eu lieu dans le pays au cours des 20 dernières années.

Synthèse de la situation de l'étendue de mangroves dans le temps

	Estimation fiable la plus récente de la surface de mangrove		Surface de mangrove 1980	Surface de mangrove 1990	Surface de mangrove 2000	Surface de mangrove 2005
	ha	**Année de réf.**	**ha**	**ha**	**ha**	**ha**
Wallis et Futuna	25	2005	25	25	25	25

Bibliography

FAO. 1995. *Forest Resources assessment 1990: Global synthesis.* FAO Forestry Paper No. 124. Rome, 46pp.

FAO. 2001. *Global Forest Resources Assessment 2000: main report.* FAO Forestry Paper No. 140. Rome. www.fao.org/forestry/fo/fra/main/index.jsp

FAO. 2003. *Status and trends in mangrove area extent worldwide.* By Wilkie, M.L. and Fortuna, S. Forest Resources Assessment Working Paper No. 63. Forest Resources Division. FAO, Rome. *(Unpublished)* http://www.fao.org/documents/

FAO. 2006. *Global Forest Resources Assessment 2005 – progress towards sustainable forest management.* FAO Forestry Paper 147. Rome (also available at www.fao.org/forestrysite/fra2005).

FAO. 2007. *The world's mangroves 1980-2005.* FAO Forestry Paper No. 153. Rome.

Saenger, P., Hegerl, E.J. & Davie, J.D.S. 1983. *Global status of mangrove ecosystems*. Commission on ecology papers No. 3. Gland, Switzerland, IUCN.

Tomlinson, P.B. 1986. *The botany of mangroves.* Cambridge Tropical Biology Series, Cambridge, 419 pp.

Country specific references used for the preparation of the assessment are reported in the specific country profiles.

Annex 1. The world's mangroves 1980-2005: Regional working papers

FAO. 2007a. *Mangroves of Africa 1980–2005: country reports.* Forest Resources Assessment Working Paper No. 135, Rome. www.fao.org/forestry/site/mangrove/statistics.

Countries included: Angola, Benin, British Indian Ocean Territory, Cameroon, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Mauritania, Mauritius, Mayotte, Mozambique, Nigeria, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Togo, United Republic of Tanzania

FAO. 2007b. *Mangroves of Asia 1980–2005: country reports*. Forest Resources Assessment Working Paper No. 136. Rome www.fao.org/forestry/site/mangrove/statistics.

Countries included: Bahrain, Bangladesh, Brunei Darussalam, Cambodia, China, India, Indonesia, Iran (Islamic Republic of), Japan, Kuwait, Malaysia, Maldives, Myanmar, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Sri Lanka, Thailand, Timor-Leste, United Arab Emirates, Viet Nam, Yemen

FAO. 2007c. *Mangroves of North and Central America 1980–2005: country reports*. Forest Resources Assessment Working Paper No. 137. Rome. www.fao.org/forestry/site/mangrove/statistics.

Countries included: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, United States, United States Virgin Islands

FAO. 2007d. *Mangroves of Oceania 1980–2005: country reports*. Forest Resources Assessment Working Paper No. 138. Rome. www.fao.org/forestry/site/mangrove/statistics.

Countries included: American Samoa, Australia, Christmas Island, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna Islands

FAO. 2007e. Mangroves of South America *1980–2005: country reports*. Forest Resources Assessment Working Paper No. 139. Rome. www.fao.org/forestry/site/mangrove/statistics.

Countries included: Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, Venezuela (Bolivarian Republic of).