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**Tidal Wetland Flora of
New Caledonia**

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Title

Tidal Wetland Flora of New Caledonia

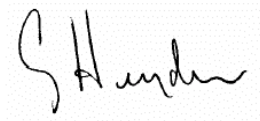
Author's Declaration

This report has been prepared in accordance with UniQuest's Quality Management System, which is compliant with AS/NZS ISO 9000:2000.

The work and opinions expressed in this report are those of the Author.

Our sincere thanks and gratitude go to the IFREMER team in New Caledonia who initiated the study in the framework of the IFREMER "Chantier lagons de la Nouvelle-Calédonie" program, and in bringing significant funding and essential logistic support for the field trips. In particular, our thanks go to Pierre Brun, Denis Coatanea, Luc Della Patrona and Lionel Loubersac.

Signed for and on behalf of UniQuest Pty Limited



.....
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HIGHLIGHTS

- Dr Norm Duke of the University of Queensland was commissioned by Ifremer to provide observations and data on mangrove and tidal saltmarsh plants of the main island of New Caledonia.
- In this report, we present data reports from 209 sites along both coasts of the main island of New Caledonia, being 47 new locations in addition to the 35 previously reported by Duke (2007).
- Our observations add to prior knowledge of plants of the mangrove and saltmarsh habitat as described in previous accounts (i.e. Morat et al. 2001; Munnzinger & Lebigre 2005).
- Description and distribution maps of 16 saltmarsh species are provided, including four new records for New Caledonia.
- Description and distribution maps of 24 mangrove species are provided - including three previously unreported species, one newly identified endemic, and two species previously thought to be present identified as unlikely to be so.
- A scientific key for tidal wetland flora identification is presented, based upon the 40 species identified during field observations.
- A new endemic *Rhizophora* hybrid species was identified during project surveys, *R. X tomlinsonii* N.C. Duke (Duke 2010).
- Revised upriver distribution profiles of mangrove species are presented for 11 major estuaries around the main island of New Caledonia.
- Recognized biogeographical affinities of New Caledonian tidal wetland plants with Asia, Australasia and Atlantic East Pacific regions are described.



Figure A *Fringing Avicennia and Rhizophora mangroves on the reef flat just south of the Ponerihouen River mouth (site 63).*

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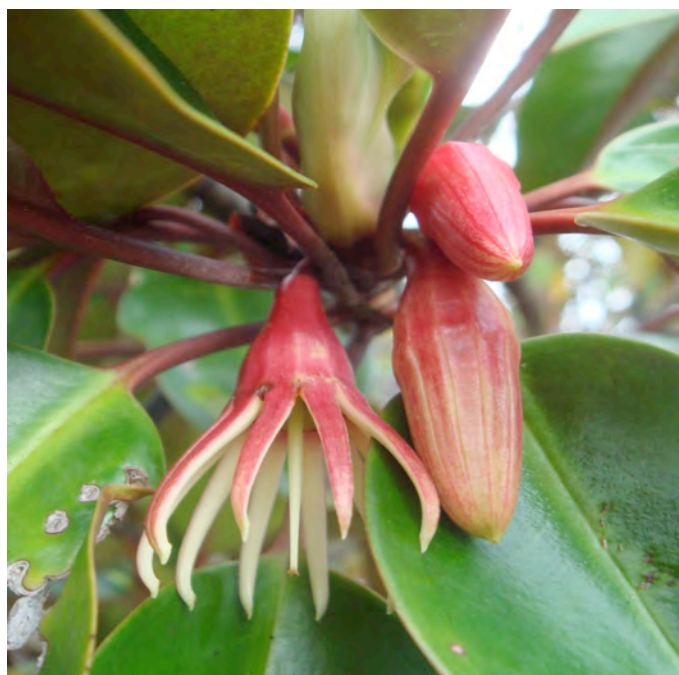


Figure B *Bruguiera gymnorhiza* flowers, near Bolee, north of Tiabet (site 34).

1. INTRODUCTION

This report provides the most comprehensive record to date documenting the halophyte flora of New Caledonia. This flora forms a unique assemblage of mangrove and saltmarsh (tidal wetland) plants. Based on extensive field observations gathered during November-December 2006 and December 2009, we present this account of the diversity, biogeography and ecology of all tidal wetland species found on the main island of Grande Terre. The report is comprised of five major parts: 1) a species list identifying 40 tidal wetland species, being 16 saltmarsh and 24 mangrove species (Table 1); 2) a scientific key to species for identification of the 40 tidal halophytes identified in the current surveys, accompanied by distribution maps for each; 3) information on selected morphological and ecological characteristics of key taxa, providing a broad understanding of the origins and dispersal affiliations of these halophyte taxa; 4) a revision and update of mangrove upriver checklists within major estuaries of New Caledonia, from those presented by Duke (2007) – to reveal patterns of upstream distribution with salinity gradients; and 5) species checklists for 82 major field collection sites around the island (Appendices 1, 2 & 3).



Figure 1: *Rhizophora* seedlings near Bourake, New Caledonia (site 7).

With respect to the key published accounts of New Caledonian tidal wetland flora (Forster 1786; Saenger et al. 1977; Schmid 1981; Ellison 1995; Lowry et al. 1998, 2004; Jaffre et al. 2001; Morat et al. 2001; Munzinger & Lebigre 2005), the data presented in the current report offers new observations and descriptions for individual species and their distributions around the island of Grande Terre. The most recent account of tidal halophyte diversity and distribution was by Munzinger and Lebigre (2005), based their assessment of local Herbarium collections and records. Munzinger and Lebigre (2005) reported 22 mangrove taxa (3 of these were not recorded in the current surveys) occurring in New Caledonia (including species and hybrids), a notable increase from the 16 species recorded a decade earlier by Ellison (1995). Our data confirms much of that reported by Munzinger and Lebigre (2005), and our new observations extend on their findings.

This report provides a clear definition and description of distinctive tidal saltmarsh plants of New Caledonia. The study also enabled a review of species previously listed and includes the clarification of a reported misnomer in species listings, with the identification of *Enchylaena tomentosa* (previously *Kochia hirsuta*). Such revised descriptions provide further insights into the biogeographical linkages between the flora of New Caledonia and Australia and specifically the radiation of Gondwanan Chenopodaceae. Previously, *E. tomentosa* was described as an endemic species of Australia. However, the findings of this study emphasise the need for further clarification within species groups. This is of particular note for the genus *Suaeda*, where it is likely the entity present is endemic to New Caledonia.

2. SURVEY SITES AND LOCATIONS

Mangrove and saltmarsh species were recorded at 82 locations around the main island of New Caledonia during November-December 2006 and December 2009 (Figure 2). Field data collection during late 2009 increased sampling site numbers from the 35 reported previously by Duke (2007). At each site, species of tidal wetland plants present were identified, photographed and site coordinates recorded. For upriver species distribution lists, additional data was collected at 11 of these locations. For these upriver checklists, 5-35 stations were surveyed along each riverine estuary from the mouth towards the tidal extent upstream. Channel water was sampled for salinity. Surveys were conducted either on foot, from a small kayak, or from a 4m runabout.



Figure 2: Locations of 82 sites surveyed in New Caledonia during November-December 2006 and December 2009. See Appendix 1, 2 & 3 for additional details of these sites and locations.

In conjunction with botanical surveys described in this report, concurrent geographical reference data were obtained for future mapping of tidal wetlands (Vrily 2007), and sampling for the assessment of character and condition of mangrove and tidal wetland soils (Marchand 2007).

3. FLORISTICS OF NEW CALEDONIAN TIDAL WETLANDS

The tidal wetlands of New Caledonia are comprised of two major halophyte habitats, being mangrove and tidal saltmarsh. These habitats have different patterns of distribution reflecting unique differences in influencing factors.

The specific distributional characteristics of these two key halophyte communities are highly dependent on climatic influences and topography. Generally, the distribution of mangrove plants follows the patterns described already by Duke et al. (1998) where key influences include: temperature marked by a decline in diversity with increased latitude; rainfall restricting some species to the wetter regions; and catchment area restricting some species to larger catchments. This results in the greatest diversity of mangrove species being found in the north and east of New Caledonia while saltmarsh species predominate on the western shoreline.

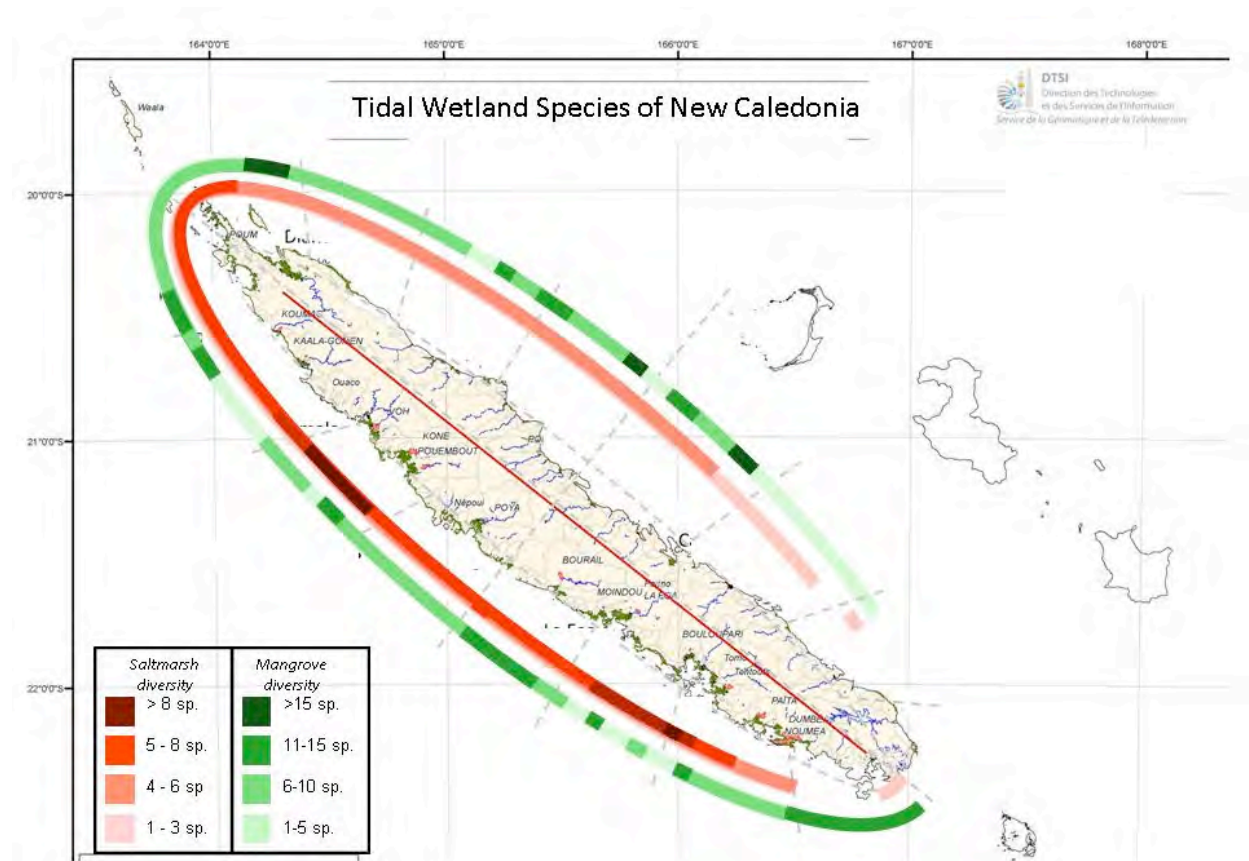


Figure 3: Species diversity of mangrove and saltmarsh plants in New Caledonia.

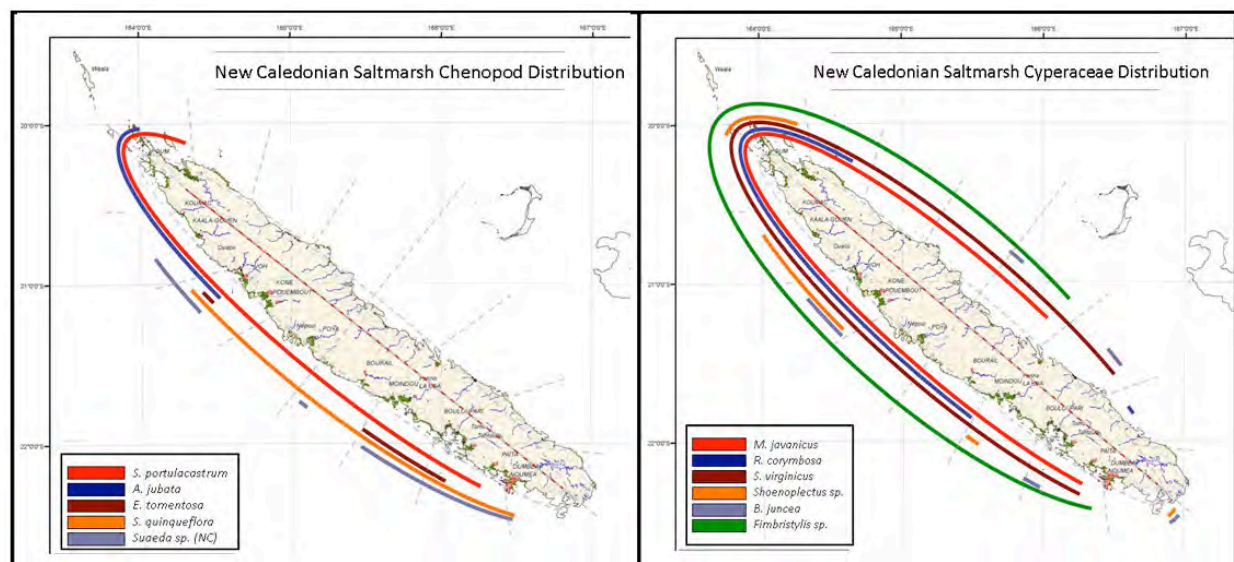


Figure 4: Geographical distribution of saltmarsh Chenopods (left) and saltmarsh sedges (right) in New Caledonia. Note how Chenopod distribution is restricted to the north and west coasts while sedges extend down the east coast.

Tidal wetland plant taxa observed in New Caledonia can be classified into four regional distributional groupings, being: 1) generalists, 2) north restricted, 3) moisture preferring, and 4) arid specialists. Note that mangrove hybrids occur where parental distributions overlap. These groupings are based on the 82 sites visited during the current surveys; see Appendices 1, 2 & 3. Respective numbers of sites for each species is given below in brackets.

1. **Generalists.** Seven mangrove species and four saltmarsh species are widespread around New Caledonia. The mangroves *Rhizophora stylosa* (26), *R. samoensis* (28), their dependant hybrid *R.X selala* (21), *Acanthus ilicifolius* (18), *Avicennia marina* (28), *Bruguiera gymnorhiza* (30) and *Excoecaria agallocha* (29) may be considered ubiquitous to most estuaries around Grande Terre. Saltmarsh species *Cyperus javanicus* (30), *Sporobolus virginicus* (46), *Fimbristylis ferruginea* (45) and *F. cymosa* (20) are broadly distributed across northern Grande Terre and extend down both the east and west coasts.
2. **North restricted.** Eight mangrove species appear limited to northern latitudes, being: *Ceriops tagal* (1), *Scyphiphora hydrophyllacea* (5), *Pemphis acidula* (1), *Dolichandrone spathacea* (2), *Acrostichum aureum* (2) and *Rhizophora apiculata* (10) plus dependant hybrids *R.X tomlinsonii* (4) and *R.X lamarckii* (6). Only *Salsola kali* (1) of the saltmarsh plants is wholly restricted to the north of the island, however *Ruppia maritima* (6) shows a tendency to occur toward the north, but extends some way down the west coast.
3. **Moisture Preferring.** Ten mangrove species are more commonly found in areas of higher rainfall, being: *Acrostichum speciosum* (19), *Heritiera littoralis* (14), *Sonneratia alba* (16), *Lumnitzera littorea* (12), and *Xylocarpus granatum* (17). *Rhizophora apiculata* and its two hybrids, *R.X lamarckii* and *R.X tomlinsonii* are not only restricted to north estuaries but also the more moist areas. *Sonneratia caseolaris* (5) and *Cynometra iripa* (1) prefer areas of highest rainfall. Saltmarsh species from the Cyperaceae family occur in wetter areas, including areas of high rainfall. These include *Schoenoplectus s.p* (16), *Cynodon dactylon* (30), *Fimbristylis ferruginea* (45) and *F. polytrichoides* (8).
4. **Arid Specialist.** One mangrove species, *Lumnitzera racemosa* (16), is largely restricted to areas of low rainfall, notably along the western coastline. Its hybrid form, *L.X rosea* (2), occurs at both northern and southern overlap zones with the moisture restricted, *L. littorea*. Of the saltmarsh species, all chenopods occur in areas receiving less than 1400 mm rainfall per year, with all species being largely restricted to the dryer western coastline.

3.1 Biodiversity of Saltmarsh

Tidal saltmarsh plants are defined as those plants growing mostly below the highest astronomical tide mark and above mean sea level. In this setting, these generally low-formed, herbaceous or succulent plant species receive regular, but sometimes infrequent, tidal flushing, growing amongst taller upper-intertidal mangroves. Tidal saltmarsh species may also occur along low wave energy beach fringes, and occasionally along flooded brackish marshes and upper-intertidal depressions. Plants of the tidal saltmarsh zone form three distinct groupings: 1) those exclusively present in saline conditions; 2) a number of salt-tolerant generalists mostly present within tidal areas but not restricted to them; and, 3) supra-tidal associates being marginally salt-tolerant and occurring directly adjacent to the high tide mark often adjoining tidal saltmarsh.

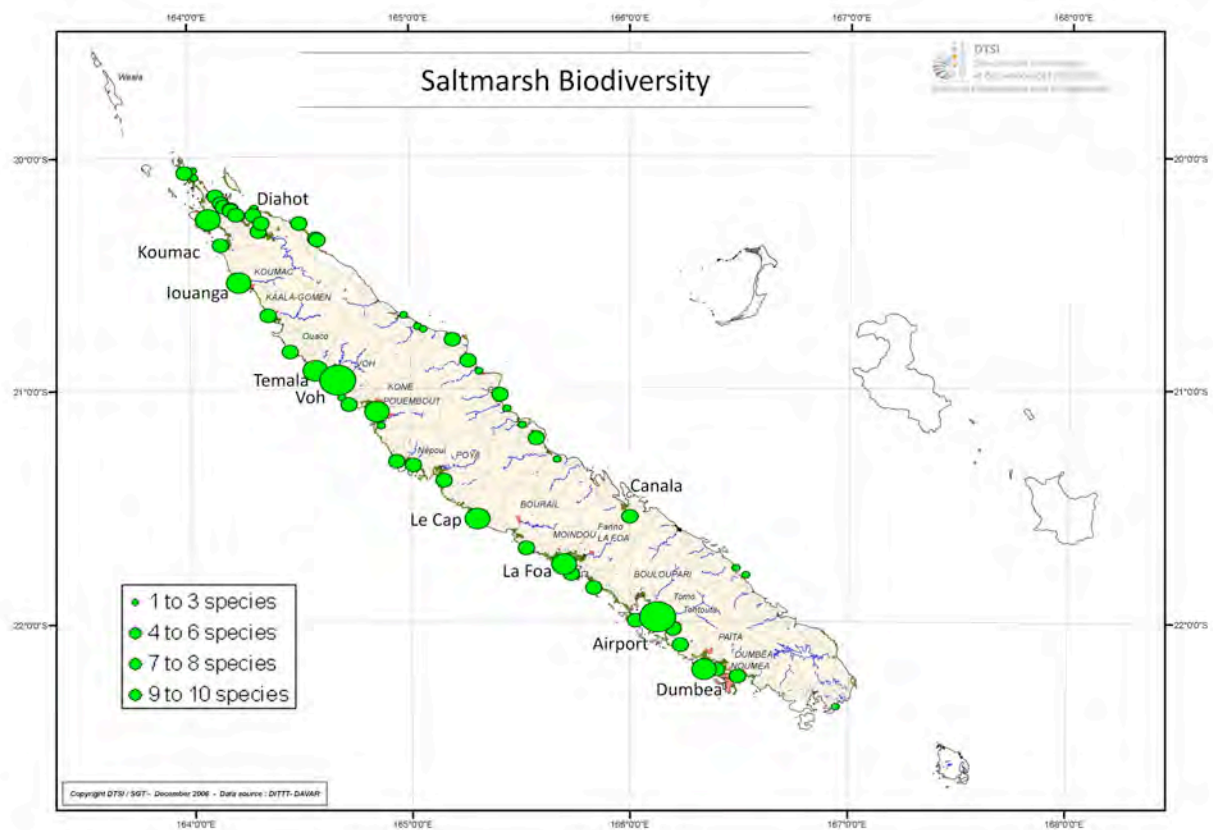


Figure 5: Saltmarsh biodiversity for surveyed locations in New Caledonia

The surveys in Dec 2009 identified 16 saltmarsh species; comprising 14 genera from 5 plant families (see Table 1). The surveys provided an opportunity to clarify one species listing for New Caledonian saltmarsh, identifying the previously described *Kochia hirsuta* (= *Bassia hirsuta*), a northern hemisphere chenopod, as *Enchylaena tomentosa*. There is also evidence from these surveys that the chenopod previously recorded as *Suaeda australis* (syn. *S. maritima*), may in fact be a distinct species endemic to New Caledonia, this species will hereby be referred to as *Suaeda* sp. (NC). The survey identified a new species previously not described for New Caledonian tidal wetlands, *Ruppia maritima*, which with further investigation may also prove to be a separate endemic species. Saltmarsh biodiversity in New Caledonia is shown in Figure 5.

Of the species identified, only four are classified as being exclusively tidal, namely the chenopod (Chenopodiaceae) species of *Suaeda* sp (NC), *Enchylaena tomentosa*, *Sarcocornia quinqueflora*, as well as *Ruppia maritima* (Ruppiaceae). A further 12 species were classified as salt-tolerant generalist saltmarsh species of *Sesuvium portulacastrum*, *Atriplex jubata*, *Salsola kali*, *Limonium tetragonum*, *Sporobolus virginicus*, *Fimbristylis* sp (3 species), *Baumea juncea*, *Schoenoplectus* sp., *Rhynchospora corymbosa* and *Cyperus javanicus* (formerly *Mariscus javanicus*). Five additional herbaceous species were found to be commonly associated with saltmarsh and tidal wetland areas and were classified as saltmarsh associates; these were *Portulaca oleracea*, *Centaurium spicatum*, *Pluchea odorata* (introduced) *Euphorbia obliqua* and *Cynodon dactylon*. These saltmarsh associates are not included in the identification key or species descriptions of the current report.

Tidal wetland species previously recorded as occurring in New Caledonia by Munzinger & Lebigre (2005) but not identified during the current project include *Bruguiera sexangula* (Rhizophoraceae), *Xylocarpus moluccensis* (Meliaceae), *Ximenia americana* (Olacaceae), *Cynometra iripa* (Caesalpiniaceae), *Guettarda speciosa* (Rubiaceae), *Triglochin striatum* (Juncaginaceae) and *Schoenoplectus validus* (Cyperaceae).

Table 1: List of dominant saltmarsh and mangrove species and families identified during field surveys of New Caledonia in Nov-Dec 2006 and Dec 2009. Habit of each species are identified as mangrove (M), saltmarsh exclusive (S), saltmarsh generalist (SG) and creeper (C).¹ Species identified previously by: 1) current surveys; 2) Munzinger & Lebigre (2005); and 3) Ellison (1995).

| Plant Family | Taxa (Species & hybrids) | Observed Habit | Source |
|----------------|---|-------------------|---------|
| Acanthaceae | Acanthus ilicifolius | M | 1, 2 |
| Pteridaceae | Acrostichum aureum | M | 1, 2 |
| | Acrostichum speciosum | M | 1 |
| Chenopodiaceae | Atriplex jubata | SG | 1, 2 |
| Avicenniaceae | Avicennia marina var. australasica | M | 1, 2, 3 |
| Rhizophoraceae | Bruguiera gymnorhiza | M | 1, 2, 3 |
| Cyperaceae | Baumea juncea | SG | 1, 2 |
| Rhizophoraceae | Ceriops tagal | M | 1, 2, 3 |
| Cyperaceae | Cyperus javanicus (syn. Mariscus javanicus) | SG | 1, 2 |
| Papilionaceae | Derris trifoliata | C | 1, 2 |
| Bignoniaceae | Dolichandrone spathacea | M | 1, 2 |
| Euphorbiaceae | Excoecaria agallocha | M | 1, 2, 3 |
| Chenopodiaceae | Enchylaena tomentosa (syn. Kochia hirsuta) | S | 1, 2 |
| Cyperaceae | Fimbristylis cymosa | SG | 1, 2 |
| | Fimbristylis ferruginea | SG | 1, 2 |
| | Fimbristylis polytrichoides | SG | 1, 2 |
| Sterculiaceae | Heritiera littoralis | M | 1, 2, 3 |
| Plumbaginaceae | Limonium tetragonum | SG | 1 |
| Combretaceae | Lumnitzera littorea | M | 1, 2, 3 |
| | Lumnitzera racemosa | M | 1, 2 |
| | Lumnitzera X rosea | M | 1 |
| Lythraceae | Pemphis acidula | M | 1 |
| Rhizophoraceae | Rhizophora apiculata | M | 1, 2, 3 |
| | Rhizophora X lamarckii | M | 1, 2, 3 |
| | Rhizophora X tomlinsonii | M | 1 |
| | Rhizophora samoensis | M | 1, 2, 3 |
| | Rhizophora samoensis var. neocaledonica | M | 1 |
| | Rhizophora X selala | M | 1, 2, 3 |
| | Rhizophora stylosa | M | 1, 2, 3 |
| Cyperaceae | Rhyncospora corymbosa | SG | 1, 2 |
| Ruppiaceae | Ruppia maritima | S | 1 |
| Chenopodiaceae | Salsola kali | SG | 1 |
| Chenopodiaceae | Sarcocornia quinqueflora | S | 1, 2 |
| Cyperaceae | Schoenoplectus sp. | SG | 1, 2 |
| Aizoaceae | Sesuvium portulacastrum | SG | 1, 2 |
| Sonneratiaceae | Sonneratia alba | M | 1, 2, 3 |
| | Sonneratia caseolaris | M | 1, 2 |
| Rubiaceae | Scyphiphora hydrophylacea | M | 1, 2 |
| Poaceae | Sporobolus virginicus | SG | 1, 2 |
| Chenopodiaceae | Suaeda australis (syn. S. maritima) | S | 1, 2 |
| Meliaceae | Xylocarpus granatum | M | 1, 2, 3 |
| >>> | TOTAL Recognised (current survey) = | 41 | |

3.2 Biodiversity of Mangroves

The surveys in Nov-Dec 2006 and Dec 2009 identified 24 mangrove plant taxa (i.e., species and hybrid species), comprising 15 genera from 13 plant families (see Table 1). The newly described mangrove flora of New Caledonia comprises four hybrids, one of which, *Rhizophora X tomlinsonii* (Duke 2010) described for the first time, was discovered at five locations during the surveys. One other hybrid, *Lumnitzera X rosea*, found in four locations, had only been described previously from one location in north-eastern Australia and the putative Type locality in The Philippines (Tomlinson et al. 1978). Distribution of mangrove biodiversity in New Caledonia is shown in Figure 6.

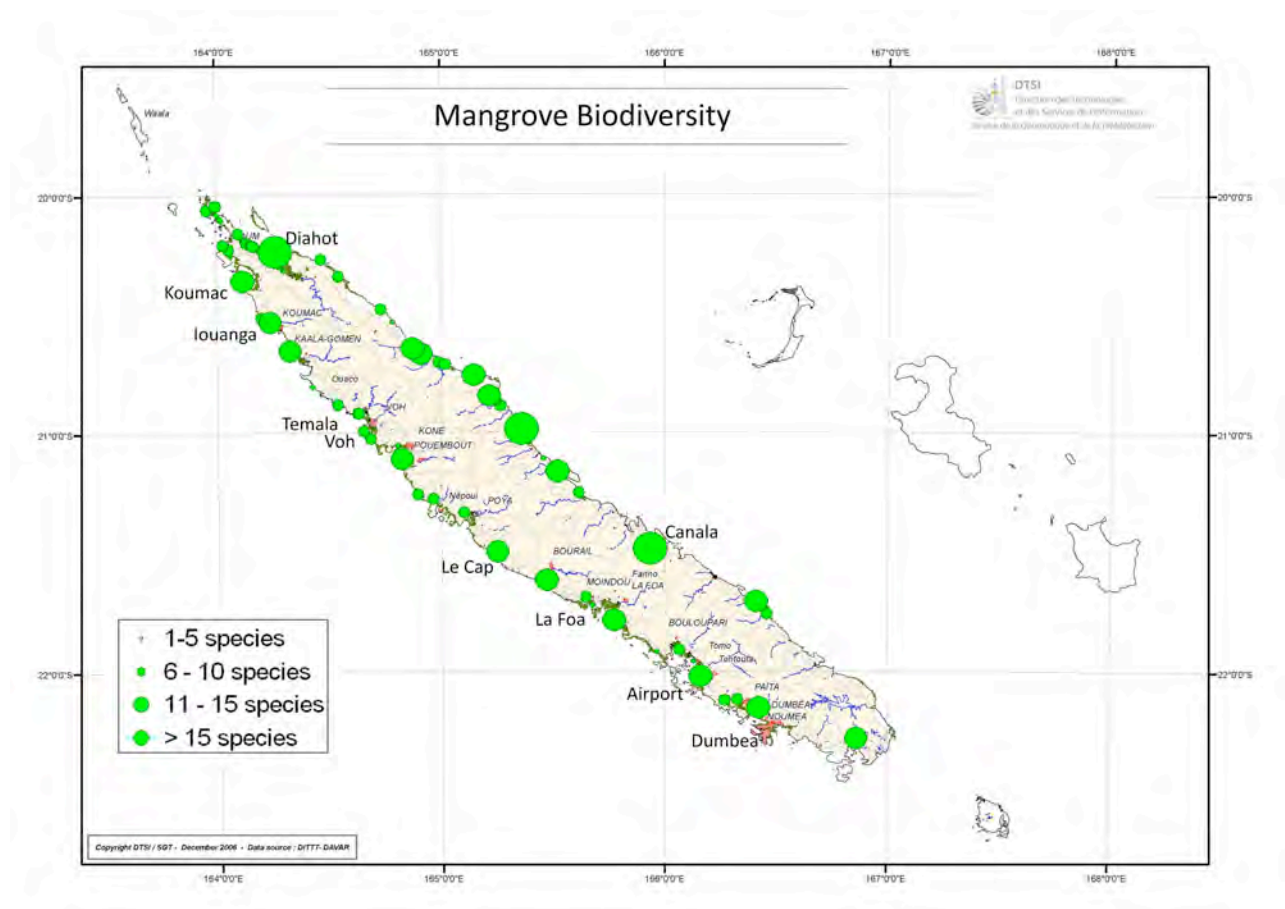


Figure 6: Mangrove biodiversity in the 82 surveyed locations in New Caledonia

Based on the current research two species, *Bruguiera sexangula* and *Xylocarpus moluccensis*, are no longer considered part of the New Caledonian mangrove flora as they appear to have been mistakenly confused with respective congeners, *Bruguiera gymnorhiza* and *Xylocarpus granatum*. One other species, *Cynometra iripa*, was not found during the survey either, but its presence is based on a single Herbarium collection cited by Munzinger & Lebigre (2005).

Avicennia marina was present throughout New Caledonia. It was assigned as var. *australasica* based on its distinctive morphological traits on flower buds and foliage, see Duke (2006). This occurrence identifies what might be considered a distinctly Australasian mangrove component, as compared with those more aligned with an Asian component, like *Ceriops tagal*, *Dolichandrone spathacea*, *Sonneratia caseolaris*, and even local variants of *Sonneratia alba* and *Rhizophora apiculata*.

Rhizophora taxa are the most complex part of all components of the New Caledonian mangrove flora. The genus is represented by six local taxa, consisting of three species and three hybrids. The three parent species are each derived from distinctly different mangrove components with: *R. apiculata* having strongest affinity with its typical Asian variant; *R. stylosa* having affinity with those observed in eastern Australia; and *R. samoensis* having closest affinity with *R. mangle* from the Atlantic East Pacific (AEP) flora. The presence and abundance of numerous hybrid stands of each parental crossover suggests these associations are not recent. It also says a lot about *Rhizophora* evolution where not even the most distinctive of species are divergent enough to avoid hybridisation where they grow alongside each other (Duke 2010).

The observations of the mangrove flora of New Caledonia noted above indicate its complex make-up. The location of New Caledonia in the south west Pacific makes it a unique biogeographical setting – being the interface and major crossover site between three global regions. While there are no truly endemic species, apart from the endemic hybrid taxon, there are some morphological traits that are especially well-developed or unique to New Caledonia. The most notable was the red colouration in many *Bruguiera gymnorhiza* trees. This is manifest with some trees having a distinctively dark appearance. These ‘red’ trees have both red and green pigments within their foliage that appears as reddish in those plant parts that are normally lighter green, like around apical shoots, young leaves and stems. The ‘red’ condition was also more common in southern estuaries with a noticeable decline in the proportion of ‘red’ trees in sites further north. As a matter of interest, the pigment colouration was not accompanied by any corresponding morphological traits between ‘red’ and ‘green’ variants. Nor were there any differences in floral phenology or growth form. It is curious to reflect on a possible association with the ‘albino’ trait previously reported in several mangrove genera, but restricted to propagules (Duke and Watkinson 2002).

Mangrove Hybrids

New Caledonian mangrove communities are distinguished by four relatively widespread hybrid species. These have been derived within two common genera, *Lumnitzera* and *Rhizophora*. In most cases, hybrid taxa are distinguished by shared morphological characteristics of two putative parents in each case. During the survey, hybrid taxa were typically located in areas where both parental species co-exist. In each case, one parent was notably widespread while the other had a more limited distribution. The four hybrids and their respective putative parental associates are listed as follows:

Lumnitzera X *rosea* = *L. racemosa* X *L. littorea*

Rhizophora X *lamarckii* = *R. stylosa* X *R. apiculata*

Rhizophora X *selala* = *R. stylosa* X *R. samoensis*

Rhizophora X *tomlinsonii* = *R. samoensis* X *R. apiculata*

The latter hybrid taxon, *Rhizophora* X *tomlinsonii*, is new to science, being observed and reported for the first time with the 2006 survey. A full description of this new hybrid species, being the only endemic mangrove taxon in New Caledonia, was recently published in September 2010 (Duke 2010). Munzinger & Lebigre (2005) proposed there might also be a *Sonneratia* hybrid, *S. X gulngai*, present since both parents co-exist in some estuaries. This was considered and investigated during the recent survey but no *Sonneratia* hybrid was located.

4. REGIONAL BIOGEOGRAPHY AND ECOLOGY

4.1 Factors Influencing Saltmarsh Distributions

There are two distinct saltmarsh floral families, Chenopodaceae (succulents) and Cyperaceae (sedges). Succulent genera of the Chenopodaceae and Aizoaceae families, *Suaeda*, *Enchylaeana*, *Sarcocornia* and *Sesuvium* have high capacity to withstand extremes in salinity and waterlogging, but cannot withstand extended periods of flooding and require salt to withstand osmotic pressures associated with water limitation. Consequently, these species dominate the frequently inundated yet well-drained intertidal zone. Salt-tolerant succulent species with limited waterlogging capacity, such as *Salsola kali*, *Atriplex jubata* as well as the salt tolerant *Limonium tetragonum* (Plumbaginaceae) occupy the upper-intertidal zone where tides are less frequent. *Fimbristylis*, a genera of Cyperaceae, have some capacity to withstand reduced water availability and have moderate salt-tolerance, hence these can be found in moist, upper intertidal areas. Only two species of Cyperaceae, *Fimbristylis ferruginnea* and

Baumea juncea can withstand extended periods of sediment waterlogging and can also be found in and adjacent to wet-depressions.

Cyperaceae generally have less salt tolerance than chenopods but most can survive and even rely on extended periods of inundation. These species occupy intertidal areas with continuous water supply in the form of freshwater seeps or depressions that retain water after tidal flooding. Wet depressions trap tidal water for days or even months and these areas are colonised by waterlogging tolerant species *Fimbristylis ferruginea* and *Schoenoplectus* sp. (as represented by *Saline Swamp* in Figure 9). In areas with extended, mostly constant flooding and high salinity resulting from evaporative loss, only *Ruppia maritima* is present. The other Cyperaceae, *Rhynchospora* and *Cyperus*, occur in wet areas with reduced salinity resulting from freshwater seeps. The Poaceae, *Sporobolus virginicus*, is a generalist grass species that can withstand a range of salinities and water logging and is found throughout the intertidal and supratidal zones.

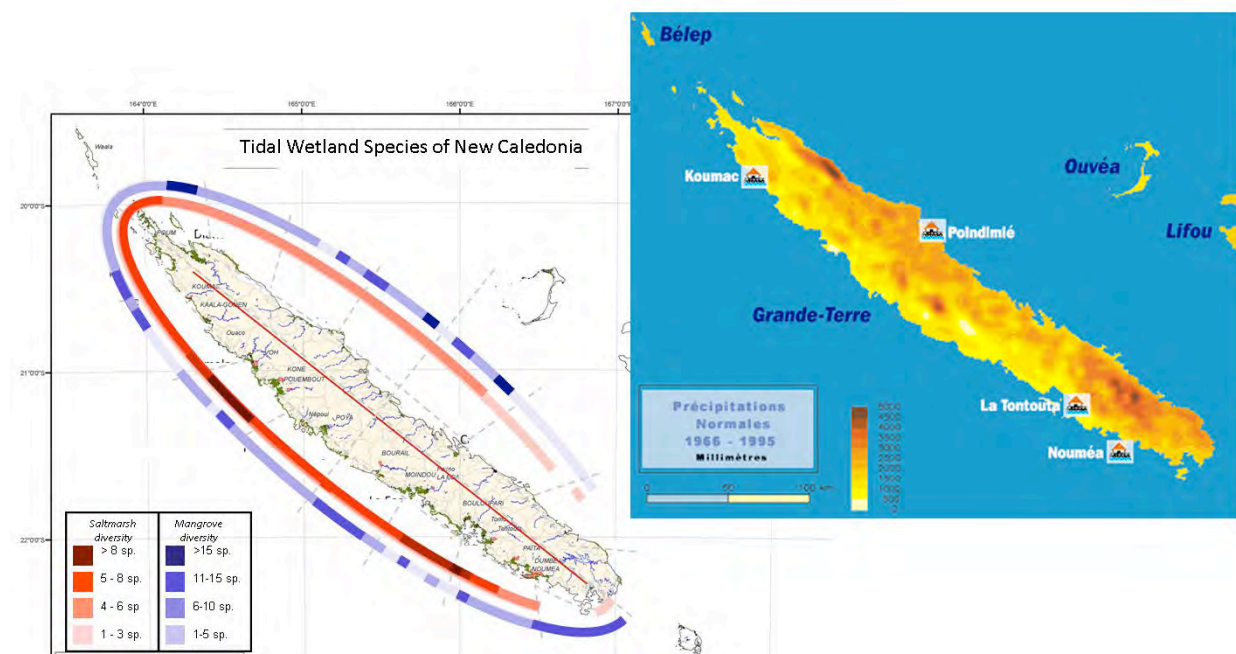


Figure 7 Geographical diversity of saltmarsh sedges and *Chenopods* in New Caledonia (left); Mean annual rainfall for the island of Grande Terre, New Caledonia 1966-1995 (right).

As noted, there is a distinct pattern of saltmarsh species distribution on the New Caledonian coast. Of the saltmarsh families represented in New Caledonia, only one, the Cyperaceae, is present on the wetter, east coast, whereas all families are represented on the dry, west coast (Figure 4). This distributional pattern is driven by rainfall and habitat availability. High rainfall, as occurs on the east coast (Figure 7), reduces salinity and enables mangroves to dominate the intertidal zone. As mangroves are trees, they effectively shade-out the more diminutive

saltmarsh plants. On the east coast at the upper-intertidal margins where mangroves are not present, steep topographical profile limits habitat availability and in combination with high rainfall creates freshwater seeps which maintain high sediment water content and anoxic conditions. Only species with the capacity to withstand extended periods of waterlogging, such as Cyperaceae species, can survive these conditions. Figure 8, showing the occurrence of saltmarsh species relative to annual rainfall, highlights effect of rainfall on saltmarsh distribution.

On the dry, west coast, lower topographical profiles and higher salinities provide suitable habitat for species more tolerant of high salinities and water deficiency. In the intertidal zone on the west coast there is greater habitat variability, enabling the presence of more species. Species in the drier saltmarsh areas show distinct zonation patterns that represent their specific salinity and moisture tolerance limits. Table 2 and Figure 9 outline the different salinity and moisture preferences of each species and their generalised position in the saltmarsh along a tidal profile.

Figure 9 shows a hypothetical distribution of saltmarsh plants along an elevation gradient, with different soil moisture conditions. The variation in moisture profile is dependent on tidal frequency, rainfall and groundwater influence. The Lower Intertidal zone is occupied by species with a high salt tolerance. The dominant species in this zone are *Sarcocornia quinqueflora* and *Suaeda* sp.. Zonation between these species is driven by sediment moisture related to tidal frequency and micro-topography, with *Suaeda* sp. preferring drier regions of the Lower Intertidal zone. In the Upper Intertidal zone, salt is reduced and moisture is the primary abiotic driver of zonation. In drier climates, species that have low waterlogging tolerance and some salt tolerance can be found in the Upper Intertidal zone. In wetter areas, water availability enables species such as those in the Cyperaceae family to overcome salt stress, and these species are therefore more commonly found in the Upper Intertidal zone in these regions. In some regions saline swamps occur where high rainfall causes regular inundation of the Upper Intertidal zone, or depressions allow for water to stand. In these swamp areas, species of the Cyperaceae which can tolerate and often require high levels of waterlogging and low to moderate salt stress are present.

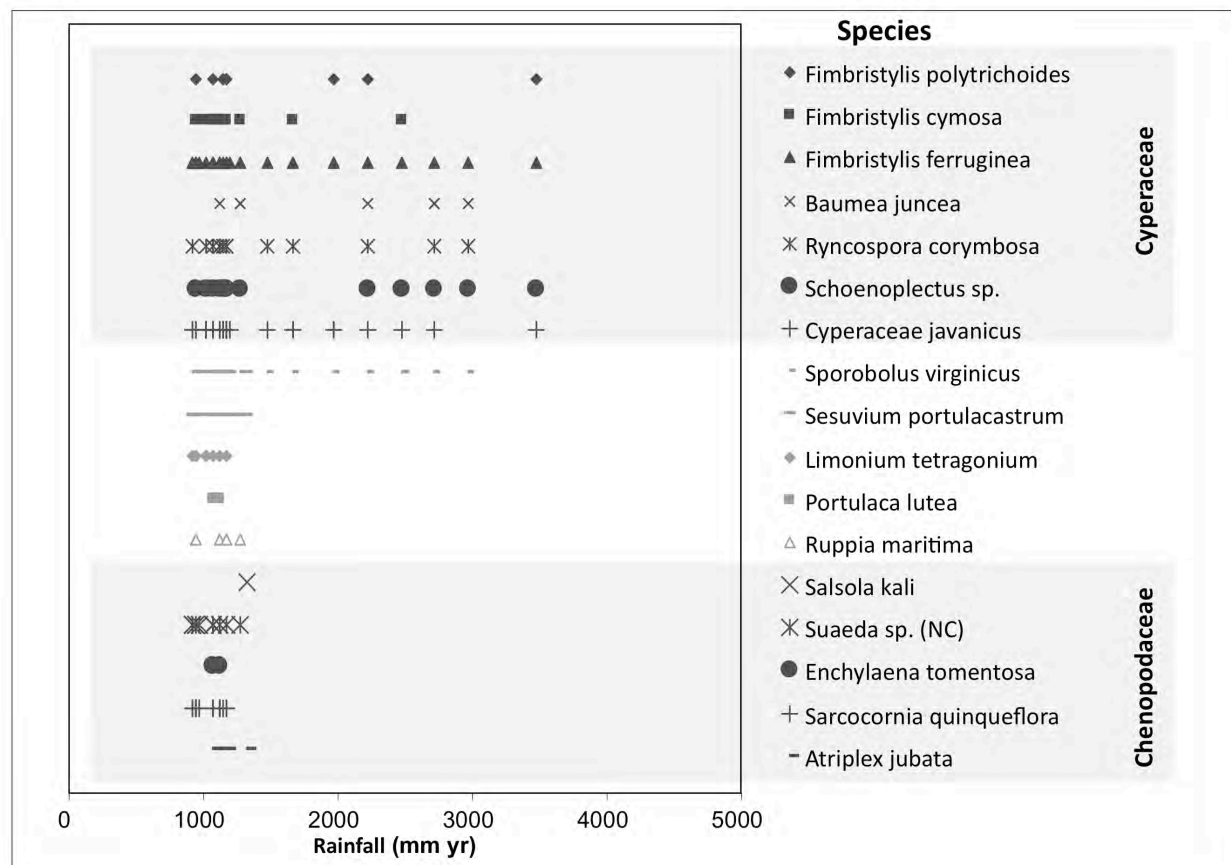


Figure 8 Distribution of saltmarsh plants relative to mean annual rainfall. Species from the Cyperaceae family can withstand high levels of rainfall when compared with the Chenopods.

In areas with low topographical relief and extensive tidal zone, dry, bare saltflats occur in the mid-intertidal zone. These areas are mostly un-vegetated. Where sediment moisture is present, saltflats are colonised by thick cyanobacterial mats, which are very important for atmospheric nitrogen fixation and are highly productive (Lovelock et al. 2010). The algal mats have a tessellated appearance when dry, but recover quickly when re-wetted.

Table 2 Distribution of saltmarsh species and associates relative to both salinity levels and water availability. Green shading denotes those site characteristics occurring only on the west coast of New Caledonia. Species codes are listed in Appendix 4.

| Water availability | Salinity (ppk) | Very Low 3 | Low 12 | Moderate 36 | High 70 |
|--------------------|----------------|--------------------------|------------------------------|-------------------------|-------------|
| | | | | | |
| Dry | | SpoV, FimP, (associates) | EnchT, AtriJ, LimT, FimP | Suasp | |
| Moist | | SpoV, FimC, FimP, FimF | Salk, SesP, FimC, SpoV, FimP | Suasp, SarQ, SesP, SpoV | Suasp, SarQ |
| Wet | | SpoV, FimF, CypJ, RynC | SpoV, FimF, BauJ | SarQ, SpoV, BauJ | SarQ |
| Very Wet | | FimF, RynC, Scho | FimF, Scho | FimF, Scho | RupM |

Saltmarsh in New Caledonia is heavily impacted by grazing from feral deer and cattle. Heavy grazing and trampling reduces species diversity and vegetation extent. Saltmarsh is also threatened by aquaculture pond construction which can replace saltmarsh, alter local hydrology and increase nutrient input, all of which are capable of negatively impacting saltmarsh species distributions and ecological function if not properly managed.

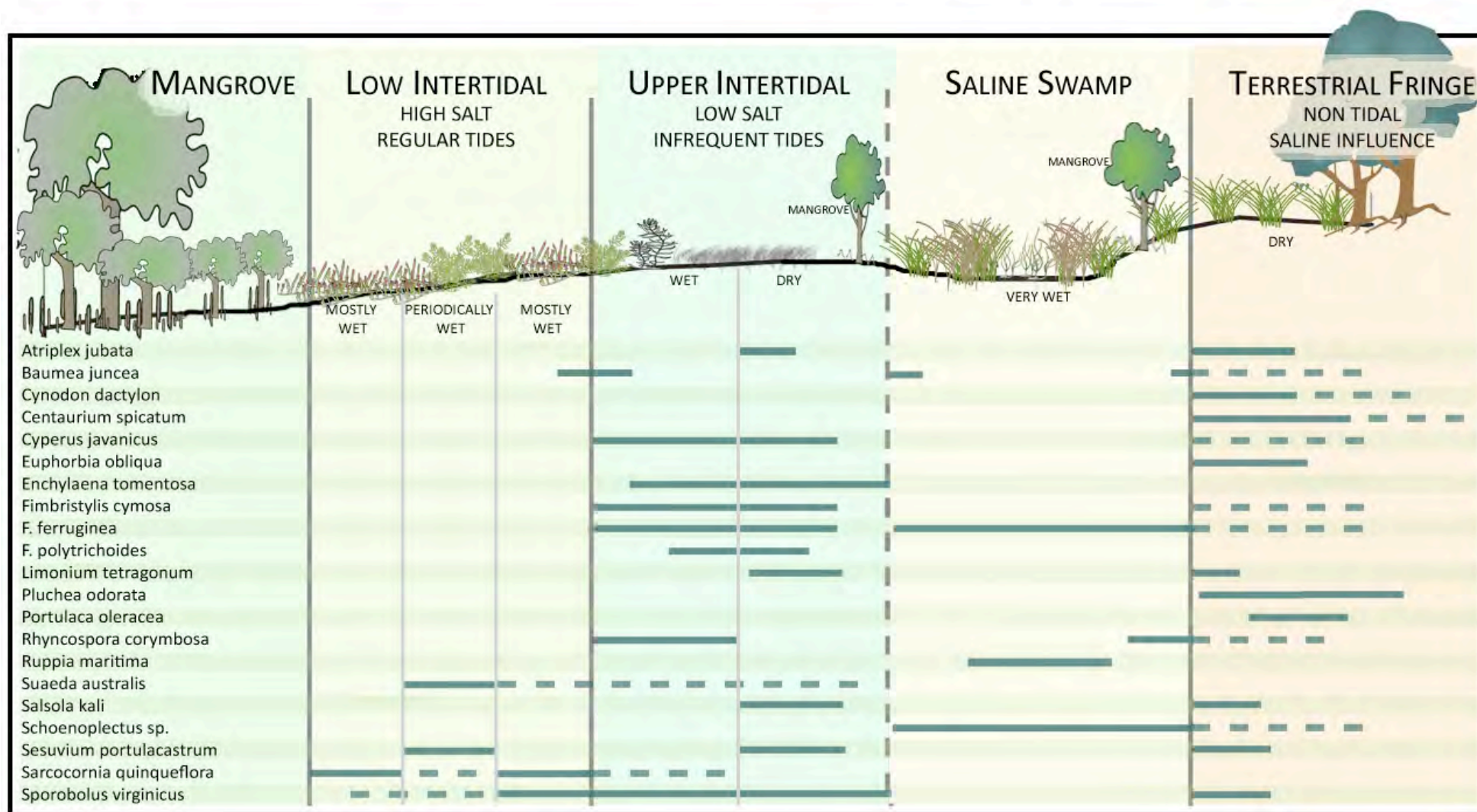


Figure 9 Conceptual model showing locations of New Caledonian saltmarsh species within the tidal profile. Common presence of a species within a given zone is shown by a solid horizontal line. Dashed horizontal lines represent areas where species are potentially found.

4.2 Factors Contributing to Mangrove Distribution Patterns

Mangrove distributions are primarily limited by temperature and niche availability (Duke et al. 1998). The southern limits of species in southern latitudes are therefore considered defining characteristics of respective species. A comparative list is presented in Table 2, shows southern distributional limits of mangrove species in New Caledonia. Many closely match those in Australia (Duke 2006).

Table 3 Southern limits of mangrove taxa in New Caledonia.

| Taxa (Species & hybrids) | Latitude S | New Caledonian Location |
|---|------------|----------------------------|
| <i>Acanthus ilicifolius</i> | 22° 11' S | Dumbéa River |
| <i>Acrostichum aureum</i> | 21° 31' S | Canala River |
| <i>Acrostichum speciosum</i> | 22° 20' S | Baie du Carénage |
| <i>Avicennia marina</i> var. <i>australasica</i> | 22° 18' S | Corniche Sud |
| <i>Bruguiera gymnorhiza</i> | 22° 20' S | Baie du Carénage |
| <i>Ceriops tagal</i> | 20° 16' S | Diahot River |
| <i>Cynometra iripa</i> | 20° 52' S | Tiwaka River |
| <i>Dolichandrone spathacea</i> | 21° 01' S | Tchamba River |
| <i>Excoecaria agallocha</i> | 22° 20' S | Baie du Carénage |
| <i>Heritiera littoralis</i> | 22° 18' S | Corniche Sud |
| <i>Lumnitzera littorea</i> | 22° 20' S | Baie du Carénage |
| <i>Lumnitzera racemosa</i> | 22° 18' S | Corniche Sud |
| <i>Lumnitzera</i> X <i>rosea</i> | 22° 02' S | South of Tontouta |
| <i>Pemphis acidula</i> | 20° 34' S | Koumac River |
| <i>Rhizophora apiculata</i> | 21° 31' S | Canala River |
| <i>Rhizophora</i> X <i>lamarckii</i> | 21° 31' S | Canala River |
| <i>Rhizophora</i> X <i>tomlinsonii</i> | 21° 31' S | Canala River |
| <i>Rhizophora samoensis</i> | 22° 18' S | Corniche Sud |
| <i>Rhizophora samoensis</i> var. <i>neocaledonica</i> | 21° 22' S | Poya |
| <i>Rhizophora</i> X <i>selala</i> | 22° 18' S | Corniche Sud |
| <i>Rhizophora stylosa</i> | 22° 20' S | Baie du Carénage |
| <i>Scyphiphora hydrophyllacea</i> | 21° 31' S | Canala River |
| <i>Sonneratia alba</i> | 22° 18' S | Corniche Sud |
| <i>Sonneratia caseolaris</i> | 21° 01' S | Tchamba River |
| <i>Xylocarpus granatum</i> | 22° 18' S | Corniche Sud |

There are at least five New Caledonian mangrove species that extend to higher latitude sites in New Caledonia than occur in Australia (Duke 2006). At least one, *Dolichandrone spathacea*, has a significantly higher southern distribution than in Australia. All these species are notable components of the Asian mangrove flora. Furthermore, three *Rhizophora* taxa (*R. X tomlinsonii*, *R. samoensis* and *R. X selala*) are absent from Australia, and represent Atlantic East Pacific (AEP) flora. Some Australian species are absent in New Caledonia at comparable latitudes, demonstrating the long separation and isolation of New Caledonia from Australia. The presence of a much stronger Asian component in New Caledonia further reveals its greater connection with that region. In fact, it appears based on these floristic similarities that the connection between New Caledonia and Asia has been greater than that between Australia and Asia.

4.3 Influences of Catchment Size and Rainfall – Regional Influences

Further to the general groupings noted above, there are tangible patterns that relate specifically to catchment size and rainfall. The distribution of mangrove biodiversity illustrated in Figure 6, shows that maximal species numbers occur towards the north and east of the island.

Species numbers are not directly correlated with rainfall. Figure 10 shows a simple polynomial equation of best fit that suggests the influence of rainfall increases up to 2000 mm mean annual rainfall, and peaks around 2,000-2,500 mm after which biodiversity is notably reduced. Comparable observations have been made for northern Australian mangrove floras by Duke (1992).

Of further interest is the influence of catchment size. General catchment, or watershed, areas are shown for New Caledonia in Figure 11. Note how these extend in a relatively homogeneous spread along the length of the island. Also note catchment area estimates listed in Appendix 1. The one notably large catchment is the Diahot River catchment situated in the north of the island. This maximal catchment size for New Caledonia has an area of 689 km².

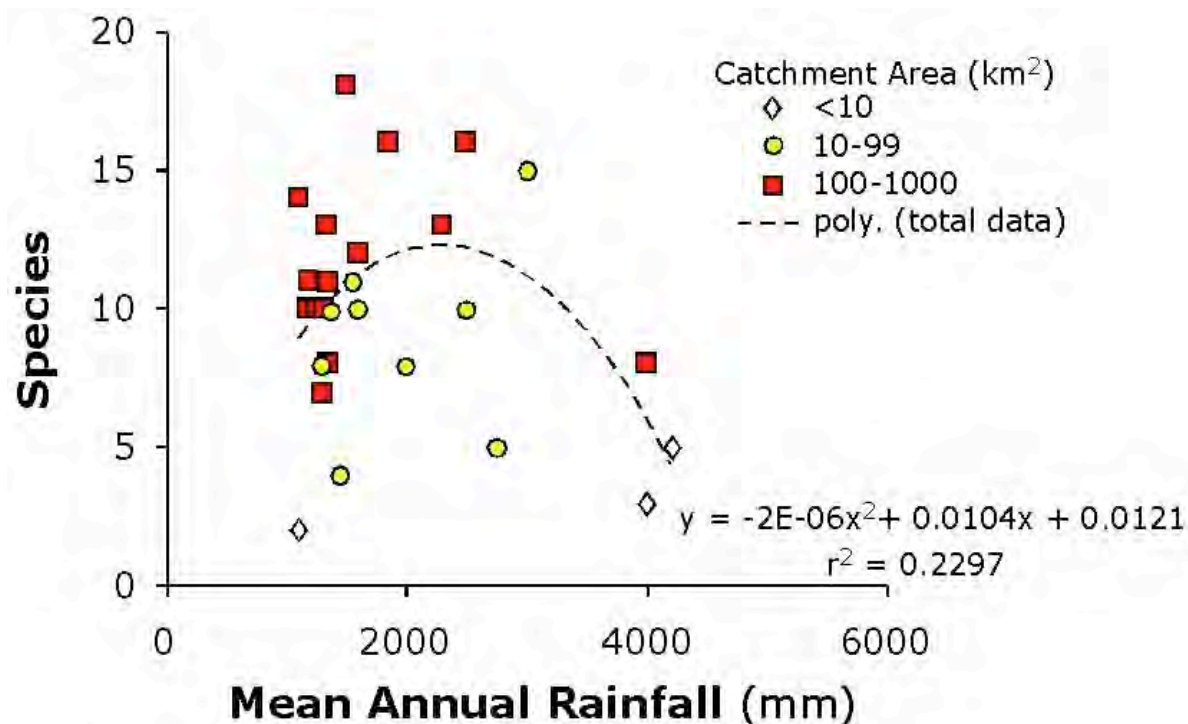


Figure 10 Mangrove biodiversity and mean annual rainfall grouped by catchment area for estuarine locations in New Caledonia. ($r=0.4600$; $n=28$; $P<0.05$).

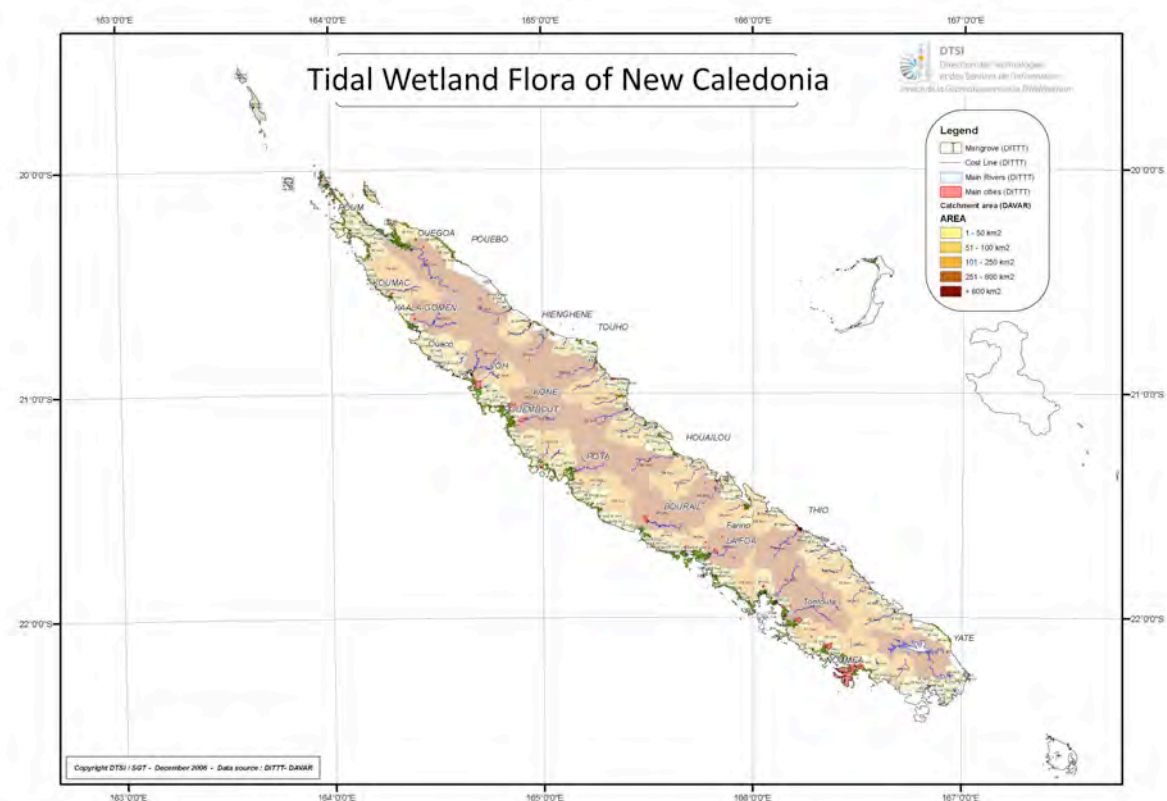


Figure 11 Catchments of major estuarine outflows for New Caledonia. Darker shading represents larger estuarine systems.

The relationship between catchment size and biodiversity is shown in Figure 12. After noting that catchment area has been log transformed, the trend is linear where mangrove species numbers are significantly greater in estuaries with larger catchments. It is of interest that rainfall has little influence of this strong relationship.

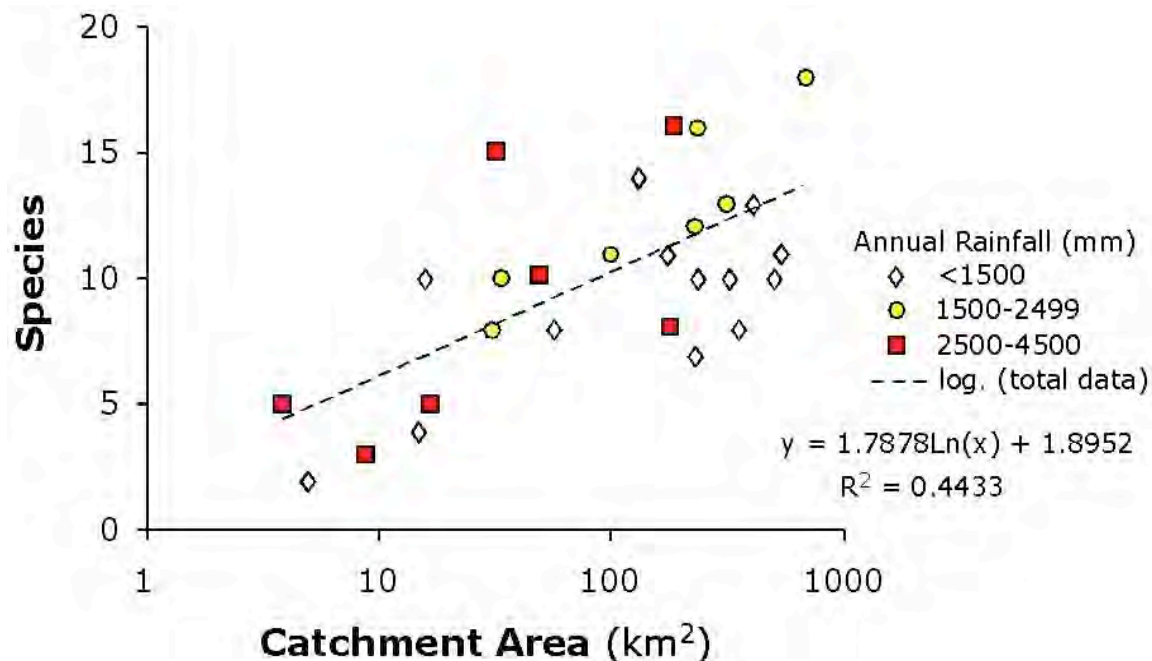


Figure 12 Mangrove biodiversity and catchment area grouped by mean annual rainfall for estuarine locations in New Caledonia ($r=0.6456$; $n=28$; $P<0.001$).

4.4 Salinity and Estuarine Position - Influences Within Estuaries

The distribution of mangroves within estuaries is largely a function of species present, and how these are sorted according to individual tolerances to the salinity of channel waters. Site visits in 2009, building on those in 2006, surveyed 11 estuarine locations, noting species present at a number of sites from the mouth to as close to the upstream limit as practical.

Based on these surveys, New Caledonian mangrove taxa have been classified into three estuarine sub-groupings using upriver checklists for each river estuary (respectively, with the number of intra estuarine sites surveyed given in brackets), including: Dumbea (10), Tamoa (9), La Foa (6), Le Cap (19), Temala (6), Voh (8), Iouanga (11), Koumac (9), Diahot (35), Canala (12) and Carenage (13). These estuary groupings include: 1) downstream and marine influenced, (2) intermediate within the body of the estuary, and (3) upstream where species rely more heavily on riverine flows. Numbers of sites for respective species have been listed in brackets. Downstream species: *Pemphis acidula* (3); *Cerriops tagal* (2); *Rhizophora stylosa* (11); *Sonneratia alba* (4); *Avicennia marina* (9); *Lumnitzera racemosa* (7); *Excoecaria agallocha* (11). Intermediate upriver species: *Rhizophora samoensis* (11); *R. X selala* (11); *R.*

apiculata (2); *Bruguiera gymnorhiza* (11); *Heritiera littoralis* (7); *Scyphiphora hydrophylacea* (3); *R. X lamarckii* (2); *R. X tomlinsonii* (1); *Lumnitzera littorea* (5); *L. X rosea* (3); *Xylocarpus granatum* (7); *Acrostichum speciosum* (8). Upstream species: *Dolichandrone spathacea* (1); *Acanthus ilicifolius* (7); *Acrostichum aureum* (2); *Cynometra iripa* (0* reference to Australian occurrence in Duke 2006); *Sonneratia caseolaris* (0* reference to Australian occurrence in Duke 2006).

Upriver checklists were plotted using the GPS position within each estuary and the linear distance along each water course estimated from maps in conjunction with aerial imagery from Google Earth. Mangrove species were ranked according to species presence along the estuary with those listed first being found most often towards the estuary mouth. Salinity data are presented in the plots.

Dumbea River (Figure 13)

The Dumbea River is situated in the south-western part of the main island of New Caledonia around 22° 10.5' S, 166° 26.0' E. The climate is moderate with a mean annual rainfall of around 1,600 mm. The estuary is influenced by a catchment area of around 231 km². The total number of mangrove species found in this river estuary was 12. One additional site at the mouth of the estuary was surveyed during December 2009, making a total of 10 sites surveyed.

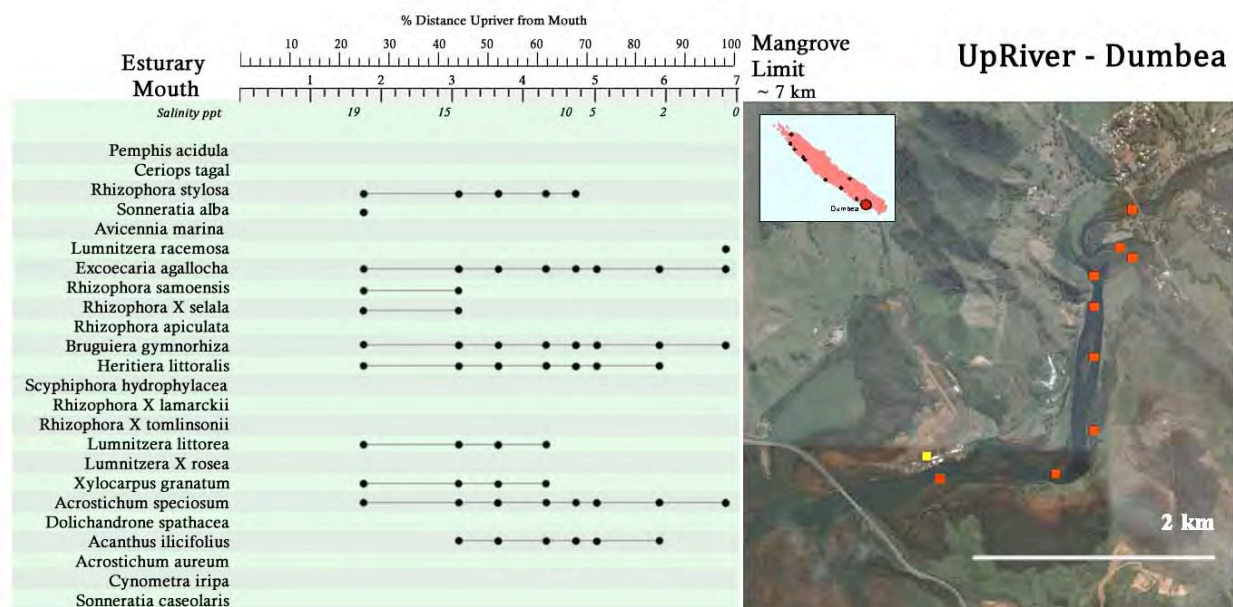


Figure 13 Upriver distribution of mangroves in the Dumbea River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 14 Dumbea River, looking upstream from the highway bridge.

Tamoa River, South of Tontouta (Figure 15)

The river estuary south of the Tontouta River is situated in the south-western part of the main island of New Caledonia around 22° 1.9' S, 166° 9.8' E. The climate is moderate to semi-arid with a mean annual rainfall of around 1,100 mm. The estuary is influenced by a catchment area of around 132 km². Nine sites were surveyed in the Tamoa River. The total number of mangrove species found in this river estuary was 13.

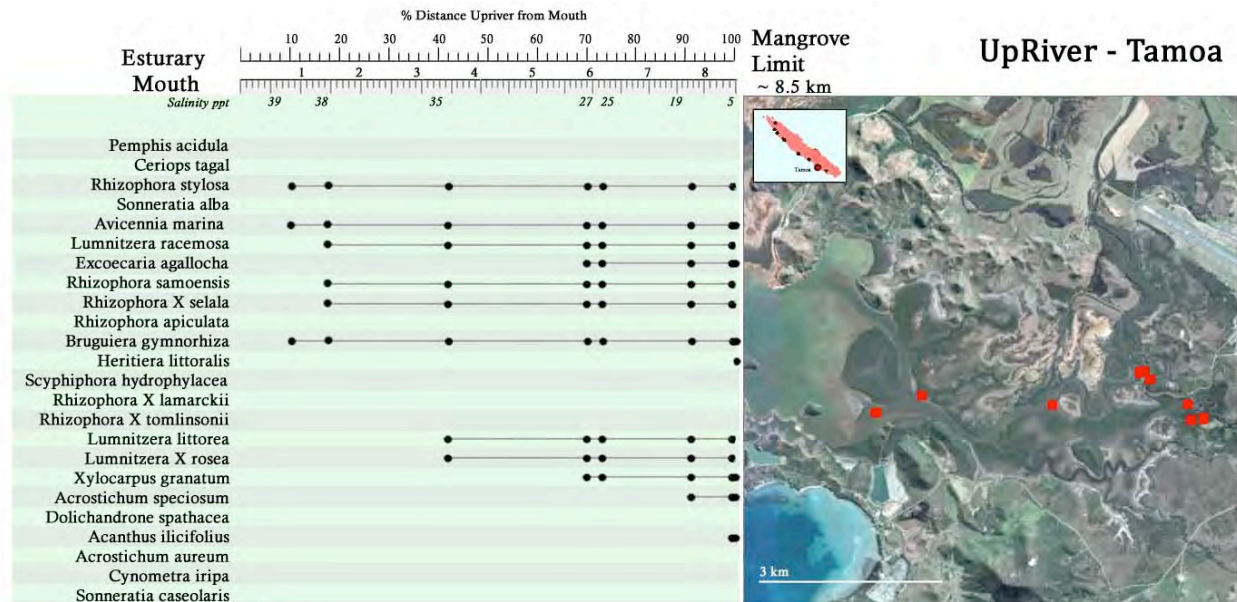


Figure 15 UpRiver distribution of mangroves in the Tamoa River, south of Tontouta and the airport, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 16 Tidal wetland of the Tamoa River

La Foa River (Figure 17)

The La Foa River is situated in the western part of the main island of New Caledonia around 21° 44.2' S, 165° 43.6' E. The climate is moderate with a mean annual rainfall of around 1,350 mm. The estuary is influenced by a catchment area of around 406 km². The total number of mangrove species found in this river estuary was recorded to be 11 during the 2006 survey. No further data collection occurred during the December 2009 field excursion in the La Foa River, leaving the total number of sites surveyed at 6.

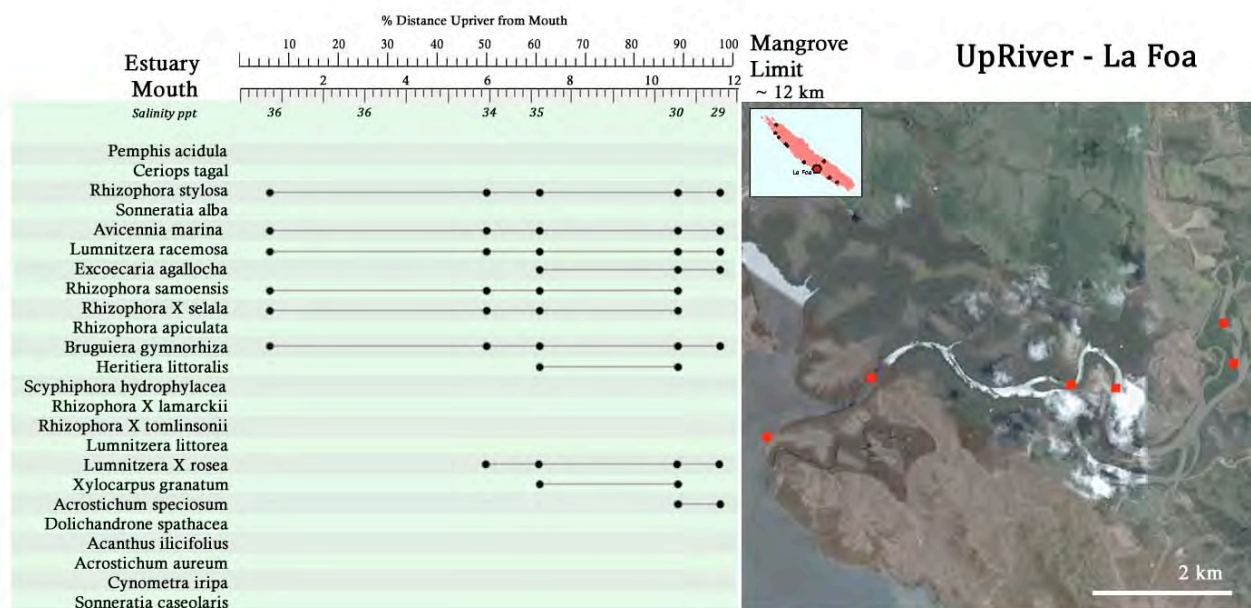


Figure 17 UpRiver distribution of mangroves in the La Foa River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations



Figure 18 La Foa River.

La Cap River (Figure 19)

The La Cap River is situated in the western part of the main island of New Caledonia around 21° 31.4' S, 165° 28.9' E. The climate is moderate to semi-arid with a mean annual rainfall of around 1,200 mm. The estuary is influenced by a catchment area of around 176 km². Nineteen sites were surveyed in the Le Cap River. The total number of mangrove species found in this river estuary was 14, which raises the number from the previously recorded 11 species (Duke 2007).

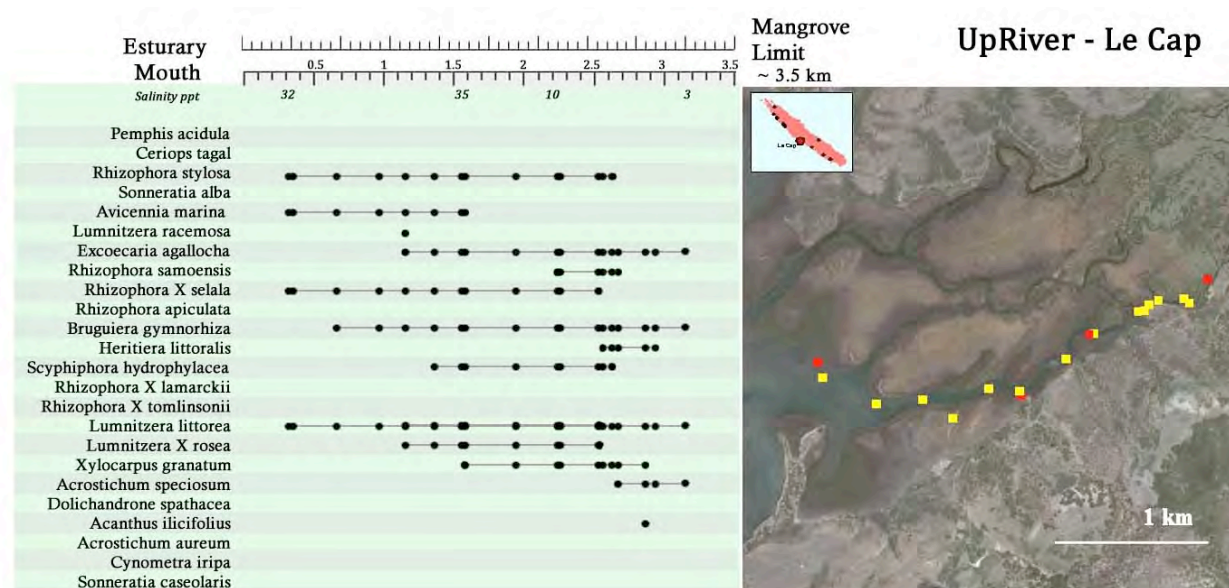


Figure 19 UpRiver distribution of mangroves in the Le Cap River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 20 Le Cap River

Voh River (Figure 21)

The Voh River is situated in the north-western part of the main island of New Caledonia around 20° 59.9' S, 164° 41.9' E. The climate is moderate with a mean annual rainfall of around 1,300 mm. The estuary is influenced by a catchment area of around 231 km². Eight sites were surveyed within Voh River. The total number of mangrove species found in this river estuary was 6.

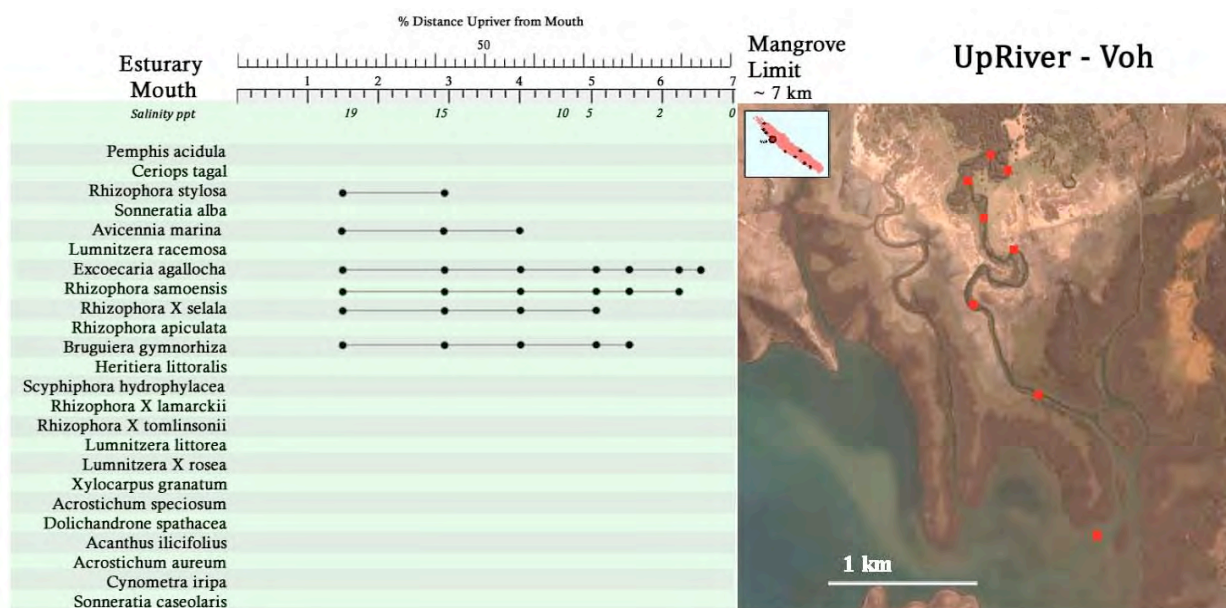


Figure 21 Upriver distribution of mangroves in the Voh River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 22 Tidal wetland of the Voh River.

Temala River (Figure 23)

The Temala River is situated in the north-western part of the main island of New Caledonia around 20° 56.0' S, 164° 39.2' E. The climate is moderate with a mean annual rainfall of around 1,350 mm. The estuary is influenced by a catchment area of around 356 km². Six sites were surveyed in the Temala River. The total number of mangrove species found in this river estuary was 7.

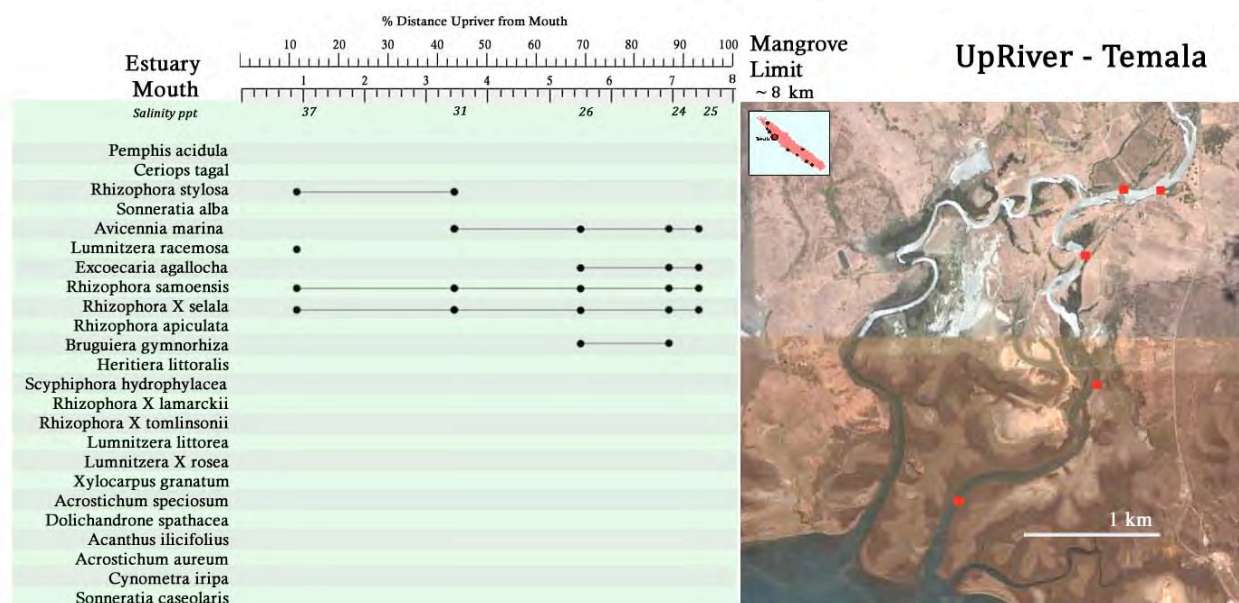


Figure 23 UpRiver distribution of mangroves in the Temala River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 24 Temala River, mid estuary looking inland.

Iouanga River (Figure 25)

The Iouanga River is situated in the north-western part of the main island of New Caledonia around 20° 42.4' S, 164° 22.6' E. The climate is semi-arid with a mean annual rainfall of around 1,250 mm. The estuary is influenced by a catchment area of around 506 km². Eleven sites were surveyed in Iouanga River. The total number of mangrove species found in this river estuary was 12.

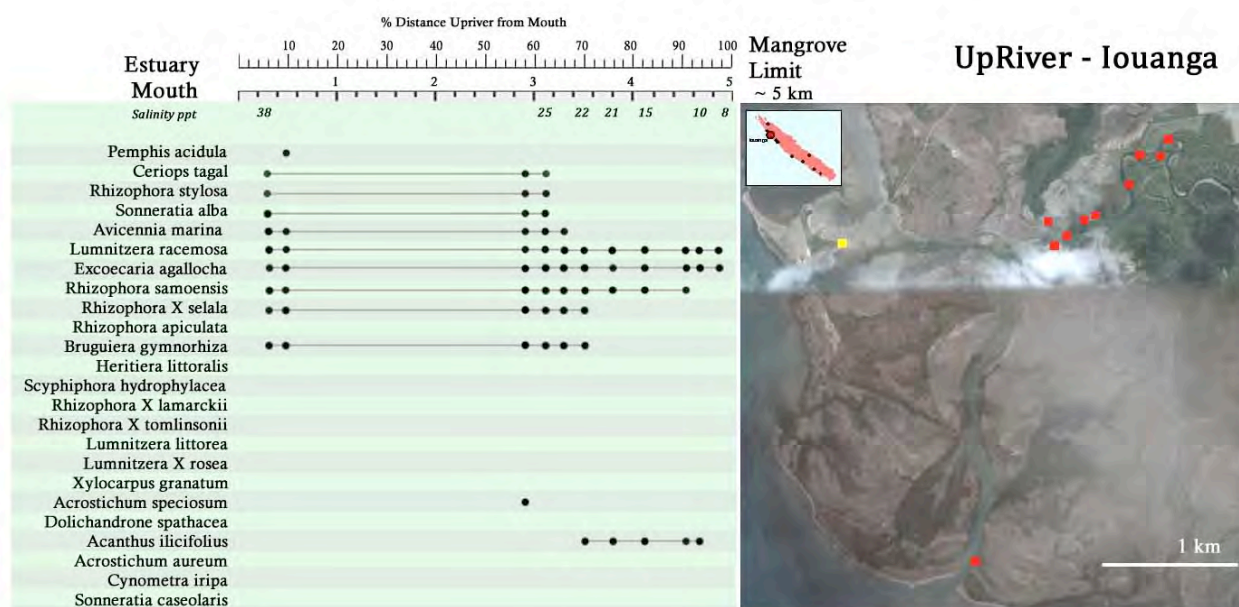


Figure 25 UpRiver distribution of mangroves in the Iouanga River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 26 Iouanga River

Koumac River (Figure 27)

The Koumac River is situated in the north-western part of the main island of New Caledonia around 20° 33.9' S, 164° 15.6' E. The climate is semi-arid with a mean annual rainfall of around 1,200 mm. The estuary is influenced by a catchment area of around 237 km². Nine sites were surveyed in the Koumac River. The total number of mangrove species found in this river estuary was 10.

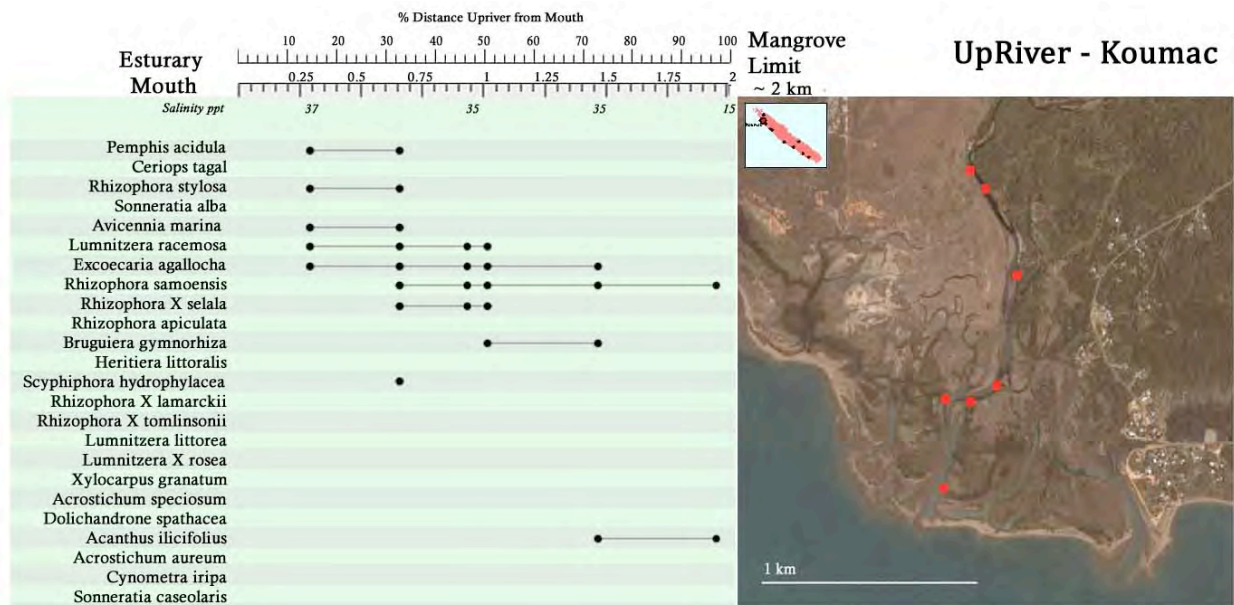


Figure 27 UpRiver distribution of mangroves in the Koumac River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 28 Koumac River

Diahot River (Figure 29)

The Diahot River is situated at the northern tip of the main island of New Caledonia around 20° 16.4' S, 164° 17.9' E. The climate is moderate with a mean annual rainfall of around 1,500 mm. The estuary is influenced by a catchment area of around 689 km². Thirty-five sites were surveyed in the Diahot River. The total number of mangrove species found in this river estuary was 19.

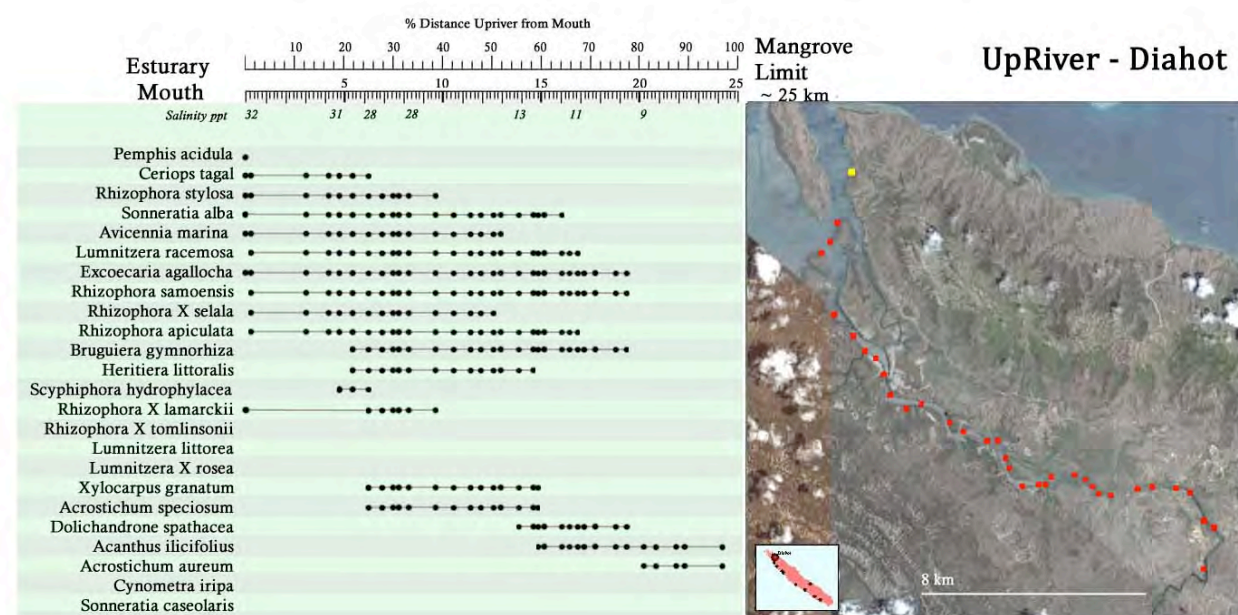


Figure 29 Upriver distribution of mangroves in the Diahot River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 30 Diahot River

Canala River (Figure 31)

The Canala River is situated on the southern, central east coast of the main island of New Caledonia around 21° 30.7' S, 165° 58.8' E. The climate is wet to moderate with a mean annual rainfall of around 1,850 mm. The estuary is influenced by a catchment area of around 239 km². Twelve sites were surveyed in the Canala River. The total number of mangrove species found in this river estuary was 16.

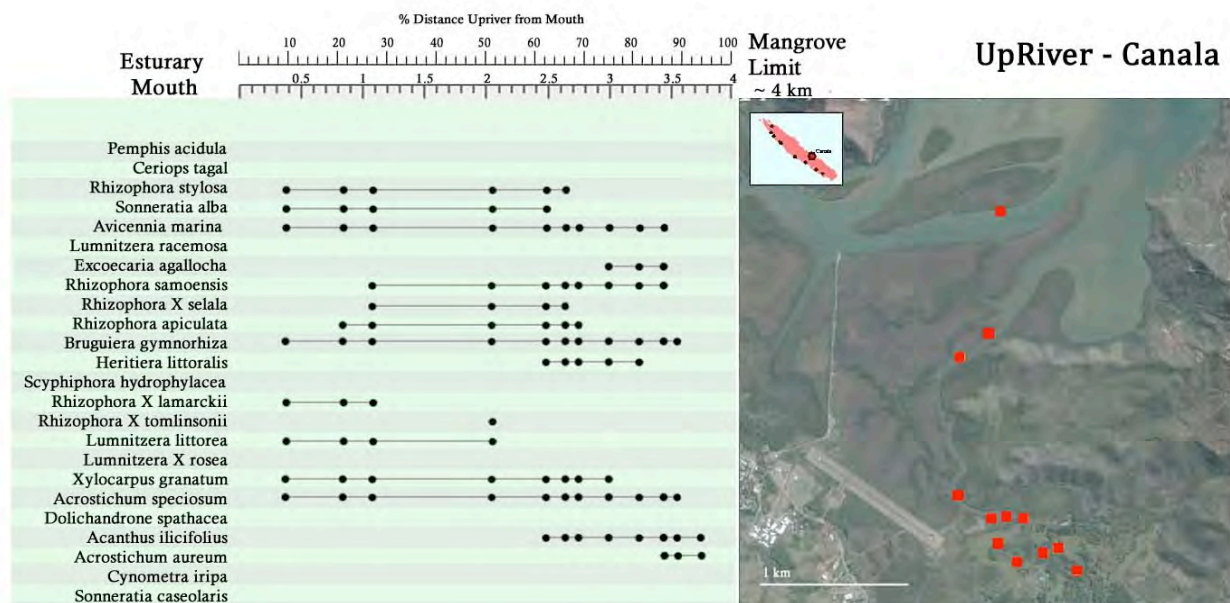


Figure 31 Upriver distribution of mangroves in the Canala River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 32 Canala River

Carenage River (Figure 33)

The Carenage River is situated in the south of the main island of New Caledonia around 22° 18.747'S, 166° 50.747'E. The climate is wet to moderate with a mean annual rainfall of around 2,000 mm. The estuary is influenced by a catchment area of around 239 km². Thirteen sites were surveyed in the Carenage River. The total number of mangrove species found in this river estuary was 9.

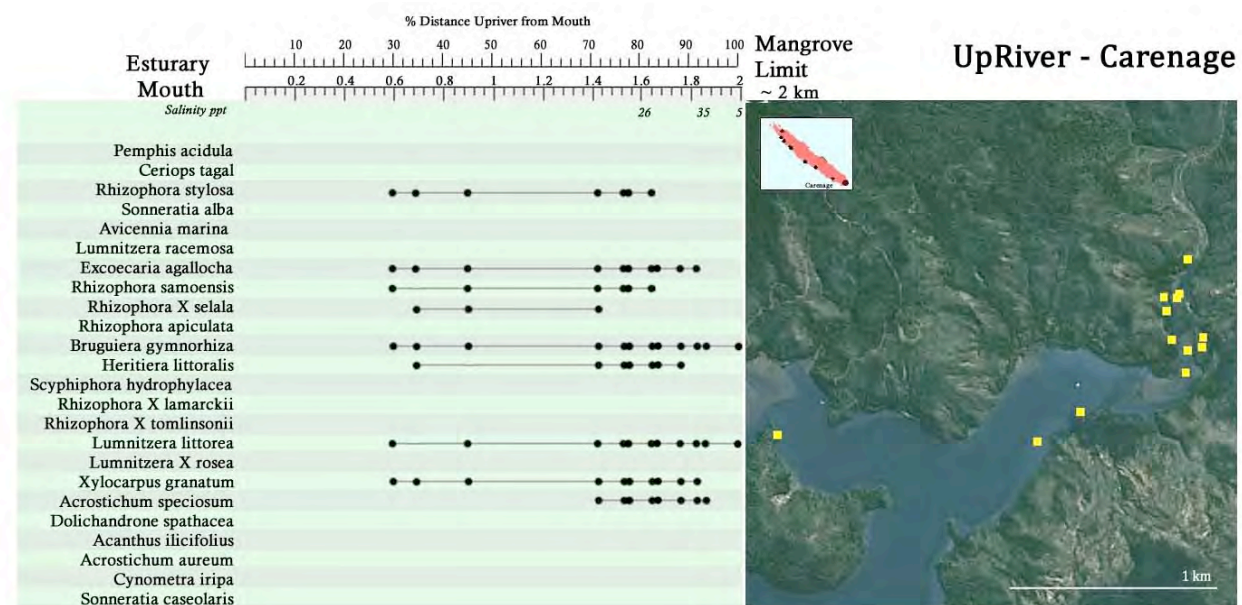


Figure 33 UpRiver distribution of mangroves in the Carenage River, New Caledonia. Red squares identify site locations surveyed during 2006, yellow squares identify 2009 survey locations.



Figure 34 Carenage River

4.5 Key to Mangrove and Saltmarsh Species of New Caledonia

The following key is intended for field use based on vegetative characters and habit. Sterile specimens may be identified using this key in the field, or by taking relevant field notes and using the key in the herbarium or laboratory. Plants identified using the keys should be checked against the appropriate description and illustration. Listed alphabetically by genus for descriptions. Herbarium specimens lodged with NOU are listed in Appendix 5.

Notes: * Species included in key based on herbarium record. Not recorded during surveys of the current project; no species description provided. ^Tidal wetland associate; no species description provided.

1. Fern on the ground 2
1. Tree, shrub..... 3
1. Succulent herb 26
1. Grass, seagrass 27
1. Climber, creeper with 3-5 leaflets *Derris trifoliata*
2. Large fronds, pinnae blunt, trunk *Acrostichum aureum*
2. Smaller fronds, pinnae pointed, trunkless..... *Acrostichum speciosum*
3. White, milky sap oozes from broken leaf or cut bark *Excoecaria agallocha*
3. No exuding white sap..... 4
5. Compound leaves 6
5. Simple leaves..... 8
6. Large flowers (>10 cm) and long terete curved seed pods.....
.....*Dolichandrone spathacea*
6. Small flowers (<1 cm) and compact rounded seed pod..... 7
7. Bivalve seed pod, deeply rugose and pubescent surface, no
pneumatophores or buttresses*Cynometra iripa**
7. Obscurely 4-valved seed pod, coriaceous, globose and often with plank
buttresses *Xylocarpus granatum*
8. Opposite leaves 9
8. Alternate leaves 23
9. Leaves densely pubescent under, giving silvery appearance.....
.....*Avicennia marina* var. *australasica*
9. Leaves not densely pubescent under 10
10. Leaves with spiny margins and flowers distinctly zygomorphic on a small
shrub rarely exceeding 2m tall *Acanthus ilicifolius*
10. Leaves never spiny, flowers never just zygomorphic on a shrub or tree 11

11. Propagules long (>6 cm), green and conspicuous attached to viviparous fruit, and shrub or tree has buttresses or prop roots..... 12
11. Propagules are fruits, rounded (<6 cm in diameter) not always green, not viviparous, and shrub or tree has no buttresses or prop roots..... 20
12. Fruit obscure within distinctly turbinate calyx tube which has 8-15 sepals *Bruguiera gymnorhiza*
12. Fruit, inverted pear-shaped with a mostly flat-expanded calyx tube and always <6 calyx sepals (lobes) 13
13. Mostly 5 calyx sepals, thick sinuous buttresses..... *Ceriops tagal*
13. Mostly 4 calyx sepals, sturdy prop roots 14. Genus *Rhizophora*
14. Leaf mucronate tip prominent, erect, mature flower buds rounded, inflorescences always bifurcate (2-branching) at first juncture 15
14. Leaf mucronate tip not erect, mature flower buds often 4-angled, inflorescences both bif- and trifurcate (3 branching) at first juncture 17
15. Mature flower buds and fruit below leaves in leafy shoot, bracts corky brown, petals with no marginal hairs, styles < 2 mm, stamens 10-12 *Rhizophora apiculata*
15. Mature flower buds and fruit within leaves in leafy shoot, bracts smooth green, petals with marginal hairs, stamens mostly 8 (rarely 6-9)..... 16
16. Mature flower buds <15 mm L, petal margins very hairy, petals fully enclosing stamens, calyx lobes <1 mm thick, mature fruits and hypocotyls seasonally present..... *Rhizophora stylosa*
16. Mature flower buds >15 mm L, petal margins minutely hairy, petals not enclosing stamens, calyx lobes >1 mm thick, mature fruits and hypocotyls not present..... *Rhizophora X lamarckii*
17. Leaf apex acute, leaf mucronate tip folded with length equal to width, mature fruits and hypocotyls never present 18
17. Leaf apex blunt, leaf mucronate tip a broad fold with length much less than the width, mature flower buds, mature fruits and hypocotyls regularly present 19
18. Leaf apex broadly acute, mature flower buds smooth, stamens 8, style >2 mm long, minutely bifurcate, petal margins wooly, calyx lobes < 1 mm thick..... *Rhizophora X selala*
18. Leaf apex sharply acute, mature flower buds with slight ribs at base of lobe sutures, stamens 11-18, style <2 mm long, deeply bifurcate, petal margins minutely hairy, calyx lobes > 1 mm thick..... *Rhizophora X tomlinsonii*

19. Inflorescences immature to mature, bi- or trifurcate at first juncture, bifurcate at second, includes mature flower buds, fruits and/or hypocotyls, stamens 8 *Rhizophora samoensis*
19. Inflorescences always immature, trifurcate at first and second junctures, never with mature flower buds, fruits and hypocotyls, stamens absent.....
..... *Rhizophora samoensis* var. *neocaledonica*
20. Stipules absent, fruits not ribbed..... 21
20. Stipules persistent, fruit small cylindrical, distinctly 8 ribbed seed pod
..... *Scyphiphora hydrophylacea*
21. Medium to large tree with large (>5 cm long) leaves, pencil-like to trunk-like pneumatophores which taper to a narrowly blunt point, fruits globular large (>3 cm diameter) 22. Genus *Sonneratia*
21. Shrub to small tree with small (<2 cm long) leaves, no pneumatophores, fruits not globular, small (<1 cm diameter) *Pemphis acidula*
22. Petals white if present; stamens white; Calyx smooth and shiny, fruit calyx cup-shaped, fruit diameter < 4 cm, less than or equal to hypanthium *Sonneratia alba*
22. Petals red, stamens red or white; Calyx leathery, fruit calyx flat-expanded, fruit diameter > 4 cm, mostly 0.5 cm or more, greater than hypanthium *Sonneratia caseolaris*
23. Leaves orbicular or deltoid, > 6 cm wide 24
23. Leaves elliptic, < 5 cm wide, glabrous 26. Genus *Lumnitzera*
24. Leaves concolorous; hairs small, rusty scales *Thespesia populneoides*[^]
24. Leaves discolorous; fine hairs or scales on lower surface silvery 25
25. Plank buttresses at stem base, keeled seed pod *Heritiera littoralis*
25. No buttresses at stem base, dried calyx seed pod *Hibiscus tiliaceus*[^]
24. Inflorescence axillary, style central, petals white, stamens equal or slightly exceeding petals, shrub or small tree to 8 m *Lumnitzera racemosa*
24. Inflorescence terminal, style off-centre 25
25. Petals pink, stamens equal or slightly exceeding petals..... *Lumnitzera X rosea*
25. Petals red, stamens twice as long as petals *Lumnitzera littorea*
26. Plant sprawling; leaves alternate; flowers inconspicuous, green-yellow
..... *Suaeda* species
26. Plant prostrate; leaves flattened, strap-like, opposite; flowers conspicuous, pink, 25-70 mm long *Sesuvium portulacastrum*
27. Often in stagnant, saline pools, flooded, occasionally dry *Ruppia maritima*

- 27. Mostly free-standing, rarely flooded 28
- 28. Stems prostrate, mat forming; inflorescence 3-5-armed *Cynodon dactylon*
- 28. Stems below ground, foliage erect; inflorescence spike-like *Sporobolus virginicus*

4.6 Descriptions of Individual Species with Specific Distribution Notes

***Acanthus ilicifolius* (Acanthaceae)**

Mangrove shrub, one species identified. The New Caledonian distribution of *Acanthus ilicifolius* is shown in Figure 35. The species was present in 27 of the 82 locations surveyed. Distributed from Diahot River (20° 16' S) in the north to Dumbéa River (22° 11' S) in the south. Present on the east coast of Australia to Fitzroy River estuary (23° 31' S). Extensive and common occurrences as dense low thickets bordering upstream water courses. Species notably present at the tidal limit of many arid coast estuaries in the west. Morphological characteristics appear normal (Duke 2006).

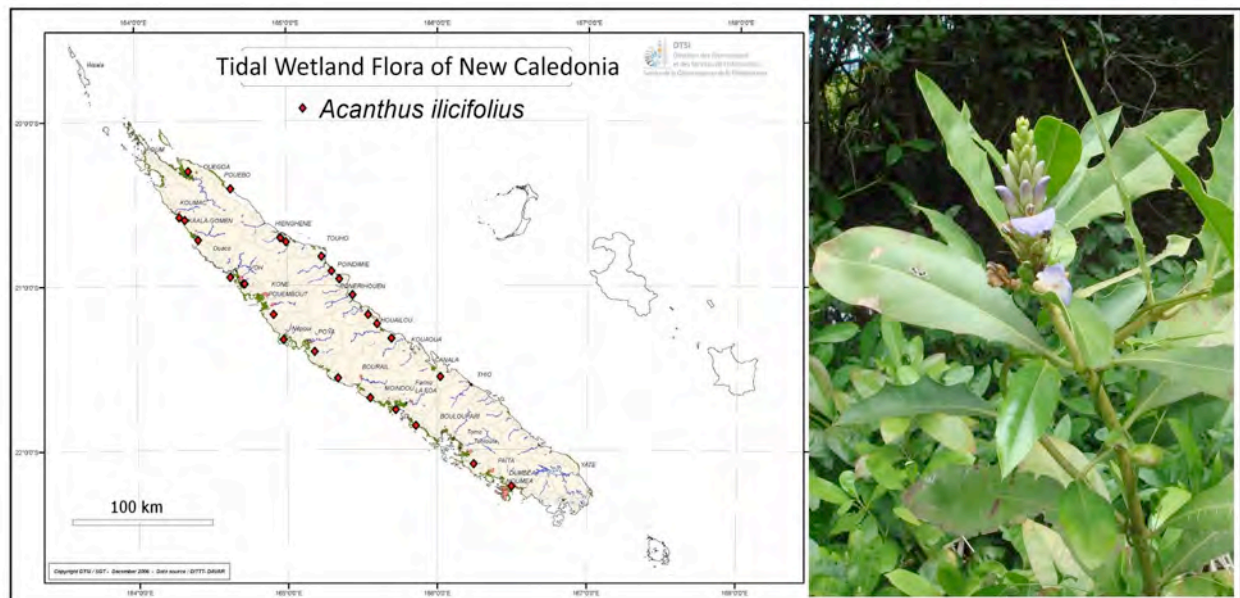


Figure 35 Distribution of *Acanthus ilicifolius* in New Caledonia (left); *A. ilicifolius* flower (right).

***Acrostichum* species (Pteridaceae)**

Mangrove fern, two species identified. The New Caledonian distribution of *Acrostichum* species, *A. aureum* and *A. speciosum*, is shown in Figure 36. *Acrostichum aureum* was present in 5 of the 82 locations surveyed. Distributed from Diahot River (20° 16' S) in the north to Canala River (21° 31' S) in the south. Recently observed on the east coast of Australia to Daintree River estuary (16° 17' S) (pers. observ.). *Acrostichum speciosum* present in 35 out of the 82 locations surveyed. Distributed from Diahot River (20° 16' S) in the north to Baie du Carénage (22° 20' S) in the south. Present on the east coast of Australia to Clarence River estuary (29° 26' S) (Duke 2006). Notable distributional preference separated these taxa. *Acrostichum aureum* located exclusively in upstream reaches overlapping with *A. speciosum* which is found in great profusion downstream within mid estuarine reaches and bordering higher tidal margins often associated with some seasonal freshwater influence.

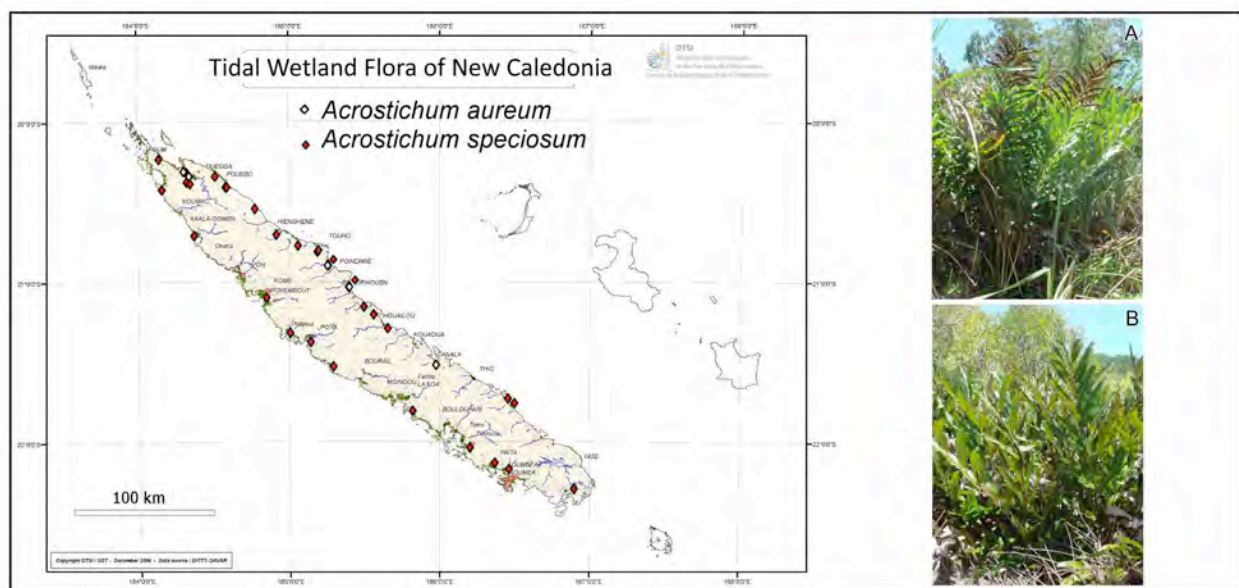


Figure 36 Distribution of *Acrostichum* species, *A. aureum* and *A. speciosum*, in New Caledonia (left); (A) *A. aureum* and (B) *A. speciosum* (right).

***Atriplex jubata* (Chenopodiaceae)**

Saltmarsh shrub, one species identified. *Atriplex jubata* is an endemic species of New Caledonia. A herbaceous procumbent shrub with flat, semi-succulent, serrated leaves. Leaves have distinctive scaly, bladder-like hairs which assist with salt secretion. Flowers are terminal and clustered with individuals being discrete and white to yellow in colour. *Atriplex* is an arid-zone genera. *Atriplex jubata* has low to moderate salt-tolerance, high drought tolerance and low waterlogging tolerance. This species can be found on the upper intertidal boundary of saltmarsh areas, but is more common on well-drained supratidal beach fronts. The New Caledonian distribution of *Atriplex jubata* is shown in Figure 37. The species was present in 6 of the 82 locations surveyed. Distributed from Arama (20° 25' S) in the north to Bouloupari (21° 93' S) in the south. Present in sites of very low rainfall (less than 1200 mm), and small catchment size mostly less than 200 km². Found in a few west coast sites and in the north at and above the high tide mark. *Atriplex* is a common dryland fodder plant for sheep and goats in arid regions. The limited distribution of this species in New Caledonia may be a result of heaving grazing by deer.

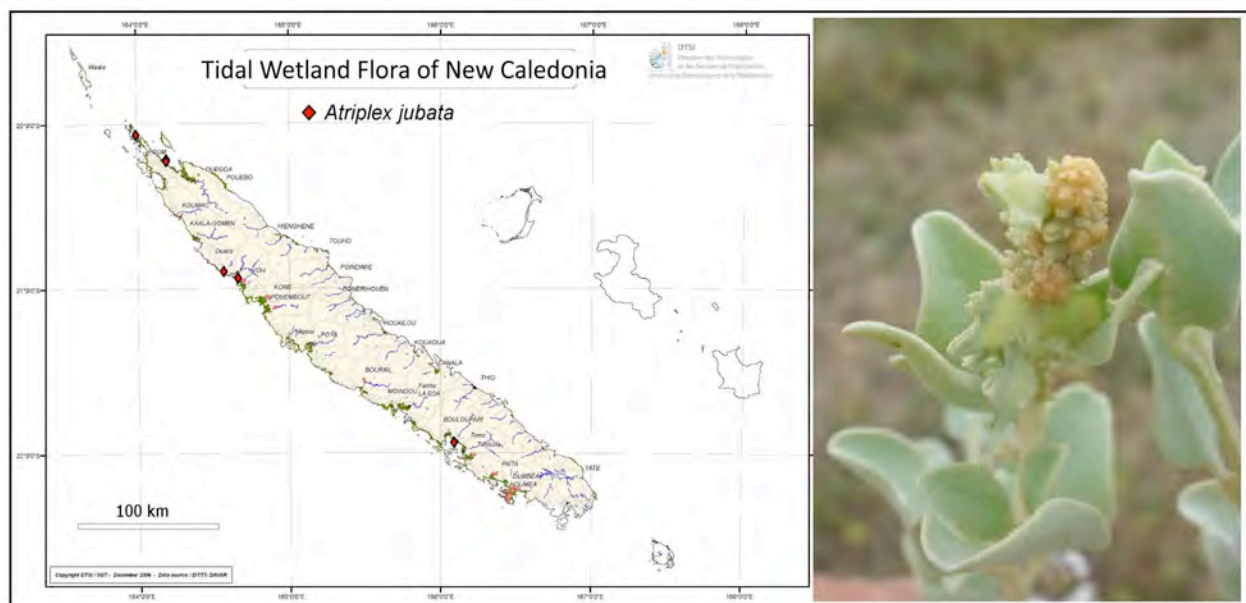


Figure 37 Distribution of *Atriplex jubata* in New Caledonia (left); *A. jubata* flower and leaves showing scaly, bladder-like hairs (right).

***Avicennia marina* (Avicenniaceae)**

Mangrove tree, one species identified. The New Caledonian distribution of *Avicennia marina* is shown in Figure 38. The species was present in 63 of the 82 locations surveyed. Distributed from Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Present on the east coast of Australia to Corner Inlet (38° 45' S) (Duke 2006). One species, one variety, var. *australasica*. Notably the same variety is found commonly in SE Australia and New Zealand. Contrasts with other mangrove species with traits showing Asian affinities, like *Sonneratia caseolaris* and *S. alba*. Plants observed as either taller trees or dense shrubbery and thickets. The latter form extensive areas across more arid areas bordering salt pans and salt marsh. In some locations, the species is heavily grazed, cropped and trampled by livestock, notably deer and cattle. In areas around Le Cap River estuary, significant *A. marina* stands have been killed by heavy grazing by deer.

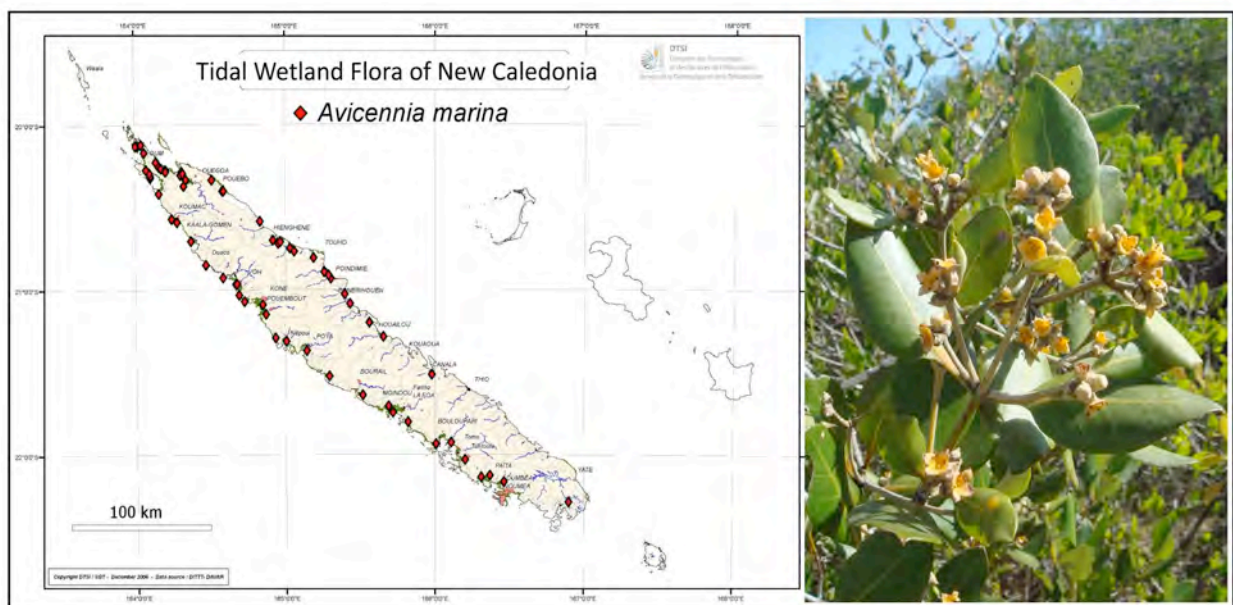


Figure 38 Distribution of *Avicennia marina* in New Caledonia (left); *A. marina* flowers (right).

***Baumea juncea* (Cyperaceae)**

Saltmarsh sedge, one species identified. The New Caledonian distribution of *Baumea juncea* is shown in Figure 39. The species was present in 7 of the 82 locations surveyed. Distributed from the Vavouto (Koniambo) (21° 01' S) in the north to Prony (22° 18' S) in the south. Found on sites scattered on the east and west coasts. Occurs in moderate but mostly low rainfall areas in varying catchment sizes. Found in low lying areas at the high intertidal.

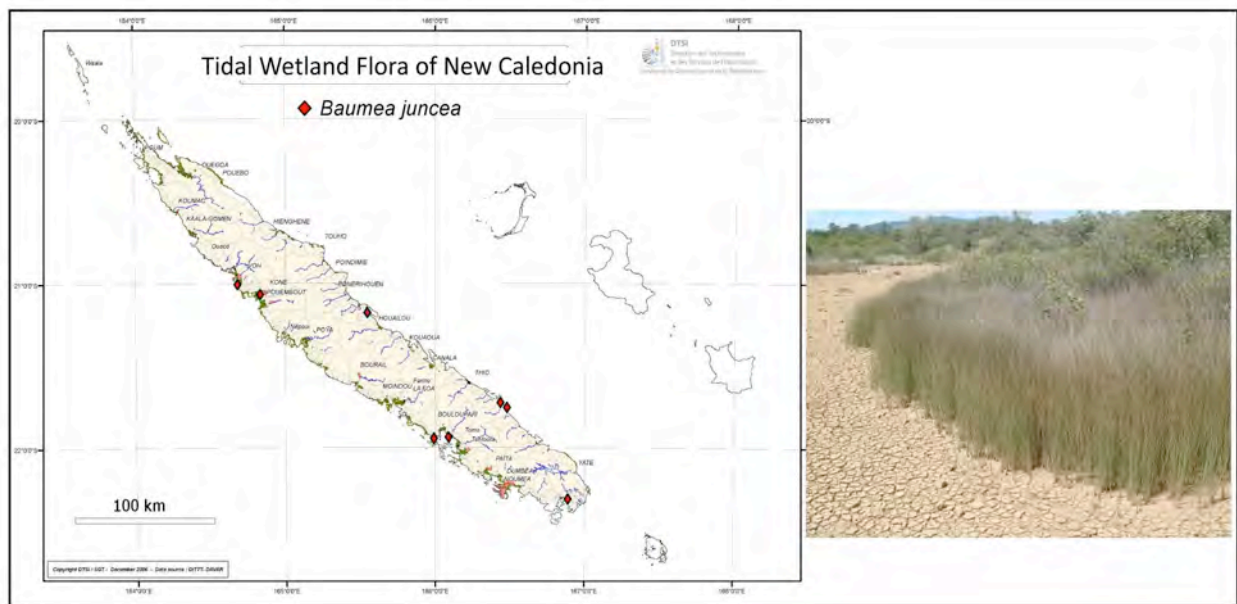


Figure 39 *Distribution of Baumea juncea in New Caledonia (left); B. juncea (right).*

***Bruguiera gymnorhiza* (Rhizophoraceae)**

Mangrove tree, one species identified. The New Caledonian distribution of *Bruguiera gymnorhiza* is shown in Figure 40. The species was present in 49 of the 82 locations surveyed. Distributed from Diahot River (20° 16' S) in the north to Baie du Carénage (22° 20' S) in the south. Present on the east coast of Australia to Moonee Creek estuary (30° 13' S) (Duke 2006). Two variants readily apparent – one with reddish coloration to foliage making it appear dark, compared with other individuals having only normal green pigment. The proportion of trees in this respective condition characterised some estuaries. Southern estuaries notably included greater numbers of 'red' trees. A comparable pigment character was notable in other locations, but there are no obvious connections between them – noting Fraser Island (NE Australia) and Yap Islands (Western Federated States of Micronesia). No corresponding other morphological characters were observed in 'red' and 'green' individuals.

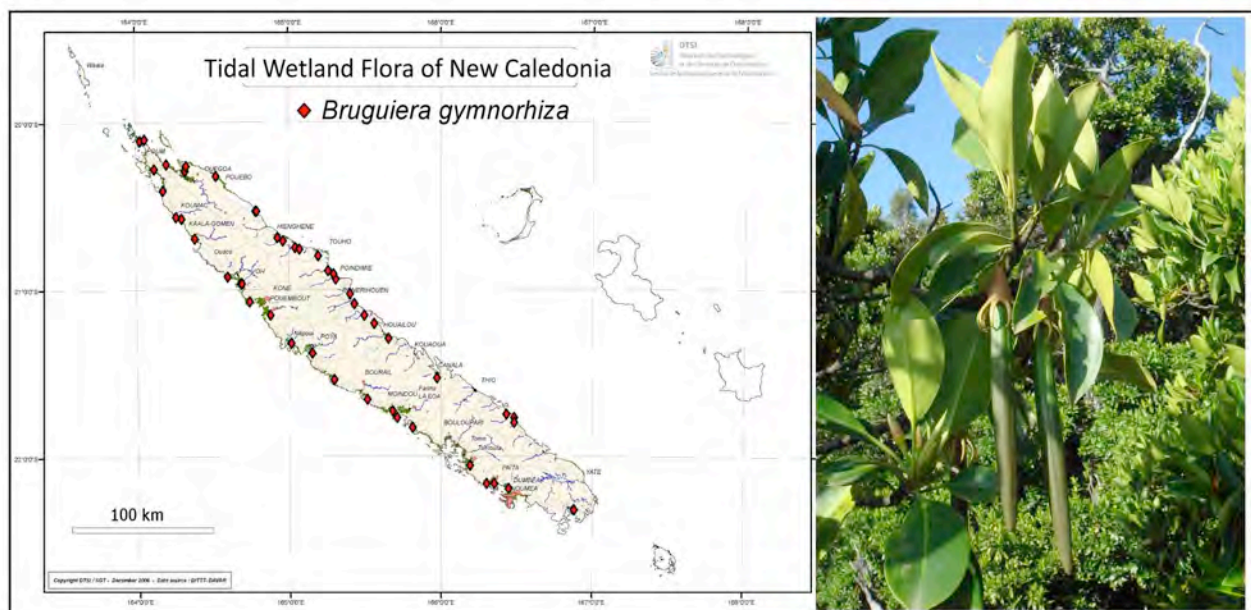


Figure 40 Distribution of *Bruguiera gymnorhiza* in New Caledonia (left); green colour morph of *B. gymnorhiza* with mature propagules (right).

***Ceriops tagal* (Rhizophoraceae)**

Mangrove small tree, one species identified. The New Caledonian distribution of *Ceriops tagal* is shown in Figure 41. The species was present in 4 of the 82 locations surveyed. Distributed only in the Diahot River (20° 16' S) in the north. Present on the east coast of Australia to Sarina Inlet estuary (21° 24' S) (Duke 2006). Confirmed as the *Ceriops* taxon having ribbed and long hypocotyls – as distinct from *C. australis*. No shorter versions observed signifying the singular occurrence of this taxon in New Caledonia. This is notable because at similar latitudes in Australia there is an increasing dominance of the shorter smoother *C. australis*. This identifies another component of an Asian mangrove flora connection.

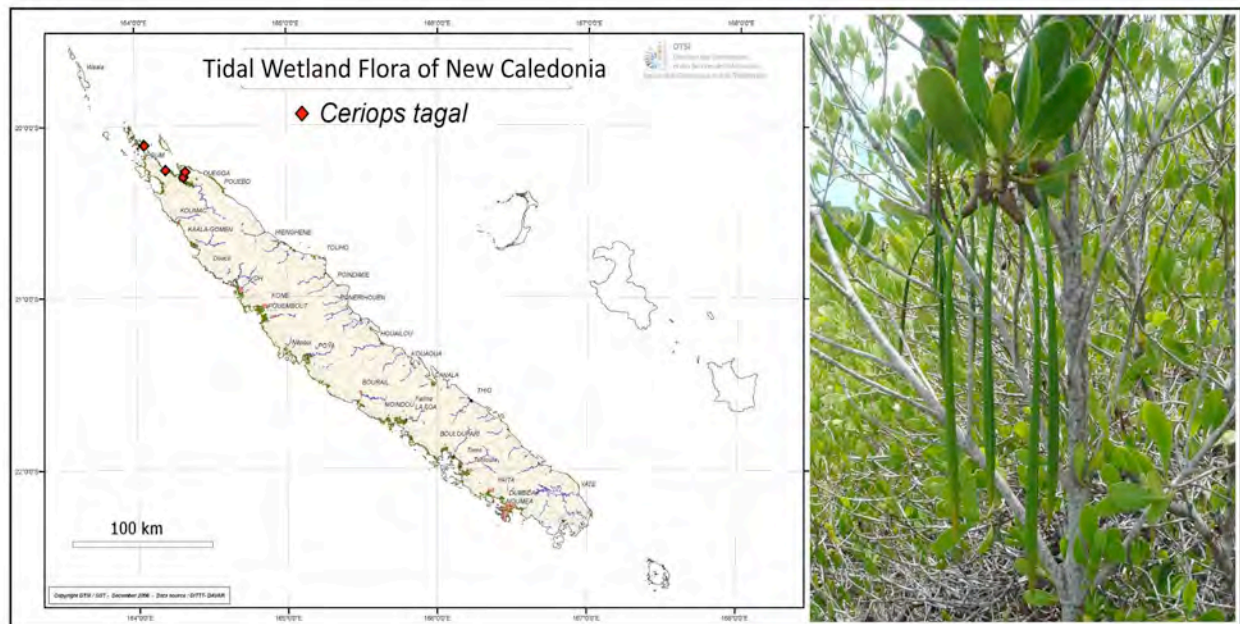


Figure 41 Distribution of *Ceriops tagal* in New Caledonia (left); *C. tagal* propagules (right).

***Cyperus javanicus* (Cyperaceae)**

Saltmarsh sedge, one species identified. The New Caledonian distribution of *Cyperus javanicus* is shown in Figure 42. The species was present in 30 out of the 82 locations surveyed. Distributed from the Poum (Tiabet) (20° 7' S) in the north to Canala (21° 31' S) in the south. Distributed in a range of wet and dry sites on the east and west coasts but more frequent in the north. Found above the high water mark, occurring often in much higher elevations also.

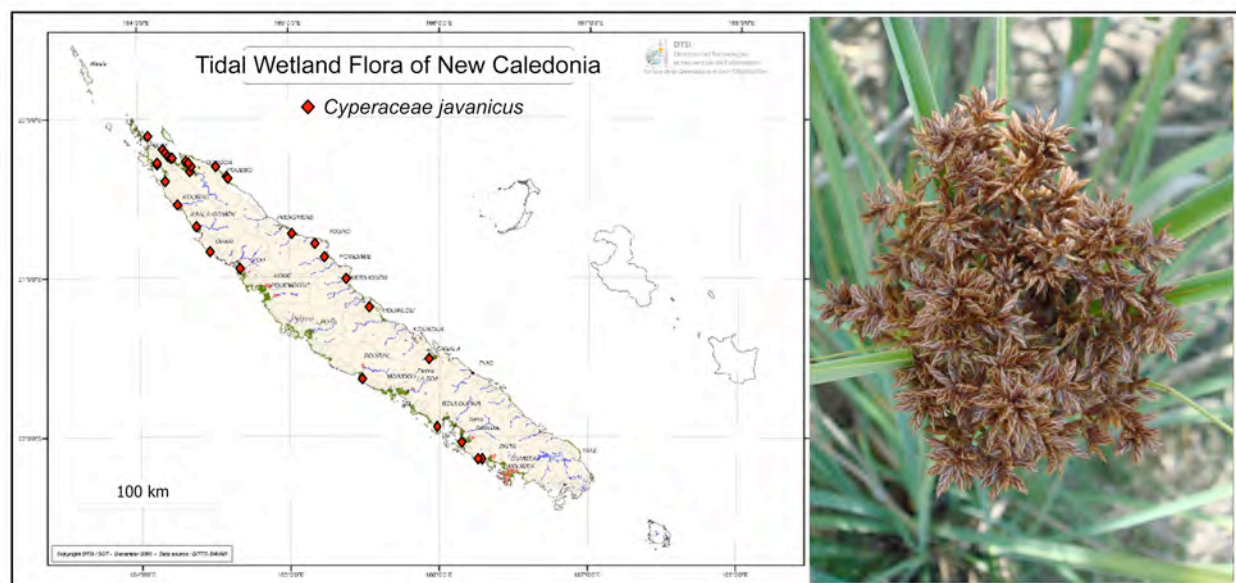


Figure 42 *Distribution of Cyperus javanicus in New Caledonia (left); C. javanicus flower (right).*

***Dolichandrone spathacea* (Bignoniaceae)**

Mangrove tree, one species identified. The New Caledonian distribution of *Dolichandrone spathacea* is shown in Figure 43. The species was present in 5 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to the Tchamba River (21° 01' S) in the south. Present on the east coast of Australia to Olive River estuary (12° 10' S) (Duke 2006). Notably present in relatively high latitude sites compared with Australia, making New Caledonia the southern most limit of this species. The species was found in upstream reaches and particularly along accreting banks of the main channel.

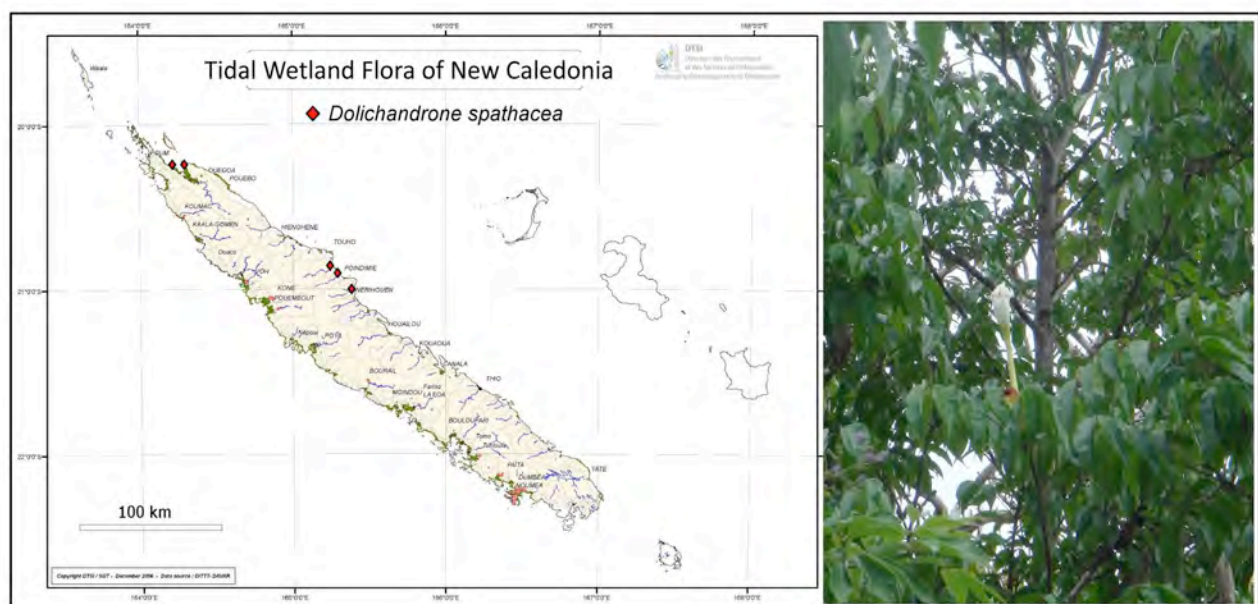


Figure 43 *Distribution of Dolichandrone spathacea in New Caledonia (left); D. spathacea flower (right).*

***Enchylaena tomentosa* (Chenopodiaceae)**

Saltmarsh succulent herb, one species identified. This is a new species listing for New Caledonia. Previously, *E. tomentosa* has been described as *Kochia hirsuta* (now *Bassia hirsuta*), a northern hemisphere dryland chenopod. However, the absence of hairy fruits and the biogeographical distributional continuity with other chenopods of the South-western Pacific, such as *Sarcocornia quinqueflora*, confirm the identification as *E. tomentosa*. This genera has previously been described as endemic to Australia, where there are 2 species. The occurrence of *E. tomentosa* in New Caledonia provides further evidence to support biogeographical linkages with the flora of Gondwanan Australia and the radiation of the austral-pacific chenopod species. *Enchylaena tomentosa* is a scrambling multi-stemmed shrub (up to 0.5m), with cylindrical, linear, succulent leaves, which often remain on the stem after senescence. This species is often confused with another similar succulent chenopod, *Sueada* sp. (NC), but is distinguished by the distinctive 5-lobed, berry-like, singular fruit forming at the base of leaves in the upper stem, and by the presence of hairs on the leaves and upper stem. Immature fruits are green and generally become red or yellow as the fruit ripens. In New Caledonia it appears that there is also a 6-lobed white-fruited variety (see Figure 45), which may be a new variety or species and requires further investigation. Two varieties of *E. tomentosa* have previously been described in Australia, both of which appear to be represented in New Caledonia. *Enchylaena tomentosa* (var. *tomentosa*) has distinctly hairy stems and leaves giving stems a velvety appearance (Figure 45) whereas *E. tomentosa* (var. *glabra*) has hairs present, but are less obvious.

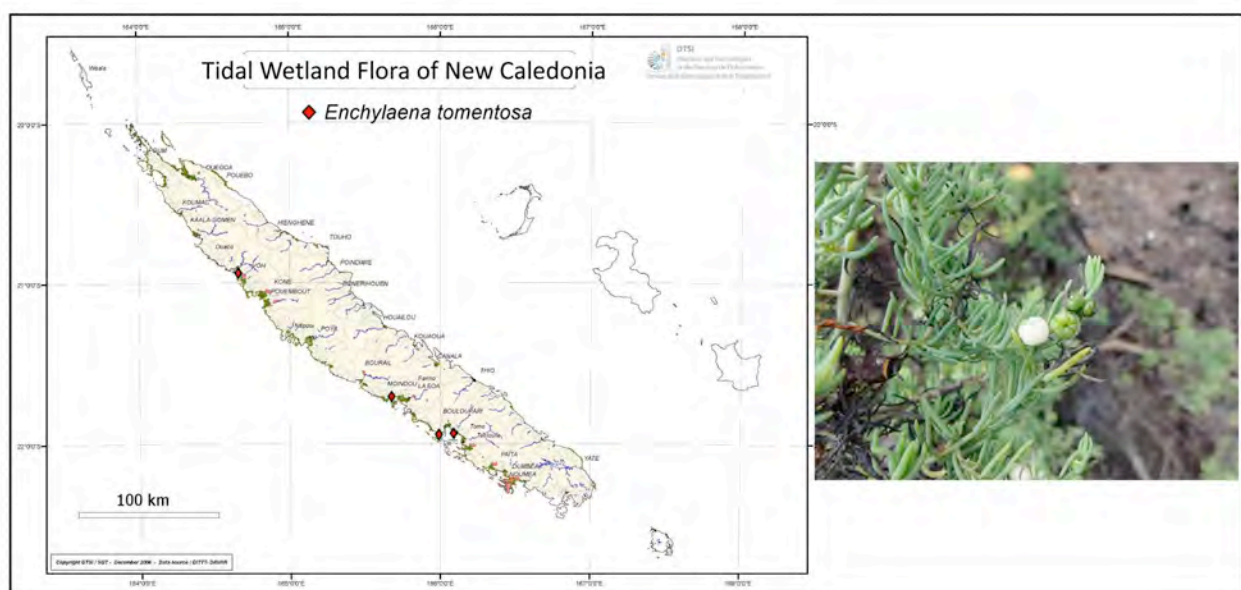


Figure 44 *Distribution of Enchylaena tomentosa* in New Caledonia (left); *E. tomentosa* with a white fruit (right).

Enchylaena tomentosa has low to moderate salinity tolerance, high drought tolerance and low waterlogging and inundation tolerance. This species occurs as isolated individuals in the upper-intertidal zone, often growing amongst dense *Sporobolus virginicus* and upper-intertidal mangrove trees. It is not found beyond the supra-tidal zone and only occurs in or directly adjacent to intertidal flats. The New Caledonian distribution of *E. tomentosa* is shown in Figure 44. The species was present in 3 out of the 82 locations surveyed. Distributed from the La Foa area (21° 44' S, 165° 44' E) in the south to Voh (20° 60' S, 164° 42' E) in the north. Occurs mainly along the west coast in sites of less than 1200mm rainfall. Distribution is related to habitat availability and the presence of extensive tidal areas of low topographical relief, with high alluvial deposits in protected embayments.



Figure 45 *Enchylaena tomentosa* (var. *tomentosa*) showing fine hairs along the stem.

***Excoecaria agallocha* (Euphorbiaceae)**

Mangrove tree, one species identified, but two normal forms noted as separate male and female trees. The New Caledonian distribution of *Excoecaria agallocha* is shown in Figure 46. The species was present in 73 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Baie du Carénage (22° 20' S) in the south. Present on the east coast of Australia to Manning River estuary (31° 53' S) (Duke 2006). In New Caledonia, this species is widespread and common. No special morphological characters were observed.

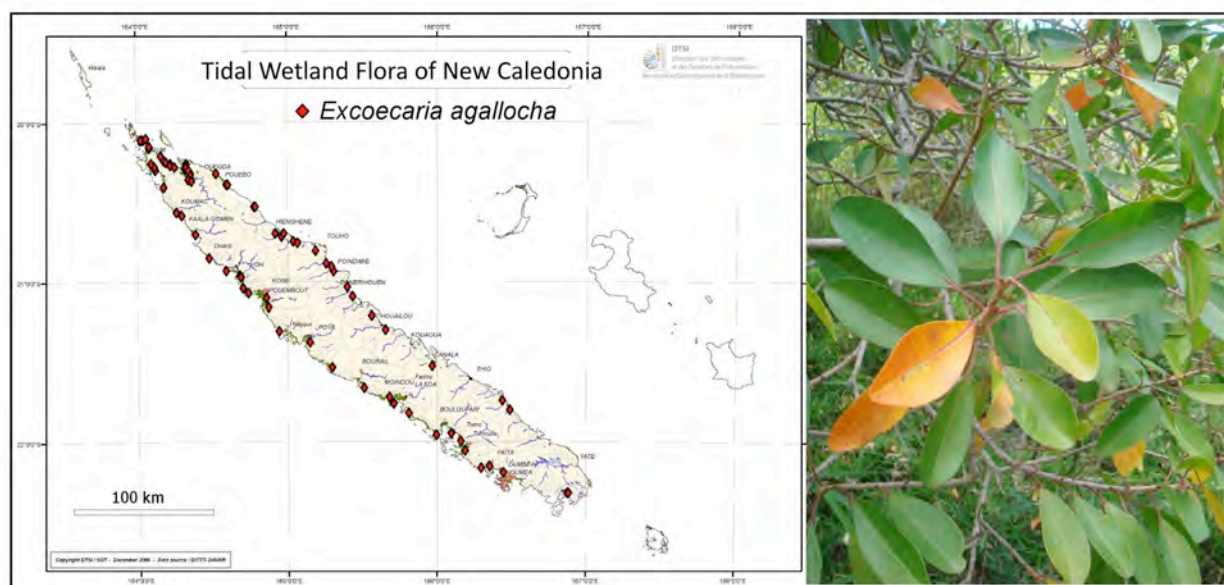


Figure 46 *Distribution of Excoecaria agallocha in New Caledonia (left); E. agallocha leaves (right).*

***Fimbristylis* species (Cyperaceae)**

Saltmarsh sedge, three species of *Fimbristylis* identified, *F. polytrichoides*, *F. ferruginea* and *F. cymosa*. Their New Caledonian distributions are shown in Figure 47. These species were present at 8 (*F. polytrichoides*), 45 (*F. ferruginea*), and 20 (*F. cymosa*) of the 82 surveyed locations. Distribution of *F. polytrichoides* is from the Diahot estuary (20° 16' S) in the north to Dumbea (22° 10' S) in the south. *Fimbristylis ferruginea* has a larger range with a northern limit at Arama (20° 12' S) and a southern limit at Dumbea (22° 10' S). *Fimbristylis cymosa* distribution is from Arama (20° 14' S) to Boulouparis (21° 56' S) in the south. *Fimbristylis polytrichoides* and *F. ferruginea* are found in varying rainfall and catchment size conditions. *Fimbristylis cymosa* tends to occur in areas of moderate to low rainfall, catchment size varies. All species found at and above the high water mark.

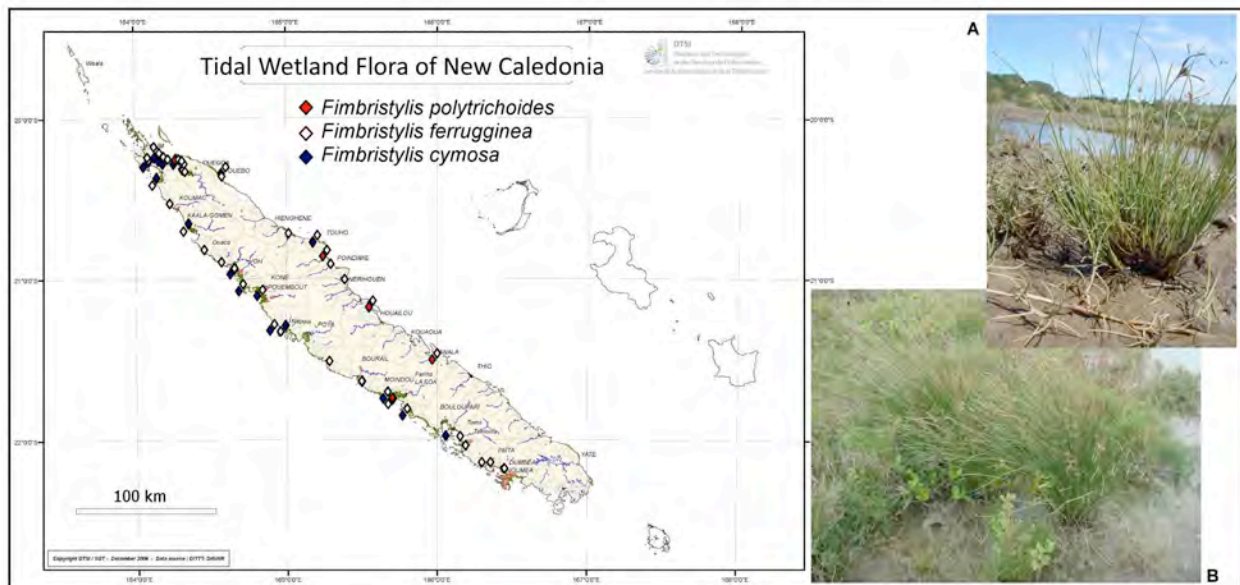


Figure 47 Distribution of *Fimbristylis* spp. in New Caledonia (left); (A) *F. cymosa* and (B) *F. ferruginea* (right).

***Heritiera littoralis* (Sterculiaceae)**

Mangrove tree, one species identified. The New Caledonian distribution of *Heritiera littoralis* is shown in Figure 48. The species was present in 22 out of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Present on the east coast of Australia to St Lawrence estuary (22° 15' S) (Duke 2006). Extensive and common occurrences. No special morphological characters noted.

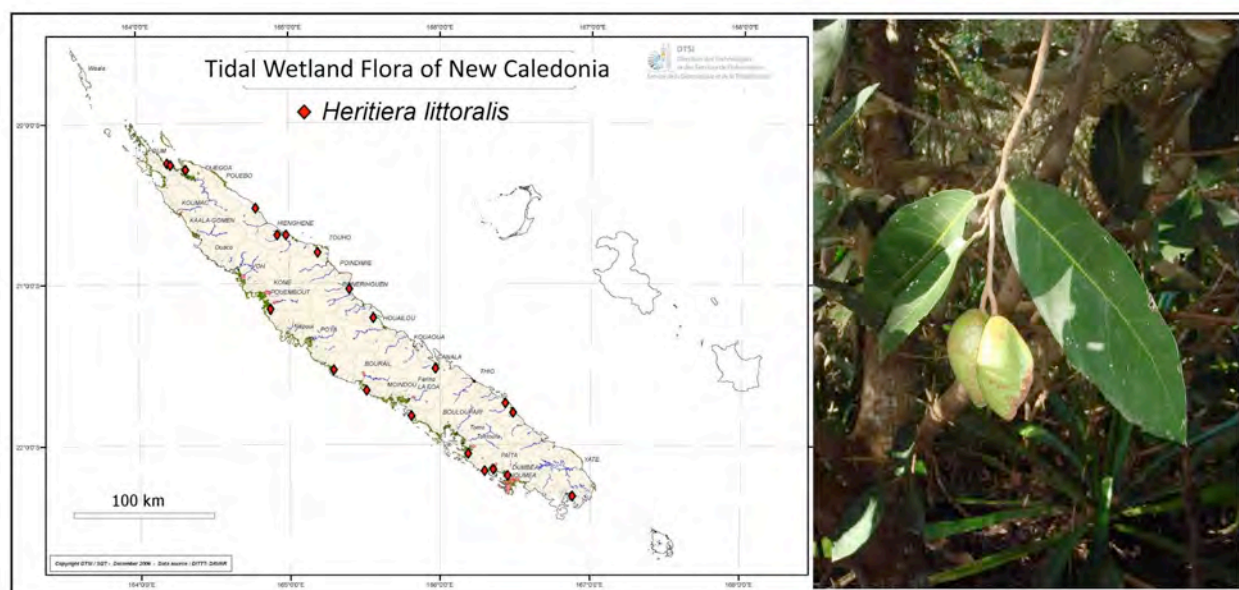


Figure 48 *Distribution of Heritiera littoralis in New Caledonia (left); H. littoralis propagules (right).*

***Limonium tetragonum* (Plumbaginaceae)**

Saltmarsh herb, one species identified. The New Caledonian distribution of *Limonium tetragonum* is shown in Figure 49. The species was present in 9 out of the 82 locations surveyed. Distributed from Arama (Pu Jam) (20° 12' S) in the north to Dumbea (22° 10' S) in the south. Occurring in sites of low rainfall (1200mm and less) and unrelated to catchment size. Restricted to the west coast at an above the high tide mark.

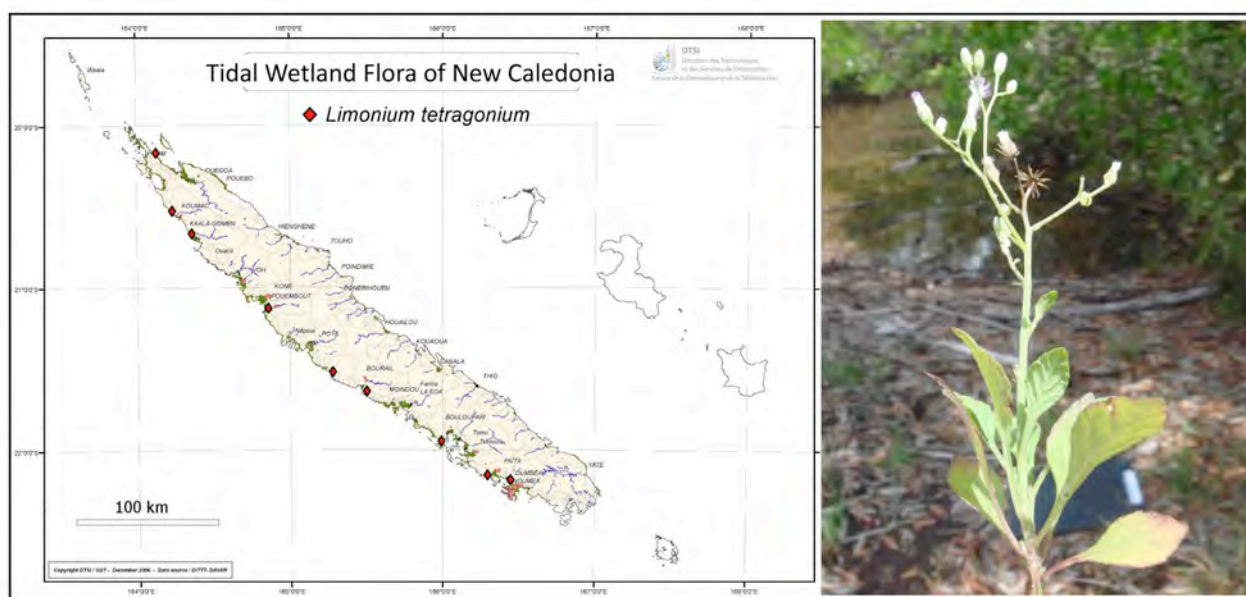


Figure 49 *Distribution of Limonium tetragonum in New Caledonia (left); L. tetragonum inflorescence (right).*

***Lumnitzera* species (Combretaceae)**

Mangrove small tree, two species and one hybrid identified. The New Caledonian distribution of *Lumnitzera* species, *L. littorea*, *L. racemosa* and hybrid *L. X rosea* is shown in Figure 50. *Lumnitzera littorea* was present in 19 out of the 82 locations surveyed. Distributed from Balade (20° 18' S) in the north to Baie du Carénage (22° 20' S) in the south. Present on the east coast of Australia to Herbert River estuary (18° 31' S) (Duke 2006). The New Caledonian record sets the southern latitudinal limit of the species. *Lumnitzera racemosa* was present in 50 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Present on the east coast of Australia to Southern Moreton Bay (27° 04' S) (Duke 2006). *Lumnitzera X rosea* was present in 4 of the 82 locations surveyed. Distributed from Sud Néhoué (20° 24' S) in the north to near Tontouta (22° 02' S) in the south. Present on the east coast of Australia to Missionary Bay (18° 16' S) (Duke 2006).

The New Caledonian records represent the most numerous observations of this taxon anywhere. There were notable occurrences of hybrid stands when both parent species were located in close proximity. There were notable differences in tree morphology, with hybrids forming open thickets while *L. littorea* occurred as small trees and dense thickets with darker foliage, and *L. racemosa* were present as low density canopy small trees with lighter green foliage. No fruits were observed on hybrid trees and shrubs.

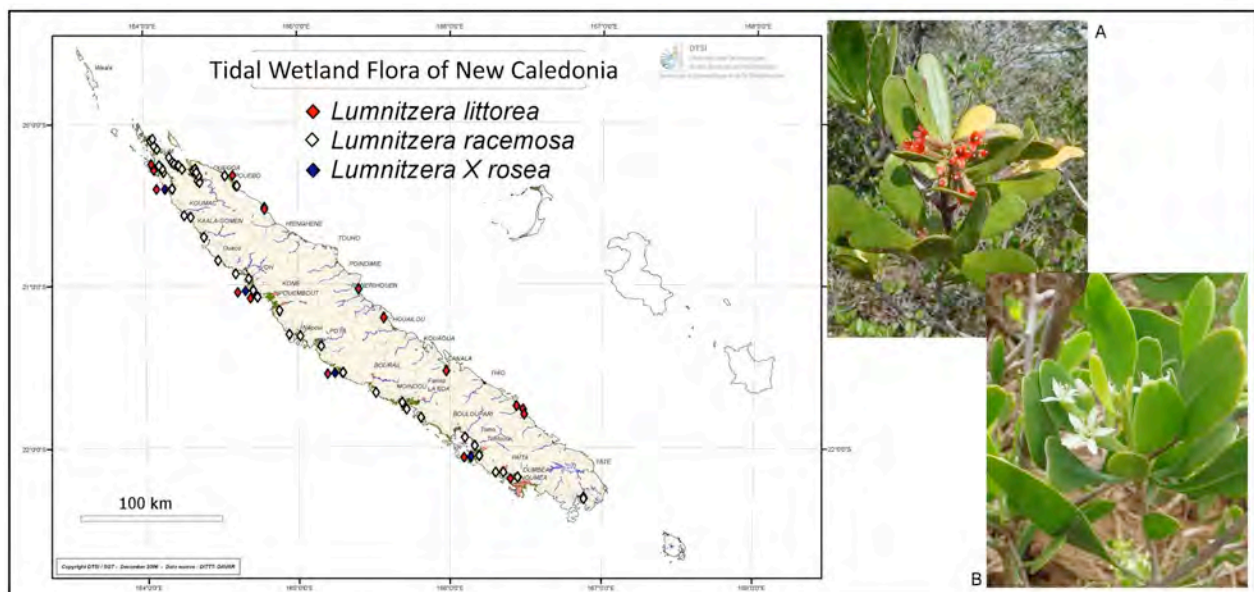


Figure 50 Distribution of *Lumnitzera* species, *L. littorea*, *L. racemosa* and hybrid *L. X rosea*, in New Caledonia (left); (A) *L. littorea* and (B) *L. racemosa* flower (right).

***Pemphis acidula* (Lythraceae)**

Mangrove shrub, one species identified. The New Caledonian distribution of *Pemphis acidula* is shown in Figure 51. The species was present in 8 of the 82 locations surveyed. Distributed only on the west coast at Koumac (Ouanac – Koumac) River mouth (20° 34' S). Present on the east coast of Australia to Bustard Head (24° 01' S) (Duke 2006). There are expected to be greater occurrences in shoreline stands, however these areas were not included in the current survey. Notable presence in dry north-western site. No unusual morphological characteristics observed.

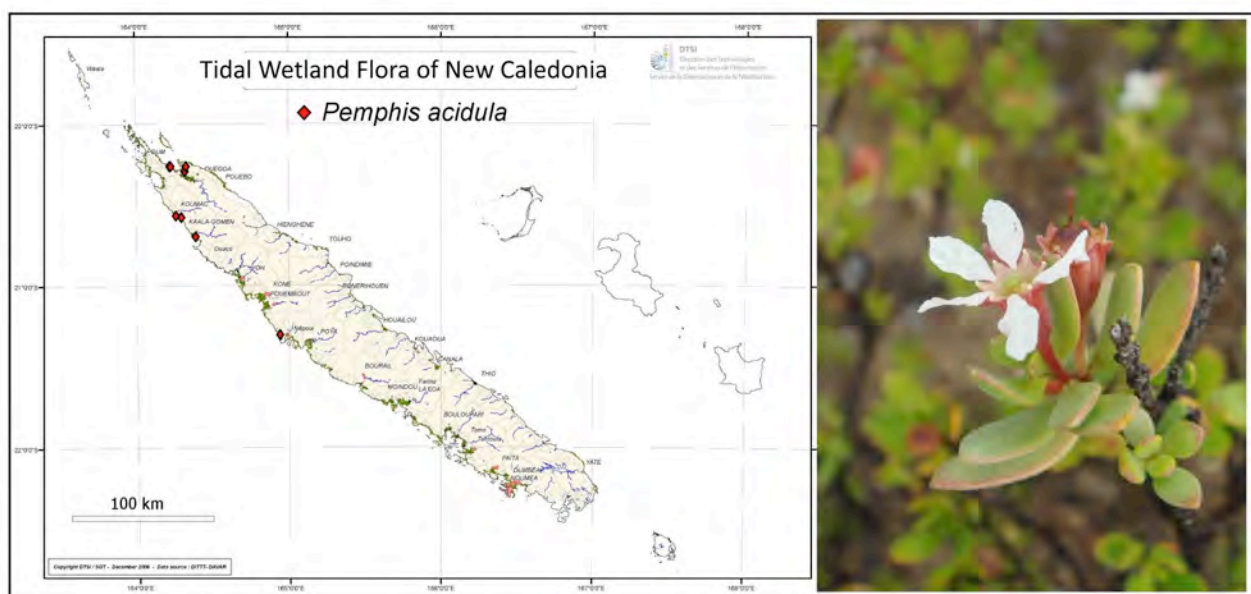


Figure 51 Distribution of *Pemphis acidula* in New Caledonia (left); *P. acidula* flower (right).

***Rhizophora* species (Rhizophoraceae)**

Mangrove tree, three species and three hybrids identified. The New Caledonian distribution of six *Rhizophora* taxa shown in Figures 52, 53, 54. Taxa include: *Rhizophora apiculata*, *R. X lamarckii*, *R. X tomlinsonii* (newly described), *R. samoensis*, *R. X selala* and *R. stylosa*. *Rhizophora apiculata* is present in 17 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Canala River (21° 31' S) in the south. Present on the east coast of Australia to Port Clinton (22° 35' S) (Duke 2006). *Rhizophora X lamarckii* present in 12 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Canala River (21° 31' S) in the south. Present on the east coast of Australia to Port Clinton (22° 35' S) (Duke 2006). *Rhizophora X tomlinsonii* present in 5 of the 82 locations surveyed. Distributed from Tanghène River (20° 41' S) in the north to Canala River (21° 31' S) in the south. Not present on the east coast of Australia. *Rhizophora samoensis* present in 45 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Not present on the east coast of Australia. *Rhizophora X selala* present in 47 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Not present on the east coast of Australia. *Rhizophora stylosa* present in 55 out of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Baie du Carénage (22° 20' S) in the south. Present on the east coast of Australia to South West Rocks (30° 53' S) (Duke 2006).

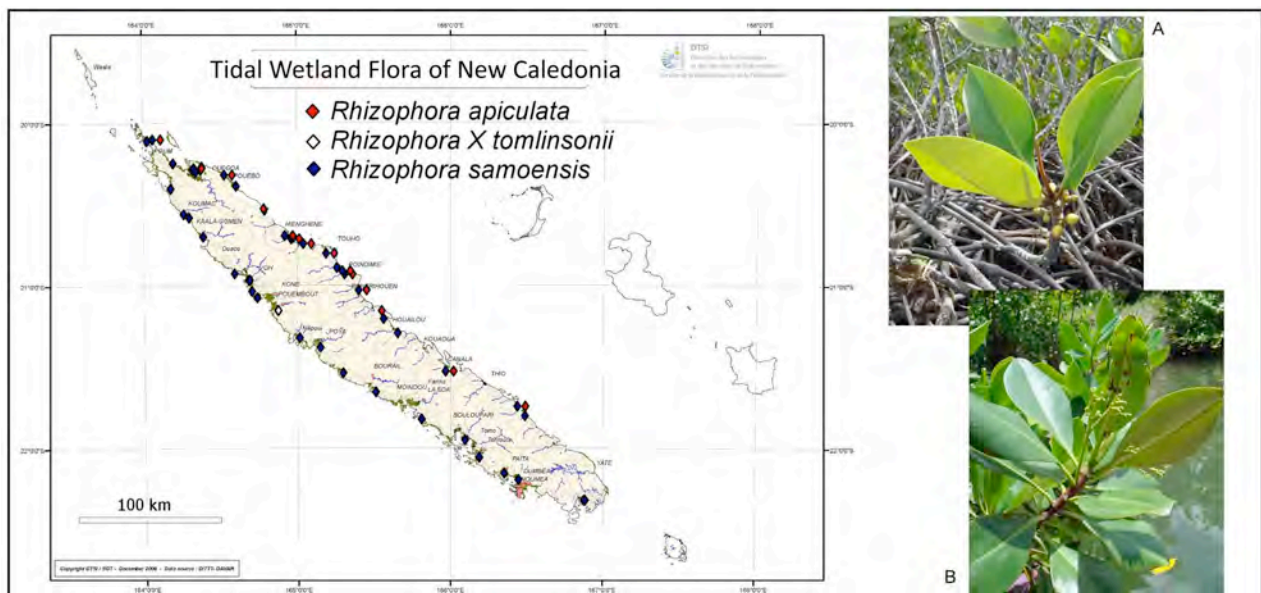


Figure 52 Distribution of *Rhizophora* species, *R. apiculata*, *R. samoensis* and hybrid *R. X tomlinsonii* (newly described), in New Caledonia (left); (A) *R. apiculata* leaves and (B) *R. X tomlinsonii* leaves (right).

It is abundantly clear that *Rhizophora* species thrive in New Caledonia. In every estuary, *Rhizophora* thickets dominate the shoreline and extend in dense stands. Their range upstream is extensive also often reaching the uppermost tidal reaches in every case. There is also clear separation of taxa along tidal and estuarine gradients. *Rhizophora stylosa* are located downstream mostly as frontal thickets. *Rhizophora samoensis* (comparable to *R. mangle* from the Atlantic East Pacific region) was often observed as dense low thickets along accreting banks of upstream estuarine reaches.

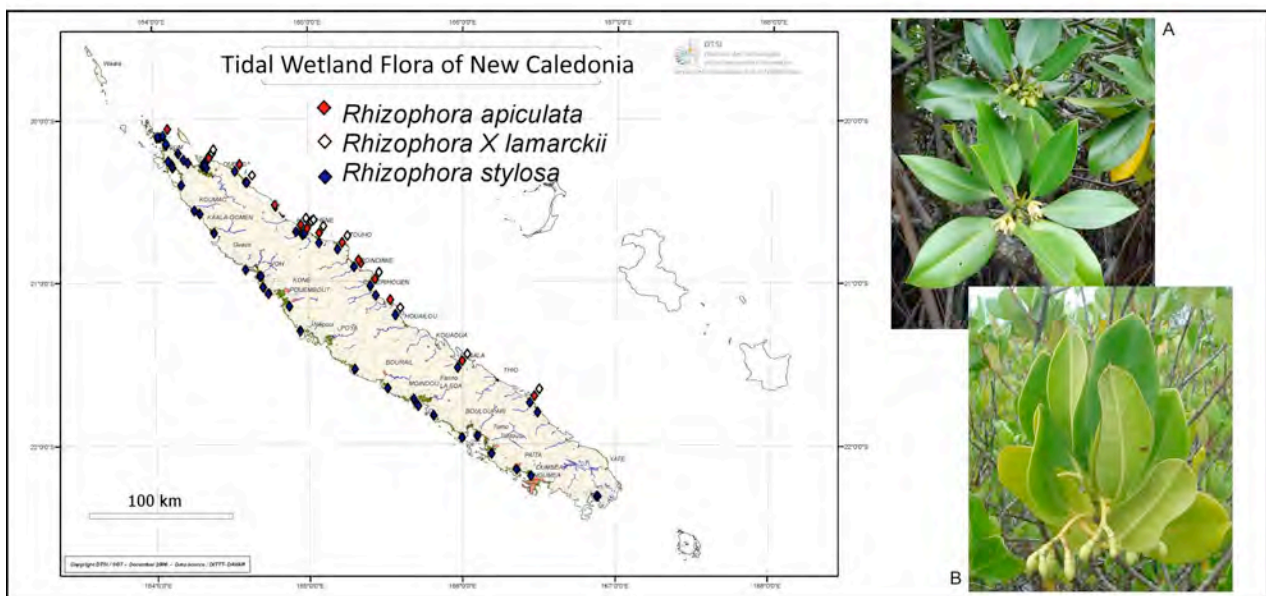


Figure 53 Distribution of *Rhizophora* species, *R. apiculata*, *R. stylosa* and hybrid *R. X lamarckii*, in New Caledonia (left); (A) *R. X lamarckii* flowers and (B) *R. stylosa* flower buds (right).

Rhizophora apiculata was usually found along middle reaches of larger estuaries with greater freshwater influence. The three hybrids appear distributed in between and overlapping with parental forms. All taxa occurred in upper tidal levels. The most common hybrid was *R. X selala*, followed by *R. X lamarckii* and lastly, *R. X tomlinsonii*. The newly identified hybrid was relatively rare, notably restricted firstly to occurrences of both parent species, and then to midstream estuarine reaches of larger freshwater influenced estuaries.

Herbarium voucher samples lodged with NOU:

- *Rhizophora*. X *tomlinsonii*: NC 22 (Tanghene River), NC 24 (Tiwae River), NC 28 (Canala River).
- *Rhizophora apiculata*: NC 29 (Canala River).
- *Rhizophora* X *lamarckii*: NC 33 (Canala River).
- *Rhizophora* X *selala*: NC 31 (Canala River).
- *Rhizophora samoensis*: NC 30 (Canala River).
- *Rhizophora stylosa*: NC 32 (Canala River).

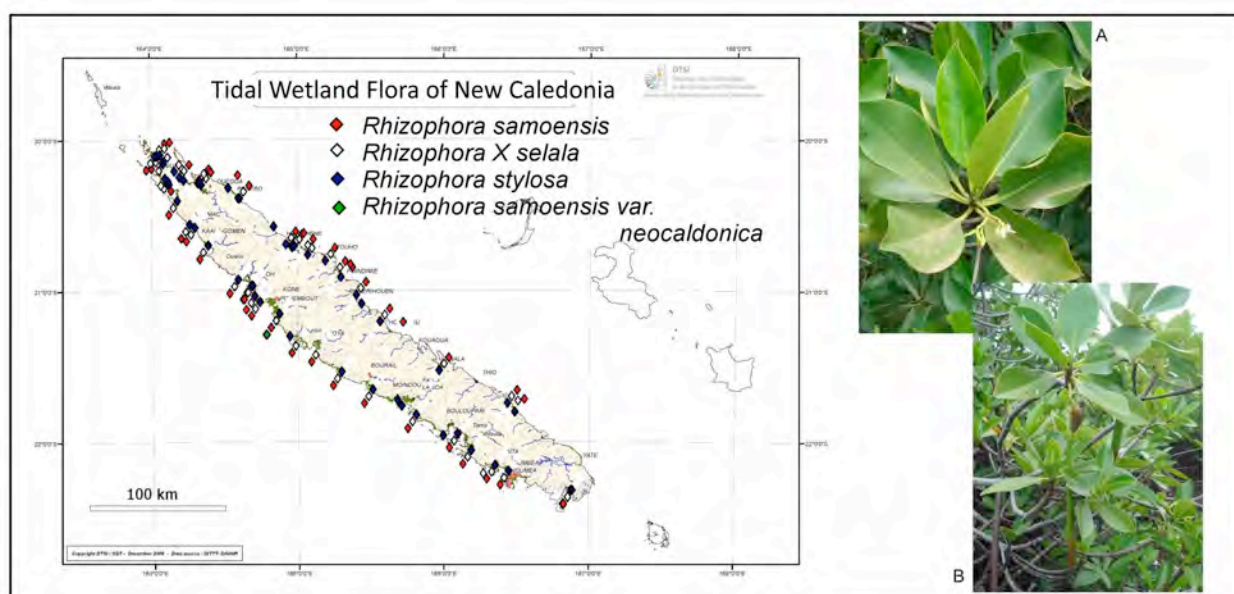


Figure 54 Distribution of *Rhizophora* species, *R. samoensis*, *R. stylosa*, hybrid *R. X selala* and *R. samoensis* var. *neocaldonica* in New Caledonia (left); (A) *R. X selala* flowers and (B) *R. samoensis* leaves (right).

***Rhyncosphora corymbosa* (Cyperaceae)**

Saltmarsh sedge, one species identified. The New Caledonian distribution of *Rhyncosphora corymbosa* is shown in Figure 55. The species was present in 17 out of the 82 locations surveyed. Distributed from the Arama (Pu Jam) (20° 12' S) in the north to Saint Jean Baptiste (21° 47' S) in the south. Distributed in a range of wet and dry sites on the east and west coasts but more frequent in the north. Found above the high water mark, often bordering low lying freshwater seeps and stream margins.

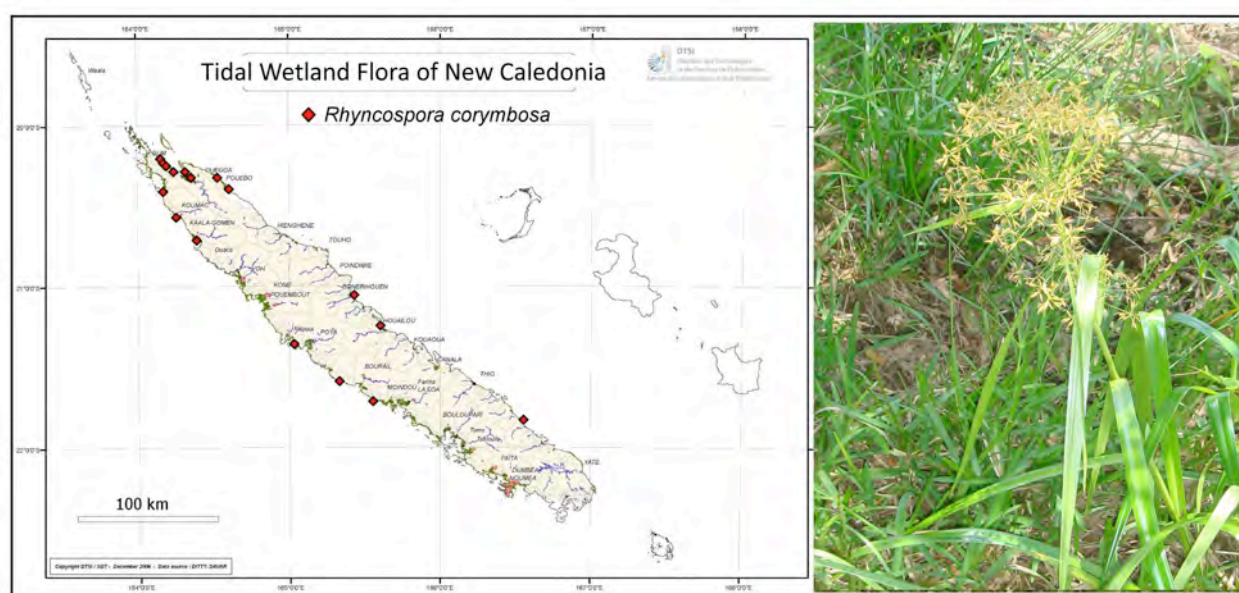


Figure 55 *Distribution of Rhyncosphora corymbosa* in New Caledonia (left); *R. corymbosa* flowers (right).

***Ruppia maritima* (Ruppiaceae)**

Saltmarsh seagrass of the upper intertidal zone, one species identified. The New Caledonian distribution of *Ruppia maritima* is shown in Figure 56. The species was present in 6 of the 82 locations surveyed. Distributed from Poum (20° 5' S) in the north to Poya (21° 22' S) in the south. Occurring in sites receiving relatively low rainfall levels (1300mm and less), mainly in the north west areas of Grand Terre. Grows in pools and low lying areas within the upper intertidal zone. In some instances plants are observed to dry out during neap tide periods. Salinities were usually measured at >40ppt. Herbarium voucher specimens lodged with NOU (see appendix 5).

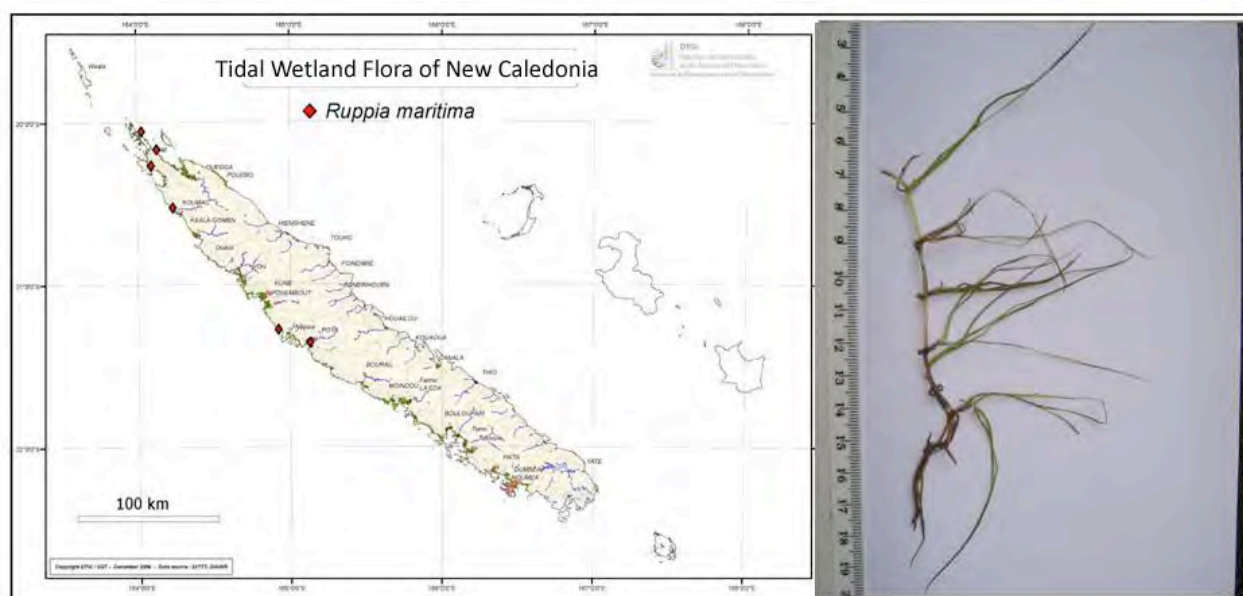


Figure 56 *Distribution of Ruppia maritima* in New Caledonia (left); *R. maritima* (right)

***Sarcocornia quinqueflora* (Chenopodiaceae)**

Saltmarsh leafless succulent herb, one species identified. *Sarcocornia quinqueflora* has a spreading, procumbent habit and often roots at the nodes, with stems growing upright. Flowers are embedded in the stem nodes of terminal spikes with 5-9 yellow or white flowers with a solitary petal in a single row. The fruiting body occurs as thickened segmented rings at the stem nodes on terminal spikes which harden and dry as the seed matures. Stem colour can vary from bright red to green. There appears to be two distinct colour-morphs in New Caledonia a green-yellow morph and a red-morph. Both can be seen growing together in distinctive patches. *Sarcocornia* has high salt tolerance, moderate drought tolerance and high water-logging tolerance, but cannot withstand extended periods of flooding. This species appears to require moderate salt levels and some sediment moisture to maintain internal water balance which excludes it growing in the upper-intertidal zone. The New Caledonian distribution of *Sarcocornia quinqueflora* is shown in Figure 57. The species was present in 15 out of the 82 locations surveyed. Distributed from the Kone area (21° 5' S) in the north to Dumbea (22° 10' S) in the south. Occurs mainly along the west coast in sites of less than 1300mm rainfall. Distribution is unrelated to catchment size. Commonly found on the salt flats below the high tide level.

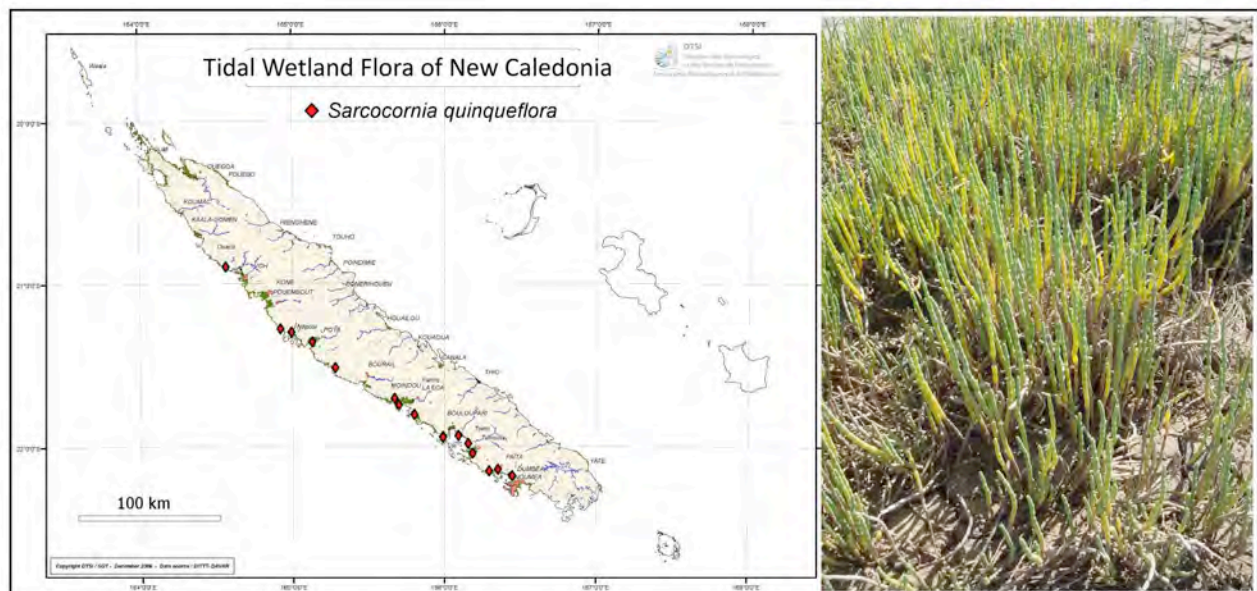


Figure 57 *Distribution of Sarcocornia quinqueflora* in New Caledonia (left); green-yellow colour-form of *S. quinqueflora* (right)

***Salsola kali* (Chenopodiaceae)**

Saltmarsh leafy herb, one species identified. The New Caledonian distribution of *Salsola kali* is shown in Figure 58. *Salsola kali* distribution was restricted to one of the 82 sites, Poup, in the far north of New Caledonia (20° 6' S). Rainfall at 1200mm and a small catchment size. Grows at or above the high tide level, similar to *Atriplex jubata*.

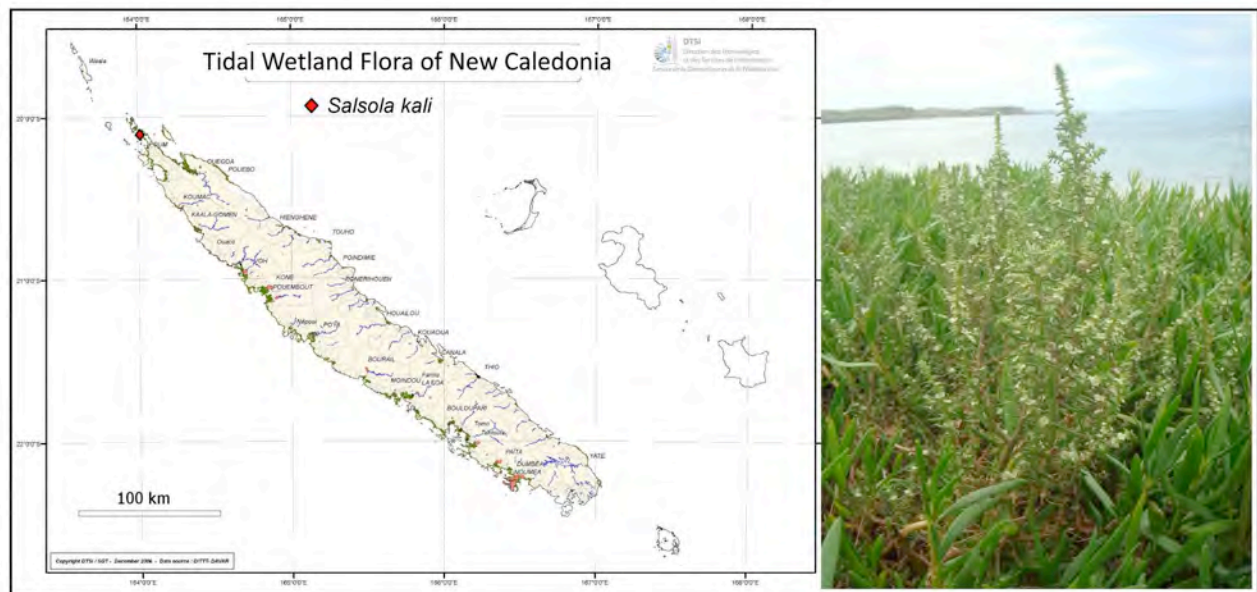


Figure 58 *Distribution of Salsola kali* in New Caledonia (left); *S. kali* flower (right).

***Shoenoplectus* sp. (Cyperaceae)**

Saltmarsh sedge, one species identified. The New Caledonian distribution of *Shoenoplectus* sp. is shown in Figure 59. The taxon was present in 16 out of the 82 locations surveyed. Distributed from the Diahot estuary (20° 16' S) in the north to Baie du Carénage (22° 18' S) in the south. Distributed in a range of wet and dry sites on the east and west coasts. Found above the high water mark, often bordering low lying fresh water seeps.

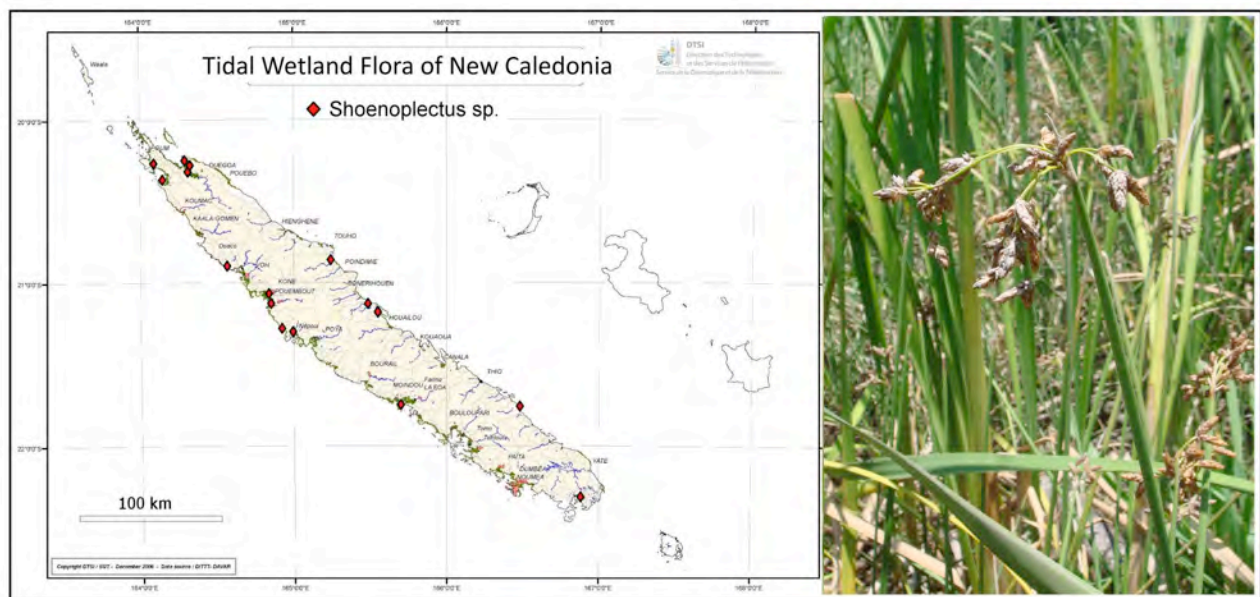


Figure 59 Distribution of *Shoenoplectus* species in New Caledonia (left); *Shoenoplectus* sp. flowers, Poya (right).

***Scyphiphora hydrophylacea* (Rubiaceae)**

Mangrove shrub, one species identified. The New Caledonian distribution of *Scyphiphora hydrophylacea* is shown in Figure 60. The species was present in 16 out of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Canala River (21° 31' S) in the south. Present on the east coast of Australia to Bustard Heads (24° 01' S) (Duke 2006). The occurrence of this species was rare, but numerous when present. No special morphological characters were observed.

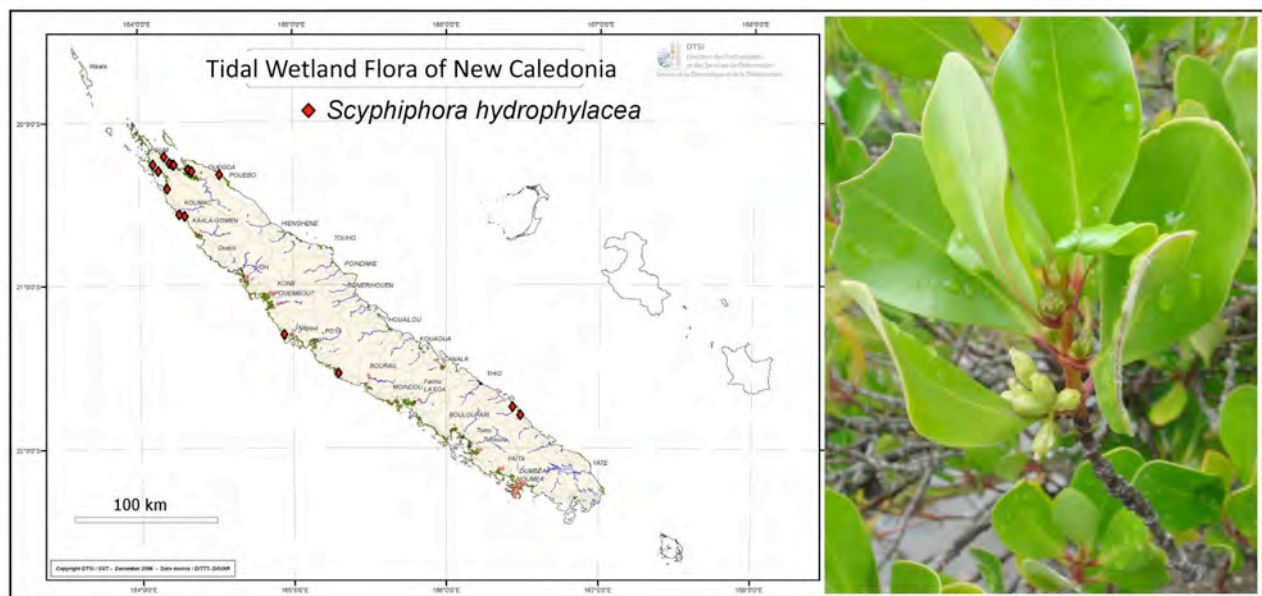


Figure 60 Distribution of *Scyphiphora hydrophylacea* in New Caledonia (left); *S. hydrophylacea* developing fruit pods.

***Sesuvium portulacastrum* (Aizoaceae)**

Saltmarsh leafy succulent, one species identified. The New Caledonian distribution of *Sesuvium portulacastrum* is shown in Figure 61. The species was present in 25 out of the 82 locations surveyed. Distributed from Poum (20° 29' S) in the north to Naniouni, Paita (22° 9' S) in the south. Occurs mainly along the west coast and the north coast in sites of less than 1400 mm. Distribution is unrelated to catchment size. Commonly found at the high intertidal, sometimes on the upper edge of the tidal flats.

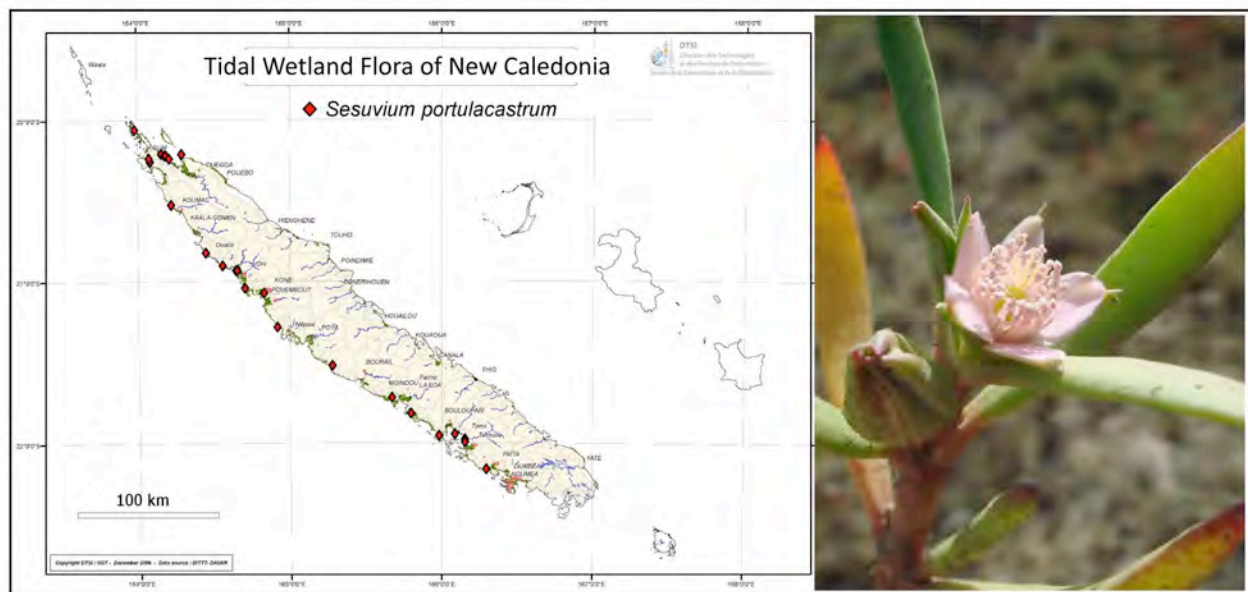


Figure 61 Distribution of *Sesuvium portulacastrum* in New Caledonia (left); *S. portulacastrum* flower (right).

***Sonneratia* species (Sonneratiaceae)**

Mangrove tree, two species identified. The New Caledonian distribution of *Sonneratia* species, *S. alba* and *S. caseolaris*, is shown in Figure 62. *Sonneratia alba* was present in 21 of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Present on the east coast of Australia to Port Clinton (22° 35' S) (Duke 2006). *Sonneratia caseolaris* was present in 5 of the 82 locations surveyed. Distributed from the Tiwae River (20° 47' S) in the north to Tchamba River (21° 01' S) in the south. Present on the east coast of Australia to Murray River (18° 05' S) (Duke 2006). There were notable differences in abundances of the two species. *Sonneratia alba* was more widespread and *S. caseolaris* was restricted to estuaries with abundant freshwater influence. There was a clear overlap in the two species in such locations so it is possible there may be hybrid individuals (*S. X gulngai*) based on evidence from Australia (Duke 2006). No hybrid was observed during the survey, despite targeted searching.

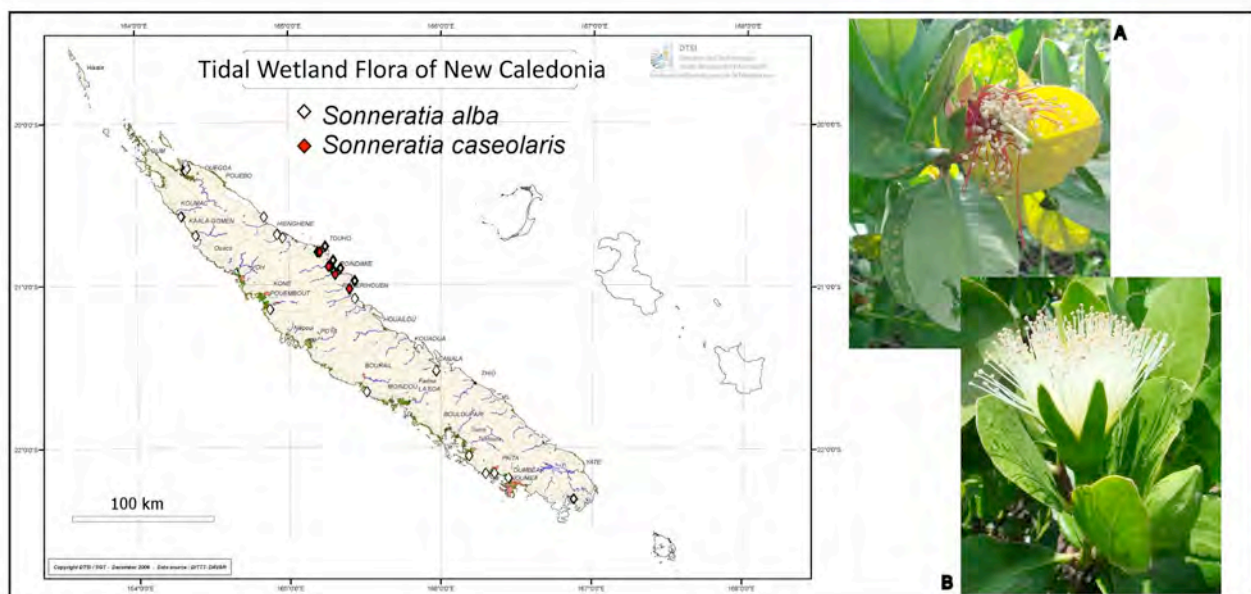


Figure 62 Distribution of *Sonneratia* species, *S. alba* and *S. caseolaris*, in New Caledonia (left); (A) *S. caseolaris* and (B) *S. alba* flowers.

***Sporobolus virginicus* (Poaceae)**

Saltmarsh grass, one species identified. The New Caledonian distribution of *Sporobolus virginicus* is shown in Figure 63. The species was present in 48 out of the 82 locations surveyed. Distributed from Poum (Gite Napoleon) (20° 6' S) in the north to Prony, Baie du Carénage (22° 18' S) in the south. Distributed commonly in most locations, not related to either rainfall or catchment size.

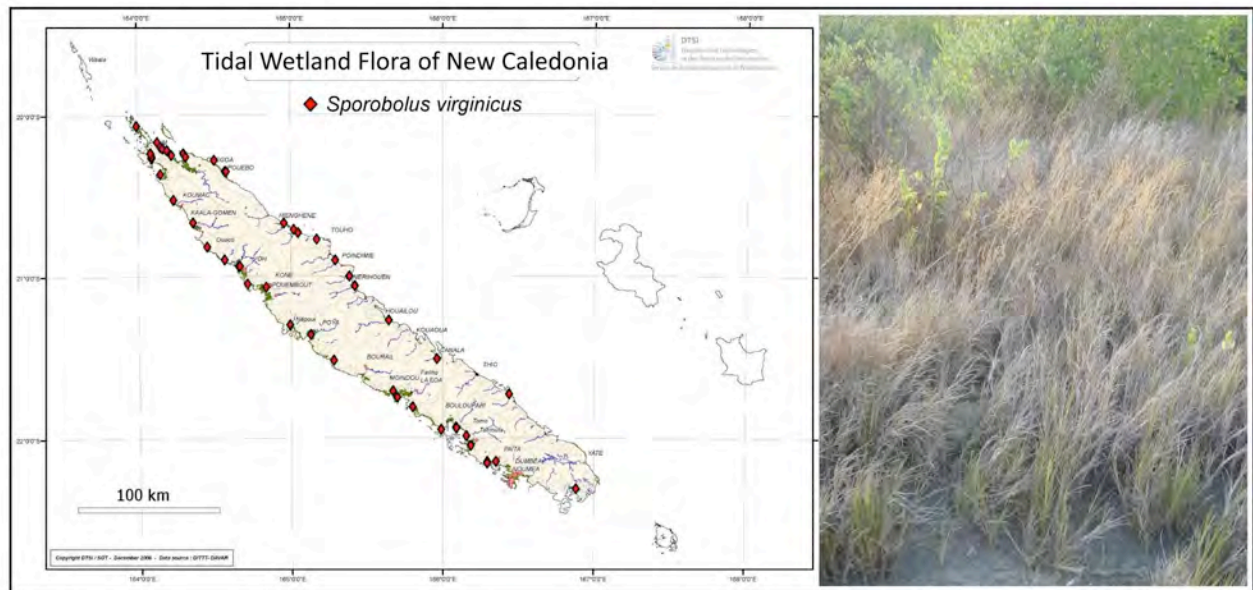


Figure 63 *Distribution of Sporobolus virginicus in New Caledonia (left); S. virginicus (right).*

***Suaeda* sp. (NC) (Chenopodiaceae)**

Saltmarsh leafy succulent herb, one species identified. The New Caledonian distribution of *Suaeda* sp. is shown in Figure 64. The species was present in 13 out of the 82 locations surveyed. Distributed from Ouaco (20° 50' S) in the north to Dumbea (22° 10' S) in the south. *Suaeda* sp. distribution was restricted to the western side of New Caledonia. Occurs mainly along the west coast in sites of less than 1200mm rainfall. Distribution is unrelated to catchment size. Commonly found on the salt flats below the high tide level.

This form of *Suaeda* has been determined to be *S. maritima* by prior authors, although this is a species of the northern Hemisphere. Its morphological characteristics place it as intermediate to two dominant taxa in Australia, *S. australis* and *S. arbusculoides*. The sprawling habit is that of *S. australis*, while the leaf shape and size is that of *S. arbusculoides*.

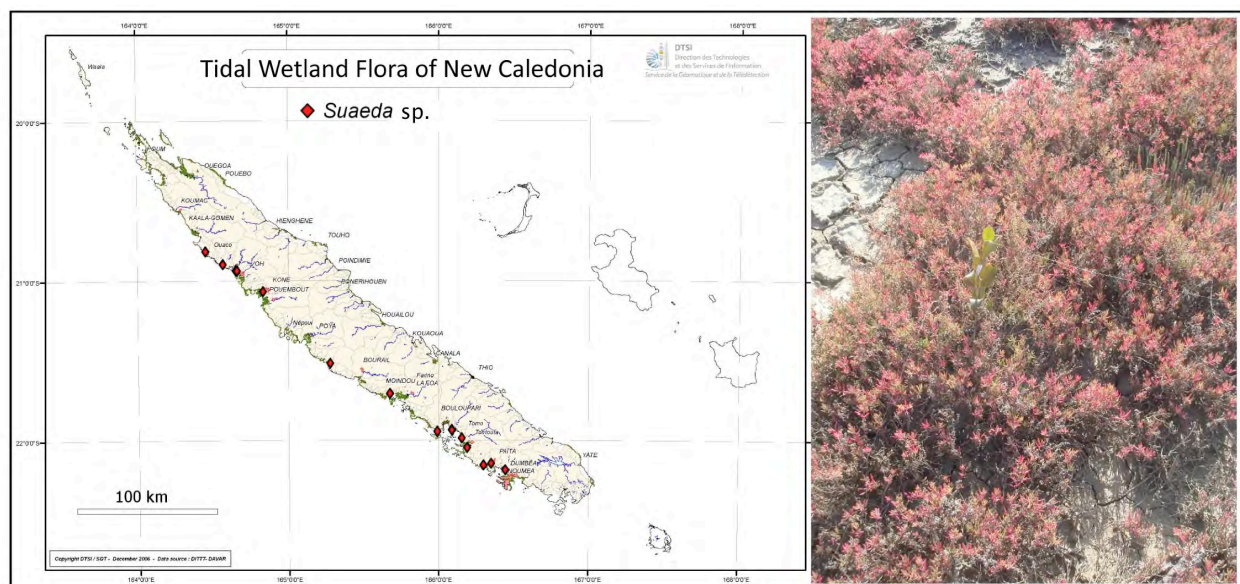


Figure 64 Distribution of *Suaeda* sp. (NC) in New Caledonia (left); *Suaeda* sp (NC) (right).

***Xylocarpus granatum* (Meliaceae)**

Mangrove tree, one species identified. The New Caledonian distribution of *Xylocarpus granatum* is shown in Figure 66. The species was present in 26 out of the 82 locations surveyed. Distributed from the Diahot River (20° 16' S) in the north to Corniche Sud (22° 18' S) in the south. Present on the east coast of Australia to Fraser Island (25° 26' S) (Duke 2006). The presence of this species was extensive and common. No special morphological characters were noted.

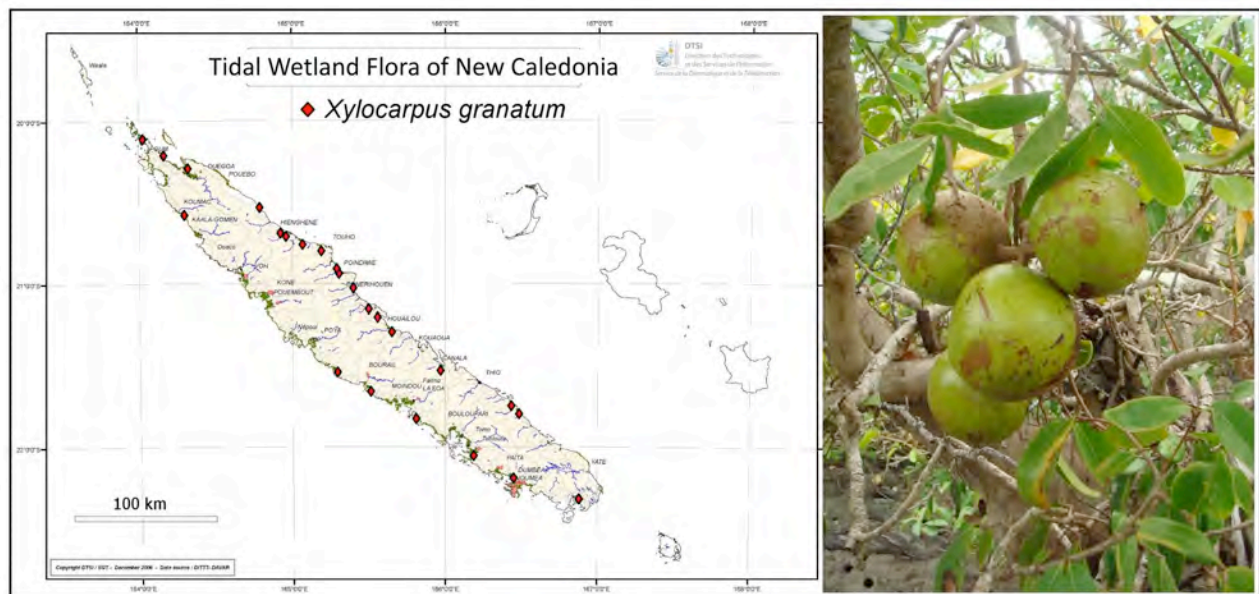


Figure 65 *Distribution of Xylocarpus granatum in New Caledonia (left); distinctive cannonball-shaped X. granatum fruits (right).*

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6. APPENDICES

1. Locations of 209 mangrove survey sites.
2. Saltmarsh species checklists
3. Mangrove species checklists
4. Tidal wetland species codes
5. Herbarium specimen voucher codes as lodged at NOU.

Appendix 1 **Locations of 209 mangrove survey sites in New Caledonia during 2006 and 2009.** Comprehensive species checklists were made at all sites, and locations marked 'Upriver' included a number of sites distributed along respective estuaries from the mouth to the upstream tidal limit (as far as practical). Rainfall measured as mean annual rainfall (mm), and catchment area (km²).

| # | Longitude | E | Latitude | S | Location | Site | No. of sites | Coast | Saltmarsh Spp. | Mangrove Spp. | Catchment size | Rainfall |
|----|-----------|-------|----------|-------|-------------|--|--------------|-------|----------------|---------------|----------------|----------|
| 1 | 166 | 25.87 | 22 | 10.46 | Dumbea | Model plane strip | 10 | west | 6 | 13 | 231 | 1600 |
| 2 | 166 | 20.36 | 22 | 8.44 | Paita | Ondemia, Port Laguerre, gun range | 1 | west | 1 | 10 | 57 | 1050 |
| 3 | 166 | 17.11 | 22 | 8.55 | Paita | Nenourie/Nenyura/Naniouni | 1 | west | 3 | 7 | 17 | 975 |
| 4 | 166 | 10.65 | 22 | 2.36 | Paita | Tamoa Riv., Pres. de Montagnes | 9 | west | 5 | 14 | 132 | 1100 |
| 5 | 166 | 8.80 | 21 | 58.59 | Tomo | Isle aux Cochons, Baie de Ouenghe | 1 | west | 0 | 2 | 525 | 1000 |
| 6 | 166 | 4.98 | 21 | 55.63 | Bouloupari | St Vincent IFREMER lab site | 1 | west | 2 | 6 | 18 | 950 |
| 7 | 165 | 59.00 | 21 | 56.34 | Bouloupari | Aigue Marine, Pres. Rousseau | 1 | west | 1 | 3 | 16 | 950 |
| 8 | 165 | 47.90 | 21 | 48.30 | La Foa | Styli-bleue, east of Pres. Lebris | 6 | west | 0 | 12 | 406 | 1350 |
| 9 | 165 | 42.12 | 21 | 44.75 | Moindou | Fort Teremba, Pres. de Tanghi, La Foa Riv. | 1 | west | 3 | 5 | 4 | 1050 |
| 10 | 165 | 40.27 | 21 | 42.43 | Moindou | Quai Ballande, Moindou | 1 | west | 3 | 6 | 106 | 1150 |
| 11 | 165 | 30.04 | 21 | 38.46 | Nessadiou | Nessadiou Riv. | 1 | west | 1 | 11 | 89 | 1150 |
| 12 | 165 | 17.15 | 21 | 31.19 | Bourail | Le Cap Riv. | 19 | west | 2 | 14 | 176 | 1200 |
| 13 | 165 | 8.25 | 21 | 21.60 | Poya | Bwire Quai on the Poya Riv. | 1 | west | 4 | 8 | 260 | 1200 |
| 14 | 165 | 0.15 | 21 | 18.04 | Nepoui | Nepoui Riv. | 1 | west | 4 | 6 | 177 | 1200 |
| 15 | 164 | 55.80 | 21 | 17.11 | Pouembout | Porrendou Riv., Plaine des Gaiacs | 1 | west | 3 | 7 | 9 | 1175 |
| 16 | 164 | 51.71 | 21 | 8.25 | Pouembout | Pouembout Riv., (RM10) | 1 | west | 6 | 11 | 324 | 1050 |
| 17 | 164 | 50.64 | 21 | 4.84 | Koné | Kone Riv., near Blue Lagoon shrimp farm | 1 | west | 5 | 3 | 270 | 1100 |
| 18 | 164 | 43.46 | 21 | 3.3 | Oundjo | Oundjo - Pinjane | 1 | west | 1 | 8 | 5 | 1100 |
| 19 | 164 | 41.48 | 21 | 1.318 | Vavouto | Koniambo | 1 | west | 3 | 8 | 11 | 1100 |
| 20 | 164 | 34.69 | 20 | 54.74 | Voh | Temala. Canecout, Anse de Pouanga | 6 | west | 6 | 8 | 356 | 1350 |
| 21 | 164 | 39.94 | 20 | 56.97 | Voh | sea side, Webuihoone shrimp farm | 8 | west | 3 | 8 | 231 | 3000 |
| 22 | 164 | 40.32 | 20 | 57.05 | Voh | land side, Webuihoone shrimp farm | 1 | west | 7 | 7 | 231 | 1150 |
| 23 | 164 | 27.89 | 20 | 50.14 | Ouaco | Ouaco, Pointe d'Uunda | 1 | west | 2 | 3 | 52 | 975 |
| 24 | 164 | 21.99 | 20 | 41.18 | Kaala-Gomen | Quai, Pointe Iounga | 11 | west | 2 | 11 | 506 | 1250 |
| 25 | 164 | 16.68 | 20 | 34.02 | Koumac | Tanoda Wharf, Koumac | 1 | west | 3 | 12 | 237 | 1050 |
| 26 | 164 | 14.38 | 20 | 33.07 | Koumac | Bwa Derok, Koumac Airport | 9 | west | 5 | 10 | 237 | 1200 |
| 27 | 164 | 9.35 | 20 | 23.69 | Poum | Quai des Americains, Sud Nehoue | 1 | west | 5 | 11 | 16 | 1350 |
| 28 | 164 | 6.09 | 20 | 17.36 | Poum | south side, Pres. De Golone | 1 | west | 4 | 3 | 5 | 1300 |
| 29 | 164 | 5.99 | 20 | 17.26 | Poum | north side, Pres. De Golone | 1 | west | 2 | 5 | 5 | 1300 |

| # | Longitude | E | Latitude | S | Location | Site | No. of sites | Coast | Saltmarsh Spp. | Mangrove Spp. | Catchment size | Rainfall |
|----|-----------|-------|----------|-------|-----------|--|--------------|-------|----------------|---------------|----------------|----------|
| 30 | 164 | 5.67 | 20 | 15.98 | Poum | Rocher, Golone River, Baie de Pouane | 1 | west | 0 | 7 | 23 | 1300 |
| 31 | 164 | 4.12 | 20 | 14.73 | Poum | Poum Junction, Baie de Poum | 1 | west | 2 | 7 | 26 | 1300 |
| 32 | 164 | 3.41 | 20 | 8.68 | Poum | Yaxave, bay south of Gaumwa | 1 | west | 3 | 4 | 46 | 1200 |
| 33 | 164 | 3.24 | 20 | 8.20 | Poum | Gaumwa | 1 | west | 2 | 3 | 46 | 1200 |
| 34 | 164 | 2.30 | 20 | 7.18 | Poum | south side, Tiabet | 1 | west | 3 | 1 | 46 | 1175 |
| 35 | 164 | 0.96 | 20 | 5.76 | Poum | north side, Tiabet | 1 | west | 2 | 4 | 46 | 1175 |
| 36 | 163 | 59.81 | 20 | 6.00 | Poum | Gite Napoleon, Bolee | 1 | west | 5 | 8 | 46 | 1200 |
| 37 | 164 | 1.94 | 20 | 5.18 | Poum | de Ko and Xam, south of Poingam | 1 | west | 2 | 9 | 46 | 1100 |
| 38 | 164 | 8.10 | 20 | 11.81 | Arama | Pu Jam, cut-off estuary site | 1 | west | 5 | 8 | 46 | 1100 |
| 39 | 164 | 9.50 | 20 | 13.49 | Arama | Phagaany | 1 | west | 2 | 4 | 6 | 1100 |
| 40 | 164 | 10.30 | 20 | 14.30 | Arama | Nijjeec, channel cut | 1 | west | 4 | 10 | 6 | 1100 |
| 41 | 164 | 11.85 | 20 | 14.92 | Arama | Arama, tidal flat next to road | 1 | west | 5 | 6 | 7 | 1100 |
| 42 | 164 | 12.04 | 20 | 15.06 | Arama | Arama point, Maa La Waap | 1 | west | 4 | 6 | 7 | 1100 |
| 43 | 164 | 13.47 | 20 | 16.22 | Arama | Noet | 1 | west | 3 | 3 | 5 | 1150 |
| 44 | 164 | 17.94 | 20 | 16.36 | Ouegoa | Diahot estuary | 35 | north | 7 | 19 | 689 | 1500 |
| 45 | 164 | 19.32 | 20 | 20.43 | Ouegoa | Carre Voyageur, Diahot south side | 1 | north | 6 | 4 | 689 | 1500 |
| 46 | 164 | 20.32 | 20 | 21.07 | Ouegoa | Vallee Charlot, Diahot south side | 1 | north | 2 | 3 | 689 | 1500 |
| 47 | 164 | 20.00 | 20 | 18.22 | Ouegoa | Pwara Yabo, Diahot north side | 1 | north | 6 | 5 | 689 | 1500 |
| 48 | 164 | 19.11 | 20 | 17.20 | Ouegoa | creek crossing, Diahot north side | 1 | north | 2 | 7 | 689 | 1500 |
| 49 | 164 | 18.26 | 20 | 14.51 | Ouegoa | Quai Balade, Pam, Diahot north side | 1 | north | 0 | 1 | 689 | 1500 |
| 50 | 164 | 18.44 | 20 | 15.05 | Ouegoa | roadside crossing, Diahot north side | 1 | north | 0 | 10 | 689 | 1500 |
| 51 | 164 | 18.44 | 20 | 15.61 | Ouegoa | roadside crossing, Diahot north side | 1 | north | 0 | 2 | 689 | 1500 |
| 52 | 164 | 18.55 | 20 | 15.86 | Ouegoa | roadside crossing, Diahot north side | 1 | north | 1 | 6 | 689 | 1500 |
| 53 | 164 | 19.11 | 20 | 17.21 | Ouegoa | roadside, near #45, Diahot north side | 1 | north | 3 | 4 | 689 | 1500 |
| 54 | 164 | 30.11 | 20 | 18.25 | Balade | St Denis, south of Maamaat | 1 | east | 4 | 10 | 34 | 1500 |
| 55 | 164 | 34.58 | 20 | 22.23 | Pouebo | Mangrove Walk, Maze Det, north of Pouebo | 1 | east | 4 | 5 | 31 | 1700 |
| 56 | 164 | 34.85 | 20 | 22.46 | Pouebo | Kareon causeway, north of Pouebo | 1 | east | 4 | 9 | 31 | 1700 |
| 57 | 164 | 45.77 | 20 | 30.54 | | Colnett | 1 | east | 0 | 6 | 4 | 4000 |
| 58 | 164 | 46.06 | 20 | 30.94 | | Galarino | 1 | east | 0 | 5 | 4 | 4000 |
| 59 | 164 | 49.19 | 20 | 33.82 | | Tao | 1 | east | 0 | 3 | 9 | 2750 |
| 60 | 164 | 56.56 | 20 | 41.70 | Hienghene | Heinghene crusie ship landing site | 1 | east | 0 | 12 | 50 | 2250 |
| 61 | 164 | 54.30 | 20 | 40.46 | | Tiouandé - Maina | 1 | east | 0 | 13 | 153 | 2250 |
| 62 | 164 | 57.65 | 20 | 40.95 | Heinghene | Linderalique saltpan | 1 | east | 1 | 7 | 153 | 2250 |

| # | Longitude | E | Latitude | S | Location | Site | No. of sites | Coast | Saltmarsh Spp. | Mangrove Spp. | Catchment size | Rainfall |
|----|-----------|-------|----------|--------|---------------------|-------------------------------------|--------------|-------|----------------|---------------|----------------|----------|
| 63 | 165 | 1.27 | 20 | 43.77 | Touho | Tipindje estuary | 1 | east | 3 | 7 | 317 | 2000 |
| 64 | 165 | 3.00 | 20 | 44.44 | Touho | Dahot Tiwade | 1 | east | 1 | 7 | 317 | 2000 |
| 65 | 165 | 10.52 | 20 | 47.00 | Touho | Tiwae River estuary | 1 | east | 4 | 15 | 32 | 2500 |
| 66 | 165 | 11.21 | 20 | 46.72 | | Tiponite | 1 | east | 0 | 3 | 32 | 2500 |
| 67 | 165 | 14.71 | 20 | 52.15 | Poindimié | Tiwaka River estuary | 1 | east | 4 | 11 | 389 | 3500 |
| 68 | 165 | 17.60 | 20 | 54.88 | Poindimié | Amoa River estuary | 1 | east | 2 | 9 | 177 | 3000 |
| 69 | 165 | 16.61 | 20 | 53.35 | | Pwééo | 1 | east | 0 | 8 | 14 | 3500 |
| 70 | 165 | 23.15 | 21 | 0.70 | Poindimié | Tchamba River estuary | 1 | east | 4 | 18 | 188 | 2750 |
| 71 | 165 | 23.78 | 21 | 4.06 | | Bâ | 1 | east | 0 | 0 | 322 | 2525 |
| 72 | 165 | 25.14 | 21 | 4.16 | Houailou | Goro Pobei, Ponerihouen, sea front | 1 | east | 1 | 5 | 5 | 2525 |
| 73 | 165 | 29.05 | 21 | 8.04 | Houailou | Moneo River estuary | 1 | east | 1 | 5 | 114 | 2500 |
| 74 | 165 | 32.82 | 21 | 11.22 | Houailou | landward seep, Baie Lebris | 1 | east | 6 | 12 | 4 | 2250 |
| 75 | 165 | 38.39 | 21 | 16.48 | Houailou | Houailou | 1 | east | 1 | 7 | 399 | 2250 |
| 76 | 165 | 57.49 | 21 | 30.56 | Canala | near Noue, Canala River estuary | 12 | south | 4 | 16 | 239 | 1850 |
| 77 | 166 | 25.35 | 21 | 43.52 | Thio | Xwe Ne Fachia River | 1 | south | 2 | 12 | 90 | 2750 |
| 78 | 166 | 28.04 | 21 | 45.15 | Thio | Mwarane, north of St. Jean Baptiste | 1 | south | 3 | 4 | 162 | 3000 |
| 79 | 166 | 28.23 | 21 | 46.81 | Saint Jean Baptiste | Comboui | 1 | south | 0 | 8 | 163 | 3250 |
| 80 | 166 | 51.68 | 22 | 17.96 | Prony | Baie du Carénage | 13 | south | 3 | 9 | 239 | 2000 |
| 81 | 166 | 51.69 | 22 | 18.14 | | Corniche Sud | 1 | south | 0 | 4 | 17 | 2750 |
| 82 | 166 | 51.69 | 22 | 18.141 | | Boulari | 1 | south | 0 | 11 | 17 | 2750 |

Appendix 2 Saltmarsh species checklists for 82 sites listed in Appendix 1. Species codes listed in Appendix 4.

| Site | AtriJ | BauJ | CypJ | EnchT | FimC | FimF | FimP | LimT | RhyC | RupM | SalK | SarQ | Scho | SuaA | SesP | SpoV |
|------|-------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | | | | | | 1 | 1 | 1 | | | | 1 | | 1 | | |
| 2 | | | | | | 1 | | | | | | 1 | | 1 | | 1 |
| 3 | | | 1 | | | 1 | | 1 | | | | 1 | | 1 | 1 | 1 |
| 4 | | | 1 | | | 1 | | | | | | 1 | | 1 | | 1 |
| 5 | | | | | | 1 | | | | | | 1 | | 1 | 1 | 1 |
| 6 | 1 | 1 | | 1 | 1 | | | | | | | 1 | | 1 | 1 | 1 |
| 7 | | | | | | | | 1 | | | | 1 | | | 1 | 1 |
| 8 | | | | | 1 | 1 | | | | | | 1 | | | 1 | 1 |
| 9 | | | | | 1 | 1 | 1 | | | | | 1 | 1 | | | 1 |
| 10 | | | | 1 | 1 | 1 | | | | | | 1 | | 1 | 1 | 1 |
| 11 | | | 1 | | 1 | 1 | | 1 | 1 | | | | | | | |
| 12 | | | | | | 1 | | 1 | 1 | | | 1 | | 1 | 1 | 1 |
| 13 | | | | | | | | | | 1 | | 1 | | | | 1 |
| 14 | | | | | 1 | 1 | | | 1 | | | 1 | 1 | | | 1 |
| 15 | | | | | 1 | 1 | | | | 1 | | 1 | 1 | | 1 | |
| 16 | | | | | | | | 1 | | | | | 1 | | | |
| 17 | | 1 | | | 1 | 1 | | | | | | | 1 | 1 | 1 | 1 |
| 18 | | | | | 1 | 1 | | | | | | | | | 1 | 1 |
| 19 | | 1 | | | | | | | | | | | | | | |
| 20 | 1 | | | | | 1 | | | | | | 1 | 1 | 1 | 1 | 1 |
| 21 | | | 1 | | | 1 | | | | | | | | 1 | 1 | 1 |
| 22 | 1 | | | 1 | 1 | 1 | | | | | | | | 1 | 1 | 1 |
| 23 | | | 1 | | | 1 | | | | | | | | 1 | 1 | 1 |
| 24 | | | 1 | | 1 | 1 | | 1 | 1 | | | | | | | 1 |
| 25 | | | | | | | | | | | | | | | | |
| 26 | | | 1 | | | 1 | | 1 | 1 | 1 | | | | | 1 | 1 |
| 27 | | | 1 | | 1 | 1 | | | 1 | | | | 1 | | | 1 |
| 28 | | | 1 | | 1 | 1 | | | | 1 | | | 1 | | 1 | 1 |
| 29 | | | 1 | | | 1 | | | | | | | | | 1 | 1 |
| 30 | | | | | | 1 | | | | | | | | | 1 | 1 |
| 31 | | | | | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | | | | | |

| Site | AtriJ | BauJ | CypJ | EnchT | FimC | FimF | FimP | LimT | RhyC | RupM | SalK | SarQ | Scho | SuaA | SesP | SpoV |
|------|-------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| 33 | | | | | | | | | | | | | | | | |
| 34 | | | 1 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | |
| 36 | 1 | | | | | | | | | | 1 | | | | 1 | 1 |
| 37 | | | | | | | | | | 1 | | | | | | |
| 38 | | | 1 | | | 1 | | 1 | 1 | 1 | | | | | | 1 |
| 39 | | | 1 | | | 1 | | | 1 | | | | | | | 1 |
| 40 | | | 1 | | 1 | 1 | | | 1 | | | | | | 1 | 1 |
| 41 | 1 | | 1 | | | 1 | | | | | | | | | 1 | 1 |
| 42 | 1 | | 1 | | 1 | 1 | | | | | | | | | 1 | |
| 43 | | | | | 1 | 1 | | | 1 | | | | | | 1 | 1 |
| 44 | | | 1 | | 1 | 1 | 1 | | 1 | | | | 1 | | | |
| 45 | | | 1 | | 1 | 1 | 1 | | | | | | 1 | | | |
| 46 | | | | | | 1 | | | | | | | | | | |
| 47 | | | 1 | | | 1 | 1 | | 1 | | | | 1 | | | |
| 48 | | | 1 | | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | | | | 1 | |
| 50 | | | | | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | | 1 |
| 53 | | | 1 | | | 1 | | | | | | | | | | 1 |
| 54 | | | 1 | | | 1 | | | 1 | | | | | | | 1 |
| 55 | | | 1 | | 1 | 1 | | | | | | | | | | 1 |
| 56 | | | 1 | | | 1 | | | 1 | | | | | | | 1 |
| 57 | | | | | | | | | | | | | | | | |
| 58 | | | | | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | | | | |
| 61 | | | | | | | | | | | | | | | | |
| 62 | | | | | | | | | | | | | | | | 1 |
| 63 | | | 1 | | | 1 | | | | | | | | | | 1 |
| 64 | | | | | | | | | | | | | | | | 1 |
| 65 | | | 1 | | 1 | 1 | | | | | | | | | | 1 |
| 66 | | | | | | | | | | | | | | | | |

| Site | AtriJ | BauJ | CypJ | EnchT | FimC | FimF | FimP | LimT | RhyC | RupM | SalK | SarQ | Scho | SuaA | SesP | SpoV |
|-------|-------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| 67 | | | 1 | | | 1 | 1 | | | | | | 1 | | | |
| 68 | | | | | | 1 | | | | | | | | | | 1 |
| 69 | | | | | | | | | | | | | | | | |
| 70 | | | 1 | | | 1 | | | 1 | | | | | | | 1 |
| 71 | | | | | | | | | | | | | | | | |
| 72 | | | | | | | | | | | | | | | | 1 |
| 73 | | | | | | | | | | | | | 1 | | | |
| 74 | | 1 | 1 | | | 1 | 1 | | 1 | | | | 1 | | | |
| 75 | | | | | | | | | | | | | | | | 1 |
| 76 | | | 1 | | | 1 | 1 | | | | | | | | | 1 |
| 77 | | 1 | | | | | | | | | | | | | | 1 |
| 78 | | 1 | | | | | | | 1 | | | | 1 | | | |
| 79 | | | | | | | | | | | | | | | | |
| 80 | | 1 | | | | | | | | | | | 1 | | | 1 |
| 81 | | | | | | | | | | | | | | | | |
| 82 | | | | | | | | | | | | | | | | |
| Total | 6 | 7 | 30 | 3 | 20 | 45 | 8 | 9 | 17 | 6 | 1 | 15 | 16 | 13 | 24 | 46 |

Appendix 3 Mangrove species checklists for 82 sites listed in Appendix 1. Species codes listed in Appendix 4.

| Site | Accli | Acr osA | Acro sS | AviM | BruG | CerT | Doli S | Exo A | HerL | Lum L | Lum R | LumRo | Pem A | RhiA | RhiL | RhiS a | RhiS e | RhiS t | RhiSx N | RhiT | Scy H | SonA | Son C | XylG |
|------|-------|------------|------------|------|------|------|-----------|----------|------|----------|----------|-------|----------|------|------|-----------|-----------|-----------|------------|------|----------|------|----------|------|
| 1 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | | | | | 1 | 1 | 1 | | | | 1 | | 1 |
| 2 | | | 1 | 1 | 1 | | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | | | | 1 | | |
| 3 | | | | 1 | 1 | | | 1 | 1 | | 1 | | | | | | 1 | | | | | 1 | | |
| 4 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 | | | | 1 | | 1 |
| 5 | | | | | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 6 | | | | 1 | | | | 1 | | | 1 | | | | | 1 | 1 | 1 | | | | | | |
| 7 | | | | 1 | | | | 1 | | | | | | | | | | 1 | | | | | | |
| 8 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | | | | | 1 | 1 | 1 | | | | | | 1 |
| 9 | | | | 1 | 1 | | | 1 | | | 1 | | | | | | | 1 | | | | | | |
| 10 | 1 | | | 1 | 1 | | | 1 | | | 1 | | | | | | | 1 | | | | | | |
| 11 | 1 | | | 1 | 1 | | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | | | | 1 | | 1 |
| 12 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 | | | 1 | | | 1 |
| 13 | 1 | | 1 | 1 | 1 | | | 1 | | | 1 | | | | | 1 | 1 | | | | | | | |
| 14 | | | 1 | 1 | 1 | | | | | | 1 | | | | | 1 | 1 | | | | | | | |
| 15 | 1 | | | 1 | | | | 1 | | | 1 | | 1 | | | | | 1 | | | 1 | | | |
| 16 | 1 | | | 1 | 1 | | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | 1 | | | 1 | | |
| 17 | | | 1 | 1 | | | | 1 | | | | | | | | | | | | | | | | |
| 18 | | | | 1 | 1 | | | 1 | | 1 | 1 | | | | | 1 | 1 | 1 | | | | | | |
| 19 | | | | 1 | | | | 1 | | 1 | 1 | 1 | | | | 1 | 1 | 1 | | | | | | |
| 20 | 1 | | | 1 | 1 | | | 1 | | | 1 | | | | | 1 | 1 | 1 | | | | | | |
| 21 | 1 | | | 1 | 1 | | | 1 | | | 1 | | | | | 1 | 1 | 1 | | | | | | |
| 22 | 1 | | | 1 | 1 | | | 1 | | | | | | | | 1 | 1 | 1 | | | | | | |
| 23 | | | | 1 | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 24 | 1 | | 1 | 1 | 1 | | | 1 | | | 1 | | 1 | | | 1 | 1 | 1 | | | | 1 | | |
| 25 | 1 | | | 1 | 1 | | | 1 | | | 1 | | 1 | | | 1 | 1 | 1 | | | 1 | 1 | | 1 |
| 26 | 1 | | | 1 | 1 | | | 1 | | | 1 | | 1 | | | 1 | 1 | 1 | | | 1 | | | |
| 27 | | | 1 | 1 | 1 | | | 1 | | 1 | 1 | 1 | | | | 1 | 1 | 1 | | | 1 | | | |
| 28 | | | | 1 | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 29 | | | | 1 | | | | 1 | | | 1 | | | | | | | 1 | | | 1 | | | |
| 30 | | | | 1 | 1 | | | 1 | | 1 | 1 | | | | | | 1 | 1 | | | | | | |

Report For: Ifremer
Re: Tidal Wetland Flora of New Caledonia

| Site | Acli | Acr osA | Acro sS | AviM | BruG | CerT | Doli S | Exo A | HerL | Lum L | Lum R | LumRo | Pem A | RhiA | RhiL | RhiS a | RhiS e | RhiS t | RhiSx N | RhiT | Scy H | SonA | Son C | XylG |
|------|------|------------|------------|------|------|------|-----------|----------|------|----------|----------|-------|----------|------|------|-----------|-----------|-----------|------------|------|----------|------|----------|------|
| 31 | | | | 1 | | | | 1 | | 1 | 1 | | | | | | 1 | 1 | | | 1 | | | |
| 32 | | | | | | | | 1 | | | 1 | | | | | | 1 | 1 | | | | | | |
| 33 | | | | 1 | | | | 1 | | | | | | | | | | 1 | | | | | | |
| 34 | | | | | | | | | | | 1 | | | | | | | | | | | | | |
| 35 | | | | 1 | | | | 1 | | | 1 | | | | | | | 1 | | | | | | |
| 36 | | | | 1 | 1 | | | 1 | | | 1 | | | | | 1 | 1 | 1 | | | | | | 1 |
| 37 | | | | 1 | 1 | 1 | | 1 | | | 1 | | | 1 | | 1 | 1 | 1 | | | | | | |
| 38 | | | 1 | 1 | | | | 1 | | | 1 | | | | | | 1 | 1 | | | 1 | | | 1 |
| 39 | | | | 1 | | | | 1 | | | 1 | | | | | | 1 | | | | | | | |
| 40 | | | | 1 | 1 | 1 | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | | | 1 | | | |
| 41 | | | | 1 | | | | 1 | 1 | | 1 | | 1 | | | | | | | | 1 | | | |
| 42 | | | | 1 | | | | 1 | | | 1 | | 1 | | | | | 1 | | | 1 | | | |
| 43 | | | | | | | 1 | 1 | | | 1 | | | | | | | | | | | | | |
| 44 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | | 1 |
| 45 | | | 1 | 1 | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 46 | | | 1 | | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 47 | | 1 | 1 | 1 | | | | 1 | | | 1 | | | | | | | | | | | | | |
| 48 | | | 1 | | | | | 1 | | | 1 | | | | | 1 | 1 | 1 | | | 1 | | | |
| 49 | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| 50 | | | | 1 | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | | 1 | 1 | | | | 1 | | |
| 51 | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | |
| 52 | | | | 1 | | | | 1 | | | 1 | | | | | 1 | | 1 | | | | 1 | | |
| 53 | | | 1 | | | | | 1 | | | 1 | | | | | 1 | | | | | | | | |
| 54 | | | 1 | 1 | 1 | | | 1 | | 1 | 1 | | | 1 | | 1 | | 1 | | | 1 | | | |
| 55 | | | 1 | 1 | | | | 1 | | | 1 | | | | | | | 1 | | | | | | |
| 56 | 1 | | 1 | 1 | | | | 1 | | | 1 | | | | 1 | 1 | 1 | 1 | | | | | | |
| 57 | | | 1 | | 1 | | | 1 | 1 | 1 | | | | 1 | | | | | | | | | | |
| 58 | | | | | 1 | | | 1 | | 1 | | | | 1 | | | | | | | | | | 1 |
| 59 | | | | 1 | | | | | | | | | | | | | | 1 | | | | 1 | | |
| 60 | 1 | | | 1 | 1 | | | 1 | | | | | | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | | 1 |
| 61 | 1 | | 1 | 1 | 1 | | | 1 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 1 |
| 62 | | | | 1 | | | | 1 | 1 | | | | | | 1 | 1 | 1 | 1 | | | | | | |
| 63 | | | | 1 | 1 | | | 1 | | | | | | 1 | 1 | 1 | 1 | | | | | | | |

Report For: Ifremer
Re: Tidal Wetland Flora of New Caledonia

| Site | Acli | Acr osA | Acro sS | AviM | BruG | CerT | Doli S | Exo A | HerL | Lum L | Lum R | LumRo | Pem A | RhiA | RhiL | RhiS a | RhiS e | RhiS t | RhiSx N | RhiT | Scy H | SonA | Son C | XylG |
|-------|------|------------|------------|------|------|------|-----------|----------|------|----------|----------|-------|----------|------|------|-----------|-----------|-----------|------------|------|----------|------|----------|------|
| 64 | | | 1 | 1 | 1 | | | 1 | | | | | | | | | 1 | 1 | | | | | | 1 |
| 65 | 1 | | 1 | 1 | 1 | | | 1 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | 1 | 1 |
| 66 | | | 1 | | | | | | | | | | | | | | | | | 1 | | | 1 | |
| 67 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | | | | | | | 1 | 1 | | | | | 1 | 1 | |
| 68 | 1 | | | 1 | 1 | | 1 | 1 | | | | | | 1 | | 1 | | | | | | | 1 | 1 |
| 69 | | | | 1 | 1 | | | 1 | | | | | | 1 | | 1 | | 1 | | | | 1 | | 1 |
| 70 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | 1 | 1 |
| 71 | | | | | | | | | | | | | | | | | | | | | | | | |
| 72 | | | | 1 | 1 | | | 1 | | | | | | | | | | 1 | | | | 1 | | |
| 73 | 1 | | 1 | | 1 | | | | | | | | | 1 | | | | | | | | | | 1 |
| 74 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | | | | | 1 | 1 | 1 | 1 | | | | | | 1 |
| 75 | 1 | | 1 | 1 | 1 | | | 1 | | | | | | | | 1 | | | | | | | | 1 |
| 76 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | | 1 |
| 77 | | | 1 | | 1 | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | | | 1 | | | 1 |
| 78 | | | 1 | | 1 | | | | | 1 | | | | | | | 1 | | | | | | | |
| 79 | | | | | 1 | | | 1 | 1 | 1 | | | | | | 1 | | 1 | | | 1 | | | 1 |
| 80 | | | 1 | | 1 | | | 1 | 1 | 1 | | | | | | 1 | 1 | 1 | | | | | | 1 |
| 81 | | | | | 1 | | | | | | | | | | | 1 | 1 | | | | | | | 1 |
| 82 | | | 1 | 1 | 1 | | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | | | | 1 | | 1 |
| Total | 27 | 5 | 35 | 63 | 49 | 4 | 5 | 73 | 22 | 19 | 50 | 4 | 8 | 17 | 12 | 45 | 47 | 55 | 1 | 5 | 16 | 21 | 5 | 26 |

Appendix 4 List of tidal wetland species and species codes as used in appendices and Table 2.

| Genus | Species | Code |
|----------------|------------------------------|--------|
| Acanthus | ilicifolius | AcIli |
| Acrostichum | aureum | AcroSA |
| Acrostichum | speciosum | AcroSS |
| Atriplex | jubata | AtriJ |
| Avicennia | marina | AviM |
| Baumea | juncea | BauJ |
| Bruguiera | gymnorhiza | BruG |
| Ceriops | tagal | CerT |
| Cyperus | javanicus | CypJ |
| Dolichandrone | spathacea | DoliS |
| Enchylaena | tomentosa | EnchT |
| Excoecaria | agallocha | ExoA |
| Fimbristylis | cymosa | FimC |
| Fimbristylis | ferruginea | FimF |
| Fimbristylis | polytrichoides | FimP |
| Heritiera | littoralis | HerL |
| Limonium | tetragonum | LimT |
| Lumnitzera | littorea | LumL |
| Lumnitzera | racemosa | LumR |
| Lumnitzera | rosea | LumRo |
| Pemphis | acidula | PemA |
| Rhizophora | apiculata | RhiA |
| Rhizophora | lamarckii | RhiL |
| Rhizophora | samoensis | RhiSa |
| Rhizophora | samoensis var. neocaledonica | RhiSxN |
| Rhizophora | selala | RhiSe |
| Rhizophora | stylosa | RhiSt |
| Rhizophora | tomlinsonii | RhiT |
| Rhyncospora | corymbosa | RhyC |
| Ruppia | maritima | RupM |
| Salsola | kali | SalK |
| Sarcocornia | quinqueflora | SarQ |
| Schoenoplectus | sp. | Scho |
| Scyphiphora | hydrophylacea | ScyH |
| Sesuvium | portulacastrum | SesP |
| Sonneratia | alba | SonA |
| Sonneratia | caseolaris | SonC |
| Sporobolus | virginicus | SpoV |
| Suaeda | Sp. | SuaA |
| Xylocarpus | granatum | XylG |

Appendix 5 Specimen voucher identification for those species where specimens were lodged at NOU.

| NC# | Way Point | Date | Genus | Species | Family |
|-----|-----------|----------|----------------|----------------|----------------|
| 101 | 317 | 27-Nov | Fimbristylis | ferruginea | Cyperaceae |
| 102 | 321 | 27-Nov | Fimbristylis | polytrichoides | Cyperaceae |
| 103 | 319 | 27-Nov | Avicennia | marina | Avicenniaceae |
| 104 | 320 | 27-Nov | Myoporum | | Myoporaceae |
| | | | | | Poaceae |
| 106 | 320 | 27-Nov | Sporobolus | virginicus | (=Gramineae) |
| 107 | 320 | 27-Nov | Limonium | tetragonum | Plumbaginaceae |
| 108 | jm3/ | 27-Nov | Sarcocornia | quinqueflora | Chenopodiaceae |
| | | | UNK-tobacco | | |
| 109 | 320 | 27-Nov | leaf | | |
| 110 | 320 | 27-Nov | Suaeda | sp | Chenopodiaceae |
| 111 | 321 | 27-Nov | Suaeda | sp | Chenopodiaceae |
| 112 | 320 | 27-Nov | Centaurium | spicatum | Gentianaceae |
| 113 | 320 | 27-Nov | Sarcocornia | quinqueflora | Chenopodiaceae |
| 114 | 321 | 27-Nov | Sarcocornia | quinqueflora | Chenopodiaceae |
| | | | | | Poaceae |
| 115 | 321 | 27-Nov | UNK-grass | | (=Gramineae) |
| 116 | jm/3 | 27-Nov | Fimbristylis | ferruginea | Cyperaceae |
| 117 | | | | | |
| 118 | jm2 | 27-Nov | Fimbristylis | ferruginea | Cyperaceae |
| 119 | 327 | 27-Nov | Avicennia | marina | Avicenniaceae |
| 120 | 327 | 27-Nov | Suaeda | sp | Chenopodiaceae |
| 121 | 327 | 27-Nov | Myoporum | | Myoporaceae |
| 122 | 319 | 27-Nov | Myoporum | | Myoporaceae |
| 123 | 331 | 27/11/09 | Sesuvium | portulacastrum | Aizoaceae |
| 124 | 331 | 27-Nov | Myoporum | | Myoporaceae |
| | | | | | Poaceae |
| 125 | jm29 | 28-Nov | Sporobolus | virginicus | (=Gramineae) |
| 126 | jm40 | 28-Nov | Sarcocornia | quinqueflora | Chenopodiaceae |
| 127 | jm40 | 28-Nov | Sarcocornia | quinqueflora | Chenopodiaceae |
| 128 | jm40 | 28-Nov | Suaeda | sp | Chenopodiaceae |
| 129 | jm41 | 28-Nov | Fimbristylis | ferruginea | Cyperaceae |
| 130 | jm41 | 28-Nov | Centaurium | spicatum | Gentianaceae |
| 131 | jm41/2 | 28-Nov | Fimbristylis | ferruginea | Cyperaceae |
| 132 | jm44/3 | 28-Nov | Fimbristylis | cymosa | Cyperaceae |
| 133 | jm50/3 | 28/11/09 | Enchylaena | tomentosa | Chenopodiaceae |
| 134 | jm50/3 | 28-Nov | Portulaca | bicolor | Portulacaceae |
| 135 | jm/3 | 28-Nov | Euphorbia | obliqua | Euphorbiaceae |
| 136 | jm/3 | 28/11/09 | Sesuvium | portulacastrum | Aizoaceae |
| 137 | jm/3 | 28/11/09 | Sesuvium | portulacastrum | Aizoaceae |
| 138 | jm65/3 | 29-Nov | Centaurium | spicatum | Gentianaceae |
| 139 | 361 | 30-Nov | Centaurium | spicatum | Gentianaceae |
| 140 | | | | | |
| 141 | 370 | 30-Nov | Lumnitzera | rosea | Combretaceae |
| 142 | 370 | 30-Nov | Lumnitzera | racemosa | Combretaceae |
| 143 | 371 | 30-Nov | Schoenoplectus | litoralis | Cyperaceae |
| 144 | /2 | 1-Dec | Baumea | juncea | Cyperaceae |
| 145 | /2 | 1-Dec | Suaeda | sp | Chenopodiaceae |
| 146 | jm/2 | 1-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 147 | /2 | 1-Dec | Sporobolus | virginicus | Poaceae |

| NC# | Way Point | Date | Genus | Species | Family |
|-----|-----------|---------|----------------|----------------|------------------|
| | | | | | (=Gramineae) |
| 148 | /1 | 1-Dec | Suaeda | sp | Chenopodiaceae |
| 149 | 400 | 1-Dec | Lumnitzera | racemosa | Combretaceae |
| | | | | | Poaceae |
| 150 | 386 | 1-Dec | Sporobolus | virginicus | (=Gramineae) |
| 151 | | | | | Poaceae |
| 152 | jm/1 | 1-Dec | UNK-grass | | (=Gramineae) |
| 153 | jm4,6/1 | 1-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 154 | jm7/1 | 1-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 155 | 393 | 1/12/09 | Sesuvium | portulacastrum | Aizoaceae |
| 156 | 389 | 1-Dec | Ruppia | maritima | Ruppiaceae |
| 157 | 387 | 1-Dec | Ruppia | maritima | Ruppiaceae |
| 158 | 423 | 2-Dec | Sesuvium | portulacastrum | Aizoaceae |
| 159 | 423 | 2-Dec | Limonium | tetragonum | Plumbaginaceae |
| | | | UNK-clumped | | |
| 160 | 423 | 2-Dec | herb | | |
| 161 | 436 | 2-Dec | Suaeda | sp | Chenopodiaceae |
| 162 | 434 | 2-Dec | Clerodendrum | inerme | Labiaceae |
| 163 | 431 | 2-Dec | Atriplex | jubata | Chenopodiaceae |
| 164 | 402 | 2-Dec | Pemphis | acidula | Lythraceae |
| 166 | jm19 | 3-Dec | Ipomoea | pes-carprae | Convolvulaceae |
| | 445, | | | | |
| 167 | jm/3 | 3-Dec | Atriplex | jubata | Chenopodiaceae |
| 168 | 439 | 3-Dec | Suaeda | sp | Chenopodiaceae |
| 169 | 439 | 3-Dec | Suaeda | sp | Chenopodiaceae |
| 170 | jm30/3 | 3-Dec | Enchylaena | tomentosa | Chenopodiaceae |
| 171 | 457 | 3-Dec | Portulaca | bicolor | Portulacaceae |
| 172 | jm19 | 3-Dec | Sesuvium | portulacastrum | Aizoaceae |
| 173 | jm72/ | 6-Dec | Atriplex | jubata | Chenopodiaceae |
| 174 | jm72/ | 6-Dec | Salsola | kali | Chenopodiaceae |
| 175 | | 6-Dec | Aglaia | elaeagnoidea | Meliaceae |
| 176 | | 6-Dec | Bruguiera | gymnorhiza | Rhizophoraceae |
| 177 | | 6-Dec | Fimbristylis | cymosa | Cyperaceae |
| 178 | jm401 | 6-Dec | Suriana | maritima | Surianaceae |
| 179 | jm2 | 5-Dec | Rhynchospora | corymbosa | Cyperaceae |
| | | | UNK-grass | | Poaceae |
| 180 | 491 | 5-Dec | Xerochia | | (=Gramineae) |
| 181 | 491 | 5-Dec | Limonium | tetragonum | Plumbaginaceae |
| | | | UNK-clover | | |
| 182 | 491 | 5-Dec | white flower | | |
| 183 | 491 | 5-Dec | Fimbristylis | cymosa | Cyperaceae |
| 184 | 492 | 5-Dec | Lumnitzera | racemosa | Combretaceae |
| 185 | 492 | 5-Dec | Lumnitzera | rosea | Combretaceae |
| 186 | 488 | 5-Dec | Suriana | maritima | Surianaceae |
| 187 | 492 | 5-Dec | Lumnitzera | littorea | Combretaceae |
| 188 | 2 | 8-Dec | Halodule | univervis | Potamogetonaceae |
| 189 | 2 | 8-Dec | UNK-algal mat | | Cyanobacteria |
| 190 | 501 | 5-Dec | Purpureostemon | ciliatus | Myrtaceae |
| 191 | 11 | 9-Dec | Halodule | univervis | Potamogetonaceae |
| 192 | jm35/4 | 9-Dec | Fimbristylis | cymosa | Cyperaceae |
| 193 | 7 | | Limonium | tetragonum | Plumbaginaceae |

| NC# | Way Point | Date | Genus | Species | Family |
|-----|-----------|--------|-----------------|----------------|----------------|
| 194 | 22 | 9-Dec | Ceriops | tagal | Rhizophoraceae |
| 195 | 22 | 9-Dec | Avicennia | marina | Avicenniaceae |
| 196 | 32 | 9-Dec | Pemphis | acidula | Lythraceae |
| 197 | 32 | 9-Dec | Fimbristylis | cymosa | Cyperaceae |
| 198 | 32 | 9-Dec | Sesuvium | portulacastrum | Aizoaceae |
| 199 | | | | | |
| 200 | | | | | |
| 201 | jm1/ | 9-Dec | Scirpus | | Cyperaceae |
| | | | | | Poaceae |
| 202 | 56 | 10-Dec | Sporobolus | virginicus | (=Gramineae) |
| | | | UNK-thorny | | |
| 203 | 56 | 10-Dec | purple flower | | |
| 204 | | | | | |
| 205 | 56 | 10-Dec | Rhynchospora | corymbosa | Cyperaceae |
| 206 | 54 | 10-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 207 | | | | | |
| 208 | 54 | 10-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 209 | 54 | 10-Dec | Centaurium | spicatum | Gentianaceae |
| 210 | 57 | 10-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 211 | 71 | 11-Dec | Triglochin | striata | Juncaginaceae |
| 212 | | | | | |
| 213 | 71 | 11-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 213 | 68 | 11-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 214 | 70 | 11-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 215 | 70 | 11-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 216 | 70 | 11-Dec | Fimbristylis | cymosa | Cyperaceae |
| 217 | 70 | 11-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 218 | | | | | |
| 219 | 84 | 12-Dec | Derris | trifoliata | Papiionaceae |
| 220 | 107 | 12-Dec | Rhizophora | tomlinsoni | Rhizophoraceae |
| 221 | 90 | 12-Dec | Derris | trifoliata | Papiionaceae |
| 222 | 132 | 13-Dec | Rhizophora | tomlinsoni | Rhizophoraceae |
| 223 | 119 | 13-Dec | Rhizophora | lamarckii | Rhizophoraceae |
| 224 | 118 | 13-Dec | Rhizophora | samoensis | Rhizophoraceae |
| 225 | 116 | 13-Dec | Avicennia | marina | Avicenniaceae |
| 226 | 116 | 13-Dec | Avicennia | marina | Avicenniaceae |
| 227 | | 13-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 228 | | 13-Dec | Fimbristylis | ferruginea | Cyperaceae |
| | | | UNK-Mariscus | | |
| 229 | 137 | 14-Dec | like? | | Cyperaceae |
| 230 | 136 | 14-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 231 | 135 | 14-Dec | Sonneratia | caseolaris | Sonneratiaceae |
| 232 | 136 | 14-Dec | Acrostichum | aureum | Pteridaceae |
| 233 | 151 | 14-Dec | Scirpus | | Cyperaceae |
| 234 | 136 | 14-Dec | Barringtonia | | Lecythidaceae |
| | | | UNK-spinach | | |
| 235 | 140 | 14-Dec | yellow flower | | |
| 236 | 151 | 14-Dec | Rhizophora | tomlinsoni | Rhizophoraceae |
| 237 | 137 | 14-Dec | Schoenoplectus | litoralis | Cyperaceae |
| | | | UNK-pink flower | | |
| 238 | 151 | 14-Dec | shrub | | |
| 239 | 151 | 14-Dec | UNK-clover | | |

| NC# | Way Point | Date | Genus | Species | Family |
|-----|-----------|----------|--------------------------------------|----------------|------------------|
| 240 | 151 | 14-Dec | white flower Rhizophora | apiculata | Rhizophoraceae |
| 241 | 151 | 14-Dec | Fagraea | berteroana | Gentianaceae |
| 242 | 152 | 14-Dec | UNK-water cress, purple flower | | |
| 243 | 151 | 14-Dec | Rhizophora | lamarckii | Rhizophoraceae |
| 244 | 155 | 15-Dec | Cymodocea | serulata | Potamogetonaceae |
| 245 | 155 | 15-Dec | Cymodocea | rotundata | Potamogetonaceae |
| 246 | 163 | 15-Dec | Rhizophora | selala | Rhizophoraceae |
| 247 | 167 | 15-Dec | UNK- triangle sedge | | Cyperaceae |
| 248 | 167 | 15-Dec | UNK-mint yellow flower | | |
| 249 | 167 | 15-Dec | UNK-clover white flower | | |
| 250 | 167 | 15-Dec | Baumea | juncea | Cyperaceae |
| 251 | 167 | 15-Dec | Fimbristylis | polytrichoides | Cyperaceae |
| 252 | 182 | 16-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 253 | 182 | 16-Dec | Fimbristylis | ferruginea | Cyperaceae |
| 254 | 208 | 18-Dec | Baumea | juncea | Cyperaceae |
| 255 | 207 | 18-Dec | UNK-triangle sedge | | Cyperaceae |
| 256 | 207 | 18-Dec | Baumea | juncea | Cyperaceae |
| 257 | 215 | 18-Dec | Schoenoplectus | litoralis | Cyperaceae |
| 258 | 207 | 18-Dec | UNK-mini pandanus | | Cyperaceae |
| 259 | 180 | 16-Dec | Avicennia | marina | Avicenniaceae |
| 260 | jm72/ | 6-Dec | Euphorbia | atoto | Euphorbiaceae |
| 261 | jm16 | 3-Dec | Fimbristylis | cymosa | Cyperaceae |
| 262 | | | | | |
| 263 | jm72/ | 6-Dec | Euphorbia | atoto | Euphorbiaceae |
| 263 | jm72/ | 6-Dec | Euphorbia | | Euphorbiaceae |
| 264 | jm48/3 | 28/11/09 | Atriplex | jubata | Chenopodiaceae |