1 Historical Prelude

Mangrove vegetation was encountered by early travelers from temperate regions as plants that would prevent easy landfall. In particular, they would have been visible in the estuaries of major tropical rivers that would have provided easy access to interior regions. This familiarity generated a number of still current myths, notably the impenetrability of the mangal, as voiced by Dampier (*Voyage au nouvelle monde*, 1723): "Where this sort of tree grows, it is impossible to march by reason of these stakes, which grow so mixed one among the other that I have, when forced to go through them, gone half a mile and never stepped foot on the ground, stepping from root to root" (Fig. 1.4). This route is demonstrated in the Frontispiece. They can, however, be explored by shallow draught boat along their numerous tributary creeks. Penetrability also depends on the size and maturity of the forest. In stands with tall trees up to a canopy height of 30 m, the common absence of any undergrowth allows easy access by walking or wading under, rather than over, the flying-buttress roots of *Rhizophora* (Plate 13A). With the settlement of Europeans in the tropics, the study and description of mangroves made information about them necessary and, with it, their naming.

Outstanding in this respect is the monumental work of the Georg Everhard Rumpf (1627–1702), of German origin, known to posterity by the Latinized form *Rumphius*, and in the format of the six-volume *Herbarium Amboinense* ("The Amboinese Hebarium"), a description of the plants of Amboina, a colony of the Dutch East India Company, where he was a merchant. Corner (1966), in his *The Natural History of Palms*, has provided a succinct summary of the extraordinary history of this work and the unlikely circumstances under which it ever appeared. Corner's book is an appropriate source because Rumphius himself emphasized palms as the group first described in Volume 1.

> . . .the leading Dutch merchant Georg Everard Rumpf (1627–1702) was writing his Herbarium Amboinense. He started in 1662, but never saw its publication; he never saw, indeed, the final manuscript. Tragedy upon tragedy beset this unfortunate man who became known to botany as Rumphius. In 1670 he grew blind. On 17 February 1674, an earthquake destroyed the larger part of the town of Amboina. His wife and younger daughter were killed; and a clerk, in his account of the devastation, has recorded these words: 'Very sad it was to perceive that man sitting near these his bodies, and to hear his lament, both on this accident and his blindness'. In 1687 a fire ravaged the town and Rumphius' library, manuscripts and illustrations for the Herbarium Amboinense were destroyed. He commenced to repair the loss by means of assistants who were put at his disposal by the authorities, to copy out what he could remember. The first six books were dispatched in 1690 to Holland via Batavia in Java, but the ship was sunk by the French and its

cargo lost. Fortune smiled because the governor general of Batavia, Camphius, had caused a copy to be made and this arrived in Holland in 1696. Rumphius completed his task in 1701, and the last books reached their destination. On 19 May 1702, the Governor of Amboina wrote that 'nothing more was to be expected of that old gentleman, having lived his years'. His grave was destroyed by a party of English soldiers who hoped to find gold buried under the stone. A second monument, erected in 1824 to honour the pioneer naturalist, 'remained until it was hit by a bomb in the last world war and was smashed'. The Herbarium Amboinense was eventually published by the Dutch botanist Johannes Burmann (1706–1779) in the years 1741–1755 and an index was supplied in 1769.

His monument in Amboina was the site for old pilgrimages, but now new ones, as a more recent monument has been erected.

Herbarium Amboinense is profusely illustrated, with a text jointly in Latin and medieval Dutch. Until recently it existed in rare book collections, but has been translated into English – over 250 years later! – by the Dutch scholar E. M. Beekman (2011), making this work, which includes a wealth of economic and ethnobotanical information, more accessible. The book was not written from the limited approach of a medieval herbal, but included extensive descriptions of the structure and biological attributes and habitat locations of plants that were largely unfamiliar to botanists of that era (Fig. 1.1). Rumphius had a particular fascination with mangroves, as remarkable

Figure 1.1. From Rumphius (1741–1755), Plate 71, vol. 2, Book 4, with the habit of *Mangium candelaria* in the original.

Table 1.1 Rumphius' Terminology using Mangium: Five "Genera"

1.	*Mangium legitimum*, "proper Mangium" with four further "species"	
	1a.	*Mangium celsum*, "tall or lofty mangium"
	1b.	*Mangium minus*, "small mangium"
	1c.	*Mangium digitatum*, "fingered mangium"
	1d.	*Mangium candelarium*, "candle mangium"
2.	*Mangium caseolare*, "cheese mangium"	
3.	*Mangium album*, "white mangium"	
4.	*Mangium fru[c]ticans*, "shrub-like mangium"	
5.	*Mangium ferreum*, "hard or iron mangium"	

trees growing in salt water. He named them (Table 1.1), using *Mangium* as a generic name with an ecological rather than a systematic connotation. The work provides insights into the general level of botanical understanding of that period and, together with its predecessor *Hortus Malabaricus* of Rheede (1678–1703), drew to the attention of European botanists the great wealth and diversity of tropical floras, providing a source of information and direction for the later exploration of the tropics worldwide in the eighteenth and nineteenth centuries.

Identifying Rumphius' Plant Names

Although *Herbarium Amboinense* predated the starting point of modern botanical nomenclature (Linnaeus, 1753), it still had some influence on subsequent naming despite difficulties in providing equivalent modern names of precise application. This exercise was attempted in great detail by Merrill (1917), with extended discussion (Table 1.2). The interpreted nomenclature is an essential tool in Beekman's translation, especially in its marginal notes. Scrutinizing the illustrations, without commenting on their quality, one discovers how they portray biological features of appreciable accuracy even from the point of view of modern investigation. The translated version is a work of complex scholarship, especially as it is intended to be acceptable to an English-speaking reader of the period in which the original was written (E. M. Beekman, personal communication). The layout for the most part cannot be seen as systematic in the modern sense but relates to groups of plants with similar uses. It begins with the palms, as easily recognized, economically important, and perhaps most iconic of tropical plants. The mangroves are discussed as an ecological group, readily categorized by their exclusively intertidal location.

Merrill (1917), in trying to recognize the species described in *Herbarium Amboinense*, discusses many of the uncertainties of identification and he was critical of their representation, describing many of them as "crude," but if one steps back from the niceties of modern nomenclature (which itself has its own necessary uncertainties) and accepts them without the unfair advantage of over 300 years of

Table 1.2 Rumphian Names, in English Translation (Beekman, 2011) and their Presumed Modern Equivalents. Sources: Merrill (1917), Ding Hou (1958)

Avicenniaceae
Mangium album, "the white mangi tree" [= *Avicennia officinalis* L. (Merrill, p. 456)]

Lythraceae
Mangium ferreum mas, "the iron mangi tree" [= *Pemphis acidula*, Forst]
Mangium ferreum porcellanicum, "the iron mangi tree" [= *Pemphis acidula*, Forst]

Myrsinaceae (Primulaceae)
Mangium corniculatum, "the horned mangi tree" [= *Aegiceras corniculatum* (L.), Blanco (Merrill, p. 413)]
Mangium fru[c]ticans, "the horned mangi tree," second species of this genus but not illustrated [= *Aegiceras floridum*, Roem and Schultes]
Mangium fru[c]ticans II parvifolium; *Mangium floridum*; *Mangium parvifolium II* [all probably = *Aegiceras floridum*, Roem and Schultes]

Rhizophoraceae
Mangium candelarium or *arcuatum*, "candle-bearing mangi tree" [= *R. apiculata*, Blume (Merrill, p. 387)]
Mangium digitatum, "the fingered mangi tree" [= *Bruguiera sexangula* (Lour.), Poir (Merrill, p. 389)]
Mangium celsum, "the small mangi tree" [= composite species of *Bruguiera gymnorrhiza* (L.), Lamk (espec. "fruits" = seedlings) and *B. cylindrica* (L.), Blume (flowers)]
Mangium celsum, "the clove-shaped mangi tree" [= *Bruguiera cylindrica* (L.), Blume (Merrill, p. 388–389)]
Mangium celsum, "the fingered mangi tree" [= *Bruguiera sexangula* (Lour.), Poir (Merrill, p. 389) but *Bruguiera gymnorrhiza* (L.), Lamk (Ding Hou, 1958)]
Mangium celsum, "the tall mangi tree or lalary wood" [= *Bruguiera gymnorrhiza* (L.) Lamk]
Mangium minus [= ?*Bruguiera gymnorrhiza* (L.) Lamk (Ding Hou, 1958)]
Mangium caryophylloides I [= *Bruguiera cylindrica*) (L.), Blume]
Mangium caryophylloides II parvifolium [= *Ceriops tagal* (Perr.), C. B. Rob (Merrill, p. 386)]
Mangium caryophylloides III latifolium [= *Ceriops tagal* (Perr.), C. B. Rob (Merrill, p. 386)]

Sonneratiaceae
Mangium caseolare album, "the white cheese-bearing* tree" [= *Sonneratia alba* Sm.] (Merrill, p. 383)]
Mangium caseolare rubrum, "the red cheese-bearing* tree" [= *Sonneratia caseolaris* (L.), Engler] (Merrill, p. 383)]

* "cheese-bearing" because Rumphius was reminded by the shape of the fruits of small cheeses, perhaps natural for Dutchmen.

post-Rumphian research, there is great pleasure in using this book if one has some familiarity with the plants described in it, and may even be drawn to marvel at the accuracy of their representation. The example to which attention is drawn is the very accurate rendition of the seedling of *Rhizophora* (Fig. 1.2) in relation to a recent study of this topic (Tomlinson and Cox, 2000), as discussed in the later description of this genus.

Mangroves in Rumphius

In *Herbarium Amboinense*, the section on mangroves treats them as an ecological group of plants, unfamiliar to European botanists because they were trees that grow within the tidal influence of the sea. Rumphius admired mangroves because of their location in salt

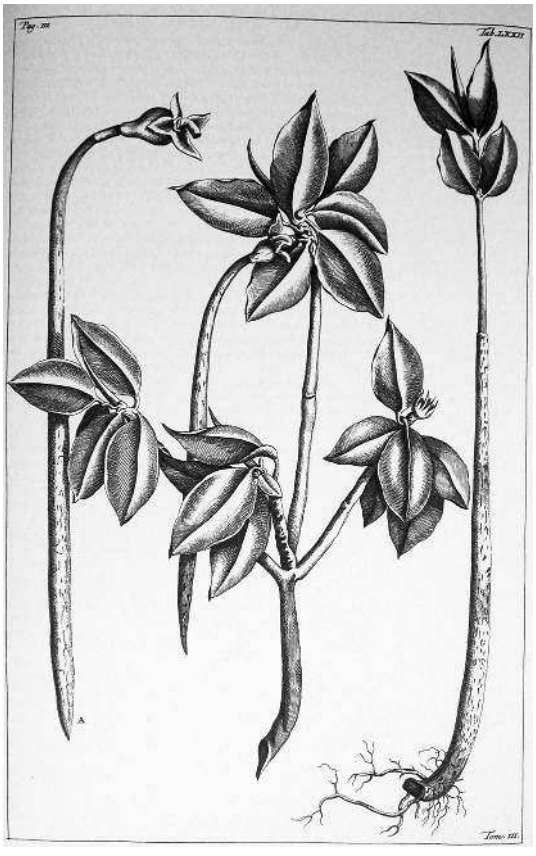

Figure 1.2. From Rumphius (1741–1755), Plate 72, vol. 2, Book 4, with an illustration of *Rhizophora apiculata*, showing the characteristic basal hook.

water and the presence of roots arising from branches, features unknown outside the tropics. He also recognized them as a distinct ecological group, in contrast to most of the other plants he described that were categorized largely according to their uses. He referred to the mangrove plants as "mangi-mangi." This can be interpreted as either the vegetation *in toto* or the individual species. The vernacular of his time would have been Malay, in which language a plural is produced by repeating a noun, thus mangi mangi would seem to mean mangroves collectively. In modern parlance, the distinction is made between mangal as the community and mangroves as the plants in order to avoid any confusion, although in context, readers usually have no difficulty. Rumphius Latinized the singular as *Mangium*, which he used largely to refer to the plants as an ecological group. Beekman (2011) has faithfully retained this terminology in his translation; for example, *Mangium candelarium*, "The candle-bearing mangi tree," which turns out to be *Rhizophora*; the "candles" are the pendulous hypocotyls of the viviparous seedlings (Plate 14B). The result is an association of some dozen species that are currently distributed among several unrelated families (Table 3.1). *Nypa*, the

mangrove palm, is described elsewhere, and appropriately so, in the introductory palm chapters. Thus, my own treatment of an ecological assemblage has followed the same nonsystematic context. However, Rumphius also added a number of other plants under the same category that had no particular association with coastal vegetation (e.g., *Eucalyptus deglupta* Blume, "the many-colored mangi tree" – the rainbow eucalypt of cultivation). The word "mangium" in modern use is found only in *Acacia mangium* Willd. (originally *Mangium montanum*, "the mountain mangi tree," Herb. Amb. T. 81), an inland Asian tree and a modern source of fuel wood. He says these additions could have been described elsewhere, but "preferred not to." Nor are the mangrove associates or members of "back-mangrove" communities described, as is done in this book (Table 3.2). Other than these, mangium has a purely ecological connotation. The names Rumphius used and their modern equivalents, in so far as they have been identified, are listed in Table 1.1, 1.2. In the translation of Rumphius, the terms genus and species are used, but this should not be interpreted in a modern connotation. His usage was summarized by him but translated in Beekman (2011) as follows:

Rumphius and Mangrove Biology

One can understand some of the frustration expressed by Merrill (1917) that may have led to his rather severe criticism, resulting from his inability to name Rumphian species with precision. This was largely due to the absence of discernable diagnostic features, although for the most part, genera can be identified. In addition, some of the illustrations were from a mixture of taxa or were even copied from earlier works; for example, the *Hortus Malabaricus* of Rheede. Hence, the comment by Merrill in his notes on *Mangium* that the text of their chapters was acceptable but the illustrations were "very crude." Rumphius, after all, was blind and did not see the plates in their final form. However, this does not mean that we should dismiss them as worthless. If one approaches them from the perspective of what useful information can be gleaned from them, they can be seen to represent the growth and development of taxa without too much concern for precise nomenclature.

Architecture. The drawing including the habit of *Rhizophora* (Herb. Amb. Tab. 71, our Fig. 1.1) is very accurate and shows the obconical base of a rooted trunk progressively widened upward and associated with the development of aerial roots of increasing diameter upward; that is, in reverse order of their age. Biomechanically, the canopy of the tree is thus supported by a series of aerial roots of increasing size acting as flying buttresses (Plate 13A). Clearly, the illustration by Rumphius was drawn from nature. Rumphius also shows aerial roots arising from distal branches, which does occur, but exceptionally and largely as a response either to direct damage of the crown or where the canopy above a crown is opened, as by storm damage. Such roots in tall trees, even if they can reach the ground, may be of little architectural significance, although they may be very important in the development of a shrub-like habit in open or marginal communities, notably so in

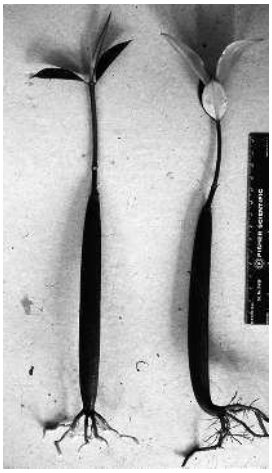

Figure 1.3. Seedlings of *Bruguiera gymnorrhiza*: left, planted vertically, axis remains straight; right, planted horizontally, erected by basal hook.

the Florida Everglades (Plate 1). This form of rooting is also the reason plants of limited stature can survive in a vegetative state, as described by Guppy (1906) for *Rhizophora* x *selala* in Fiji. Once again, Rumphius presents what is easily observed.

Seedling dispersal and establishment. We agree with Merrill that the comments of Rumphius on seedling development are accurate, although we must point out that both of them referred to these structures as "fruits" (the "candles" of Rumphius), although they are actually the extended hypocotyls of viviparous seedlings. Particularly accurate is the Rumphian illustration of an established seedling of *Rhizophora* with its characteristic basal "hook" (Fig. 1.2). The development of this basal hook is easily demonstrated by field observation and experiment (Fig. 1.3), and we have much to say about this in relation to the description of the viviparous condition in Chapter 10. In his description of seedlings on the tree, Rumphius implies that they "remain upright" (strictly, pendulous; Plate 14B), and where they hang low enough "to touch the ground," they send out roots to become "new little trees." This is extremely unlikely, but more significantly and "they are tossed elsewhere by the flowing tide, where they will nevertheless root and establish themselves." This aspect of dispersal and establishment was to become a major focus of ecological research, but with several miss-steps along the way, as discussed in Chapter 7.

Conclusion

We may find fault with the publications of a blind botanist of the seventeenth century, but we might better be employed in extracting original information from his work in

Figure 1.4. Rhizophora forest, Biscayne Bay, Miami, FL. (From a color transparency by AMJ.)

a more positive frame of mind. Rumphius did not have the opportunity to see the plates published in his name and to continue the many and careful observations that he had made initially. Perhaps it is as well; he could easily have scooped us all and many hypotheses about mangrove biology need not have existed and an experimental approach to plant ecology might have begun earlier!