

Short Communication: New distributional records of *Sonneratia* spp. from Andaman and Nicobar Islands, India

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ABSTRACT

Ragavan P, Ravichandran K, Mohan PM, Sxaena A, Prasanth R S, Jayaraj RSC, Saravanan S. 2014. New distributional records of *Sonneratia* spp. from Andaman and Nicobar Islands, India. *Biodiversitas* 15: 251-260. *Sonneratia lanceolata*, *Sonneratia x urama* and *Sonneratia x gulngai* was collected from Great Nicobar Island, which representing a new addition to the mangrove flora of India. *S. lanceolata* is distinguished from *S. caseolaris* by its drooping branches, lanceolate leaves and ovoidal bud without medial constriction. *S. x urama* and *S. x gulngai* are putative hybrids. *S. x urama* is putative hybrid between *S. alba* and *S. lanceolata*, whereas *S. x gulngai* is putative hybrid between *S. alba* and *S. caseolaris*. A detailed description along with colour plate and relevant notes is provided for further collection and identification of these species in the field.

Key words: Andaman and Nicobar Islands, India, new records, *Sonneratia*.

INTRODUCTION

Sonneratia (Lythraceae sensu lato), a typical mangrove genus comprising about nine species (Li and Chen 2008) is widely distributed from eastern Africa through Indo-Malaya to north eastern Australia and some islands in the west Pacific Ocean (Qiu et al. 2008). In India including Andaman and Nicobar Islands (ANI), five species of *Sonneratia* viz *Sonneratia alba* Smith, *S. apetala* Buch-Ham., *S. caseolaris* (L.) Engler, *S. griffithii* Kurz, and *S. ovata* were reported so far (Dagar et al. 1991; Debnath 2004; Dam Roy et al. 2009). During floristic study at Great Nicobar Islands revealed the presence of *Sonneratia lanceolata*, *Sonneratia x urama* and *Sonneratia x gulngai*; *S. caseolaris* also recorded in this survey from Great Nicobar Island. Among them former three species are new distributional records for India. *Sonneratia lanceolata* and *S. caseolaris* was collected from Preambhadrur Nallah and *S. x urama* and *S. x gulngai* was collected from Galathea Bay. *S. x urama* is putative hybrid between *S. alba* and *S. lanceolata*, whereas *S. x gulngai* is putative hybrid between *S. alba* and *S. caseolaris* (Duke 1984; 1994). In Great Nicobar Island *Sonneratia* spp. are observed in newly formed intertidal habitat formed after 2004 tsunami at the expense of flat coastal forests (littoral forest) and coconut plantations that existed adjacent to the coast and are now dominated by *Sonneratia* spp. The collected specimens were identified based on the morphometric analysis of wide range of vegetative and reproductive characters in comparison

with diagnostic characters described by Duke and Jackes (1987) and Duke (2006) (Table 1). The taxonomical distinction between *S. caseolaris* and *S. lanceolata* is not clear (Kathiresan 2010). In order provide the clear distinction between them specimens of *Sonneratia caseolaris* was also collected from little Andaman for comparative study. Herbarium for each species was prepared and deposited at Botanical Survey of India, Regional Centre at Port Blair. A detailed description along with colour photograph and relevant notes are discussed in details.

TAXONOMIC TREATMENT

Key to *Sonneratia* spp. in ANI

- 1.a. Petals present 2
- b. Petals absent 4
- 2.a. Petals white, stamens white, leaves ovate to oblong-ovate with rounded mucronate folded underside of the leaf, fissured bark, ellipsoidal buds constricted medially, cup shaped calyx persistent on fruit, calyx lobes 6-7 reflexed towards the fruit stalk on maturity, seeds are sickle shaped *S. alba*
- b. Petals red, stamens red or white 3
- 3.a. Stamens red, leaves elliptic or oblong with pointed mucronate, bark smooth or lightly fissured, grey in colour, flower buds with slight medial constricted, ellipsoidal in shape, flat calyx persistent on mature fruit, calyx lobes 5-7, seeds irregular angular *S. caseolaris*

Table 1. Diagnostic character of *S. caseolaris*, *S. lanceolata*, *S. x urama* and *S. x gulngai* with references to Duke and Jackes (1987) and Duke (2006)

[illegible]

- b. Stamens red, leaves obovate to ovate with recurved mucronate, apex rounded, bark smooth or lightly fissured, grey in colour, flower buds with prominent medial constricted, ellipsoidal in shape, flat calyx persistent on mature fruit, calyx lobes 5-7, seeds irregular angular *S. x gulngai*
 - c. Stamens red leaves lanceolate, apex acute with recurved mucronate, bark smooth or lightly fissured, grey in colour, flower buds without prominent medial constricted, ovoidal in shape, flat calyx persistent on mature fruit, calyx lobes 5-7, seeds irregular angular *S. lanceolata*
 - d. Stamens white, leaves elliptic to broadly elliptic, apex acute with recurved mucronate, mature bud ellipsoidal with prominent medial constriction, bark smooth or lightly fissured, grey in colour, flat calyx persistent on mature fruit, calyx lobes 5-7, seeds irregular angular *S. x urama*
- 4.a. Leaves broadly ovate, mucronate absent, calyx surface verruculose, calyx lobes always 6 enveloped the fruits, seeds are irregular *S. ovata*
- b. Leaves obovate to sub-orbicular, base rounded, mucronate present folded underside of the leaf, closed buds rounded, no medial constriction, calyx surface smooth, calyx lobes 6-7 not enveloped the fruits, flat calyx persistent on mature fruit, seeds angular *S. griffithii*
- c. Narrowly elliptic to lanceolate leaves, bark light brown irregularly fissured, calyx lobes 4, lie flat in mature fruit, umbrella shaped stigma..... *S. apetalata*

DESCRIPTION

Sonneratia lanceolata Blume, Mus. Bot. Lugd.-Bat. 1 (1851) 337; Miq., Fl. Ned. Ind. 1, 1 (1855) 497; Koord., Versl. Minahasa (1898) 471; Becc., Nelle Foreste di Born. (1902) 579; CT. White, Proc. Roy. Soc. Queensl. 34 (1922) 45; R. Parker, Indian For. 51 (1925) 505; Duke & Jackes in Blumea 32: 297 (1987). *Sonneratia acida* auct. non L. f.: Benth., Fl. Austral. 3 (1866) 301, p. p. *S. alba* auct. non L. Smith; Merr., Enum. Born. PI. 448 (1921). *S. caseolaris* auct. non (L.) Engl., ex parte; Ridely, Fl. Malay Penins. I: 825. (1922) (Figure 1)

Tree columnar or spreading, 15-25m high, evergreen, branches are drooping, stem base simple, bark grey to pale green, smooth or lightly fissured with numerous lenticels, roots pneumatophores, conical, slender, ca 40cm long. Leaves simple, opposite, pale green, 6-12.3cm L, 2.5-4.4cm W, elliptic or lanceolate, margin entire, base attenuate, apex acute with recurved mucronate; petiole very short, flattened, red, ca 2-6mm long; stipules absent. Inflorescence terminal, mostly 1 flowered, rarely 2; mature buds 2.2-3.5cm L, 1.5-2.4cm W, ovoidal or ellipsoidal without medial constriction, apex acute to obtuse, bract 2, lateral, not persistent; calyx lobes 5-7, green, elliptic-triangular, apex acute; petals 5-7, ribbon like, 1.8-2.2 cm × 2.5-3 mm, dark red; stamens numerous, ca 4.5cm long, red; ovary superior multilocular, style terete, coiled in bud, extended at anthesis to 5.1-5.6cm long; stigma fungiform, ca 1.8-2.1mm. Berry globose, green, leathery, 2.1-2.5 × 4.5-5cm W, persistent withered style up to 6cm L; calyx persistent flat expanded, calyx lobes erect; hypanthium saucer-shaped; seeds numerous, angular irregular.

Distribution. *Sonneratia lanceolata* is found in Australia, Indonesia, New Guinea and Vietnam.

Habitat and ecology. The species occurs at low intertidal position or in upstream estuarine positions in rivers subjected to relatively high levels of freshwater runoff. Substrate is usually fine soft silt on the accreting inside banks of river meanders. In Great Nicobar Island it was observed at high intertidal region along with *S. caseolaris* and *Bruguiera gymnorrhiza*.

Phenology. Flowering and fruiting occurs throughout the year apparently.

Specimen examined. India: Andaman and Nicobar Islands, Great Nicobar Island, Preambhadrur Nallah, 13/2/2014, 06°56'59.3"N and 93°54'28.0"E, P.Ragavan # 30922 (PBL).

Sonneratia x urama N.C. Duke. Duke & Jackes in Blumea 32: 297 (1987); Duke in Australian Systematic Botany, 7, 521-526 (1994). (Figure 2)

Tree 10 to 20m high, spreading with dense canopy; stem base simple, bark grey, smooth, lightly fissured and flaky on maturity, pneumatophores, conical, slender, ca 20-40cm long. Leaves simple, opposite, pale green, 7-9.3 × 4.7-6.2 cm, elliptic to broadly elliptic, margin entire, glabrous, base attenuate, apex acute or broadly acute with recurved mucronate; petiole short, flattened, reddish-green, ca 3-6mm long; stipules absent. Inflorescence terminal, 1 - 2 flowered, mature buds 3.5-4 × 2-2.2cm, ellipsoidal bud with prominent medial constriction, apex acute, bract 2, lateral, not persistent; calyx lobes 6-7, green, apex acute; petals, 6-7, ribbon like, ca 2.3cm × 0.2cm, red; stamens, numerous, white, ca 5.2cm long; ovary multilocular, style terete, coiled in bud, extended at anthesis to 5.6-6.5cm long, stigma fungiform, ca 1.9-2.1mm. Berry globose, green, leathery, 2-3.3 × 5.6-6cm, persistent withered style up to 8.3cm long, base convex; calyx persistent, flat expanded, calyx lobes reflexed upwards; seeds numerous, angular and irregular.

Distribution. This putative hybrid has been reported in three countries, Australia, Indonesia and Papua New Guinea.

Habitat and ecology. Common in mid intertidal and intermediate estuarine position. In Galathea Bay it was found in downstream estuarine position along with *Acrostichum aureum*, *Bruguiera gymnorrhiza* and *Sonneratia x gulngai*.

Phenology. Flowering and fruiting occurs throughout the year apparently

Specimen examined. India: Andaman and Nicobar Islands, Great Nicobar Island, Galathea Bay, 14/02/2014, 06°49'14.1"N and 93°51'56.5"E, P.Ragavan #30926 (PBL).

Sonneratia x gulngai N.C. Duke, Duke & Jackes in Blumea 32: 297 (1987); Duke in Austrobaileya 2(1) 103 - 105 (1984). (Figure 3)

Tree up 10-20m high, spreading with dense canopy, stem simple, glabrous, bark smooth, grey, lightly fissured and flaky on maturity, pneumatophores conical, slender, ca 40-60 cm long. Leaves simple, opposite, pale green, 7-9.3

× 4.7-6.2 cm, obovate to ovate, margins entire, glabrous, base rounded or obtuse, apex broadly acute with recurved mucronate; petioles short, flattened, red, ca 2-5 mm long; stipules absent. Inflorescence terminal, 1-2 flowered, mostly 1; mature buds 3.8-4.4 × 2-2.3 cm, ellipsoidal with prominent medial constriction, apex acute, bract 2, lateral, not persistent; calyx lobes 5-7, apex acute; petals 5-7, red, ribbon like, ca 2.5 × 0.2 cm; stamens numerous, red, 4.5-5.6 cm long; ovary multilocular, style terete, coiled in bud, extended at anthesis up to 6.5 cm long; stigma fungiform, ca 1.7-1.9 mm. Berry globose, green, leathery, 2.5-3.3 × 5.5-6 cm, persistent withered style up to 8.6 cm long, calyx persistent, calyx lobes reflexed upwards; seeds numerous, angular and irregular.

Distribution. *Sonneratia x gulngai* may occur from southern Malaysia and China, through southern Asia and Indonesia, to northern New Guinea and northern Australia. Here it is reported from first in India.

Habitat and ecology. Common in Mid intertidal and intermediate estuarine position, found on firm mud or silt. In Galathea bay it was found in downstream estuarine position along with *Acrostichum aureum*, *Bruguiera gymnorrhiza* and *Sonneratia x urama*.

Phenology. Flowering and fruiting occurs throughout the year apparently.

Specimen examined. India: Andaman and Nicobar Islands, Great Nicobar Island, Galathea Bay, 14/02/2014, 06°49'14.1"N and 93°51'56.5"E, P. Ragavan # 30927 (PBL).

DISCUSSION

Vegetative structures of *Sonneratia* spp. are very similar (Tomlinson 1986). However the occurrence of petals and its color is more useful for identification of *Sonneratia* spp. (Duke and Jackes 1987). Based on the occurrence of petals we can broadly classify the *Sonneratia* spp. into two i.e. petalous species (*S. alba*, *S. caseolaris*, *S. lanceolata*, *S. x urama*, *S. x gulngai* and *S. x hainanensis*) and apetalous species (*S. apetala*, *S. griffithii* and *S. ovata*). Among the petalous species except *S. alba* and *S. x hainanensis* others are having red petals. However, the taxonomical distinction between *S. lanceolata* and *S. caseolaris* is not clear because of the morphological similarities between them (Kathiresan 2010). But during the recent survey both *S. caseolaris* and *S. lanceolata* recorded from Preambhadrur Nallah, Great Nicobar. According to Duke and Jackes (1987) *S. lanceolata* is distinguished from *S. caseolaris* by its lanceolate leaves, white stamens, red petals and ovoidal flower buds without medial constriction. But *S. lanceolata* observed here exhibit red stamen and red petals like *S. caseolaris*; except the stamens color all the other characters are resembles the *S. lanceolata* described by Duke and Jackes (1987) and Duke (2006). In order to distinguish the *S. lanceolata* from *S. caseolaris* in Great Nicobar, specimens of *S. caseolaris* from V.K. Pur creek, Little Andaman was subjected to morphometric analysis. By comparing the specimens it was found that in *S. caseolaris* leaves shapes varied from

lanceolate to broadly elliptic with acute or rounded apex (Figure 4A-D), branches are not drooping, inflorescences with 1-3 flowers, mature buds are ellipsoidal and constricted medially and fruit is comparatively larger than *S. lanceolata* (Figure 4). Whereas in *S. lanceolata* branches are highly drooping, mostly inflorescences with 1 flowered, mature bud ovoidal or ellipsoidal without medial constriction and all the leaves are lanceolate with acute tip, fruits are smaller than *S. caseolaris*. So here it is noted that stamen color of *S. lanceolata* is can be red or white. In contrast to Duke and Jakes (1987) calyx tubes of *S. caseolaris* observed here are not grooved below the lobe fusion point (Figure 4E&J). The notable difference observed in the specimens of *S. caseolaris* from Great Nicobar is the inflexed ribbon like petals (Figure 4K-L) whereas in Little Andaman petals of *S. caseolaris* are not inflexed and lanceolate in shape (Figure 4F). Some individuals of *S. caseolaris* in little Andaman exhibit bud without medial constriction particularly in single flowered inflorescence (Figure 4E) but in multi-flowered inflorescences mature buds are with prominent medial constriction (Figure 4H). In Great Nicobar Island bud shape of *S. caseolaris* uniform in the population (Figure 4J). Another interesting variation noted in specimens of *S. caseolaris* from Great Nicobar are fruits with enveloped by calyx lobes in young stage and erected and spreading calyx lobes on maturity (Figure 4M and Figure 5G). But in Little Andaman calyx lobes are not enveloped at any stage (Figure 4G).

Sonneratia x urama is putative hybrid between *S. alba* and *S. lanceolata* and known to occur in Indonesia, New guinea and Australia (Duke 2006). *Sonneratia x gulngai* is putative hybrid between *S. alba* and *S. caseolaris*, occur in Southern Malaysia and china through Southern Asia and Indonesia, to northern new Guinea and Northern Australia (Duke 2006). Duke (1994) and Duke (1984) reported the hybrid nature *S. x urama* and *S. x gulngai* respectively. We recorded these two species from Galathea bay, Great Nicobar. Both are present abundantly without their possible parents. *S. x urama* is distinguished from *S. x gulngai* and *S. caseolaris* by its white's stamens and red petals whereas in *S. x gulngai* and *S. caseolaris* stamens and petals are red. Further it's distinguished from *S. lanceolata* by its prominent medial constriction in mature bud, elliptic leaf with broadly acute or obtuse apex and large sized fruits. *S. x gulngai* is distinguished from other *Sonneratia* spp. by its red stamens and petals, ovoid to obovate leaf with broadly acute tip, mature bud with medial constriction. Duke (1994), Duke and Jackes (1987) and Duke (2006) described that *S. x urama* exhibit cup shaped calyx, fissured and flaky bark and small fruit indented around style base. But *S. x urama* reported here have flattened calyx (Figure 2J), smooth bark (Figure 2G) and large sized fruits convex around the style base (Figure 2J). Similarly *S. x gulngai* reported here differs in morphological characters described by Duke (1984) by its flattened calyx (Figure 3G) and large sized fruits convex around the style base (Figure 3K). This notable variation along with considerable fruit setting and existence without their possible parents suggests the self sustaining ability of *S. x urama* and *S. x gulngai*. Moreover



Figure 1. *Sonneratia lanceolata*: A. Leaf blade, B. Drooping branch, C. Drooping branchlet with fruit, D. Branchlet with bud, E. Stem base, F. Pneumatophores, G. Bark, H. Mature bud, I. Opened bud, J. Dark red petals, K. Red stamens, L. Fruit with flattened calyx, M. Fruit, N. Cross section of fruit showing multilocular ovary and irregular seeds.

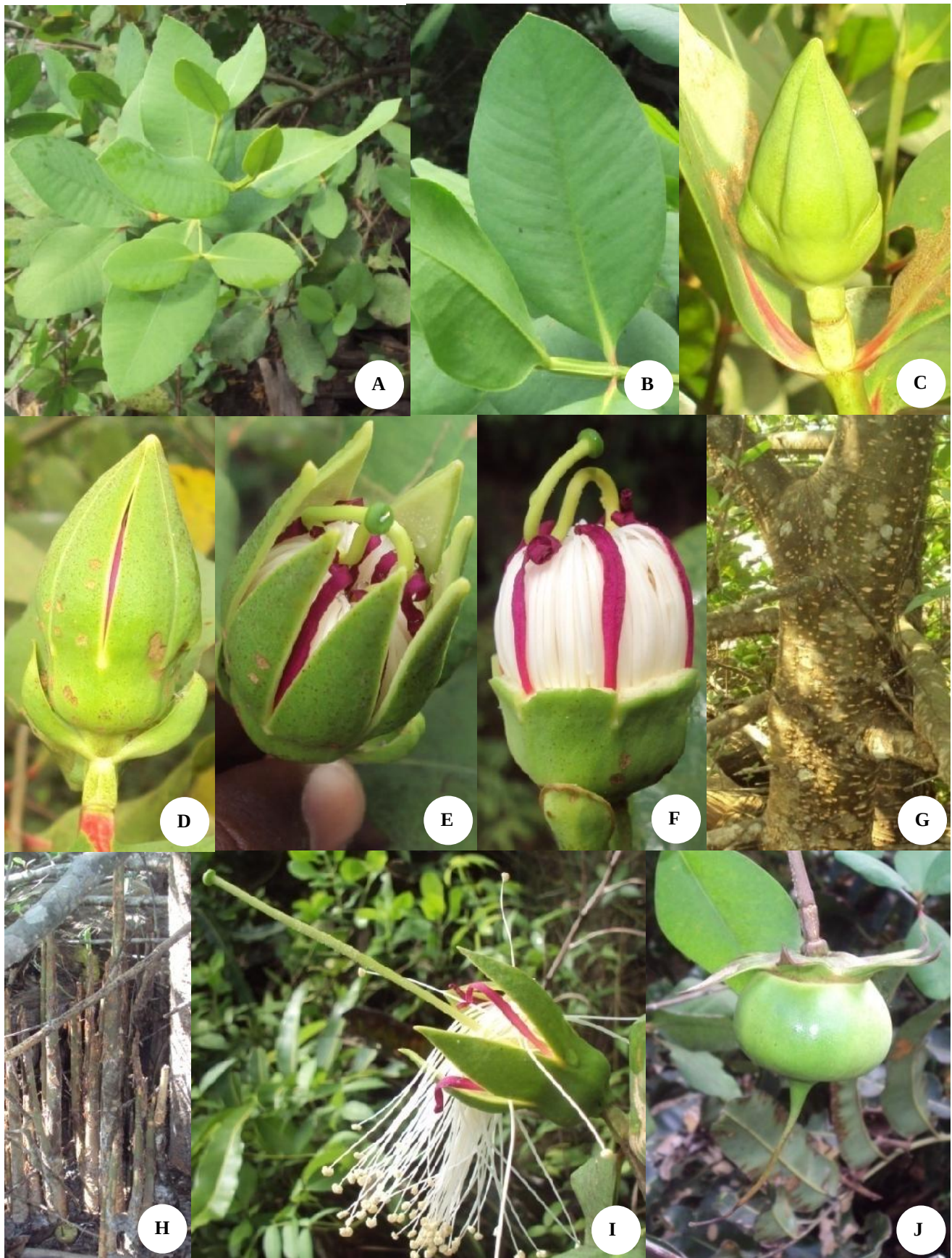


Figure 2. *Sonneratia x urama*: A. Branchlet, B. Leaf blade, C. Young bud with bract, D. Mature bud, E. Opened bud, F. Red petals, G. Bark, H. Pneumatophores, I. White stamens, J. Fruit.

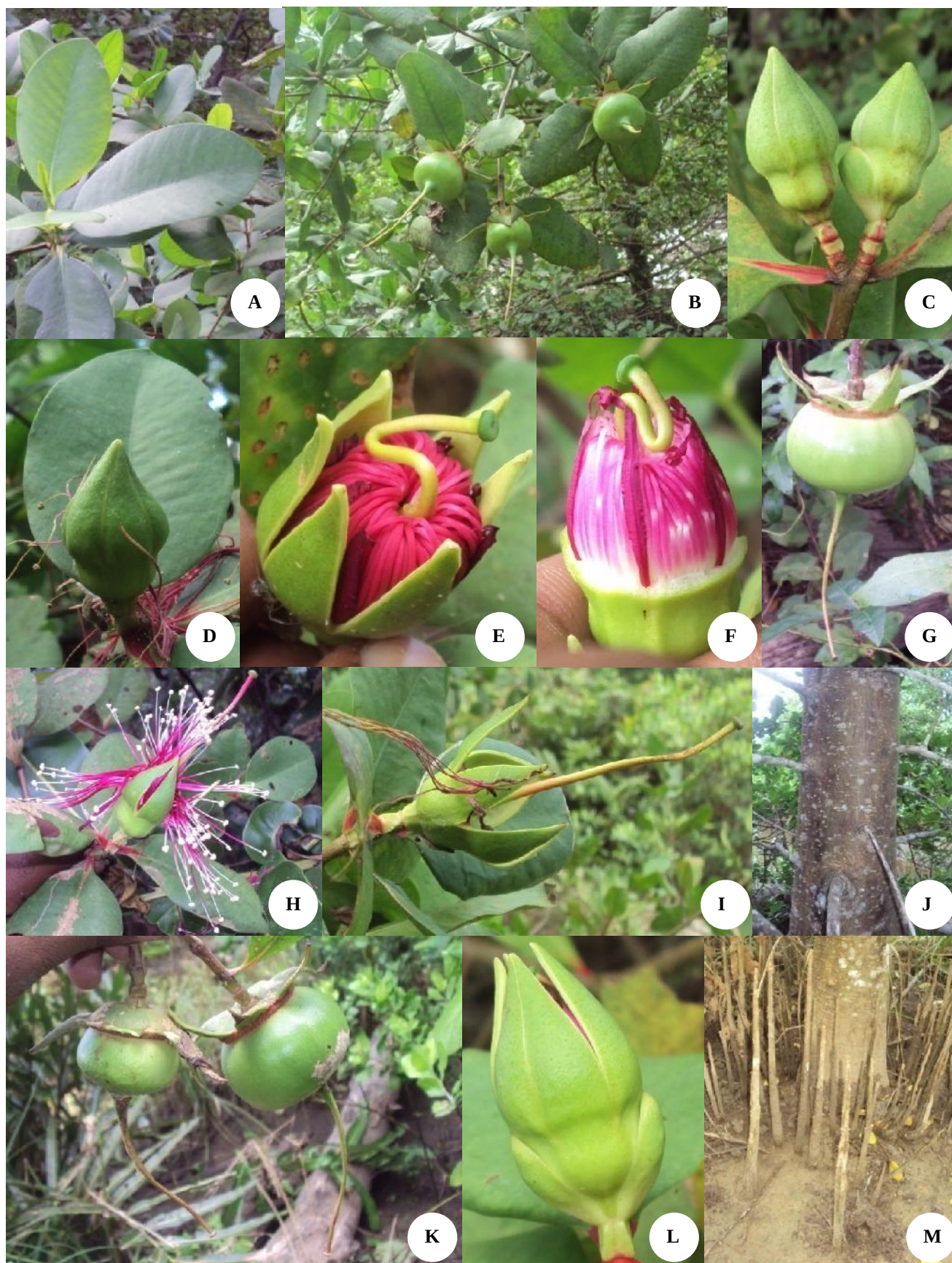


Figure 3. *Sonneratia x gulngai*: A. Leaf blade, B. Branchlet with fruits, C. Mature buds with prominent medial constriction, D. Young bud, E. Opened flower, F. Red petals, G. Mature fruit with reflexed calyx lobes, H. Red stamens, I. Style after anthesis, J. Bark, K. Young and mature fruit, L. Mature bud with bract, M. Stem base with pneumatophores.



Figure 4. Variation in *Sonneratia caseolaris*: A-D. Leaf shape and apex variation, E. Bud without medial constriction, F. Lanceolate petals, G. Young fruit with un-enveloped calyx lobes, H. Mature bud with medial constriction, I. Oblong elliptic leaf, J. Bud with medial constriction, K. Inflexed petal, L. Ribbon like dark red petal, M. Young fruit with enveloped calyx. (A-H=Specimens from Little Andaman; I-M= specimens from Great Nicobar Islands).

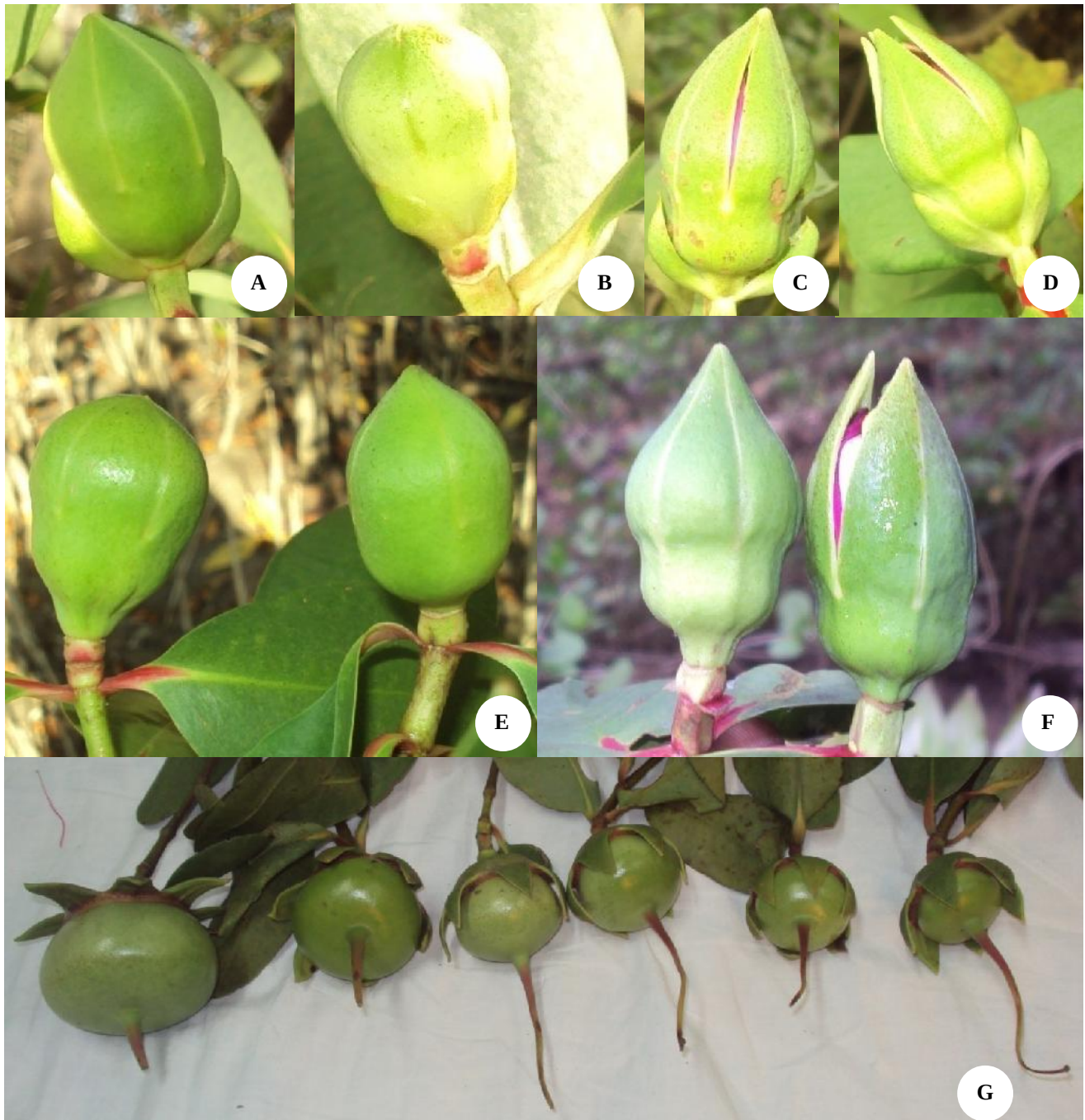


Figure 5. Presence of bract in: A. *S. lanceolata*, B. *S. caseolaris*, C. *S. x urama*, D. *S. x gulngai* ; bud shape difference between, E. *S. caseolaris* (left) and *S. lanceolata* (right), F. *S. x gulngai* (left) and *S. x urama* (right), G. Various stage of fruits with enveloped calyx (right) to flat reflexed calyx.

we observed large number of young seedlings all over the bay. So here it's documented that *S. x urama* and *S. x gulngai* deserve the species status. More interestingly mature buds of all observed *Sonneratia* spp. in Great Nicobar possess distinct bract (Figure 5 A-D). Difference in shape of mature buds of *S. caseolaris*, *S. lanceolata*, *S. urama* and *S. gulngai* is given in Figure 5 (E-F).

Ecologically *S. lanceolata* and *S. caseolaris* occurs in upstream estuarine position (Duke 2006) but in Great Nicobar these two species were observed in low intertidal

region along with *Bruguiera* spp. and *Rhizophora* spp. But in little Andaman *S. caseolaris* was observed in upstream estuarine position along with *Barringtonia racemosa* and *Nypa fruticans*. *S. x urama* and *S. x gulngai* was observed in downstream estuarine position in Galathea bay. It was known from local peoples that both the places are affected by tsunami and *Sonneratia* spp. were colonizing the area after tsunami. In Galathea bay mangroves are completely wiped off and in Preambhadur Nallah earlier coconut plantation were exist. It was variously estimated that the

tsunami wiped off 60-70 % of the mangrove forests in the Nicobar Islands (Ramachandran et al. 2005; Sridhar et al. 2006) and land has submerged by about 1m. This submergence caused the formation of new inter tidal areas at the expense of flat coastal forests (littoral forest) and coconut plantations that existed adjacent to the coast (Nehru and Balasubramanian 2011) and mangroves started colonizing in these newly formed habitats. We also observed the *S. lanceolata* population in Preambhadrur Nallah within the degraded coconut plantation and in Galathea bay the present mangrove vegetation are dominated only by *Sonneratia* spp. Hence the probable reasons for the current occurrence of these species is the seeds from the nearest sources viz. Indonesia, Malaysia and Singapore must have been carried by the tsunami and established a new population on Newly formed habitat in Great Nicobar Island. These present observations claim the colonizing ability of *Sonneratia* spp. in degraded mangrove area. So emphasis has to be given for *Sonneratia* spp. in mangrove restoration activity like *Rhizophora* spp, *Bruguiera* spp. and *Avicennia* spp. The present record of *S. lanceolata*, *S. x urama* and *S. x gulngai* from Great Nicobar Islands represents a new addition to the mangrove flora of ANI, as well highlighting as its floristic affinities towards with Southeast Asian countries. Further, it suggests the need for periodical floristic survey to updating of information on the extent and status of mangroves in the ANI.

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