

**Terminalia catappa L.****COMBRETACEAE**

Synonym: *Terminalia procera*

Common name: Country almond

Dhivehi names: Midhili gas, madhu gas, gobu gas

Status: Abundant in the forested areas and also grown around residential places.

Description: A tall, semi-deciduous, erect, medium to large sized tree 10 to 25 m tall. Trunk is usually straight and more or less cylindrical but it may also be crooked and leaning. Bark is grey brown coloured, smooth in young trees, rough with age. In younger trees branches are almost horizontal and erect and arranged in tiers, giving the tree a pagoda like shape, which becomes less noticeable as the branches elongate and droop at the tips. Leaves are single, alternate, obovate in shape, large (15 to 36 cm long and 8 to 24 cm wide) and spirally clustered at the tips. Leaves are dark green above, pale below, leathery and shiny; before dropping leaf colour changes to yellow and red. Flowers are small, white or cream coloured, five lobed and arranged on long axillary spikes. There are no petals. Majority of the flowers are male and bisexual flower are located towards the base of spikes. Fruit is a sessile, laterally compressed, oval-shaped drupe. Fruit colour changes from green in young to dark purplish red at full maturity. Rind of the fruit is light, pithy or corky tissue and float in the sea and thus dispersed by ocean currents. Each fruit contain a cream-coloured seed, which encloses the kernel (nut).

Uses: Country almond is an important timber tree in the Maldives. Timber is strong, elastic, moderately hard, smooth and lustrous. It is brown or reddish-brown in colour and medium coarse in texture. Timber is widely used in boat building, mainly for keel (*fargun*). It is also used for flooring and furniture. Wood is not suitable for long-term ground contact. Outer flesh of the fruit is eaten raw. Nut is eaten fresh or used as a substitute for cashew nut. Nut is preserved by sun drying and also sold in market. It can be an important component of the coastal bioshield from economic point of view.

Ecology, propagation and management: It grows on silt, loam, clay soils but prefers neutral or slightly alkaline sand and sandy loams. It tolerates slightly saline soils and its tolerance to drought is moderate. It is adapted to salt-laden winds but tolerance to aerosol salt spray is limited. Country almond can be readily propagated by seeds. Seeds can be collected from fresh fruits and should be sown within four to six weeks. No pretreatment is needed. Seedlings grow rapidly in the initial stages. Seedlings of four month old or about 25 cm in height can be used for outplanting. Stem cuttings of 20 to 30 cm can be rooted in the nursery before planting.



*Thespesia populnea* - Hirun'dhu

**Thespesia populnea** (L.) Soland. ex Correa MALVACEAE

Synonyms: *Hibiscus populneoides*, *Thespesia macrophylla*

Common names: Thespesia, tulip tree, milo, portia tree

Dhivehi name: Hirun' dhu

Status: Abundant in the forested areas and also grown as avenue and shade tree.

Description: A small, evergreen tree 6 to 10 m in height with short and often crooked main stem. Crown is round, broad, dense and regular in outline. Bark is brownish or greyish and fissured. Leaves are simple, alternate with 5 to 10 cm long leafstalk. Leaf blade is broadly ovate in shape, 8 to 15 cm long with pointed tip and very broad, slightly heart shaped base. Leaves are somewhat fleshy, shiny and palmately veined and turn yellow before falling. Flowers are single, large, about 4 to 7 cm long, bell-shaped and borne on the axils. Petals are five in number, which are broad, round shaped, overlapping and yellow in colour with a maroon spot at the base of each petal. Flower open and close on the same day and flower colour changes to purplish as the day progress. Fruit is a capsule, round but flattened, grown on short stalks and clustered at the ends of the branches. Matured capsules are brown to grey in colour and exude a bright yellow resin when cut. Seeds are brown in colour and hairy. Fruits float in seawater and are dispersed by ocean currents.

Uses: Tulip tree is one of the important timber species of the Maldives. Timber is fine grained, heavy, strong, and durable especially under water and highly esteemed. Timber is mostly pale-pink in colour. Wood from mature trees is widely used in building many parts of the boat. It is a premier carving wood, because the wood can be cut to fine details. It is also used for furniture and household items. Wood from young stems and trees are less dense and more prone to rotting. Bark may be used for rope and caulking boats. It is a candidate species for multispecies coastal bioshield in atoll environment.

Ecology, propagation and management: It grows well on nutrient poor coastal sandy soils and also on soils derived from limestone. It prefers slightly alkaline soil condition. It is highly tolerant to both soil salinity and aerosol salt spray. It is also tolerant to drought. It is easily propagated by seed and stem cuttings. Seeds can be collected from dry capsules by crushing them by hand. Normally no pretreatment is required but germination may be improved by soaking the seeds in water overnight. It can be directly sown or seedlings can be raised in nursery. Seedlings 40 to 50 cm, which are hardened off with reduced watering and exposure to full sunlight, can be used for outplanting. Stems cuttings 2 m long are normally used for propagation but smaller cuttings produce healthier trees. Initial growth is slow.



*Tournefortia argentea* - Boshi

**Tournefortia argentea L.f.**

BORAGINACEAE

Synonym: *Messerschmidia argentea*

Common name: Beach heliotrope

Dhivehi name: Boshi

Status: Abundant along the beaches in all islands

Description: A small- to medium- sized size tree that grows to 4 to 6 m all. Trunk is often slanted and branches are crooked. Bark is light grey to brown in colour and deeply corrugated. An important feature of the tree is its silky, hairy, fleshy light green leaves, which have a silvery grey lustre. They are simple, obovate to oblanceolate in structure, 10 to 20 cm long and 3 to 12 cm wide and arranged spirally at the branch tips. Inflorescence is large, hairy, consisting of numerous small, white sessile flowers. Flowers are about 0.6 cm in diameter and 0.2 cm in height with five lobed calyx and corolla. Fruit is round, small, 0.2 to 0.8 cm long, greenish white to brown in colour, which divides into two to four nutlets. Seeds, two to four in number, are enclosed in a corky tissue.

Uses: Sea heliotrope is important for its ecological benefits. It acts as a barrier against aerosol salt spray, as a windbreak on exposed coasts and as a stabilizer of coastal soils. In the Maldives, wood, which is lightweight and strong, is used as oars for small boats called *bhokura*. It is also used to make small implements used in boat. It is also used for firewood. According to some of the elders, young leaves were once widely used as salad. Leaves were cooked with rice and fish after removing the midrib and cut into small pieces to prepare a delicious food namely, *boshi baij*. Liquid from flowers are used for making medicines to treat skin diseases. Bark and flowers are chewed with areca nut. It is a candidate species for multispecies coastal bioshield in atoll environment and can be planted in the front rows along with other salt spray tolerant plants.

Ecology, propagation and management: It is an important component of the strand plant (means restricted to coastal environment) community. It is commonly found on beach sands and rocky coral limestone slopes, indicating its adaptation to shallow, well-drained and infertile soil. It is highly tolerant to salt spray. It can grow very close to sea. It can be propagated easily by seeds and cuttings. Fresh seeds can be directly sown without any pretreatment or seedlings can be grown in nursery and outplanted. Since it is slow growing seedlings may take long time, up to one year, to reach a size (about 35 cm tall) suitable for outplanting. Hardened or green woodcuttings 15 to 30 cm length can be used for planting.



*Vitex negundo* - Dhunnika

**Vitex negundo L.**

## VERBENACEAE

Synonym: *Vitex incisa*

Common name: Five-leaved chaste tree

Dhivehi name: Dhunnika

Status: Occasional; grown as an ornamental plant.

Description: A large, deciduous, much-branched shrub or small tree 3 to 5 m in height. Branchlets are four-sided and hairy. Crown is round, spreading, open and irregular in outline. Bark is thin, grey coloured and smooth. Leaves are palmately compound with three to five leaflets, which are lanceolate in shape, 4 to 10 cm in length, pointed at both ends, somewhat shiny on the upper side and hairy beneath; middle leaflet with distinct stalk is always larger than the others. Leaf when crushed produces a fragrant smell. Flowers are small, pleasantly fragrant, bluish-purple in colour and arranged in a pyramid shaped terminal inflorescence. Fruit is a succulent drupe, black when ripe and 0.4 to 0.5 cm in diameter.

Uses: *Vitex negundo* has a strong and deep root system, which produce large number of suckers and thus it can be used in sandy areas for soil retention and moisture conservation. It is also found suitable for coastal windbreaks and can be a component in the multiple coastal bioshield. Leaves have insecticidal properties and they are laid over stored grain to ward off insects. It is reported that houses that have *V. negundo* around are free of mosquitoes. Oil extracted from seed and leaves is an excellent medicine to treat sloughing, gangrene wounds and ulcers. Branches are used as firewood. In the Maldives, all parts of the plant, roots, flowers, leaves and bark are used for medicinal purposes relating to women. Leaves are lactagogue (increases secretion of mother's milk) and emmenagogue (promotes and regulates menstruation). A decoction of the leaves is given to women in puerperal state to alleviate abdominal pain. It is also used in aromatic baths.

Ecology, propagation and management: Five-leaved chaste tree grows in clay or sandy soils but prefers a loose, well-drained moist but not wet, alkaline soil for better growth performance. It often suffers from shoot dieback in organic rich, murky or other soil, which is too wet. Its tolerance to hot weather is good and to aerosol salt is moderate. It grows well in full sun and light shade. Propagation is generally by stem cuttings that are planted in nursery beds or polythene containers and transplanted after two months. Cuttings can also be planted directly. Its growth rate is moderate to fast. Though it is usually seen as a shrub with multiple branches it can be trained onto a tree with one or several trunks.



*Ximenia americana* - En'boo



**Ximenia americana L.**

OLACACEAE

Synonyms: *Ximenia laurina*, *Ximenia rogersii*

Common names: Hog plum, sour plum, wild plum

Dhivehi name: En'boo

Status: Common in the forested areas.

Description: A spiny, semi-scandent bush-forming shrub or small tree 2 to 6 m tall. Trunk diameter is seldom greater than 10 cm. Bark of the trunk is smooth to scaly, pale grey to reddish in colour; old trunks are superficially fissured and with large number of brown spots (lenticels). Main stems, which are laid back, have divergent branches forming a conical or rounded, thin canopy. Young branchlets are green in colour with prominent longitudinal ridges whereas mature branchlets are purple red with a waxy bloom. Branchlets are armed with long, slender, straight spines that are borne at the axils of the leaves. Leaves are simple, alternate, and oblong to elliptic in shape with obtuse or slightly notched tip. Leaf blade is 3 to 7 cm long, 1.5 to 4 cm wide, green, leathery and variable in thickness. When crushed, young leaves smell like bitter almonds. Flowers are yellowish white, fragrant and less than 1 cm in length. Fruit is a somewhat round or ellipsoidal drupe, about 3 cm long, greenish and shiny when young, becoming yellowish when ripe, containing a juicy pulp. Fruit is single seeded with a fatty kernel.

Uses: Fruit is eaten raw and can be used to make juice, jams and jelly. Kernel is considered as poisonous. In the Maldives, fruits, which have sweet and sour tastes, are eaten raw. Wood, which is very hard, strong and malleable, was popularly used in the past to make skewers and pegs. Leaves are used in traditional medicine to treat bone fractures and gonorrhoea. Fruits are used to prepare a medicine that is given to women during pregnancy and after childbirth. Spines and leaves are used in the preparation of medicinal oil called '*ruhgalu beys*', which is used to treat bone fractures.

Ecology, propagation and management: It grows on a variety of soil from clay, clayey loam, and sandy clayey-loam to fine sand. It is well adapted to poor and dry soil and also grows well in wet soils. It is drought resistant and tolerant to salinity. It is not cultivated. It regenerates naturally from the seed in the forested areas and coppice from stems and form impenetrable thickets. Seeds are normally dispersed by animal. It can also be propagated by seed and stem cuttings. Fresh seeds should be used for direct sowing. It is suited for cultivation as a hedge plant.



*Ziziphus mauritiana* - Kunnaaru

**Ziziphus mauritiana Lam.**

RHAMNACEAE

Synonym: *Ziziphus jujuba*

Common names: Indian jujube, jujube

Dhivehi name: Kunnaaru

Status: Common in home gardens and not observed in the wild.

Description: A spiny, fast growing evergreen tree which is capable of growing 15 m tall. In harsh environmental conditions, it grows as a shrub. Crown is round, spreading and irregular. Bark is grey or dull black, irregularly fissured. Branches are many, drooping with hairy zigzag branchlets. Spines are small, paired at leaf bases. Leaves are single, alternate, ovate to oblong-elliptic in shape, entire or finely toothed. On the upper side leaves are smooth, glossy and dark green but dense, silky, white or greyish hair is present on the underside. Leaf blade is also characterized by the presence of three conspicuous longitudinal parallel veins. Inflorescence is axillary with 7 to 20 flowers. Flowers are small, greenish-yellow in colour, with five-reflexed petals and a calyx with five-deltoid lobes, which are hairy outside. Fruit is round, oval or oblong in shape, with smooth or rough skin, which is light green to yellow in unripe fruits. Ripe fruits are reddish or red-brown or blackish in colour with spongy, musky flesh. Each fruit contains a single, hard, oval shaped, rough stone, which contains two brown seeds.

Uses: Fruits are eaten fresh or dried, used to make drinks, candy and syrup. Unripe yellow-green fruits are also edible but sour in taste. Wood is hard, strong and fairly lustrous, split slightly during seasoning and used for general construction, furniture and cabinetwork and packaging. In the Maldives, fruits are considered as an appetizer and fruit juice is used as an antihelminthic. Leaves are ground and applied to affected body parts to reduce swellings. Water with crushed leaves is used to wash corpse to delay onset of *rigor mortis* (muscular stiffening following death). Seeds are used for quick healing of broken bones.

Ecology, propagation and management: Grows on a variety of soils but best soil is sandy loam, which may be neutral or slightly alkaline. It is highly tolerant to heat and drought and moderately tolerant to soil salinity. Propagation is mainly by seeds. Either stone or seed extracted from the stone may be used for sowing. Uncracked stones require two to three weeks for germination whereas extracted seeds germinate within a week. Seedlings of about 15 month old are suitable for outplanting. Superior selections are grafted or budded onto seedlings. Stem cuttings of mature wood, at least two years old, can be used for propagation, which result in better yields.



**Mangrove trees and shrubs**

# Mangroves

## Environment

Mangroves are defined as assemblages of salt tolerant trees and shrubs that grow in the intertidal regions of the tropical and subtropical coastlines. They grow luxuriantly in the places where freshwater mixes with seawater and where sediment is composed of accumulated deposits of mud. Mangrove wetlands are normally classified into six types on the basis of the geophysical, geomorphological and biological factors. They are (a) river dominated, (b) tide dominated, (c) wave dominated, (d) composite river and wave dominated, (e) drowned bedrock valley mangroves and (f) mangroves in carbonate settings (Thom, 1984). The first five types of mangrove wetlands can be seen on coasts dominated by terrigenous sediments (shallow marine sediment consisting of material derived from the land surface) whereas the last one can be seen in oceanic islands, coral reefs and carbonate banks.

Mangroves of the Maldives belongs to carbonate setting type and within this broad category mangroves of the Maldives are found in four different environmental conditions: i) in the fringe area of some of the islands, where wave energy and wind speed is less and brackish water is present due to mixing of seawater with the margin of the freshwater lens, ii) in between two islands, where the water is shallow and there is accumulated deposits of sediments, iii) along the borders of lagoon that is connected to the sea, iv) along the borders of lagoon that has lost connection to the sea but receives seawater periodically through seepage and v) in shallow depressions, where rain water accumulates. Freshwater enters into all these types of mangroves through surface runoff and underground seepage. These areas normally receive limited amount of terrestrial sediment but they are rich in calcareous sediment or lime mud (marl).

## Flora

Plants of mangroves are generally divided into two groups, namely, i) true or exclusive mangroves species and ii) associated mangrove species. True mangrove species grow only in mangrove environment and do not extend into terrestrial plant community and are morphologically, physiologically and reproductively adapted to saline, waterlogged and anaerobic condition. A total number of 69 species in 27 genera, belonging to 20 families are considered as true mangrove species (Duke, 1992; Bringham and Kathiresan, 2001; Selvam *et al.*, 2004). In Maldives, a total number of 13 true mangrove species are present and fact sheet for each of these species is given in this book. Some of the plants that grow in the terrestrial environment and pure halophytes (plants that grow only in saline environment) are also found within or in the peripheral area of mangrove wetlands. These species are considered as mangrove associates.

## Adaptation

Mangrove environment is highly dynamic and harsh and mangrove species are variously adapted to cope with these environmental conditions.

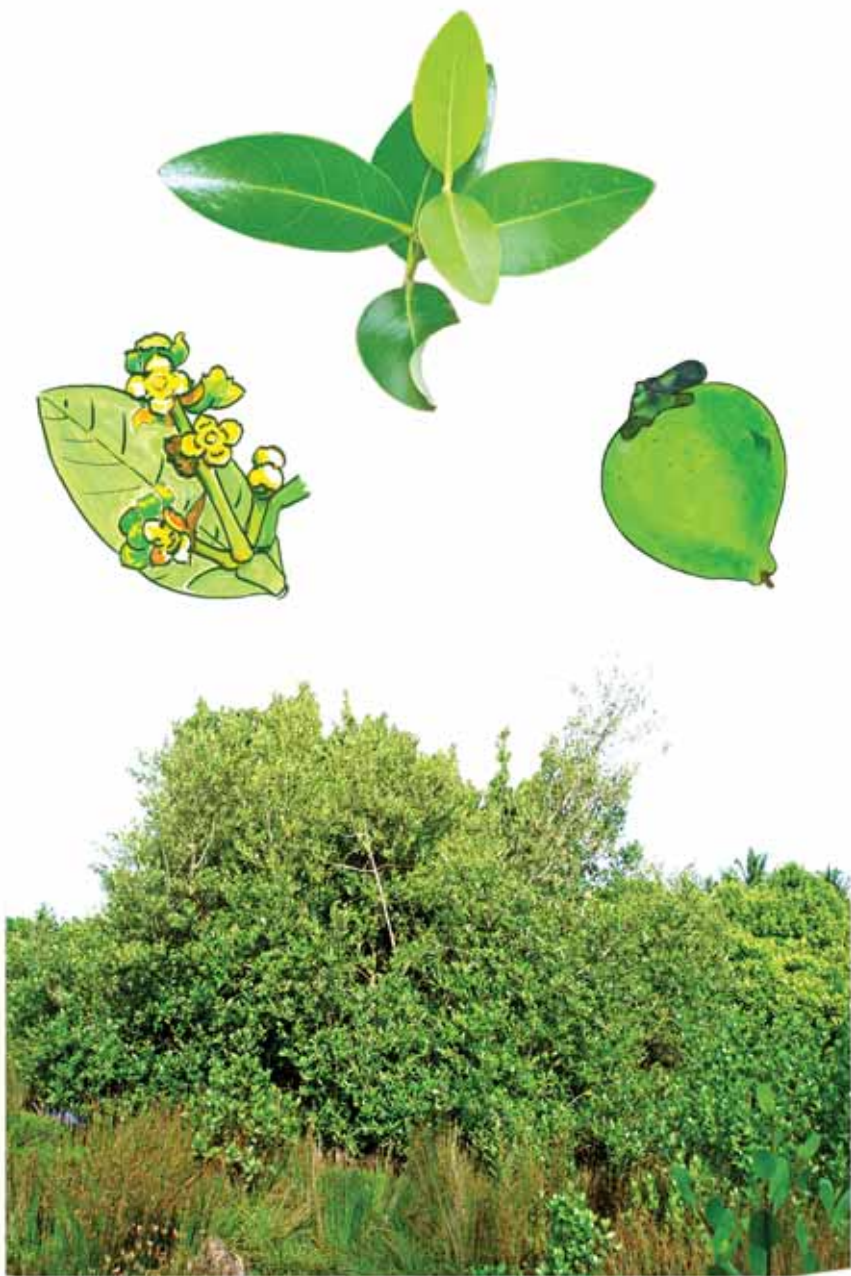
*Breathing roots:* Underground tissue of any plant requires oxygen for respiration and in mangrove environment, oxygen in soil is very limited or nil. This necessitates mangrove root system to take up oxygen from the atmosphere. For this purpose, mangrove species have specialized above ground roots called breathing roots or pneumatophores. In some species, these roots are pencil sized and peg like whereas in some other species they look like a knee. These roots have numerous pores through which oxygen enters into the underground tissues. In some plants buttress roots function as breathing roots and also provide mechanical support to the tree.

*Silt roots:* In some mangrove species, roots diverge from stems and branches and penetrate the soil some distance away from the main stem as in the case of banyan trees. Because of their appearance and because they provide the main physical support to these they are called as stilt roots. These roots also have many pores through which atmospheric oxygen enters into the roots.

*Vivipary:* Saline water, unconsolidated saline soil with little or no oxygen is not a conducive environment for seeds to germinate and establish. To overcome this, mangrove species have unique way of reproduction, which is generally known as vivipary. In this method of reproduction, seeds germinate and develop into seedlings while the seeds are still attached to the parent tree. These seedlings are normally called as propagules and they photosynthesize while still attached to the mother tree. The parent tree supplies water and necessary nutrients. They are buoyant and float in the water for sometime before rooting themselves on suitable soil.

## Uses

Mangrove wetland is a multiple use ecosystem. It is considered as a best form of coastal bioshield since it plays a critical role in reducing the impact of cyclonic storms, hurricanes and tsunami on human lives and properties (Danielsen *et al.*, 2005; Selvam, 2005). It also avoids or reduces soil erosion. It enhances fishery productivity of the adjacent coastal waters by acting as a nursery ground for commercially important fish, prawn and crabs and supplying organic and inorganic nutrients. They are also rich in biodiversity and act as habitats for wildlife.



*Avicennia marina* - Baru



**Avicennia marina (Forssk.) Vierh.** AVICENNIACEAE

Common name: Grey mangrove

Dhivehi name: Baru

Status: Occasional; restricted to northern islands. Only a very few seedlings are noticed.

Description: An evergreen shrub or tree 2 to 10 m tall with pencil-sized peg type above-ground roots, which are commonly called as pneumatophores or breathing roots. Bark is whitish to greyish or yellow-green in colour, smooth, often powdery and scaly. Leaves are single, opposite in arrangement, leathery, yellowish-green and hairless above and silver-grey below with pointed apex. Underside of the leaf has special glands for secreting excess salt. Flowers are small, 0.3 to 0.5 cm across, sessile, fragrant, pale-yellow in colour in condensed terminal flower head. Fruit is heart shaped, rounded or sometimes shortly beaked; outer skin is greyish with fine hairs and inside is radiant green or russet brown or dark green.

Uses: Leaves are considered as one of the best fodder for camel. Cattle also feed on shoots and leaves during the rainy season when the salt content is low in the leaves. Wood is considered as excellent firewood. Roots and bark are used as stimulant.

Ecology, propagation and management: Grey mangrove grows luxuriantly in any position in the intertidal regions of estuaries, lagoons (called *kulhi* in Dhivehi), backwater etc. Though it is capable of growing in sandy soils and rocks it prefers fine clay and alluvial soil for better performance. It is highly saline tolerant and tolerates widest range of soil salinity. Its tolerance to aridity is also high. It can be easily propagated by propagules and the position where it should be planted can be decided on the basis of the distribution of species (zonation pattern) on that location. Propagules of grey mangroves do not look like typical spindle-shaped propagules of some other mangrove species because embryonic axis (hypocotyl) of the developing embryo does not penetrate the seed coat. Hence, propagules of grey mangrove look more or less like normal seeds in appearance and they are called cryptoviviparous propagules. It is produced in large numbers and matured propagules float freely in water and can be easily collected by hand or by a scoop net. They can also be collected from trees. Collected propagules are soaked in brackish water for a day to facilitate shedding of outer coat. These naked propagules are used for plantation. While sowing, radicle (the part of plant embryo that develops into a root) side of the propagules is lightly pushed into wet soil. Nursery raised seedlings of about 30 cm can also be used for outplanting.



*Bruguiera cylindrica* - Kan'doo

**Bruguiera cylindrica Bl.****RHIZOPHORACEAE**

Synonyms: *Bruguiera caryophylloides*, *Rhizophora caryophylloides*, *Rhizophora cylindrica*

Common name: Small-leafed orange mangrove

Dhivehi name: Kan'doo

Status: Common; found either as a dominant or co-dominant species in many of the mangrove ecosystem of the Maldives. It also found in the form of pure stands. A large number of young seedlings are found growing in the areas wherever this species is dominant.

Description: A small, erect, evergreen tree 6 to 10 m tall with knee-like above-ground breathing roots. These knee roots comprise a sponge like system of air chambers, which act as an air reservoir when the roots are submerged. These roots are also covered with numerous pores, which allow air but not water to enter the root. Bark is light to dark grey or pale pink in colour and scaly at the bottom. Leaves are simple, opposite in arrangement, lanceolate in shape, about 7 to 12 cm long, shiny, dark green in colour with pointed apex. Inflorescence is a three-flowered cyme with about 1 cm long peduncle and axillary in position. Flowers are small, white in colour with 8-lobed greenish-yellow calyx, which is persistent, forming a cap-like structure above the propagules. Propagules are spindle shaped, 10 to 15 cm long, 0.5 to 1 cm in diameter, smooth, slightly curved, cylindrical and green to purplish-green in colour, which are buoyant and dispersed by currents.

Uses: In the Maldives, propagules are consumed after removing the skin and boiling them three to four times, first with ash to remove the bitterness and then with salt for taste. It is considered as a famine food and it was once planted in large areas in some islands, primarily for use during famine. It is also considered as a timber tree. Timber is hard and strong and used for boat building. Timber is normally buried in sand at the edges of the sea for about six months to prevent easy decay. Poles are used for house construction.

Ecology, propagation and management: It grows on light, medium and heavy soil but prefers silty clay soil and high- and mid- tidal zone for better performance. Its optimum soil salinity ranges from 8 to 34 ppt. It is propagated by propagules. Unlike in *Avicennia* spp., propagules of *Bruguiera* spp. are spindle shaped because hypocotyl penetrates the seed coat and elongates (called as viviparous propagules). Matured propagules are purplish-green in colour which can be collected from water or plucked from trees. They can be directly planted in the selected locations by inserting them up to one-third of their length into the soil. Nursery-raised seedlings 20 to 30 cm height can be also used for outplanting. Direct planting of propagules are economical and less time consuming.



*Bruguiera gymnorrhiza* - Bodu Kandoo, Boda vaki

**Bruguiera gymnorrhiza (L.) Lam.** HIZOPHORACEAE

Synonyms: *Bruguiera conjugata*, *Rhizophora conjugata*, *Rhizophora gymnorrhiza*

Common names: Large-leafed mangroves, oriental mangroves

Dhivehi names: Bodu Kandoo, Boda vaki

Status: Common. It is found growing as a dominant or co-dominant species in many of the mangrove ecosystem of the Maldives. In some areas it is found in the form of pure stands.

Description: A small to moderately sized, evergreen tree that is capable of growing to 35 m tall but most of the trees found in the Maldives are 6 to 10 m in height. It is a single-stemmed tree with short buttresses and characteristic knee-shaped above-ground breathing roots. Bark is pale grey or brown, thick, hard and rough. Leaves are simple, opposite in arrangement, leathery, dark green in colour, 8 to 22 cm long and 5 to 8 cm wide with 2 to 5 cm long leaf stalk. Flowers are single and axillary in position. Calyx is reddish to scarlet in colour with ten to 14 pointed lobes, which are smooth or with grooves above lobe junctures. Petals are orange-brown in matured flowers, bilobed and each lobe has three to four long bristles. Viviparous propagules are cigar shaped, 15 to 25 cm in length, 1.5 to 2 cm in diameter, stocky with blunt narrowed apex. Propagules detach with calyx, buoyant and dispersed by currents.

Uses: In the Maldives, propagules are consumed regularly during the fruiting season. They are peeled, soaked and boiled three or four times in water and eaten. Sometimes they are cooked with salt, dried and then consumed. Though the timber is hard and tough it is not widely used because it easily decays. Bark is used for tanning fishing nets.

Ecology, propagation and management: It is capable of growing well in somewhat dry and well-aerated soil in the mid- and high- tidal areas of the intertidal zone. It tolerates up to 50 ppt of soil salinity but optimal salinity range is reported to be between 8 and 26 ppt. It is one of the most shade tolerant mangrove species and seedlings may grow under a full forest canopy. It is propagated by propagules. Matured propagules are reddish-brown or greenish-red in colour. Fresh and healthy propagules can be collected from the mother trees or freshly fallen propagules without any damage can be used for planting. Propagules can be stored for about a week by keeping the lower portion in brackish water or by wrapping them with wet jute bags. Propagules can be directly planted in selected fields by inserting them up to one-third of their length. Nursery-raised seedlings about 35 cm in height can be used for outplanting. Direct planting is most successful and economical.



*Bruguiera sexangula* - Boda vaki

**Bruguiera sexangula (Lour.) Poir.** HIZOPHORACEAESynonyms: *Bruguiera eriopetala*, *Rhizophora sexangula*

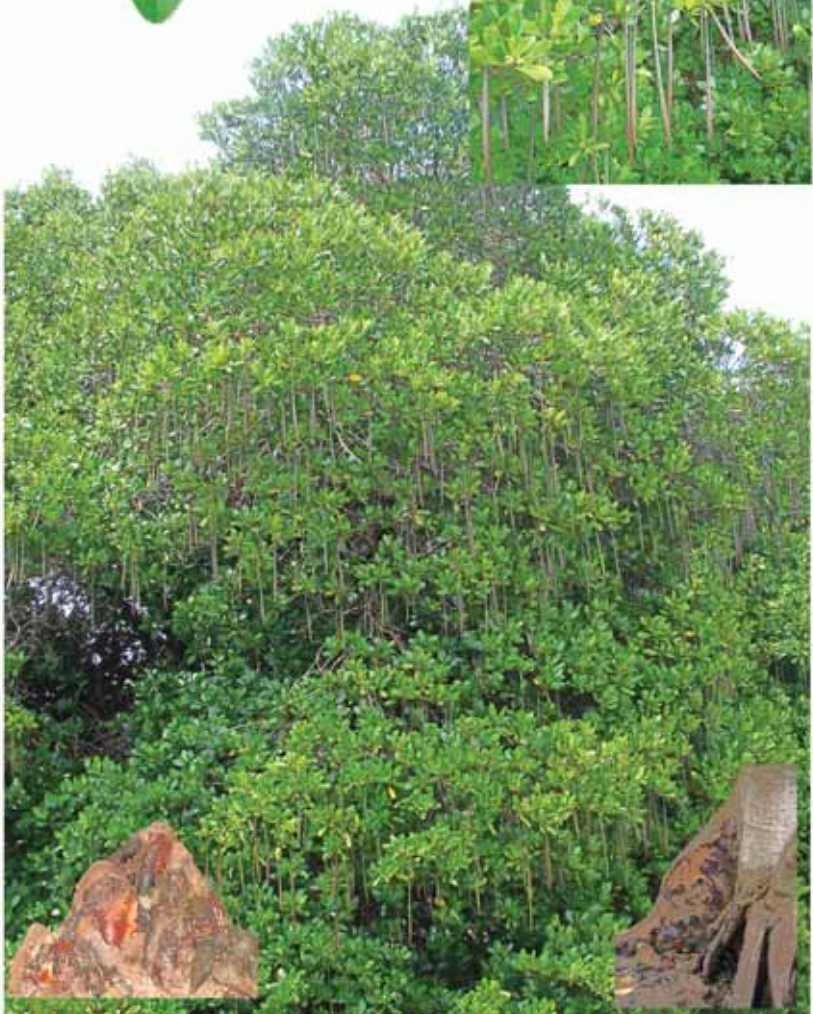
Dhivehi name: Boda vaki

Status: Rare. It is observed only in Fuvamulah island, where 10 to 12 trees are found growing on the landward portion of a brackish water lagoon (*kulhi*). These are found growing among taro (cocoyam - *Colocasia esculenta*) crops where a few wild trees of pond apple (*Annona glabra*) are also present. A few healthy seedlings are also found in this area.

Description: A medium sized, erect, evergreen tree capable of growing to a height of about 20 m but trees found in the Maldives are only about 5 m tall. Single stemmed, multi-branched tree with spreading or diffused crown. Above-ground breathing roots are knee shaped and small buttress can be seen at the base of the stem. Bark is grey in colour and smooth. Leaves are simple, opposite in arrangement, clustered at the tip, elliptic or lanceolate in shape, about 5 to 10 cm long and 4 to 5 cm wide. Leaves of *B. sexangula* are normally more yellow-green and with shorter leafstalk than those of *B. gymnorhiza*. Inflorescence is a single flowered pendulous cyme and axillary in position. Calyx is either yellow or yellow-green in colour with 10 to 14 lobes. Petals are white or brown in colour, 10 to 12 in number, bilobed with or without bristles at the tip. Propagules are much shorter than those of *B. cylindrica* and *B. gymnorhiza*, about 6 to 8 cm long and 1.5 to 2 cm in diameter, smooth and green to purple tinted brown in colour, detaches with calyx, is buoyant and is dispersed by currents.

Uses: Propagules are eaten after peeling, soaking and boiling. Timber, which is hard and strong, can be used for boat building and carpentry work. It yields high-calorific valued fuel woods.

Ecology, propagation and management: It is normally found in the landward zone of mangrove forests and grows well in well-drained medium to heavy textured soil. It is also capable of growing well in waterlogged, deep, slushy and anaerobic soil. Among the six species of *Bruguiera* it is relatively less saline tolerant and prefers low saline condition for better performance. Propagation is mainly by propagules. As in the case of other *Bruguiera* spp. matured propagules can be collected from mother trees or freshly fallen propagules can be used for planting. Matured propagules, which are green or purple tinted, can be directly planted by inserting them up to one-third of their length in wet soil and sprouting takes place within five weeks. Nursery raised seedlings of about 20 to 35 cm in height, which is attained in about ten months, can be used for outplanting. Direct planting is the most successful and economical.



*Ceriops tagal* - Karamana



**Ceriops tagal (Perr.) Robins.****RHIZOPHORACEAE**

Synonyms: *Ceriops candolliana*, *Rhizophora tagal*

Common name: Yellow mangrove

Dhivehi name: Karamana

**Status:** Rare; found only in Farukolhu Funadhoo island in the northern group of islands. It is present in two to three rows along the boarder of a large lagoon, which is still connected to the sea by a channel. Only a few seedlings are noticed indicating poor natural regeneration.

**Description:** An evergreen tree that grows up to 40 m in height in favourable sites, but most of the trees found in the Maldives are only 4 to 10 m tall. It has short buttress, which originate like stilt roots. It also has knee-like or knobby above-ground breathing roots. Bark is pale grey to reddish brown in colour, smooth in young trees, deeply fissured in old ones and flaky at the bottom. Leaves are simple, shiny, opposite in arrangement and inverted-egg shaped. Leaves are dark green in colour in shade, bright greenish-yellow in full sun and apex is rounded or notched. Inflorescence is a condensed cyme with five to ten flowers and axillary in position. Calyx is deeply divided into five lobes and green in colour. Petals are five in number and white and brown coloured, two lobed and ending in two to four bristles. Viviparous propagules are cylindrical, club-shaped, sharply angular, 25 cm or more in length, 0.8 to 1.2 cm in diameter and green to brown in colour. Surface of the propagules is warty and ridged, buoyant and dispersed by currents.

**Uses:** Bark yields high-quality tannin, which fetches good price in the international market. This tannin is widely used in “batik” to provide warm yellowish-brown colour to cotton cloth. Wood is heavy and moderately durable but in contact with ground it decays in about two years. Wood yields excellent charcoal and good firewood, but has been said to burn with too hot a flame for domestic use. No use is attributed to this tree in the Maldives.

**Ecology, propagation and management:** It prefers mid- and high- tidal areas in the intertidal zone for better survival and growth. In the Maldives it grows in soft, shallow, sandy soil of coral origin and silt and clay is almost nil in the area where it grows. It can tolerate soil salinity up to 45 ppt but optimum salinity range is between 0 and 15 ppt. It is propagated by propagules. Mature propagules can be identified by yellow collar (cotyledon), which may be about 1 cm long or by brownish green hypocotyl. They can be plucked from mother trees or freshly fallen propagules can be used for planting. During plantation, one-third of the propagules is inserted into the mud. Nursery-raised seedlings 20 cm height can be used for outplanting. Direct plantation is preferred because of higher survival rate.



*Excoecaria agallocha* - Thela

**Excoecaria agallocha L.**

EUPHORBIACEAE

Common names: Blinding tree, river poison tree

Dhivehi name: Thela

Status: Occasional; found on the landward side of the mangroves in some of the northern islands. No seedling is noticed in the areas where the trees are found, indicating poor rate of natural regeneration.

Description: A small or medium sized, low branching tree 6 to 12 m tall. Bark is grey, smooth with longitudinal rows of corky air pores. No prominent above ground breathing root is present. Leaves are simple, alternate in arrangement, shiny, leathery with pointed tips and bluntly toothed margins. Leaves are 6 to 10 cm long, pinkish in colour first, turning to green and then to bright red when about to drop off. Male and female flowers are present on separate trees and inflorescence is spike. Male spike is catkin like in appearance, yellowish and up to 7 cm long. Female spike is shorter than male spike. Flowers are tiny, about 0.2 to 0.3 cm across, fragrant with yellowish-green calyx and greenish white petals. It is not a viviparous tree. Fruits are small, round and clustered. Each fruit consists of three cells and each cell contains a seed. One of the characteristic features of this tree is that when branches and leaves are broken or bark is damaged it exudes a milky sap, which may cause intense pain and blistering, if it makes contact with skin. It can cause temporary blindness, if it gets into the eyes.

Uses: In the Maldives, poles are found being used as fencing stakes. Rarely used in roof structures as purling. It is also reported to be used as firewood. Heartwood of this tree was used in the past for burning as incense. In some countries it is a primary pulping species for paper industry and also used in traditional medicine to treat chronic ulcerous diseases such as leprosy.

Ecology, propagation and management: It grows well in sandy soil with very low salinity and in these places gregarious monospecific stands with large trunk and profusely branched trees can be seen. Trees with lean stems and limited branches are seen in places where soil salinity is high. It is normally propagated by nursery raised seedlings, wildlings and stem cuttings. Seedlings, which are raised in the nursery from seeds and about 40 cm in height, can be used for outplanting. More than 95% survival has been reported with this method. Wildlings collected and transplanted on the same day also perform well. Stems cuttings 20 cm in length and about 1 cm in diameter can be used for propagation. These cuttings are kept in the nursery for rooting and rooted cuttings with 10 to 12 leaves are used for outplanting.



*Heritiera littoralis* Aiton - Kaharuvah gas

**Heritiera littoralis** Aiton

## STERCULIACEAE

Synonym: *Heritiera minor*

Common name: Looking-glass mangroves

Dhivehi name: Kaharuvah gas

Status: Rare; a single tree is observed in Male.

Description: A medium to large sized, much branched, evergreen tree that can attain heights up to 30 m. Presence of well-developed buttresses, which develop into plank roots, is a characteristic feature of this species. They function like air-breathing roots and also provide mechanical support to the trunk. Bark is greyish, fissured and scaly. Leaves are simple, alternate in arrangement, elliptical to obovate in shape, 10 to 15 cm long, dark green on top and very white to silvery white underneath. Inflorescence is loose panicles, up to 10 cm long and axillary or terminal in position. Flowers are small, densely haired and unisexual. Male flowers are smaller than female flowers. Calyx is bell shaped, four to six lobed and reddish in colour. Petals are purplish or brown in colour. Fruit is large, woody, smooth and ellipsoid in shape with a prominent dorsal ridge or 'keel'. Fruit colour changes from green to brown when mature. Fruits are buoyant and dispersed by currents and when the fruit is floating, the "keel" acts as a sail, aiding dispersal.

Uses: It is one of the important timber trees found in the mangroves. Heartwood is brown, red-brown or dark red brown in colour, coarse textured, fine grained, hard and strong and takes polish well but is nondurable. It is considered as a utility timber, used for boat building, flooring, furniture, interior finishing and decorative veneers. It was informed by some of the elders that in the Maldives, trees of *H. littoralis* were present in considerable numbers in some of the southern islands but now it has become rare.

Ecology, propagation and management: It grows well in the landward edge of mangroves where soil salinity is low. It prefers sandy loam for better performance. It is propagated by seeds and nursery-raised seedlings. Mature fruits, which are brown in colour, become dark brown as soon as they come into contact with water or moist soil. These fruits are collected from the forest floor and used for direct dibbling in containers in the nursery since germination rate of naked seeds is very poor. Germination, which starts in about eight days and complete within 50 days, is nearly 75% when the matured fruits are dibbled. Seedlings attain a height of about 50 to 60 cm in about ten months, which can be used for outplanting and in this method of propagation survival rate is nearly 90%.



*Lumnitzera racemosa* - Burevi