

RESEARCH ARTICLE

Evaluating the occurrence and conservation status of Sri Lankan species of Anacardiaceae

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Received: 17/02/2017; Accepted: 09/05/2017

Abstract: Sri Lanka is a tropical island with variety of climatic, geographical and weather combinations. These significant variations have resulted high biodiversity in the country. Sri Lanka together with the Western Ghats is one of the biodiversity hotspots. Presently, Sri Lanka harbors 3,154 species of Angiosperm families of which 894 are endemic. The family Anacardiaceae is one of the flora groups that did not attract attention of the researchers. However, 47.4% of this family, including 46.7% endemics was considered as nationally threatened during the National Red listing in 2012. This study was carried out to investigate the current occurrence and conservation status of the members of this family. Observations on plant species were made in both protected and un-protected areas. This study present the recent occurrences of 14 species in 6 genera with 11 endemics belongs to this family. These species are dispersed in two strict nature reserves, one Man and Biosphere Reserve, one sanctuary, five forest reserves and two un-protected locations. Among the observed species 35.7% including 36.4% endemics are accounted as nationally threatened which includes 'Critically Endangered', 'Endangered' and 'Vulnerable' species. This information will be contributed to establish precise conservation measures and updating of the conservation status of these species in Global and National level red listing.

Keywords: Sri Lankan Anacardiaceae, *Semecarpus*, conservation status.

INTRODUCTION

Sri Lanka is a tropical island of 65,610 km² located in the Indian Ocean close to the southern tip of India. The combine effect of the climatic conditions, topography and soil types have contributed to the various vegetation types of Sri Lanka (Ashton *et al.*, 1997). Sri Lanka together

with Western Ghats is a biodiversity hot spot among other 35 regions in worldwide due to its richness of endemic fauna and flora and their threatened status due to destruction (Mittermeier *et al.*, 2011). In the Asian region, the country is the most compact region (number of species present per 10,000 km²) for flowering plants, amphibians, reptiles and mammals (NARESA, 1991). As per Red List of Sri Lanka (2012), this country has 3154 species with 894 endemic species of Angiosperms. However, among these, there are some families yet to be explored.

Family Anacardiaceae, commonly known as the Cashew family is composed of economically important genera like *Mangifera* L., *Anacardium* L. and few other medicinally important taxa. Members of this family consist of trees or shrubs containing resinous barks and spirally arranged simple, trifoliate or imparipinnate leaves (Meijer, 1983). There are more than 700 species belong to 82 genera dispersed in world wide and 19 species belong to 7 genera are found in Sri Lanka of which 15 species are endemics (Meijer, 1983; MOE, 2012). This family is recognized for its cultivated or naturally grown edible fruits and seeds (mangos, pistachios, and cashews), resinous exudes where in some cases, turning to black on exposure (*Semecarpus* L. f., *Anacardium* L., *Lannea* A. Rich., *Mangifera* L., and *Nothopegia* Blume), dermatitis causing taxa (*Comocladia* P. Br., *Metopium* P. Browne, *Semecarpus* L. f., *Toxicodendron* Mill.) and lacquer plants (*Toxicodendron* Mill. and *Gluta* L. spp.). Members of family Anacardiaceae are commonly distributed in tropical lowlands in the world. In

Sri Lanka, members of this family are dispersed in all climatic zones except in arid zone. The genus *Semecarpus* L. f. is widely spread in the wet zone and some species are even spread out in to the intermediate zone. *Spondias pinnata* (L.f.) Kurz and *Lannea coromandelica* (Houtt.) Merr. have shown vast dispersion in Indo-Malesian area while genus *Buchanania* Spreng. and genus *Nothopegia* Blume, have one species in India as well as in Sri Lanka (Ashton *et al.*, 1997; Meijer, 1983).

Members of this family in other countries have been investigated for their occurrence (Tien-lu, 1980; Swaminath, 2000; Yi *et al.*, 2004; Wang, 2014), chemical composition and their applications (Garcia *et al.*, 1999; Ippen, 1982; Benzi, 2009; Makom, 2010; Ojewole, 2005; Ameyapoh, 2010; Al Sayed, 2010; Murray, 2009; Descamps, 2011) and as well as for their molecular data (Wang *et al.*, 2014; Miller *et al.*, 2001, Pell, 2004; Yi, 2008). However, in Sri Lanka, members of this family have been studied for their ecological contributions (Weerakkody, and Parkinson, 2006; Gunatilleke, *et al.*, 2005; Jayasekara, *et al.*, 2003; Ganashan, 1996; Gunatilleke and Gunatilleke, 1991; De Zoysa, *et al.*, 1988; Jayasekera, 1992) and medicinal values (Kankanamalage, *et al.*, 2014).

There are 7 main categories of protected areas in the world established by the IUCN protected areas categories (Dudley, 2008). According to the published statistics of the Department of Wildlife Conservation (DWLC) Sri Lanka, there are three Strict Nature Reserves (SNR), 22 National Parks (NP), 64 Sanctuaries, and five Nature Reserves (NR), that are managed by them (Performance report, 2011). In addition, Forest Department of Sri Lanka governs two World Heritage Wilderness areas, two International Man and Biosphere (MAB) Reserves and a Conservation Forest. Based on the available statistics 13% of land surface of the country is protected by the law. However, still 43.9% of Angiosperms, 59.5% of Pteridophytes and 43% of vertebrates are listed under the nationally threatened categories (MOE, 2012).

As per the National Conservation Status (NCS) established by the National Red List 2012 of Sri Lanka, 47.4% of species belong to the family Anacardiaceae including 46.7% of

endemics are considered as nationally threatened. Among these, 31.6% including 33.3% endemics are categorized as 'Vulnerable' (VU), 10.5% including 6.7% endemics are categorized as 'Endangered' (EN) and 5.3% including 6.7% endemics are categorized as 'Critically Endangered' (CR). Other than these species, 5.3% including 6.7% endemics are categorized as 'Near Threatened' (NT) and 42.1% including 40% of endemics are included in the category 'Least Concerned' (LC). *Mangifera pseudoindica* Kosterm. which is an endemic species, is categorized as 'Critically Endangered and Possibly Extinct' [CR(PE)].

However, these figures are based on herbarium material, available literature and other records and therefore the existence of these species are constantly altering in the context of clearing forests and other protected areas and as a result of scrutinized field based taxonomic studies from time to time. The present study was carried out in both inside and outside of the protected areas focusing on the current occurrence and conservation status of the species of the family Anacardiaceae. The information generated would serve as a valuable source of data for updating the current Red-data list and the Flora of Sri Lanka.

MATERIALS AND METHODS

Information on the species belong to the family Anacardiaceae in Sri Lanka were extracted using available literature (Meijer, 1983; MOE, 2012; Senaratna, 2001) and observing herbarium specimens deposited at the National Herbarium, Peradeniya. Field visits were carried out from November, 2013 to March, 2016 in order to collect and make observations on the recorded members of the family. The visited sites are shown in Figure 1, including two strict nature reserves (Ritigala SNR and Hakgala SNR), one Man and Biosphere reserve (Kanneliya MAB reserve), one forest sanctuary (Adam's Peak), five forest reserves (Sinharaja FR, Riverston FR, Kalupahana FR, Hantane FR and Kithulgala Makandawa FR) and two outside locations (Mawathagama and Anuradhapura). Specimens were collected to prepare herbarium specimens and the locations were recorded using Global Positioning System (GPS) data points with details of latitude, longitude and elevation.

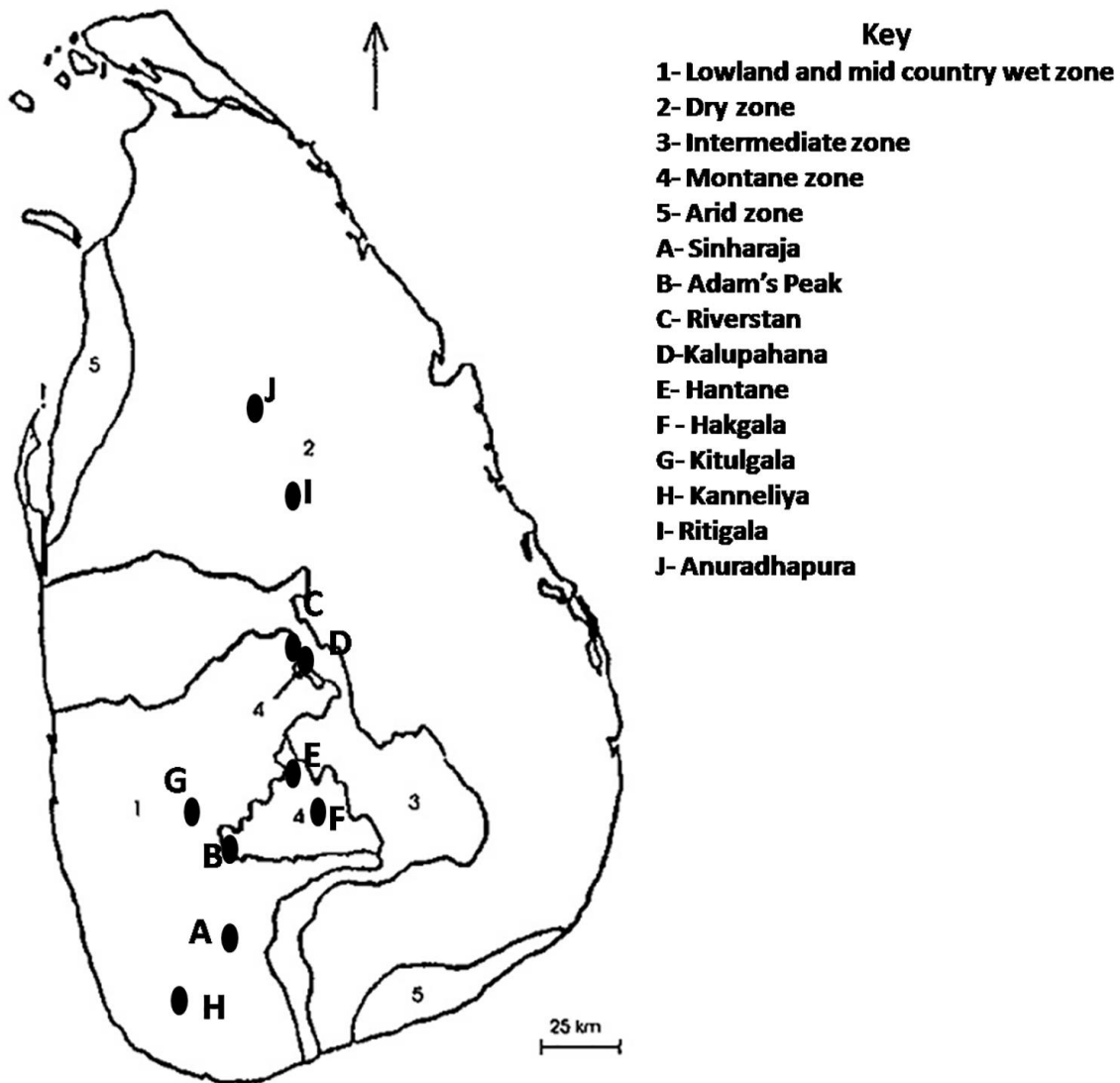


Figure 1: The map of Sri Lanka showing the locations of the visited sites during the study period.

Identification of the specimens was done using voucher specimens deposited at the National Herbarium, Peradeniya (PDA). The collected data were analyzed based on the species richness in each site and recorded NCS according to MOE, 2012.

RESULTS

The observations were made in two SNRs (Ritigala SNR and Hakgala SNR), Kanneliya MAB reserve, Adam's peak sanctuary and five FRs (Kithulgala FR, Sinharaja FR, Riverston FR, Kalupahana FR and Hantane FR). The study recorded 14 (73.7%) species in 6 genera (85%) including 11 (73.3%) endemics belonging to the family Anacardiaceae. Observations were made in 11 sites and the data given in the Table 1 and Figure 2 shows the four species belonging to three genera of the Family Anacardiaceae. Comparative species richness of the each

observed site including the recorded endemics are given in the figure 3.

Kanneliya International MAB reserve in Galle district is harboring 8 species which is 61.5% of total observed species and all these species are endemic to the country. Sinharaja FR and Ritigala SNR also recorded 3 species in each site where all the species in Sinharaja are endemics while only 2 endemic Anacardiaceae species were recorded in Ritigala. Hantane, Riverston, Kithulgala and Kalupahana FRs harbor 2 species in each and both species in latter 2 sites were endemics while the first 2 sites, Hakgala SNR and Mawathagama sites had one endemic species in each.



Figure 2: Fruits of (A). *Camposperma zeylanicum* Thw. (B). *Mangifera zeylanica* (Blume) Hook.f. (C). *Semecarpus marginata* Thw. (D). *Semecarpus nigro-viridis* Thw.

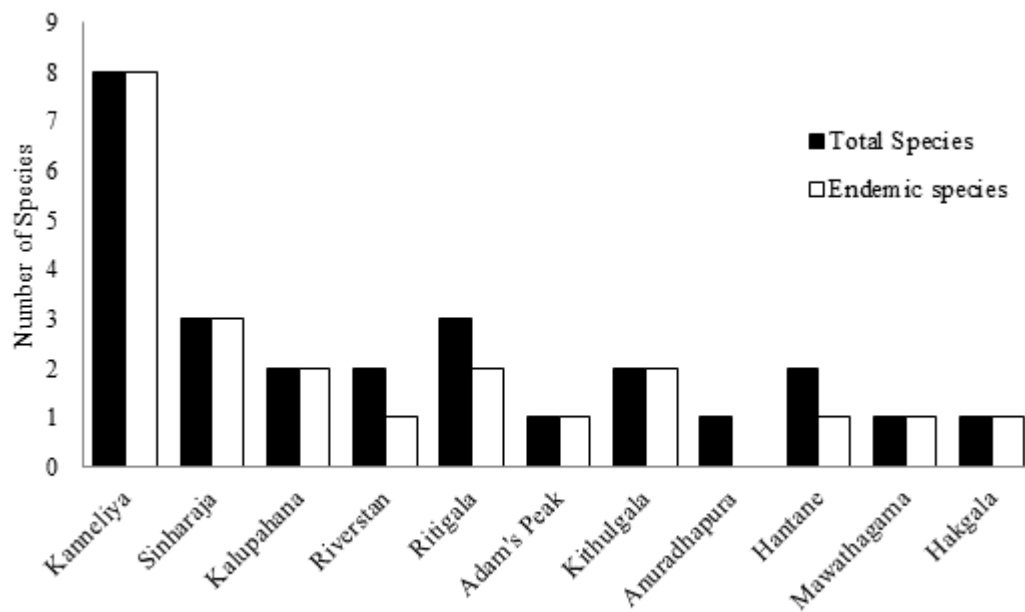


Figure 3: Occurrence of species of the family Anacardiaceae recorded in different sites during the study period.

DISCUSSION

The most recent comprehensive taxonomic survey on the family Anacardiaceae was carried out by Meijer in 1983, for the Revised Handbook of the Flora of Ceylon, recording 21 species in 8 genera including 13 endemics. The last national Red List of Sri Lanka (2012) consists of 19 species with 15 endemics dispersed in 7 genera. This list has been prepared excluding 4 cultivated species (*Mangifera indica*, *Spondias dulcis*, *Spondias mombin* and *Anacardium occidentale*) and including 2 new species, *Semecarpus pseudo-emarginata* Kosterm. (Kostermans, 1982) and *Mangifera pseudoindica* Kosterm. (Kostermans and Bompard, 1993). Even though *S. pseudo-emarginata* (Kostermans, 1982) was established as a species in 1982, it was not mentioned by Meijer in 1983. The present study has recorded the occurrence of 14 species of the family Anacardiaceae including 11 endemics. The findings also record for 73.7% of documented species including 73.3% endemics. However, some species are not taken in to count in this taxonomic survey as these plants are considered as cultivated plants. Kanneliya MAB reserve was found to be the most Anacardiaceae rich site in the present study. In 1983, Meijer recorded 6 species; *C. zeylanicum*, *S. subpeltata*, *S. walkeri*, *S. gardneri*, *S. parvifolia* and *L. coromandelica* from Kanneliya. *Semecarpus walkeri* and *S. parvifolia*, *C. zeylanicum* were also recorded by Singhakumara (1996) from Kanneliya MAB reserve. The present study recorded 3 species *C. zeylanicum*, *M. zeylanica* and *S. marginata* from Sinharaja FR while Meijer in 1983 recorded 6 species (*C. zeylanicum*, *S. subpeltata*, *S. walkeri*, *S. gardneri*, *S. acuminata*, *S. nigro-viridis*) in Sinharaja FR. In 1988, De Zoysa *et al.*, recorded 3 Anacardiaceae species, *N. beddomei*, *S. nigro-viridis* and *S. marginata* from Sinharaja FR and Gunatilleke and Gunatilleke (1991) observed 10 species including *C. zeylanicum*, *M. zeylanica* and 8 *Semecarpus* species (*S. gardneri*, *S. marginata*, *S. nigro-viridis*, *S. ochracea*, *S. parvifolia*, *S. pubescens*, *S. subpeltata* and *S. walkeri*). Jayasekara *et al.*, (2003) recorded only *S. walkeri* and Gunatilleke *et al.*, in 2005 mentioned only *C. zeylanicum*. Three species, *L. coromandelica*, *N. beddomei* and *M. zeylanica* were observed from Ritigala SNR. In 1984, Jayasuriya recorded 2 species (*M. zeylanica* and *N. beddomei*) and *Spondias pinnata* was recorded by Meijer in 1983. The present study

also recorded 2 species from Kithulgala FR and the same species were recorded by Meijer in 1983. Among the study sites, two species (*S. marginata* and *S. nigro-viridis*) were recorded from Kalupahana FR. However, Meijer (1983) recorded *S. nigro-viridis* and *S. walkeri* from the Kalupahana FR. According to Meijer (1983) *Buchanania axillaris* and *M. zeylanica* were found in Hantane but during this study only *N. beddomei* and *S. nigro-viridis* were observed from Hantane. Medawatte *et al.*, (2011) recorded 5 species (*M. zeylanica*, *N. beddomei*, *S. gardneri*, *S. nigro-viridis*, *S. walkeri*) from the Morella forest fragment and *N. beddomei* and *S. nigro-viridis* have been observed by Skinner (2004) in Knuckles region. The present study recorded the same two species as Skinner (2004). In 1983, Meijer recorded 2 species (*S. marginata* and *S. walkeri*) from Adam's Peak Wilderness Sanctuary and DWC (2007) documented *M. zeylanica* and 2 unidentified *Semecarpus* species. This study states only one species *S. walkeri* from the Adam's Peak Wilderness. *Semecarpus coriacea* was observed from Hakgala SNR and the same species was recorded by Meijer (1983), Jayasekara (1992), Weerakkody and Parkinson (2006).

Reasons for not observing previously recorded species during this survey could be due to degradation of forest habitats as a result of developmental activities and natural causes like landslides, wild fires and cyclones.

Following is the genus-wise enumeration of the observed species. The conservation status cited based on the National Red List 2012 of Sri Lanka (MOE, 2012).

***Camptosperma* Thw.**

Camptosperma zeylanicum, the endemic species found in this genus and is a LC species.

***Lannea* A. Richard**

Lannea coromandelica is the only species belong to this genus found in Sri Lanka. This species is a LC species.

***Mangifera* L.**

This genus consists with 2 wild endemic species. *Mangifera zeylanica* was observed with fruits. This species is categorized as LC according to the National Conservation status (NCS) and Vulnerable (VU) as per Global Conservation Status (GCS).

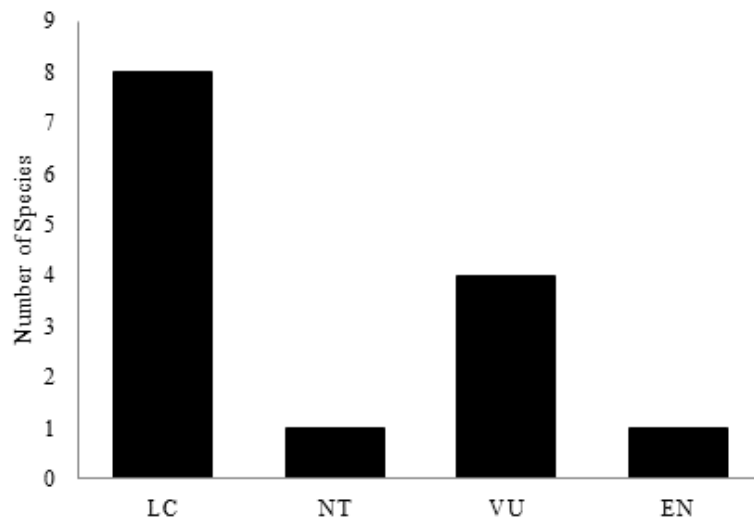


Figure 4: Categorization of species based on assigned National Conservation Statuses (LC = Least Concerned; NT = Near Threatened; VU= Vulnerable and EN= Endangered).

***Nothopegia* Blume**

This genus composed of one species found in Sri Lanka and it is a LC species.

***Semecarpus* L.f.**

The 12 species recorded in this genus are endemic to Sri Lanka and 9 species were observed in the present study. Among these, 4 species are LC (*S. gardneri*, *S. nigro-viridis*, *S. parvifolia*, *S. walkeri*), 3 species are VU (*S. coriacea*, *S. moonii*, *S. subpeltata*), a Near Threatened (NT) *S. marginata* and an Endangered (EN) *S. obovata*. All these species are stated as VU species as per GCS except *S. coriacea* which is an EN species.

***Spondias* L.**

According to Meijer (1983), 3 species were listed under this genus as (*S. pinnata* (L. f.) Kurz, *S. dulcis* Sol. ex Parkinso and *S. mombin* L.) and the latter two are cultivated in foreign countries. This could be the reason for not considering of *S. dulcis* and *S. mombin*, during the last red listing process. *Spondias pinnata* was evaluated and established as a VU species.

The observed species are plotted based on the NCS (Figure 4).

Among the observed species, 7.1% including 9.1% endemics are in the EN category, 28.6% including 27.3% endemics are in the VU category, 7.1% including 9.1% of endemics are in the NT category and 57.1% including 54.5% of endemics are in the LC category.

In order to establish conservation measures for these natural resources, it is vital to understand their present status of occurrence. Therefore, it is crucial to carry out constant and precise field-focused taxonomic investigations on these species, where the data would be a valuable source of information in evaluating the richness in different areas as well as in updating information such as Red Data Book.

CONCLUSION

This study records 14 species including 11 endemics in 6 genera belonging to the family Anacardiaceae. Gathered data will be used for revising the Flora of Sri Lanka and Red data listing and to establish the *Ex-situ* conservation measures to protect these species.

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