Parasitic Plants at the Coastal of Setiu, Terengganu: Distribution and Its Association with Host Trees

Shahrudin Rohani, Ai Lim Teh, and Muhamad Razali Salam

Abstract Parasitic plants have long been perceived as unwanted species due to the habit of destructing their hosts. However, parasite may play a significant roles in determining the species composition in one ecosystem. Therefore, this study was conducted to identify the parasitic plants and their hosts in the coastal forest in Setiu, Terengganu. We recorded seven species of parasites, with *Cassytha filiformis* was found dominating both sites. The inland site showed a higher species number with seven species, while beach site recorded only three species. Parasitic plants was found infested a total of 21 plant species, and *Syzygium zeylanicum* was the host tree that highly parasitized.

Keywords Cover percentage · Host specificity · Infestation

Introduction

Parasitic plants can be defined as plants that live on other plant where the plants, parasites, will harm or killed the host. They can be categorised into four main categories, which are obligate parasites, facultative parasites, holoparasites and hemiparasites (Nickrent and Musselman 2004). These parasites might be stem parasites, root parasites or both. Parasitism is an excellent and highly successful life strategy (Westwood et al. 2010). It is estimated that approximately 1% of the angiosperm evolved the ability to gain their nutritional needs through parasitizing on other plants (Bouwmeester et al. 2007).

The distribution of the parasitic plants is determined by several factors such as pollination, seed dispersal and also host characters (Okubamichael et al. 2016). They normally invade host plants that are quite similar to them both in size and physiological needs. The pattern of host preference is related to the local abundance of hosts. The number of potential host plants may varies among parasite species,

S. Rohani (✉) · A. L. Teh · M. R. Salam
School of Marine and Environmental Sciences, Universiti Malaysia Terengganu, Kuala Nerus, Terengganu, Malaysia
e-mail: rohanishahrudin@umt.edu.my

M. T. Abdullah et al. (eds.), *Greater Kenyir Landscapes*,
https://doi.org/10.1007/978-3-319-92264-5_9

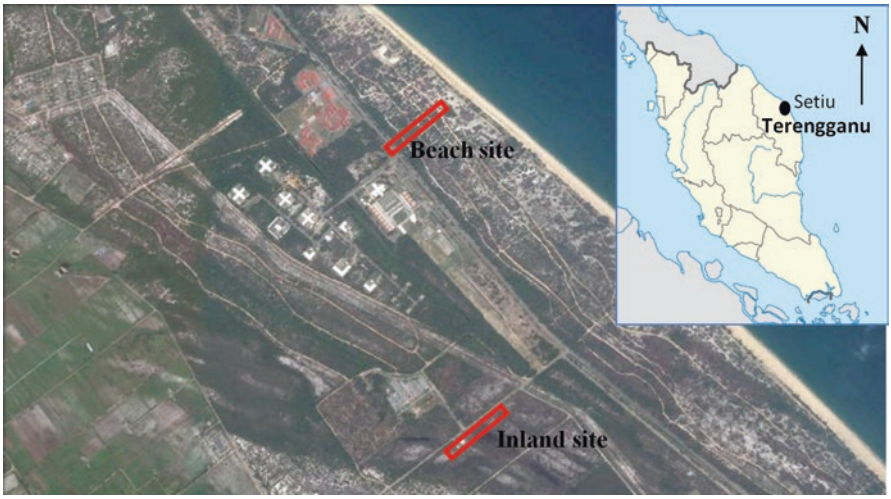

Fig. 1 Map of Peninsular Malaysia showing the study sites (beach plot and inland plot) in Mengabang Panjang, Setiu. (Source: adaptation from Google Earth)

depending on the factors such as host availability, quality and resistance against parasitism and parasite preference (Parker and Riches 1993). Those species with large host range are known as generalist, while species with narrow host range are known as specialist.

This study was initiated to document the parasitic plants that occur in an area at the east coast of Peninsular Malaysia. It is interesting to know about the richness of parasitic plant in the coastal area since this type of ecosystem is still poorly studied. The aims of this study are to identify the abundance and distribution of parasitic plants, and also to identify the plants that associate with the parasites. Transects were established near to the beach and also in inland. Parasites and host plants were identified within the transects (Fig. 1). Visual estimation was used to determine the percentage cover of the parasitic plants. Percentage cover of parasitic plants was estimated in eight cover classes using modified Braun-Blanquet cover classes according to Von Holle and Motzkin (2007).

Parasitic Plants Distribution

A total of seven parasitic plant species were found at both studied sites, which comprised of six genera and three families (Table 1). Out of seven species, five of them were mistletoe while the other two were parasitic vine species. For comparison, five species, four genera and two families were found in the study of the roadside parasitic plants in Penang, Malaysia (Rahmad et al. 2014). However, the roadside study

Table 1 List of parasitic plants in the study area

Parasite species	Family	Common name
Cassytha filiformis	Lauraceae	Dodder vines
Dendrotrophe varians	Santalaceae	–
Dendrophthoe pentandra	Loranthaceae	Malayan mistletoe
Scurrula ferruginea	Loranthaceae	Rusty-leaf mistletoe
Viscum articulatum	Santalaceae	Leafless mistletoe
Macrosolen retusus	Loranthaceae	Pink-flowered mistletoe
Macrosolen cochinchinensis	Loranthaceae	Common Chinese mistletoe

Table 2 The occurrence of parasitic plants in both area (beach and inland) with their percentage cover

Parasitic species	Beach site	Inland site
Cassytha filiformis	4.9%	33.7%
Dendrotrophe varians	34.8%	41.2%
Dendrophthoe pentandra	0.4%	9.6%
Scurrula ferruginea	0	9.6%
Viscum articulatum	0	2.4%
Macrosolen retusus	0	1.2%
Macrosolen cochinchinensis	0	1.2%

was only focused on Loranthaceae family, thus might be the reason for the lower species number as compared to the coastal study.

When comparing between beach site and inland site, three species were found occurred at both sites (*Cassytha filiformis*, *Dendrotrophe varians* and *D. pentandra*) while four species were found only at the inland site (*Scurrula ferruginea*, *Viscum articulatum*, *Macrosolen retusus* and *M. cochinchinensis*) (Table 2). This shows that inland site was having a higher species of parasitic plant than the beach site. Nickrent (2002) stated that majority of the parasitic plant species occur in undisturbed ecosystem. Thus, the low species number of parasitic plants at the beach site might be due to the fragmented area of vegetation due to human activities like road constructions as well as wild fire that reduces the abundance and diversity of host species.

Species that dominated the beach area was *C. filiformis*, meanwhile *D. varians* was found dominating the inland site. *Cassytha filiformis* was found widely distributed compared to other parasitic species. The wide distribution of *C. filiformis* was not surprising since this species has a pantropical distribution, inhabiting coastal vegetation, including sandy dunes, sandy beach and coastal woodlands (Nelson 2008). The dispersion mode of this species, which is by different agents including birds, water current and strong wind (Nelson 2008; Balasubramanian 1990), might be the reason why it was found more abundant at the coastal area like Setiu.

The difference between the percentage cover of *C. filiformis* and *D. varians* was very huge where the percentage cover of *C. fliformis* almost doubled that of the *D. varians*. *Dendrophthoe pentandra* was considered rare at the beach site as their

percentage of cover was less than 1%. The parasitic plant that dominated the inland site was *D. varians*, followed by *C. filiformis*. However, there was only small difference between the percentage cover of *D. varians* and *C. filiformis*. *Viscum articulatum*, *M. retusus* and *M. cochinchinensis* were considered rare at the inland site as both of their percentage of cover was less than 3%. Only one individual of both *M. retusus* and *M. cochinchinensis* were found at the inland site.

Parasitic Plants-Host Associations

Twenty-one plant species were found hosting the parasites in this area (Table 3). *Syzygium zeylanicum* was found most frequently being parasitized by five parasitic species (*C. filiformis D. varians*, *D. petandra,* and *M. retusus*). The high frequency of infestation on *S. zeylanicum* might due to a high abundance of this species in the study area.

All parasites found in this study were having a large host range except *V. articulatum*, *M. retusus and M. cochinchinensis*, where these species were found infested only a single species. However, it is a premature decision to say either these species are host-specific or not due to a small sampling area even though *M. retusus* was reported to be a specialist (Barlow 1997). Therefore, it is strongly suggested for future study to increase the sampling area for a better understanding of the ecological aspects for parasitic plants.

This study has successfully documented the list of parasitic plant species that can be found in the Setiu coastal area. The richness of the parasitic plants in this area might contribute to the dynamics of the ecosystem in few ways. Firstly, parasitism will affect the growth and reproduction of host plant, which lead to a high competition between parasite and host. In consequence, the damages on host plant can affect the abundance and diversity of herbivores, pollinators and seed dispersers. Secondly, some parasites do play a significant role in the ecosystem as an 'ecosystem engineer'. This owe to their ability to change the physical state in their abiotic environment, such as alteration in soil water status, nutrient cycling and canopy temperature. Several studies have shown how parasitic plants are able to suppress the dominant plant, which later encourage the increased in plant diversity and also facilitated the growth of rare species (Decleer et al. 2013; Pennings and Callaway 1996). Despite of being perceived as destructor, the occurrence of parasitic plant may be an indicator. However, to determine what is the impact of parasitic plant in this area, further study need to be done to understand the factors regulating their abundance and distribution, and also on the effect after the infestation.

Table 3 List of the host plants that associate with parasitic plants in the study area

Host plant species	Frequency of host plants infested by parasites						
	Cassytha filiformis	*Dendrotrophe varians*	*Dendrophthoe pentandra*	*Scurrula ferruginea*	*Viscum articulatum*	*Macrosolen retusus*	*Macrosolen cochinchinensis*
Acronychia pedunculata	1	0	0	0	0	0	0
Ardisia sp.	1	0	0	0	0	0	0
Baeckea frutescens	1	0	0	0	0	0	0
Calophyllum rupicola	0	1	0	0	0	0	0
Carallia brachiata	1	0	0	0	0	0	0
Champereia manillana	0	0	2	3	2	0	0
Leptocarpus disjunctus	2	0	0	0	0	0	0
Melaleuca cajuputi	1	0	1	0	0	0	0
Memecylon edule	1	0	0	0	0	0	0
Myrica esculenta	0	1	0	0	0	0	0
Olea brachiata	2	0	0	0	0	0	0
Parastemon urophyllus	2	1	0	0	0	0	0
Psychotria obovata	0	0	2	0	0	0	0
Rapanea porterian	0	1	1	0	0	0	0
Rhodomyrtus tomentosa	0	0	1	0	0	0	0
Styphelia malayana	0	0	1	0	0	0	0
Syzygium grande	0	1	0	0	0	0	0

(continued)

Table 3 (continued)

Host plant species	Frequency of host plants infested by parasites						
	Cassytha filiformis	*Dendrotrophe varians*	*Dendrophthoe pentandra*	*Scurrula ferruginea*	*Viscum articulatum*	*Macrosolen retusus*	*Macrosolen cochinchinensis*
Syzygium palembanicum	3	3	0	1	0	0	1
Syzygium sp.	1	0	0	0	0	0	0
Syzygium zeylanicum	**15**	**7**	**1**	**0**	**0**	**1**	**0**
Vaccinium littoreum	0	0	1	1	0	0	0

The most frequent infested species was indicated by bold letters

Acknowledgements The authors would like to thank School of Marine and Environmental Sciences, Universiti Malaysia Terengganu, for the financial and facilities support for this research.

Appendix

(**a**) *Cassytha filiformis* hanging on its host (left). Fruits of *C. filiformis* is a drupe that enclosed by the enlarged, inflated, succulent calyx tube (right). (**b**) *Dendrotrophe varians* with inflorescence (left) and fruits (right). (**c**) *Dendrophthoe pentandra* shows different colours of leaves, which might influenced by factor such as light intensity. (**d**) The pendulous branches of *Scurrula ferruginea* (left), and closed-up picture (left) of a branch showing the structure of haustorium (in the red circle). (**e**) *Viscum articulatum* on its host, *Champereia manillana.* (**f**) *Macrosolen cochinchinensis* with fruits. (**g**) *Macrosolen retusus* with inflorescence (left) and fruits (right)


c
d


e
f
g

References

Balasubramanian, P. (1990). Seed dispersal of *Cassytha filiformis* at Point Calimere, Tamil Nadu. *Journal of the Bombay Natural History Society, 87*(3), 472.

Barlow, B. A. (1997). Loranthaceae. *Flora Malesiana-Series 1, Spermatophyta, 13*(1), 209–401.

Bouwmeester, H. J., Roux, C., Lopez-Raez, J. A., & Becard, G. (2007). Rhizosphere communication of plants, parasitic plants and AM fungi. *Trends in Plant Science, 12*(5), 224–230.

Decleer, K., Bonte, D., & Van Diggelen, R. (2013). The hemiparasite *Pedicularis palustris*: 'Ecosystem engineer' for fen-meadow restoration. *Journal for Nature Conservation, 21*(2), 65–71.

Nelson, S. C. (2008). *Cassytha filiformis*. *Plant Disease, 42*, 1–10.

Nickrent, D. L. (2002). Parasitic plants of the world. In J. A. López Sáez, P. Catalán, & L. Sáez (Eds.), *Parasitic plants of the Iberian Peninsula and Balearic Islands* (pp. 7–27). Madrid: Mundi-Prensa.

Nickrent, D. L., & Musselman, L. J. (2004). Introduction to parasitic flowering plants. *The Plant Health Instructor, 13*, 300–315.

Okubamichael, D. Y., Griffiths, M. E., & Ward, D. (2016). Host specificity in parasitic plants-perspectives from mistletoes. *AoB Plants*. https://doi.org/10.1093/aobpla/plw069.

Parker, C., & Riches, C. R. (1993). *Parasitic weeds of the world: Biology and control*. Wallinford: CAB International.

Pennings, S. C., & Callaway, R. M. (1996). Impact of a parasitic plant on the structure and dynamics of saltmarsh vegetation. *Ecology, 77*, 1410–1419.

Rahmad, Z. B., Addo-Fordjour, P., Asyraf, M., & Nik Rosely, N. F. (2014). Mistletoe abundance, distribution and their associations with trees along roadside in Penang, Malaysia. *Tropical Ecology, 55*(2), 255–262.

Von Holle, B., & Motzkin, G. (2007). Historical land use and environmental determinants of nonnative plant distribution in coastal southern New England. *Biological Conservation, 136*, 33–43.

Westwood, J. H., Yoder, J. I., & Timko, M. P. (2010). The evolution of parasitism in plants. *Trends in Plant Science, 15*(4), 227–235.