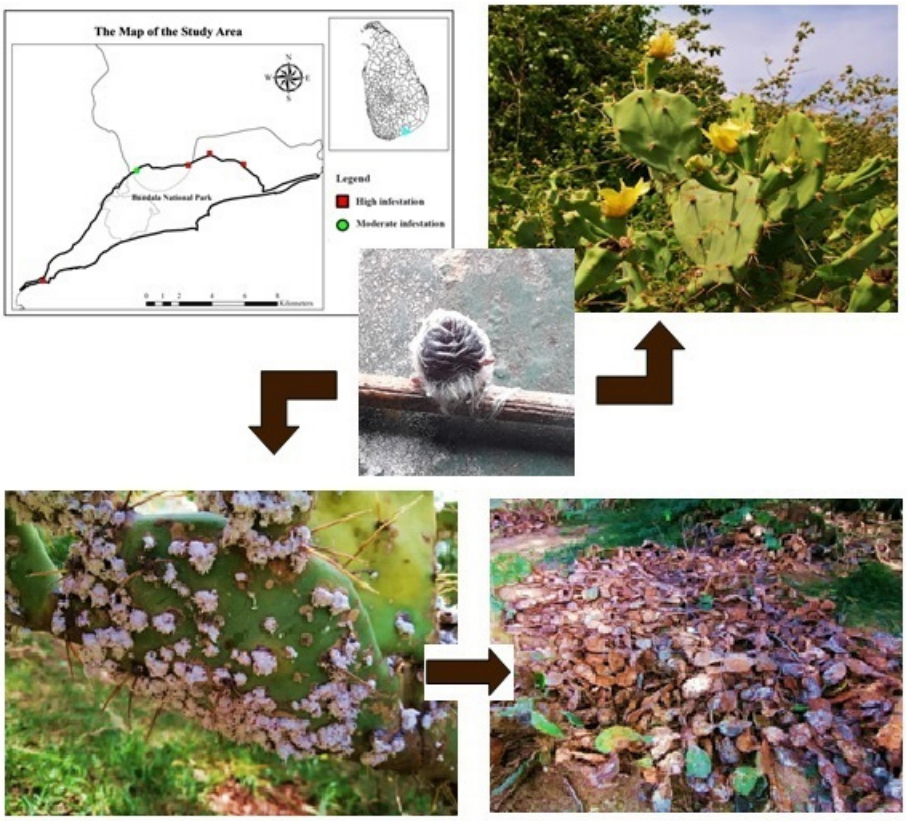
RESEARCH NOTE

Cochineal Scale *Dactylopius opuntiae* controls *Opuntia dillenii* in Bundala National Park, Sri Lanka

M.C.A. Galappaththi, N.M. Patabendige, S.S. Amarasinghe, K.B. Ranawana and W.A.I.P. Karunaratne*



***Opuntia dillenii* infested by the cochineal scale *Dactylopius opuntiae* resulting its death at Bundala National Park**

Highlights

- *Opuntia dillenii* (Ker Gawler) is an invasive plant species in Bundala National Park.
- Cochineal insect, *Dactylopius opuntiae* has infested *Opuntia dillenii*.
- Intensity of infestation was 100% along three of the five line-transects.
- Recent outbreak of *D. opuntiae* may have resulted from an unnoticed existing population in the vicinity.

Ceylon Journal of Science 50(3) 2021: 297-301
DOI: http://doi.org/10.4038/cjs.v50i3.7912

RESEARCH NOTE

Cochineal Scale *Dactylopius opuntiae* controls *Opuntia dillenii* in Bundala National Park, Sri Lanka

M.C.A. Galappaththi[1], N.M. Patabendige[2], S.S. Amarasinghe[3], K.B. Ranawana[4] and W.A.I.P. Karunaratne[4,*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Limnology and Water Technology, Faculty Fisheries and Marine Sciences and Technology, University of Ruhuna, Matara, Sri Lanka.
[3]The Wildlife and Nature Protection Society of Sri Lanka (Ceylon), Rajamalwatte Road, Battaramulla, Sri Lanka.
[4]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka.

Received: 21/10/2020; Accepted: 24/07/2021

Abstract: *Opuntia dillenii* (Ker Gawler) is an invasive plant species in Bundala National Park. The outstanding success of the cochineal insect, *Dactylopius* spp. in bio-control of the prickly pear, *Opuntia* spp. has been investigated worldwide. The present study reports the emergence of *D. opuntiae* as a pest of *O. dillenii* after several decades of its introduction to Sri Lanka. The intensity of infestation was 100% along three of the five transects surveyed and the overall damage was more than 50%. This recent outbreak of *D. opuntiae* may have resulted from an unnoticed existing population of *D. opuntiae* in the vicinity.

***Keywords*:** *Opuntia dillenii*; invasive species; *Dactylopius opuntiae*; biological control.

INTRODUCTION

Opuntia dillenii (Ker-Gawler) Haworth (prickly pear) belongs to family Cactaceae and is native to the Caribbean Islands, North and South America (USDA, 2020; Anderson, 2001). *Opuntia dillenii* is a succulent perennial shrub, forming low clumps or tall branched bushes and sometimes with distinct trunks. *Opuntia dillenii* was introduced to Sri Lanka as an ornamental plant in the 19th century and subsequently became an invasive species along the coastal area between Hambantota and Yala National Park, and especially in Bundala National Park (Dilshan *et al*., 2017). It has invaded several hectares of sand dune areas, adjacent scrub forests and pasture lands in Bundala. Certain areas are densely covered by *O. dillenii* that have developed into large prickly patches completely inaccessible to humans and animals. The seeds are spread by macaque monkeys and some birds (Gunasekara, 2009). Bambaradeniya *et al.* (2006) recorded an invasion of cactus which disturbed the regeneration of coastal vegetation consisted of *Pandanus odoratissimus, Scaevola takkada*, and *Spinifex littoreus* destroyed by the tsunami waves in 2004. Manual removal of *O. dillenii* is impossible as the area where it has spread over is vast (Gunasekara, 2009).

The cochineal scale, *Dactylopius* (Hemiptera: Coccidea: Dactylopiidae) species have been employed as an agent for biological control of invasive cactus species in various countries. Moran and Zimmermann (1984) report five species of cochineal insects used successfully for biological control of several cactus weeds around the world without any adverse consequences on environment. The first record of a herbivorous insect for biological control of a weed, anywhere, involved the release of *Dactylopius ceylonicus* (Green) onto *Opuntia vulgaris* Miller in Sri Lanka during 1863 (Tyron, 1910). Later, there had been several incidents in which *Dactylopius* spp. were introduced as a bio control agent to limit the spread of cactus species in Sri Lanka. According to Goeden (1988) *D. ceylonicus* has been introduced again in 1865 for the successful control of *Opuntia monacantha* and it is known as the first international transfer of a natural pest for biological control of weeds. Jepson (1930) recorded the position of *O. dillenii* (Cockerell) in Ceylon after introduction of *D. opuntiae* and also the study revealed that the introduction to certain areas has failed to control *O. monocantha* in these regions. Further, it was also revealed that the introduction of *D. opuntiae* to control *O. dillenii* populations in India has also been unsuccessful (Muniappan *et al*., 2009).

In 2017, *Opuntia dillenii* was the most highly invaded species and covered approximately 9% (567 ha) of the total area of the Bundala National Park (Suraweera and Dahanayaka, 2017). According to Marambe *et al*. (2010) several programs have been implemented by the Department of Wildlife Conservation (DWC) to manage the spread of *O. dillenii* in Bundala National Park. However, there has been no progression in these programs to control the spread of *O. dillenii* up to now. The present study reports a recent event of natural bio control of *O. dillenii* by *D. opuntiae* in Bundala National Park, Sri Lanka.

MATERIALS AND METHODS

Study area

Bundala National Park is a RAMSAR wetland site that lies on 6° 12' 50" N and 81° 13' 30" E, along the southern coastal region of Hambanthota district, Southern province

**Corresponding Author's Email:* inokap@pdn.ac.lk
https://orcid.org/0000-0002-1483-9494

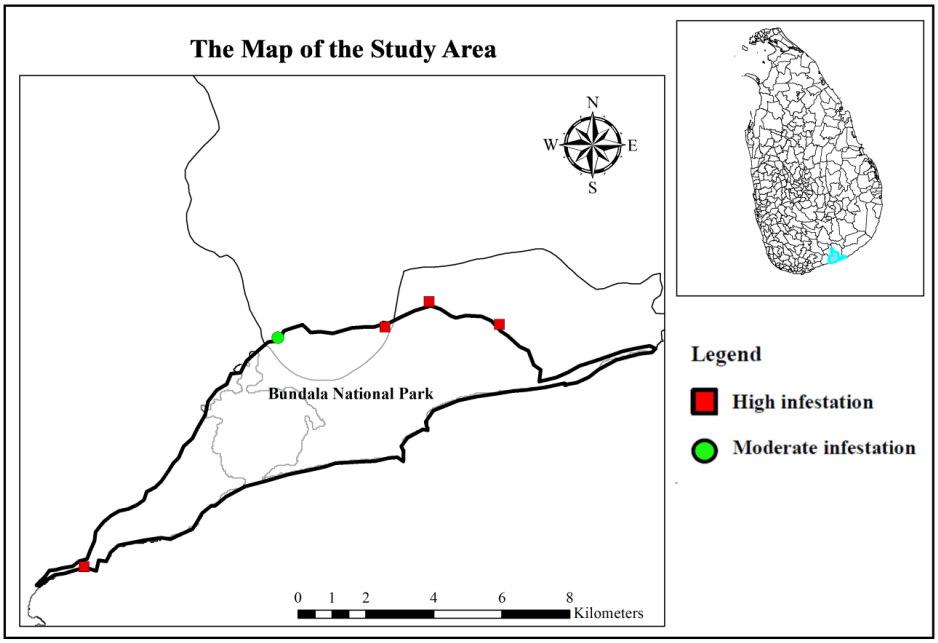


Figure 1: Map of the study area in the Bundala National Park showing areas of high infestation and moderate infestation of *O. dillenii* by *D. opuntiae.*

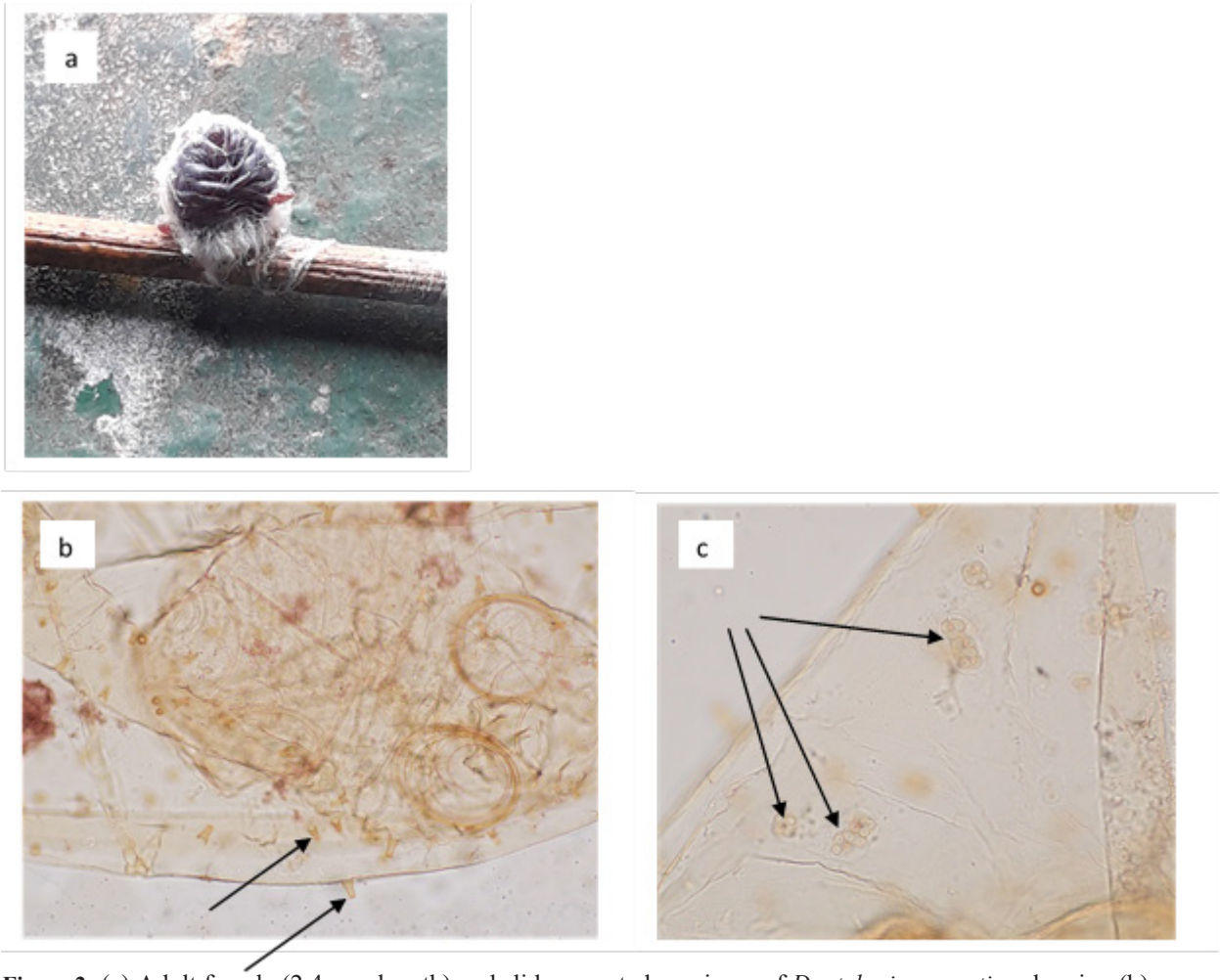


Figure 2: (a) Adult female (2.4 mm length) and slide mounted specimen of *Dactylopius opuntiae* showing (b) numerous short, cylindrical and moderately to strongly stout setae (10 × 100) and (c) narrow rimmed pores that are numerous on the ventral side of the last three abdominal segments (10 × 100 × 2).

Figure 3: (a) Healthy plant of *O. dilleniii*, (b) infested cladode with *D. opuntiae* and (c) dead bushes due to high infestation at Bundala National Park.

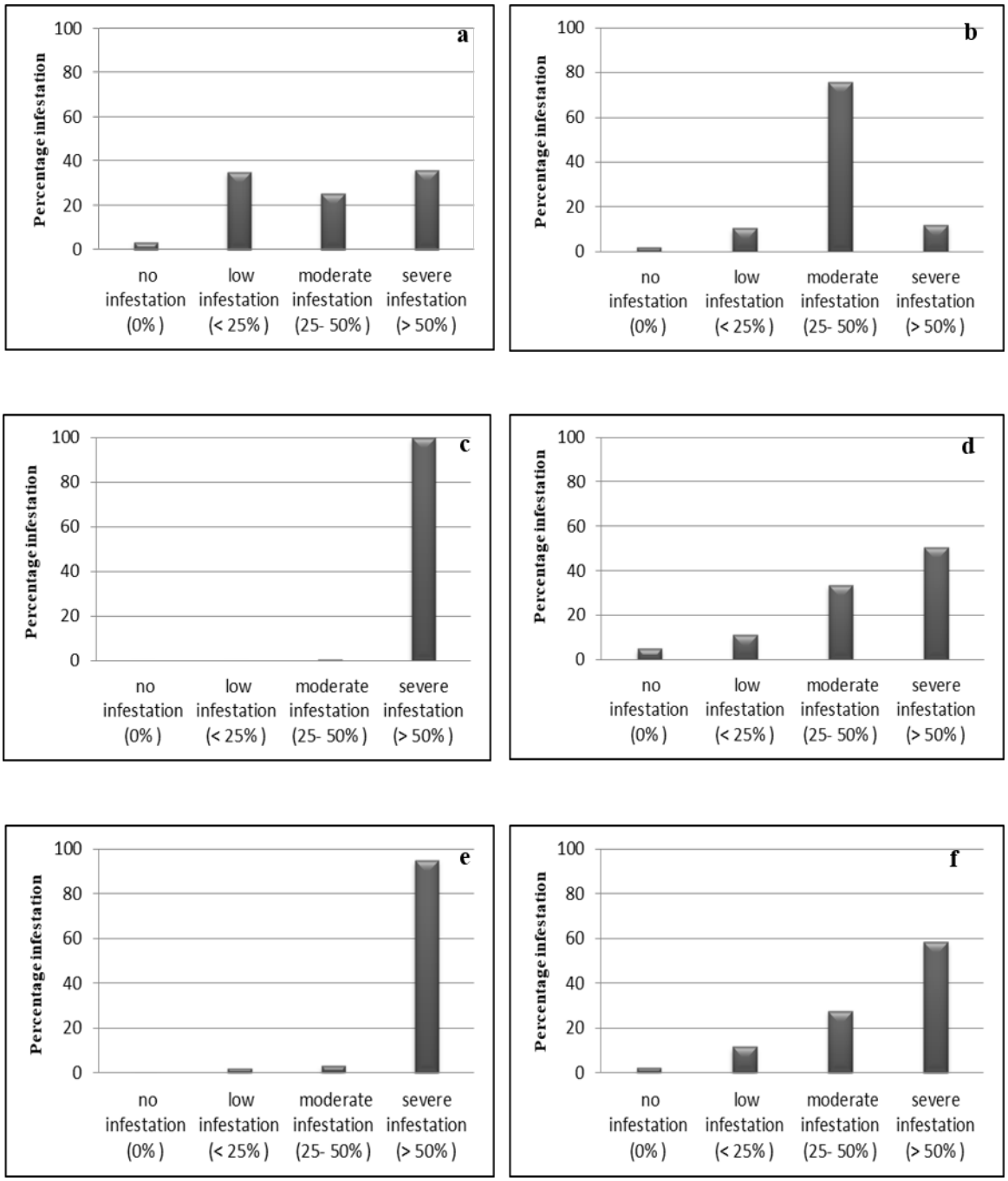


Figure 4: Percentage infestation of *O. dillenii* by *D. opuntiae* estimated in ten 1 m^2 quadrates along the (a) Transect 1, (b) Transect 2, (c) Transect 3, (d) Transect 4, (e) Transect 5, and (f) in the study area as a whole.

of Sri Lanka. The wetland consists of 6,216 ha of low land area, and five lagoons with a total surface area of 2,250 ha that are located at 10 m above mean sea level (Green *et al.*, 2008).

Study of the intensity of infestation

Dactylopius opuntiae infesting *O. dillenii* was observed in the Bundala National Park and adjacent area while in Bundala National Park the heavy infestation led to the death of cactus plants. The initial inspections were conducted to identify the infected areas and to categorize the intensity of infestation on 28th and 29th of August, 2020. The intensity of infestation was categorized by visual examination according to the scale given bellow,

0% - no infestation.

< 25% - low infestation (if less than 25% of the cladode surface was infested).

25 - 50% - moderate infestation (if 25 - 50% of the cladode surface was infested).

> 50% - severe infestation (if more than 50% of the cladode surface was infested).

Two field trips were conducted on the 30th of August and the 1st of September in 2020 to investigate the intensity of *D. opuntiae* infestation in cactus in several localities in and around Bundala National Park (Figure 1). Five line transects (100 m) were randomly selected along the boundary of National Park where *O. dillenii* were abundant. GPS locations of each site were recorded. The percentage intensity of infestation was measured using the above four infestation scale along each line transects at each 10 m interval using one square meter quadrat at each point (Moussa *et al*., 2017).

Data gathered was analyzed by IBM SPSS Statistics 22 software and Microsoft Excel 2010 software. Mean percentage values of ten quadrates in each transect were used to plot bar charts to show intensity of infestation.

Collection and identification of the insect

The heavily infested cladodes of cactus were hand collected from adjacent areas near to Bundala National Park and the insects were removed from the cladodes with a fine brush and were preserved in 70% alcohol. Few representative specimens of adult females were slide mounted using standard entomological techniques (Nye, 1947).

Photographs of the damage and insects were initially sent to Prof. J.P. Edirisinghe, Emeritus Professor, Department of Zoology, University of Peradeniya. Slide mounted specimens were further identified using the key by Lotto (1974) to confirm the identity.

RESULTS AND DISCUSSION

Dactylopius opuntiae,* the pest of *Opuntia dillenii

The collected specimen belonged to *D. opuntiae*. Live specimens of *D. opuntiae* were oval in shape and of dark maroon colour [Figure 2 (a)]. Several days after specimens were preserved in 70% alcohol, the alcohol turned into a beautiful light maroon-red colour, the colour of the cochineal dye. Mounted adult female had an elongated and oval shaped body with short and stout legs. Dorsal, ventral and lateral modified body setae are short, cylindrical and moderately to strongly stout; rather numerous [Figure 2 (b)] while narrow rimmed pores are numerous on the ventral side of the last three abdominal segments [Figure 2 (c)]. Anterior and posterior spiracles are large with a well-developed sclerotized operculum while the lateral edges rough or provided with a few minute indentations.

Intensity of infestation

Dactylopius opuntiae infesting *O. dillenii* [Figure 3 (a) and (b)] was recorded in the Bundala National Park and adjacent area. The infestation in Bundala National Park where *D. opuntiae* heavy infestation was observed led to the death of cactus plants [Figure 3 (c)]. The colonies of all stages were covered in copious cottony wax and many females were found close together forming clusters of colonies.

The intensity of damage was not equal along the five transects [Figure 4 (a - e)] examined in the study area. The intensity of damage was 100% along the Transect 3 [Figure 4 (c)] and it was nearly 100% along the Transect 5 [Figure 4 (e)] while it was little more than 50% along the Transect 2 [Figure 4 (b)]. However, after several weeks of moderate infestation, the intensity of damage became high. According to Figure 4 (f), the infestation in the whole study area was severe (> 50%) and was observed in nearly 60% of the total of 50 one square meter quadrates observed in the study area. Furthermore, the intensity of infestation was very high where *O. dillenii* grows as an understory in *Prosopis juliflora* shades than in open areas. There were plants such as *Salvadora persica, P. juliflora, Lantana camera* and *Ziziphus mauritiana* around the areas having infected *Dactylopius opuntiae*. However, these plants were found to be not infested by *O. dillenii*. Though there were several previous records of anthropogenic introduction of *Dactylopius* spp. to control cactus in Sri Lanka (Tyron, 1910; Goeden, 1988; Muniappan *et al*., 2009), the present study revealed the emergence of *D. opuntiae* as a pest of *O. dillenii* after several decades of its introduction to Sri Lanka. However, there are no published records of recent introduction of *D. opuntiae* to control cactus in Sri Lanka. Therefore, this recent outbreak may have resulted from an unnoticed existing population of *D. opuntiae* in the vicinity.

ACKNOWLEDGMENT

The authors acknowledge Mr. Ajith Gunathunga, the Park Warden and Mr. Pubudu Ranga of the Bundala National Park, Sri Lanka for giving continuous support to do the study in the area and Ms. D. Ekanayake and Mr. Niroshan Samarasinghe for assistance given in slide mounting of the specimen and for taking photographs of the slide mounted specimens respectively.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Anderson, E.F. (2001). *The Cactus a Family.* Timber Press Inc., Portland, Oregon, USA.

Bambaradeniya, C.N., Perera, M.S.J. and Samarawickrema, P. (2006). *A rapid assessment of post-tsunami environmental dynamics in relation to coastal zone rehabilitation and development activities in the Hambantota district of southern Sri Lanka*. World Conservation Union (IUCN) Sri Lanka Country Office.

Dilshan, W., Ranaweera, B., Wijenayake, W.M.H.K. and Suraweera, C. (2017). Mapping plant cover and distribution of *Prosopis juliflora* and *Opuntia dillenii* in Bundala National Park, Sri Lanka using global positioning system. *Proceeding of 16th Agricultural Research Symposium, Wayamba University of Sri Lanka*. . Pp. 1-5.

Green, M.J.B., De Alwis, S.M.D.A.U., Dayawansa, P.N., How, R., Padmalal, U.K.G.K., Singhakumara, B.M.P., Weerakoon, D. and Wijesinghe, M.R. (2008). *Biodiversity Baseline Survey: Bundala National Park.* Pp. 1-46.

Goeden, R.D. (1988). A capsule history of biological control of weeds. *Biocontrol News and Information* **9**:55-61.

Gunasekera, L. (2009). *Invasive Plants: A Guide to the Identification of the Most Invasive Plants in Sri Lanka.* Sarasavi Prakashakayo, Sri Lanka.

Jepson, F.P. (1930). Present position in regard to the control of prickly-pear (*Opuntia dillenii* Haw.) in Ceylon by the introduced cochineal insect *Dactylopius tomentosus* Lamk. *Tropical Agriculturist (Ceylon)* **75**: 63-72.

Marambe, B., Silva, P., Wijesundara, S. and Atapattu, N. (2010). *Invasive Alien Species – Strengthening Capacity to Control Introduction and Spread in Sri Lanka.* Biodiversity Secretariat of the Ministry of Environment, Sri Lanka Pp. 191.

Moran, V.C. and Zimmermann, H.G. (1984). The biological control of cactus weeds: achievements and prospects. *Biocontrol News and Information* **5**(4)**:** 297–320.

Moussa, Z., Yammouni, D. and Azar, D. (2017). *Dactylopius opuntiae* (Cockerell, 1896), a new invasive pest of the cactus plants *Opuntia ficus-indica* in the South of Lebanon (Hemiptera, Coccoidea, Dactylopiidae). *Bulletin de la Société Entomologique de France* **122**(2): 173-178.

Muniappan, R., Reddy, G.V. and Raman, A. (2009). *Biological Control of Tropical Weeds Using Arthropods*. Cambridge, Cambridge University Press.

Nye, W.P. (1947). A simple method for mounting aphids. *The Pan-Pacific Entomologist* **23**(2): 73-74.

USDA, Agricultural Research Service, National Plant Germplasm System. (2020). *Germplasm Resources Information Network (GRIN-Taxonomy).* National Germplasm Resources Laboratory, Beltsville, Maryland. Available from: https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?id=25872. Accessed on 03.08.2020.

Suraweera, P.A.C.N.B. and Dahanayaka, D.D.G.L. (2017). *Assessment, Monitoring and Management of Invasive Alien Species at Bundala National Park (A Ramsar Wetland) in Sri Lanka.* Wetlands Sri Lanka, Central Environmental Authority, Sri Lanka Pp. 80-85.

Tyron, H. (1910). The 'wild cochineal insect', with reference to its injurious action on prickly pear (*Opuntia* spp.) in India, *etc*. and to its availability for the subjugation of this plant in Queensland and elsewhere. *Queensland Agricultural Journal* **25**: 188–197.