

Full Length Research Paper

Galling insects associated with *Haloxylon* spp. (Bunge) in Abu Dhabi, United Arab Emirates

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This article introduces the arthropods that induce galls or are associated with galls in two plant species (*Haloxylon persicum* and *Haloxylon salicornicum*) in the Emirate of Abu Dhabi, United Arab Emirates. In connection with a baseline survey conducted to establish species knowledge to assess the habitat and diversity of the flora and fauna in proposed Houbara bustard (*Chlamydotis (undulata) macqueenii*) release sites of the Western Region of Abu Dhabi, Emirate. The galls were collected and studied to understand the gall-associated arthropods. In the current observation, four different types of galls were observed from stem and leaf portion of the two plant species: Swollen galls and flower-like galls from *H. persicum*; flower-like galls and spike-like galls from leaves and stem of *H. salicornicum*. In the present study, we have additionally observed arthropods associated with plant galls from both species of *Haloxylon* (gall-associated species). No attempts were made to classify them into further categories like gall inducers or parasitoids of gall-inhabiting insects. The taxon observed in the current study belong to different arthropod groups: 1) Arachnids: Acari and Araneae; 2) insect orders like Hymenoptera: Pteromalidae, Thysanoptera: Thripidae, Hemiptera: Psyllidae, Pseudococcidae, Diptera and Lepidoptera: Pyralidae.

Key words: Biodiversity, *Haloxylon persicum*, *Haloxylon salicornicum*, gall inducers, inquilines, gall associates, Western Region.

INTRODUCTION

Diverse groups of insects comprising an estimated 13,000 species induce plant galls (Shorthouse and Rohfritsch, 1992; Williams, 1994). Galls, the structures composed of plant tissue in which the insect feeds, represent distinct microhabitats that support specialist inhabitants (Narendran et al., 2007). Galls range in complexity from relatively open pits or folds to structures that completely enclose inhabitants. The publications of Mani (1964, 1973, 2000) and Anathakrishnan (1984) deal largely on a global context, with biology of gall insects (Narendran et al., 2007). In the Emirates, no adequate studies have been done on the plant galls and

gall-inducing or gall-associated species. A species (*Actilasioptera* sp.) of gall midge (Diptera: Cecidomyiidae) from the leaf galls on grey mangrove (*Avicenia marina*) was identified for the UAE Insect Inventory project (Harris and van Harten, 2010).

In the present study, gall types associated with two chenopod species, *Haloxylon salicornicum* and *Haloxylon persicum* were discussed. Both species were widespread in the survey area (Sakkir et al., 2012). *H. salicornicum* is a perennial succulent shrub, which grows to a height of about 100 cm or more whereas *H. persicum* is a perennial shrub or a small tree that grows up to 3 m with

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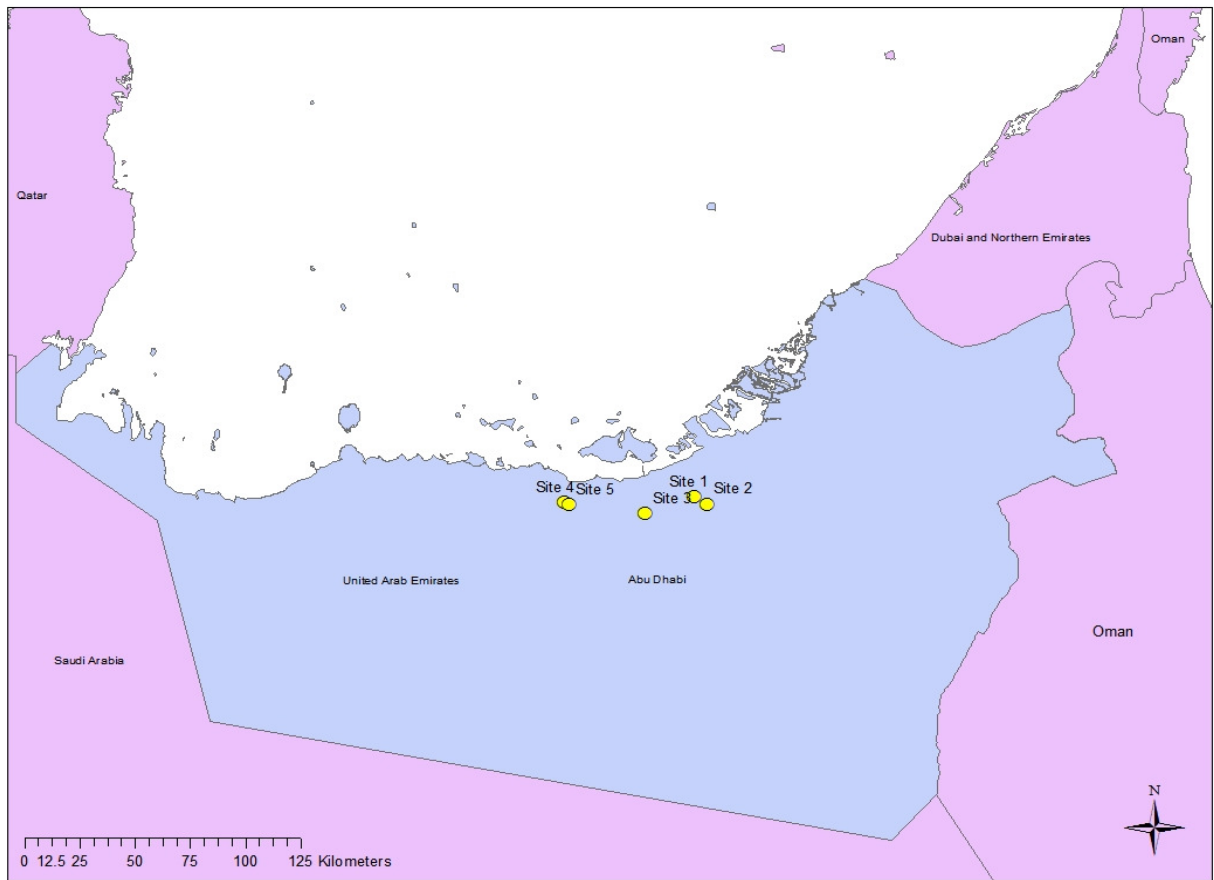


Figure 1. Satellite image of study sites.

jointed leaves, which are less succulent than *H. salicornicum*. In both species, galls are found to induce the leaves and stems and are very conspicuous. All plant organs are subject to galling including roots, stems, leaves, flowers, and fruits, as well as the various parts of these organs are preferred by certain gall insects (Zalat, et al., 2000). Gall morphotypes were used to survey the galling insects, assuming that each morphotype is unique (Stone and Schönrogge, 2003) and that each galling species is specific to its host plant (Espírito-Santo and Fernandes, 2007; Carneiro et al., 2009).

MATERIALS AND METHODS

Study area

The study was carried out at a desert site in the Western Region of Abu Dhabi, Emirate which is situated 180 km North-West of Abu Dhabi Island (Figure 1). This site is characterized by sand sheets and dunes in which shrubs of white saxual (*H. persicum*) and a common perennial shrub of the Arabian deserts (*H. salicornicum*) are seen. Other major shrubs observed in this area are papyrus sedges (*Cyperus conglomerates*) and bean caper (*Zygophyllum qatarense*). The soil substrate is of fine silt with sand and no gravel plain with signs of camel grazing.

Insect galls were observed and collected from two plant species (*H. persicum* and *H. salicornicum*) from Site 2 (Figure 1) and the gall associated species were studied during the period of February 2009 to February 2010. This site is located at the Al Marzoum area of Abu Dhabi, Emirate which is proposed to transform into a protected area. Ten plants were surveyed, taking samples from each. Various parameters were observed such as the gall type and gall occurrence on the plant. Dried branches of *H. persicum* were observed which might be due to the occurrence of galls that eventually cause the breaking of the branches.

Plants were surveyed randomly and information was collected on the position of galls and gall types. The fresh samples of galls were collected on a number of occasions and similar types were kept together in closed containers in the laboratory at EAD and the species which comes out from the galls were observed and identified up to their family level (Borror et al., 1976). Voucher specimens (insect specimens collected from galls and preserved for future reference) were later preserved in 70% ethanol and deposited in the EAD Invertebrate Collection.

RESULTS

In the current study, the species observed and collected from the gall samples are described and listed in Table 1. Two families of arachnids and four families of insects were observed from the species *H. persicum*.

Table 1. Insects and arachnids associated with galls.

Plant species	Types of galls	Figures where gall types are shown	Gall maker/associated insects	Plant part or location
<i>H. persicum</i>	Swollen galls	Figure 2: 2	Arachnida: Acari (Mites)	Stem
	Swollen galls	Figure 2: 6	Arachnida: Araneae Salticidae (Jumping Spider)	Stem
	Flower like galls	Figure 2: 3	Hymenoptera: Pteromalidae Thysanoptera (Thrips) Hemiptera: Psyllidae Hemiptera: Pseudococcidae	Leaves
<i>H. salicornicum</i>	Flower like (different from <i>H.persicum</i>)	Figure 2: 7	Hymenoptera: Pteromalidae Diptera: Thysanoptera (Thrips) Lepidoptera: Pyralidae Arachnida: Acari Arachnida: Araneae	Leaves
	Spike like galls	Figures 2: 4, 5	Hymenoptera: Pteromalidae	Stem

Gall types and species association on *H. persicum*

On *H. persicum*, the galls spotted were the swollen galls (Figure 2: 2) and the long spike-like galls which resemble a stalked flower (Figure 2: 3). Swollen galls were spotted on the internodes on the young branches. The galls that are green to yellow in the initial stages matured and became brown in colour with a prominent ostiole.

Arachnida: Acari (Mites)

This order contains predatory, parasitic and phytophagous mites representing more than 14,000 species worldwide (Chinery, 2011). Mites make a variety of plant galls, the gall mites are very small, usually whitish in colour with only two pairs of legs.

Arachnida: Araneae: Salticidae

The Salticidae 'jumping spiders' is possibly the largest family of spiders with over 30 known species described from United Arab Emirates (van Harten, 2010). Spiders inhabiting swollen galls might be gall inquilines which occupy the vacant space when the adult gall-forming insects leave galls through exit holes (Chinery, 2011) (Figure 3: 8).

The spike-like galls are pinkish in colour, whereas the true flowers of the species are inconspicuous and are yellow in colour. The flower-like galls were mainly spotted between the jointed leaves or at the terminal end of the jointed leaves and also at the nodes on the main stem and branches.

Hymenoptera: Pteromalidae

Pteromalidae, one of the large families of Chalcidoidea, currently includes 588 genera and 3506 species in 31 subfamilies throughout the world (Noyes, 2003). The Pteromalidae associated with galls develop either as inquilines, or as parasitoids feeding externally on larvae, pupae or even adults of the gall inducer.

Thysanoptera: Thripidae

Thrips are gall-inducers (Chinery, 2011) which gain food, shelter and oviposit within the gall, and developing Thrips feed by sucking out the contents of plant cell on the gall's inner wall (Figure 3: 12).

Hemiptera: Psyllidae

About 70 species of Psyllids or jumping plant lice are small plant-feeding insects that tend to be very "host specific", that is, they only feed on one plant species (monophagous) or feed on a few related plants (oligophagous). A new record of the jumping plant lice (Figure 2: 7) (Hemiptera: Psyllidae) has also been recorded from *Haloxylon* sp. and species to be identified. Several species of the jumping plant-louse (Hemiptera: Psyllidae), are recognized to damage plants by causing galls or spreading virus diseases.

Hemiptera: Pseudococcidae

The scale insects are morphologically specialized plant

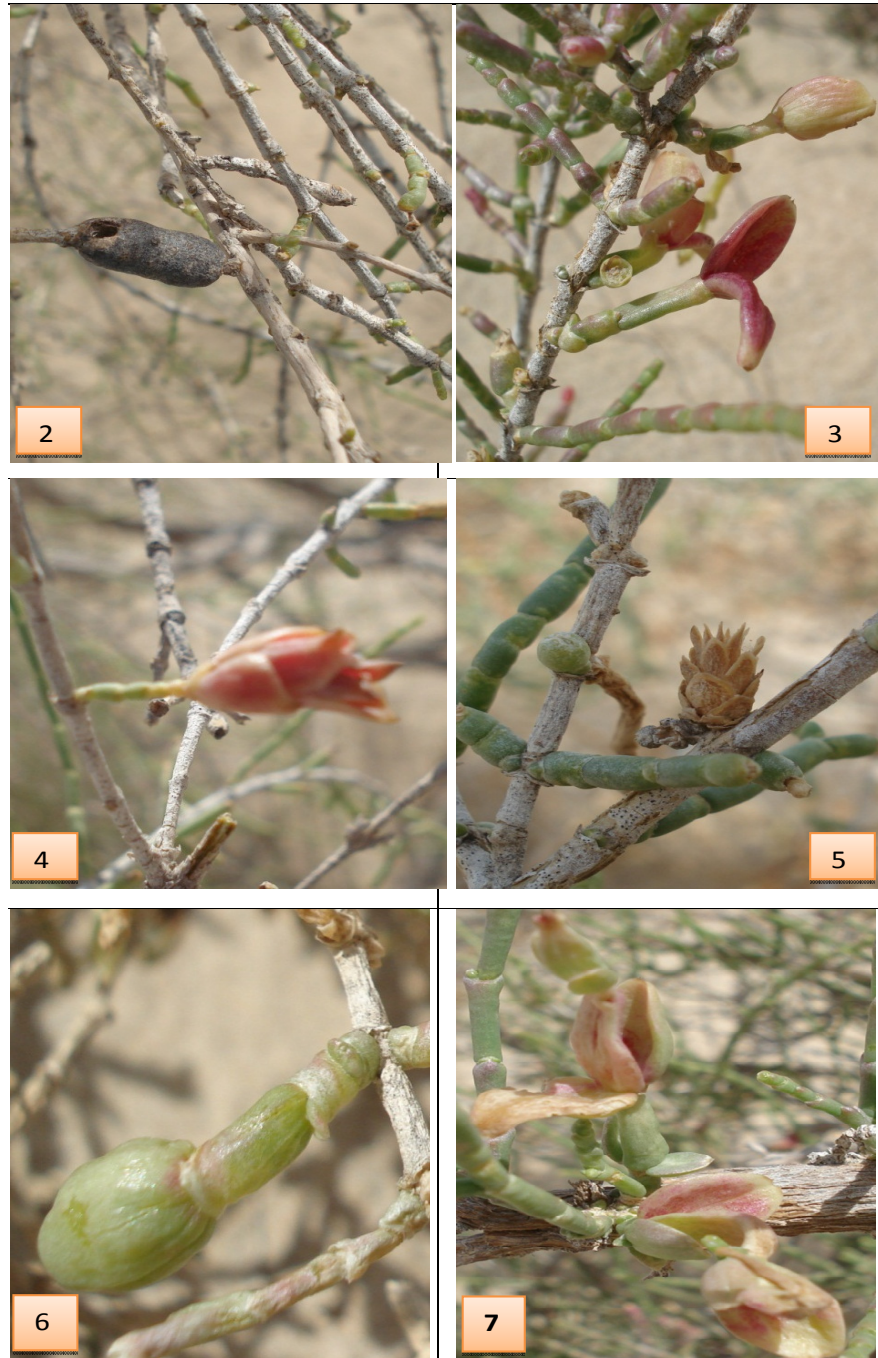
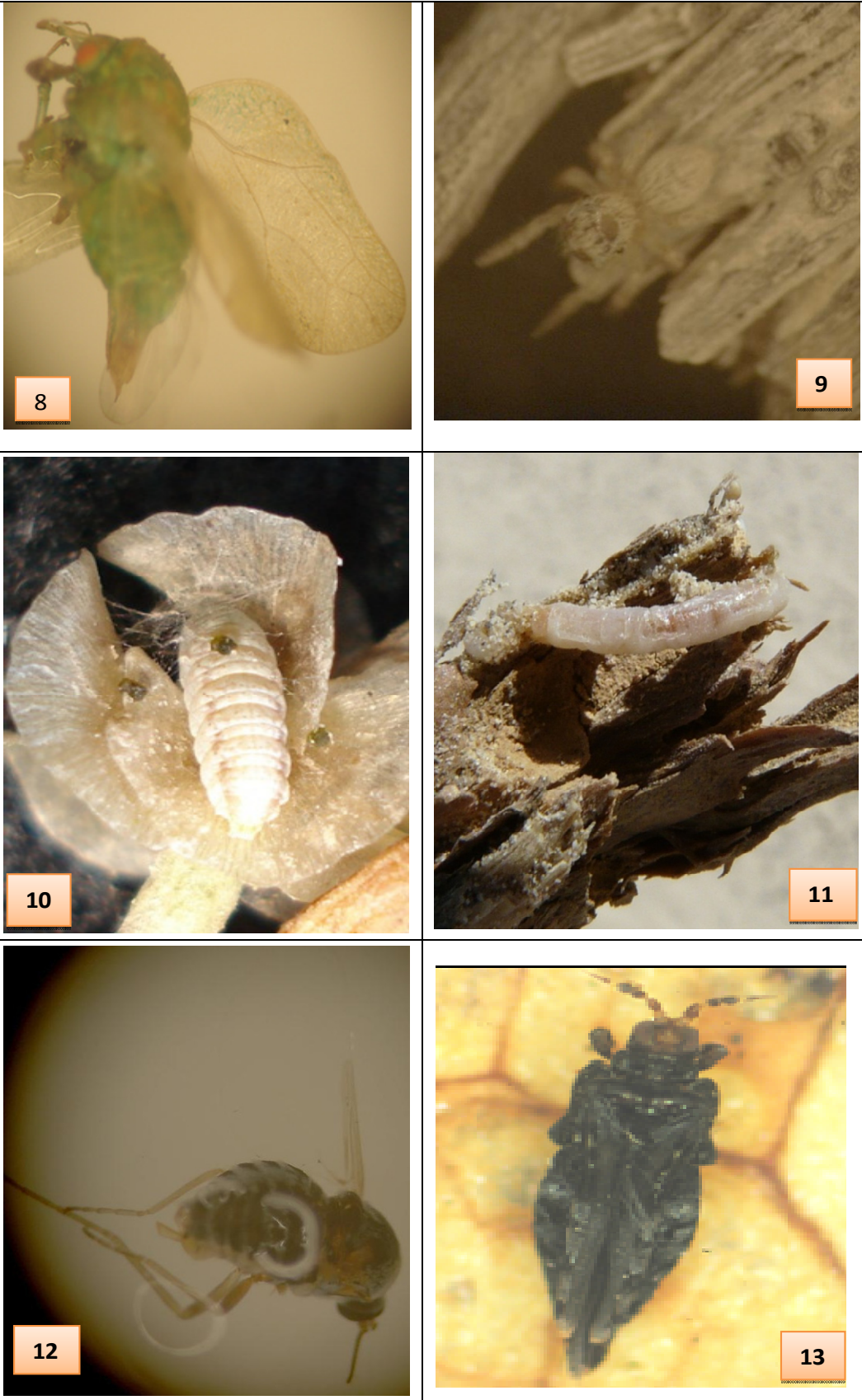


Figure 2. 2: Swollen galls (*H. persicum*), 3: flower gall (*H. salicornicum*), 4: long spike-like gall (*H. persicum*), 5: short spike-like gall (*H. salicornicum*), 6: bulb-like gall (*H. salicornicum*), 7: multiple flower-like gall (*H. salicornicum*).

parasites that mostly either live under a protective cover derived from their waxy secretions or live concealed by plant tissue, including within galls (Figure 3: 10). Female mealybugs have three immature instars and males have four (Miller 1991). Adult females are characterized by a white mealy wax secretion that covers most or all the body.

Gall types and species association on *H. salicornicum*

The gall types identified in *H. salicornicum* include the flower like galls (Figure 2: 3), short spike like gall (Figure 2: 5), bulb like gall (Figure 2: 6) and multiple flowers-like gall (Figure 2: 7). The structure of these galls was entirely



Figures 3. 8: Jumping louse, 9: jumping spider, 10: scale insect, 11: pyralid moth, 12: true fly, 13: thrips.

different from the ones found in the species *H. persicum*. As in the case of *H. salicornicum*, the flowers-like galls are produced between the jointed leaves. The short spike-like galls are seen at the nodes on the main stem.

Four insect families and two arachnid families were identified from flower-like gall of *H. salicornicum*. Species of Lepidoptera and Diptera were observed separately from the families of Hymenoptera, Thysanoptera and Arachnid species which were same as that from *H. salicornicum*.

Diptera

An unknown Dipteran fly (Figure 3: 12) was observed from the flower-like galls of *H. salicornicum*. This species can be a gall inducer, gall inquiline or parasitoids attacking the gall inducers and gall inquilines.

Lepidoptera: Pyralidae

There are about 50 species of Pyralidae moths known from UAE (van Harten, 2008). The Pyralid larvae observed might be a gall inquiline whose larvae live and feed inside gall. Pyralid larvae have few distinguishing features, but can be often recognized by its wriggling when it is disturbed.

DISCUSSION

Plant galls, which are abnormal growth of plant tissue that often resemble plant organs, can be induced by a variety of different insect species (Resh and Carde, 2004). In the Emirate, the gall-associated species are not well-known because of the lack of knowledge on their biology and their relationships. Gall-inducing capability among insects has evolved repeatedly in different insect orders (Shorthouse and Rohfritsch, 1992; Raman et al., 2005). Several species of Psyllidae (Hemiptera) induce galls, the most obvious of which are leaf-rolls on various trees and shrubs (Chinery, 2011). In the current study, 8 arthropod orders have been identified from two plant species. The taxa associated with galls develop either as inquilines or as parasitoids feeding externally on larvae, pupae or even adults of the gall inducer. Although, the majority of galls produced are small and inconspicuous, the galls in the genus, *Haloxylon* displayed beautiful colors and are conspicuous. Presence of fruit-like galls, were observed in *H. persicum* during their flowering period when the insect attack is more frequent (Al-Khalifah and Shanavaskhan, 2007). The gall causers interfere with the development of the host plants' cells, either chemically or mechanically, and make them to develop into gall tissue (Chinery, 2011).

Heavy infestation that occurs repeatedly over several

seasons may slow the growth of the plant or make the appearance unattractive. Studies have shown that gall infestation can cause reduction in vigor, premature leaf fall that reduces the amount and quality of essential oil and prevent development in many *Eucalyptus* species. The galls induced by a chalcidoid wasp in *Chamelaucium uncinatum* resulted in severely deformed branching pattern that reduces the plants suitability for cut flowers and nursery industries. Stem galls and flower-like galls, which were similar to the ones present in *Haloxylon* spp., were also reported in the beaded glass wort, *Sarcocornia* species. The galls prevented the development of normal shoots and decreased seed production in the species. In *H. persicum*, the dried branches might be due to the occurrence of galls which eventually cause the breaking of the branches. When galls are present in low numbers on native plants, their presence can usually be tolerated and may not even be noticed but when the abundance of galls reaches a stage where they are seen unsightly or reduce the health and productivity of the plant host. Gall-inducing insects also have the potential to add to the pressures affecting endangered species (Blanche, 2012). However, we believe that further studies are required to identify which are gall inducers, or parasitoids of gall-inhabiting insects associated with each type of the galls on *Haloxylon* and the effect of these galls on these plant species. Consequently, the number of insect and plant species associated with Eremian galls is likely to increase in the future as our research continues.

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