



**Centre for
Ecology & Hydrology**

NATURAL ENVIRONMENT RESEARCH COUNCIL

COST Action Short Term Scientific Mission – Alien plant species in Overseas Territories in Cyprus

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Overview

Jodey Peyton, Oli Pescott and Owen Mountford from the NERC Centre for Ecology and Hydrology (CEH), Wallingford, UK, together with Marilena Onete of the Institute of Biology Bucharest (Romanian Academy), and with the cooperation of the British Forces Joint Services Health Unit (JSHU), spent two weeks in March 2017 surveying alien species in Cyprus. This STSM built on the work conducted during an earlier mission (Peyton & Mountford, 2015; Pescott *et al.*, In review). The surveys were directed within four key areas: the Akrotiri Forest; phrygana within both the Akrotiri and Dhekelia Sovereign Base Areas (SBAs); and the Fassouri marsh. Other locations and habitats were also visited as part of an overall mission to familiarise ourselves with the habitats and species of Cyprus, and with the incidence of invasive alien species (IAS) outside the British SBAs. Finally, a workshop reviewing the application of the CICES ecosystem services classification to the topic of invasive alien species' impacts on ecosystem service provision brought together local stakeholders. The workshop considered this topic for a cross-taxon selection of IAS already present on Cyprus.

Mission phases

1. Re-survey quadrats in the Akrotiri Forest

The main purpose of the STSM was to resurvey quadrats surveyed in 2015 under an earlier mission (Peyton & Mountford, 2015). The 2015 STSM was conducted in October, earlier flowering species could therefore easily have been missed during our recording. The resurvey was intended to adjust for this potential bias, ensuring that our plot records were an accurate reflection of the plant communities found under stands of *Acacia saligna*, *Eucalyptus* spp. and *Casuarina cunninghamiana* within and around the Akrotiri Forest.

Using GPS-located points recorded during the 2015 mission, we relocated and resurveyed 108 of our 112 5 x 5 m plots. The new survey points were re-recorded using the in-built GPS of Panasonic Toughbook FZ-G1 tablet computers: note that GPS imprecision means that plots were only relocated to within the error associated with GPS positioning, this may be up to 20 m within dense forest stands. Our resurvey was not primarily intended to measure temporal change within plots, but to ensure that our characterisation of plant communities found within stands of alien species was accurate. Minor relocation error from GPS technology was not considered of importance for meeting this purpose, particularly as the communities found within the Akrotiri Forest appear to be relatively homogeneous across short distances.

Three plots were not re-recorded due to deep flooding in an area of the forest immediately to the east of the Akrotiri to Kolossi road. One plot was not re-surveyed due to the 2015 locational information being missing. Two quadrats were re-located due to access issues (due to flooding caused by a new outfall pipe draining land up-slope of the forest).

The methodology was modified slightly from our 2015 survey, as it was not considered necessary to repeat measures of canopy cover per stratum for the alien woody species (Peyton & Mountford, 2015). However, cover within the 0–5 m range was surveyed for all species within plots. The total (*i.e.* all strata) cover for the three woody alien species (*A. saligna*, *Eucalyptus* spp. and *Casuarina* spp.) was also recorded in order to give an indication of shading. Measure of bare ground and litter depth were also recorded, in addition to the area of standing water where present.

Eighty-nine taxa were recorded during the resurvey, compared to 60 taxa within the October 2015 mission. Many plots were not more species rich than when recorded in 2015, particularly under dense *Eucalyptus* and *Acacia* stands. More open forest stands, however, particularly towards the northern edge of the forest where human disturbance is more frequent and intense, were apparently richer when surveyed in spring. Examples of species that appeared to be relatively frequent throughout the forest, but which were not recorded in October 2015, include the spring bulbs *Bellavalia trifoliata* and *Allium neapolitanum*, demonstrating the necessity of multiple survey periods for accurate biodiversity assessment in strongly seasonal climates. Survey data from our plots will be added to our October 2015 dataset, and prepared for submission to the *Biodiversity Data Journal* (and GBIF) this year.

2. Survey of Fassouri Marsh

Eucalyptus and *A. saligna* in Cyprus were established primarily in order to drain lowland marshes in an attempt to control mosquito populations, as well as for erosion control and wood fuel (Pescott *et al.*, In review). Unfortunately, little detailed information exists concerning the habitats of the Akrotiri marshes east of the Kolossi road prior to afforestation (Pescott *et al.*, In review). West of Akrotiri

Forest, an area of marshland called the Fassouri Marsh does still exist, and is the current subject of restoration activities under a Darwin Initiative project (<http://www.akrotirimarsh.org/en/home>). Although differences in historic management and hydrology between the Akrotiri and Fassouri marshes may exist, we recorded a small number of plots in the Fassouri marshes to provide a comparison with the communities recorded in the afforested marshes of the Akrotiri Forest.

The northern periphery of the Fassouri marshes was sampled using 5 x 5 m plots (Fig. 1). Estimates of standing and floating litter were added to the recording methods previously established. Flooding of the main reedbeds restricted access to the main reedbeds, although observations suggested that these were composed almost entirely of the Common Reed *Phragmites australis*.

Twelve taxa were recorded in these marshland plots, with *Phragmites australis* and *Typha domingensis* being the commonest taxa in the area surveyed. The Cyprus Red Data Book species *Schoenoplectus lacustris* ssp. *tabernaemontani*, *Isolepis cernua* and *Phyla nodiflora* were also encountered (Tsintides *et al.*, 2007). With the exception of *P. australis*, these species were all either rare (*T. domingensis*, *P. nodiflora*) or absent (*I. cernua*, *S. lacustris*) from the afforested marsh east of the Kolossi road. The *Typha* and *Phyla* species were both present in very limited amounts along wet tracks in the south-western part of the Akrotiri forest.



Figure 1. The northern periphery of the Fassouri marshes, March 2017.

3. *Oxalis pes-caprae* in the Akrotiri Forest

One alien species not investigated during the STSM of Peyton & Mountford (2015) was *Oxalis pes-caprae*. This was due to its seasonal growth, with above-ground parts largely absent during the October survey period. During March 2017, *O. pes-caprae* was seen throughout the forest, and this presented an opportunity to characterise its associated plant communities and other aspects of its favoured habitat (Fig. 2). During the resurvey of our Akrotiri Forest plots, *O. pes-caprae* was often noted at low abundance in denser stands of forest, whilst being frequently locally dominant at the edges of tracks (particularly where soil had been moved to create banks) and in clearings. In order to characterise the growing conditions for this species better, the team surveyed five additional plots in stands where *O. pes-caprae* was abundant. So as best to describe the conditions associated with dense stands of *O. pes-caprae*, plot dimensions were modified to be either 12.5 x 2 m or 5 x 5 m, depending on the shape of the stand surveyed.

Across all forest plots containing *O. pes-caprae* at low abundance (here defined as < 10% cover), the average species richness was 6.7. In the five plots specially selected for high cover of *O. pes-caprae*, average species richness was 10.7; this is likely to reflect the fact that *Oxalis* was more abundant in more open forest, and where human disturbance was high, thus providing habitat for a wide variety of synanthropic species (e.g. *Lycium* species, *Hordeum vulgare*). However, no difference was found in the canopy cover of the main alien woody species of the forest between low abundance *Oxalis* plots and those especially selected for high *Oxalis* cover, although this may simply be a consequence of our simple methodology, where canopy cover was assessed in a vertical cuboid arising directly from the plot, rather than using a method intended to indicate overall levels of irradiance.

As before, data for our *Oxalis* plots will be made available through a *Biodiversity Data Journal* submission and GBIF.



Figure 2. *Oxalis pes-caprae* beneath an open *Eucalyptus* stand within the Akrotiri forest.

4. General surveys of alien species at the Akrotiri and Dhekelia SBAs

In 2015 the STSM team surveyed alien species solely in the Akrotiri SBA, with plots limited to the forest north of the salt lake (Peyton & Mountford, 2015). During the 2017 mission, the team also surveyed stands of invasive alien species in phrygana (*i.e.* garrigue) habitats, both at Akrotiri and at the Dhekelia SBA to the east of Larnaca (Figs 3 and 4). Alongside invaded stands, paired plots in stands of native woody species (primarily *Juniperus phoenicea* and *Pistacia lentiscus*) were surveyed in order to assess better whether the effects of alien woody species were different to those of natives. In addition to these plots surveyed, efforts were made to target note and digitise stands of alien species, where encountered, at both sites.

As per the resurvey of the Akrotiri forest, 5 x 5 m plots were established and recorded on Panasonic tablet computers. Areas of *A. saligna* and *Eucalyptus* spp., were targeted for survey in areas pre-identified by the team after general reconnaissance. In addition, limited areas of *A. saligna* were

mapped, with relative proportions of the component woody species estimated. Locations of *Eucalyptus* spp. were also target noted. In total 27 plots were recorded.



Figure 3. Phrygana/maquis matrix, with *Acacia saligna* and *Pistacia lentiscus*, within the Dhekelia military base.



Figure 4. Coastal phrygana within the Akrotiri military base.

Once again, data for these plots will be made available through a *Biodiversity Data Journal* submission and GBIF. In general, richness was considerably higher in the phrygana sites compared to the Akrotiri forest and salt marsh, with a median of 25 and a maximum of 48 species recorded in 5 x 5 m plots centred on stands of woody species. No richness difference was found between *Acacia*-invaded plots (median 24.5) and plots containing native woody species (median 25.5). Overall, phrygana and maquis at both Dhekelia and Akrotiri SBAs appeared much less invaded than the salt marsh surrounding the Akrotiri forest north of the salt lake. This may be due to a combination of water limitation in these locations, coupled with lower historic and current propagule pressure. Evidence for the former statement includes the fact that *Acacia* scrub at Dhekelia was frequently observed to be dead, or with numerous dead branches. This is likely to have been due to drier, hotter weather in recent years (A. Sellars, JSHU, pers. comm.). Indeed, standing dead *Eucalyptus* trees, reported to have died only recently, were also observed at Dhekelia. These trees were visually estimated to be over 1 m DBH, and so must have survived for many years before succumbing to recent environmental change. *Cupressus sempervirens* trees in our survey area at Dhekelia were also often standing dead.

General observations around the Akrotiri and Dhekelia military bases suggested that invasive alien plants were of limited occurrence in these environments, being largely restricted to the edges of compounds and nearby tracks. Within the Dhekelia SBA, a naturalised alien plant potentially new to Cyprus, and invasive elsewhere in the world, *Freesia* cf. *alba* × *leichtlinii*, was observed in two locations. The team intends to confirm and seek publication of this new species, and to perform more work on any impacts that it may have locally.

5. Akrotiri IAS and Ecosystems Services workshop

For the final task within our STSM, Dr Kelly Martinou (JSHU) organised a half-day workshop with Cypriot academics and local conservationists to establish whether, at a local level, invasive alien species, from all taxon groups, were able to be assessed critically using the Common International Classification of Ecosystem Services (CICES) methodology (<http://cices.eu>). CICES is a system for evaluating the impacts of invasive alien species upon ecosystem services established by the European Environment Agency (EEA).

At this event Kelly Martinou provided an overview of the proposed methods for the CICES assessment. Subsequently, the team, comprising Oliver Pescott, Jodey Peyton, Owen Mountford, Marilena Onete, Kelly Martinou, Pantelis Charilaou, Monica Demetriou and Elli Tzirkalli, worked through a set of target species (including *Acacia saligna*), by taxon group, for each of the ecosystem service categories listed by CICES. Participants subsequently reviewed an example for the benefit of the whole group, and suggested improvements to the methodology were gathered for feedback to the Cost Action Group. It was proposed that the taxon group participants would continue to apply the methodology to the remaining species in the context of Cyprus, and would then seek publication of the outputs in a suitable academic journal.

Conclusions

We have furthered our aim of characterising the plant communities associated with invasive and non-invasive woody alien plants associated with the Akrotiri forest, improving our first survey of October 2015 through the incorporation of a spring visit. Although these new data improved our understanding of the forest communities, they did not change our general conclusion regarding the impacts of *A. saligna* in salt marsh communities, nor on our previous characterisation of the stands beneath dense *Acacia*, *Eucalyptus* and *Casuarina* in the fresher parts of the marsh. The main difference observed in the forest for this spring visit was the greater abundance of herbs, particularly spring bulbs, in more open forest stands abutting agricultural land along the northern edge of the forest. Our other surveys in and around the forest, while necessarily limited in scope, provided interesting comparative data on both uninvaded, non-afforested marsh, and on stands with dense populations of *Oxalis pes-caprae*. In addition to data publishing, these data will inform future publications on the topic of the Akrotiri forest (as, for example, the work of Peyton & Mountford, 2015, did for Pescott *et al.*, In review).

Surveys of invasive aliens in phrygana and maquis habitats indicated limited establishment of *A. saligna* away from compounds and roads, at least for the areas of Akrotiri and Dhekelia observed. Where such bushes were established, there were no obvious impacts upon species richness that were not also created by native woody species. Given that drought may also be affecting *Acacia* in these habitats, our data may provide an interesting baseline from which to repeat such surveys in the future. Our general surveillance also revealed a potential new invader on Cyprus, a *Freesia* species, although further work will be required to establish its identity and any impacts associated with its naturalisation.

Finally, a workshop on the evaluation of alien species' impacts on ecosystem services in Cyprus proved a useful exercise for meeting new stakeholders and learning about CICES methodology. We hope that the outputs arising from this meeting will produce a clear quantification of impacts that can be shared with other stakeholders, and be perhaps ultimately used as a basis for managing invasive alien species

on Cyprus. We look forward to continuing our collaboration with our Cypriot partners through our new Darwin Initiative project on IAS in Cyprus.

References

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