Merlin Trust Bursary Report

Finding ferns in the deserts of California and Arizona

12th – 27th April 2013

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Contents

Royal Horticultural Society Bursary Report

Finding ferns in the deserts of California and Arizona

Introduction

I visited California and Arizona in April 2013 to discover more about the native species of xerophytic ferns in the wild and in cultivation.

California and Arizona are host to many species of these extraordinary plants. This is demonstrated by the wonderful collection of drought tolerant pteridophytes at the University of California Botanical Garden, Berkeley (UCBGB). I spent three days with the staff at UCBGB, learning about their dry climate fern collection and their cultivation techniques. I learned about their collection curation strategy also.

I explored many natural habitats of desert ferns across a wide area of California and in the mountains around Tucson, Arizona. This was to be my first botanizing expedition of this kind.

Aims

- To observe cultivation techniques of xerophytic ferns at the University of California Botanical Garden, Berkeley to increase my personal knowledge and increase available knowledge for RBG, Kew.
- Establish a relationship and improve collaboration with other botanical institutions from North America.
- Expand the knowledge of xerophytic ferns by observing them in their natural habitat which will inform cultivation techniques.
- Gain experience in field botany, recording and conservation work.
- Assemble a good photographic record.
- Gain knowledge and personal experience in an area which I have long found interesting and to make contacts which may be beneficial for future career opportunities.

Objectives

- Establish connections with other Botanic Gardens for future research possibilities.
- Discuss and record cultivation techniques to increase the species diversity of collections in Botanic Gardens.
- Research further into association planting to assist in improving collections, to benefit the garden aesthetically and to improve public knowledge of xerophytic ferns
- Observe a range of species of xerophytic ferns in their natural habitats and try to identify potentially successful species to grow at Botanical Gardens.

Itinerary

1	12/04/13 Friday	Flew to San Francisco, California from London Heathrow. Overnight in San Francisco, CA.
2	13/04/13 Saturday	Visited Strybing Arboretum and San Francisco Botanic Garden. Overnight in Petaluma
3	14/04/13 Sunday	Travelled to Berkeley. Visited University of California Botanical Garden, Berkeley. Overnight in Berkeley, CA.
4	15/04/13 Monday	Visited University of California Botanical Garden, Berkeley. Overnight in Berkeley, CA.
5	16/04/13 Tuesday	Visited University of California Botanical Garden, Berkeley. Overnight in Berkeley, CA.
6	17/04/13 Wednesday	University of California, Berkeley, Herbarium visit. University of California Botanical Garden, Berkeley and Tilden Botanic Garden. Overnight in Berkeley, CA
7	18/04/13 Thursday	Drove to Marin County and hiked Mount Tamalpais looking for ferns. Overnight in Mill Valley, CA.
8	19/04/13 Friday	Mount Tamalpais looking for ferns. Overnight in Oakland, CA.
9	20/04/13 Saturday	Drove down to Bakersfield, CA. Met David Schwartz, private grower of xerophytic ferns. Overnight in Bakersfield, CA.
10	21/04/13 Sunday	Drove around Kern County, Sierra Nevadas and Mojave desert with David Schwartz, looking for ferns. Overnight in Bakersfield.
11	22/04/13 Monday	Drove to Palm Springs with David Schwartz. Drove to Arizona. Overnight in Gila Bend, AZ.
12	23/04/13 Tuesday	Drove to Tucson with David Schwartz. Explored Tucson Mountains. Overnight in Tucson., AZ.
13	24/04/13 Wednesday	Drove to Santa Catalina Mountains and explored with David Schwartz. Overnight in Los Angeles.
14	25/04/13 Thursday	Visited Huntington Botanic Garden. LA. Visit Barbara Hoshizaki's garden in LA. Overnight in LA.
15	26/04/13 Friday	Visited La Rancha Santa Ana Botanic Garden and LA Arboretum. Overnight in LA.
16	27/04/13 Saturday	Flew from LAX to Heathrow. Arrived in London Sunday 28/04/13

Work details

Spending time with the staff at University of California Botanical Garden, Berkeley was fantastic as they provided details of how they cultivate their xerophytic fern planter very successfully (Figure 1).

Figure 1. Xerophytic fern planter. University of California Botanic Garden, Berkeley. Authors photo.

These ferns are also included in other areas of the garden; the New World Desert, South Africa, California and Mexico, to great effect. I found many of the staff were interested in these plants. UCBGB Associate Director of Collections and Horticulture Chris Carmichael gave me a tour of the garden with special emphasis on fern cultivation and the collection. Curator Holly Forbes and I discussed the gardens collection policy and the future of the fern collection which was inspiring. The fern collection is mainly of documented wild origin (84%) and they aim to attain 75% of the collection as a whole of documented natural source material. They have 500 fern accessions, 10% of which are xerophytic. Anthony Garza, the Supervisor of Horticulture and Grounds maintains the planter. He advised as to the growing medium they use, feeding regime and watering requirements. He has incorporated rocks to give the plants a cool root run, top dresses the planter twice a year with fish and kelp drench. There is a sub-surface and top spray irrigation system in

place for summer watering. In the winter the bed is left almost dry. These dry-growing ferns are tolerant of summer watering and are cold hardy at the site. Anthony and his colleagues explained their fern propagation techniques as they are initiating a program to grow and sell dry habitat ferns within their plant sales department. I met individually with the horticulturists who grow these ferns in their areas within the wider garden setting.

Locations and plants

University of California Botanic Garden Berkeley is a great garden with high quality horticulture and plant curation. The garden is set on a hillside just north of Berkeley. The range of xerophytic fern species is fantastic. The New World Desert display demonstrates how beautifully the combination of succulents and ferns works in a garden setting.

After my time in Berkeley I drove North-west to Mount Tamalpais, north of San Francisco in Marin County. Here I found *Cheilanthes intertexta* and *Pellaea mucronata subsp. mucronata* on a large granite boulder near the Mountain Theatre at 2020 feet of elevation on the south side of the mountain. They were slightly shaded by coast live oak (*Quercus argifolia*). On the Matt Davis trail I saw the natural hybrid *Aspidotis carlotta-halliae* growing in full sun. At the East Peak along the Verna Dunshee path (2300 ft elevation) *Cheilanthes gracillima* was growing in rock crevices in abundance. The fronds are narrow and a vivid green. It has a lovely pendant habit and fronds are tomentose on their underside.

Figure 2: *Cheilanthes gracillima* Mount Tamalpais, CA. Authors photo.

Kern County is large but we saw most of its drought tolerant species in a day, a few hours away from David Schwartz's hometown of Bakersfield. Our first site was east along Highway 155, a beautiful drive in spring with its rolling green fields and lush California horse chestnuts. We climbed up and over large boulders of granite to find a fern with a ghostly beauty, *Pentagramma pallida* (pale golden back fern). The tri-pinnate fronds are completely covered with a dusting of white farina. The stipes are near black, very lovely indeed. Endemic to the foothills of the Sierra Nevada we found it at an elevation of 3000 feet. They were growing at the base of granite boulders in abundance. Growing with them were *Pentagramma triangularis* and *Pellaea mucronata.*

Figure 3: *Pentagramma pallidus* Kern County, CA. Authors photo.

Then we make our way east into the Sierra Nevada range, through Seqouia National Forest and towards Lake Isabella. We found *Argyrochosma jonesii* on a limestone rock face. This charming little fern was growing prolifically in the seams of the rock. We drove further up the valley and found an area above a river where *Cheilanthes gracillima*, *Cheilanthes intertexta* and *Cheilanthes covellei* all inhabited the same south facing spot. The genus *Cheilanthes* (lip fern) contains some of the prettiest xerics around. And they are some of the easiest to cultivate. Their fronds are made up of many interconnecting beads which prevent total desiccation during their growing season after the moisture from the spring rains has gone. We also found *Pellaea andromedifolia*, which we would see again at various sites. Later that day we drove out to the Mojave Desert to find *Cheilanthes viscida* (sticky lace fern) in Last Chance Canyon in Red Rock Canyon State Park. It had newly emerging fronds which was surprising considering how dry it has been there this year (average winter rainfall 200mm).

The next day we found *Cheilanthes newberryi* and *Cheilanthes clevelandii* in granitic areas on the north west slopes of the San Jacinto Mountain near Hemet in San Bernardino National Forest. They were both in full growth and looked wonderful. In the afternoon we travelled to Indian Canyon in Palm

Springs. We followed the Andreas trail, flanked by a stream and a swathe of petticoat palms (*Washingtonia fillfera*). Unfortunately the ferns did not look as green as the palms. *Notholaena californica var. californica* and Notholaena *californica var.leucophila* were present but curled up and dormant in full sun.

Arizona has many species of desert ferns and the mountains surrounding Tuscon are particularly rich. In the Tucson Mountain Park, west of Tucson, surrounded by an imposing army of saguaro cactuses (*Carnegeia gigantea*), we hiked a short way up Golden Gate mountain to find *Notholaena standleyi*. A lovely fern with red stipes, pinnae rich green on top and glowing yellow farina covered beneath. The best of them were inaccessible without climbing shoes, but I tried anyway with no success. *Cheilanthes pringlei* inhabited the soil pockets, colonizing them with their long, creeping rhizomes. It was here that I first saw one of my favourite ferns in the wild. *Cheilanthes lindheimeri*. It is a common fern but very attractive. The broadly triangular fronds are very upright. The adaxial side is covered in white hairs, on the abaxial side they are tan. This dainty plant grows along the fringes of boulders. *Astrolepis cochisensis* was present further down on a limestone outcrop.

Figure 4: *Astrolepis cochisensis* Tucson Mountain Park. Authors photo.

In the Molino Basin in the Santa Catalina Mountains, north east of Tucson I was delighted to see so many ferns. We found *Pellaea truncata, Pellaea wrightiana, Cheilanthes lindheimeri, Cheilanthes tomentosa, Cheilanthes bonariensis, Cheilanthes yavapensis, Cheilanthes wootonii, Cheilanthes eatonii, Cheilanthes fendleri, Astrolepis integerrima and Bommeria hispida. Cheilanthes fendleri* is a beautiful species. It enjoys the shade of shrubs. The fronds are tall, up to 30cm high and the pinnae are more sparse than other *Cheilanthes* species.

In the Los Angeles area I visited L.A Arboretum, La Rancha Santa Ana Botanic Garden and Huntington Botanic Garden to see their fern collections and the general displays. The quality of the horticulture was very high in the gardens, they made a strong impression. I was particularly interested in the California native planting displays.

Overall summary and conclusion

I have made a strong connection between myself and the staff at UCBGB which will hopefully strengthen the links between them and Royal Botanic Gardens, Kew. Seeing the propagation program enthusiastically in motion was very inspiring. These ferns are not easy to grow in cultivation, some are easier than others, species I can now identify as the ones to start propagating. This makes wide domestic distribution a bit of a challenge, even in California, but at UCBGB they have made these ferns a point of special interest. I will stay in touch with the team at UCBGB to share advice and learn from their fern related research projects.

I made contact with Alan Smith from the Herbarium at University of California, Berkeley with the help of John Game, a retired geneticist with a passion for ferns. With John Game I visited the Herbarium and studied specimens of the ferns I was hoping to see in the wild. Alan Smith provided location data for some of the ferns in the Marin County area.

During the latter half of my trip I spent time with David Schwartz, a private xerophytic fern grower based in Bakersfield, California. He grows them, knows their habitats and can spot them at quite a distance away. His garden hosts some lovely specimens. In the field it was a little late in the season for these ferns, but we saw many green plants, some starting to curl and go dormant which was good to see as that information will be useful for identification at all times of year. It was interesting to see that although the winter rainfall had been lower than normal, there were still hydrated plants to see in most areas of habitation (except Palm Springs).

Observing desert ferns in the wild has given me a better understanding of how these species grow; the soil, rock type, aspect, light levels, water requirements, habit. Some species creep their rhizomes along the fringes of boulders; others grow out in the open with little shade and cool root run. This information naturally informs their cultivation, although cannot be wholeheartedly implemented in practice as conditions within a garden are different. I hope to cultivate these plants at RBG, Kew and domestically so this information is very useful. I have been attempting to increase the accessibility of the existing xerophytic ferns we have at Royal Botanic Gardens, Kew and where appropriate informing other horticulturists about how best to maintain them based on what I have observed in California.

My skills of identification have been improved greatly. When botanizing with David Schwartz we used many morphological features to identify species; pinnules, pinnae size, rhizome habit, hairs, scales, colour. The use of geological references to find and identify species was a very useful way of finding particular plants. For example looking for limestone outcrops to locate calcicole ferns. David Schwartz and I discussed the different species we found and he informed me of their cultivation specifications. I recorded this information as we travelled.

When I visited Huntington Botanic Gardens in Los Angeles I hoped to find xerophytic ferns within their spectacular Desert Garden display. I had heard

that Barbara Joe Hoshizaki had donated arid ferns to them but sadly they are no longer in existence at the gardens. I was introduced to the Director Jim Folsom. He was interested in my trip to discover dry climate ferns.

I had the pleasure of spending time with Janet Keyes, a member of the Los Angeles Fern Society when I visited Los Angeles. Janet introduced me to Takashi Hoshizaki, widower of the late Barbara Joe Hoshizaki, co-author of the incredible book 'The Fern Growers Manual'. Takashi showed me around Barbara's fern collection. We found three drought tolerant species in the garden doing well and I found the location data using Barbara's collection catalogue.

At La Rancha Santa Ana, a small botanic garden in West LA, I met the nursery manager Scott La Fleur. The garden exclusively consists of Californian natives but they do not possess many xerophytic ferns in their collection and none in their plant sales. I found the ferns within the garden and let the staff know that I was interested in them. They could expand their plant sales collection to arid ferns as they would probably be popular with customers. I visited Los Angeles Arboretum to see the high quality horticulture and beautiful tree ferns.

One of the pleasures of the trip was taking photographs of the landscape and the plants. I bought a new camera and lens to ensure decent images as a photographic record of the plants I found. These have been useful to refer to and to show others. I hope to present a short presentation to colleagues at RBG, Kew in the near future using these images.

Learning more about these extraordinary plants has deepened my passion for them, which will inform my motivation and career. To be a specialist in these types of plants is my ambition. I am pleased to have found a group of plants that will sustain my interest for a long duration. This trip has solidified my interest in ferns and brought me in contact with others with the same pteridological fascination.

I hope to grow these ferns at home and at Royal Botanic Gardens, Kew where I work in the Temperate House as a display horticulturist. It would be wonderful to introduce them into the arid plant displays as beautiful, surprising additions alongside cacti and succulents. To display and explain the extraordinary adaptations these plants have developed would be interesting for visitors and horticulturists at RBG, Kew and elsewhere.

Future plans

Seeing these ferns in the wild has been really exciting and I would like to see more desert ferns the U.S has to offer. The ferns of the Trans Pecos areas of Texas will be next as there are many species of xerophytic ferns in those areas, especially the Chihuahuan Desert, a beautiful mountainous region.

Budget breakdown

Car rental- £149 (+Maps- £50) = £199
Petrol- £225
Train-£5
Health insurance- £28.99
Entrance to Botanic Gardens- £33
Hotels- £945
Flights-London to San Francisco/Los Angeles to London £830
Taxi- £15
ESTA fee-£44.99
Food- £375

Total- £2700.98

Money received- Merlin Trust £1000
RHS Bursary £850
British Pteridological Society £300
Kenneth Black Bursary £500

Total received - £2650

The bursaries I received made this trip achievable and comfortable. I made efforts to keep costs down but when this was not possible I could afford to continue my plans. By completing this trip I have made my first step into field botany and internationally networking.

Acknowledgements

Funds kindly donated by the Merlin Trust enabled me to visit these wonderful locations and observe the extraordinary ferns they have there. I am very grateful for this generous contribution. Many thanks to the Trustees and Secretary Joanne Everson.
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Horticulturist, Ben Anderson

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David Schwartz
Janet Keyes
Takashi Hoshizaki

Missouri Botanic Garden:
Director of Flora of Missouri Project, George Yatskievych

RBG, Kew:
Temperate House Manager, David Cooke
Tropical Nursery Manager, Nigel Rothwell
Kew Diploma Student, Andrew Gdaniec

List of Figures

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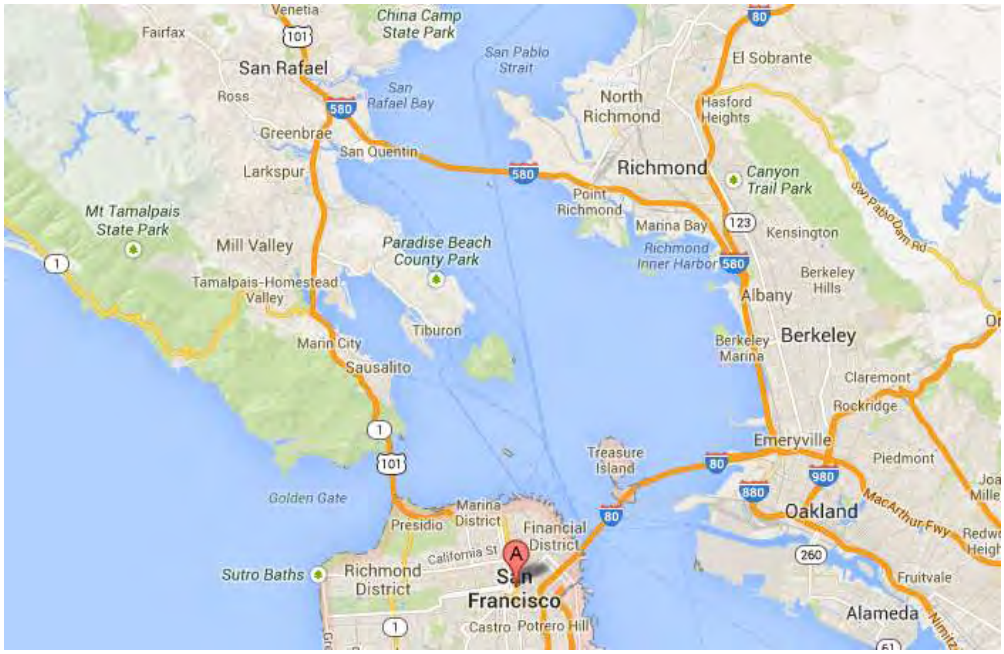
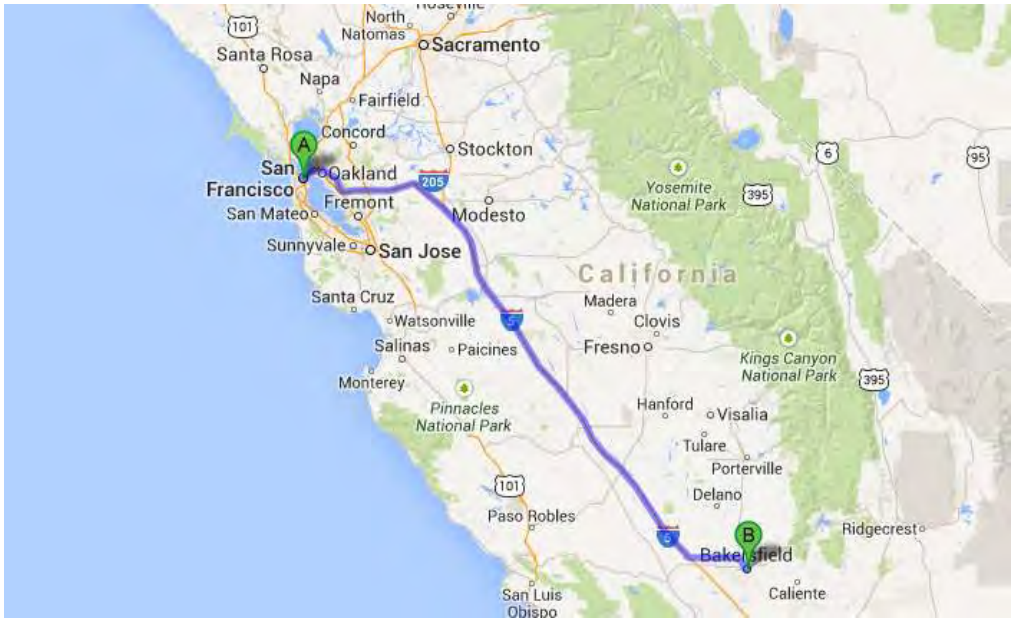
3. *Cheilanthes gracillima*. Mount Tamalpais, CA. Authors photo.
4. *Astrolepis cochisensis.* Tucson Mountain Park, AZ. Authors photo.

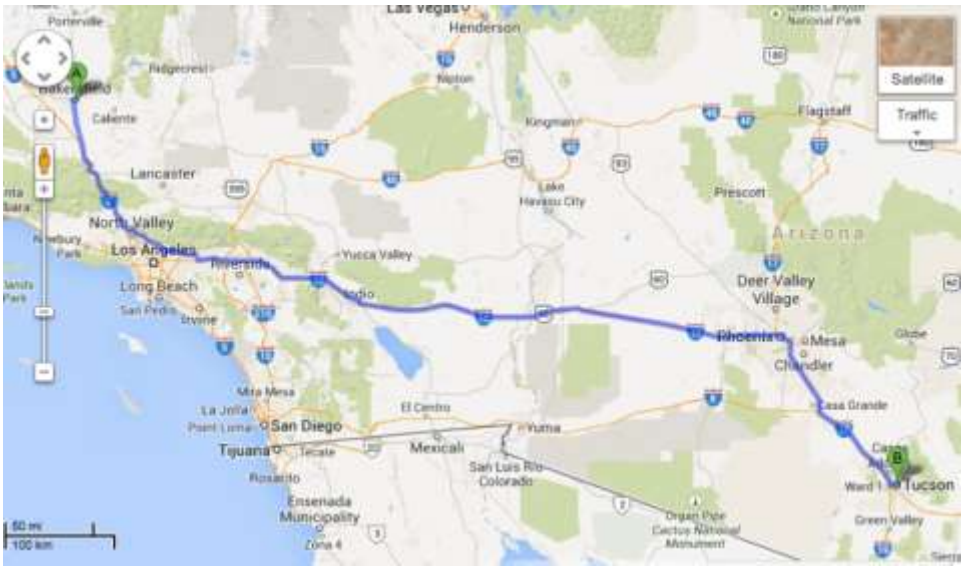
Appendices



Ap.1: Map of San Francisco bay area, including Berkeley and Mount Tamalpais, CA. Google maps July 2013.



Ap. 2: Map to indicate journey from Marin County to Kern County, CA. Google maps July 2013.



Ap.3: Map to indicate journey from Bakersfield to Tucson. Google maps July 2013.