

Collection of Arabian wetland, aquatic and semi-aquatic plants



Wadi Al Khod

Photo: Lorna MacKinnon

Background

Despite its botanical richness, the Arabian Peninsula is largely under-collected for many groups of plants. This is due to a combination of a very inhospitable climate and political instability in many areas for much of the twentieth century. Unfortunately, Yemen, the richest country from a floristic point of view, is now very unstable and field work cannot be undertaken there at present. Saudi Arabia is unsuitable for women to undertake field work of any kind. The Gulf States of Bahrain, Kuwait, Qatar and the United Arab Emirates are floristically very depauperate and only in the last ten years has it become possible to undertake fieldwork in all areas of Oman. As the second richest country with over 1200 species, this has become the focus for much of our botanical research of late. Most of our field work to date has been undertaken in conjunction with staff from the Oman Botanic Garden (OBG).

The *Flora of the Arabian Peninsula and Socotra* is being written and edited at RBGE having been started in the 1980s as a joint project between RBGE and RBG Kew. Two volumes have been published to date and work on the remaining four is on-going. The next volume to be published is likely to be Volume 5 part two, which is currently approximately 50% complete. This will contain all the monocot families except the grasses which were published as a stand-alone volume in 2007. This volume will include many aquatic and wetland species which are often overlooked by botanists making general plant collections and are consequently under-collected for this region, making herbarium-based research difficult.

Collecting locations

Due to last minute scheduling conflicts for fieldwork in Oman it was decided to include a few days collecting in the United Arab Emirates with former RBGE alumna Lisa Banfield, currently based in Abu Dhabi Emirate. Lisa was able to provide me with much needed local knowledge, as well as transport, accommodation and her extensive field expertise.

Wadi Wurayah - In the Emirate of Fujairah, Wurayah is a wadi with permanent running water and pools, and is a popular site for swimming and picnics but anthropogenic disturbance to the site seems to be relatively low.

Zakher Lake - Lying on the outskirts of Al Ain these pools are an interesting example of natural wetland colonisation in a desert environment. The pools appeared within the last 10 years and seem to originate from a number of anthropogenic sources, however, the colonisation of plants and fish in the pools are due to transportation by migratory wetland birds which were attracted to the water.

Liwa Oasis - It was hoped that this ancient oasis in the desert may have some interesting examples of weed adaptation similar to that seen in the agricultural terraces of Oman. Unfortunately the level of development of the area made it difficult to determine if there were still any areas of traditional irrigation left, and no collections were made in the vicinity of the oasis itself.

Several collections of *Cyperus* were made in dry sand dune areas throughout fieldwork as the opportunity arose.

The first week of collecting in Oman coincided with a fieldtrip being undertaken by Dr. Sabina Knees in the south of the country (Dhofar) for an unrelated project and it was decided to combine our efforts. Dhofar has a higher concentration of springs than the rest of the country and several days were spent visiting areas that we were previously aware of and also incorporating forays to known wetland areas that had not, to our knowledge, previously been sampled. Wetland areas are popular as recreational sites, utilities and are attractive to grazing animals and as a result these habitats are under extreme pressure from disturbance in addition to extreme seasonal climatic stresses.

Ash Shuwaymiyah - An area in the north of Dhofar at the edge of the central desert plateau with many cliffside seepages. The area is a popular site for picnics and as a result has a high incidence of littering but otherwise human disturbance seems to be relatively contained.

Wadi Hinna - An area of mountain woodland with permanent flowing water, this is the only population of *Adansonia digitata* in the country. Aside from having a large concrete cistern, the wadi is relatively undisturbed due to recreational activities, however, recent road construction is very close by and, although is complete for the moment, the long-term effects are unclear. It is even possible that the area will be protected as the access to the wadi is now quite obscure, if it remains undeveloped visitor numbers could remain low.

Wadi Darbat - An area of *Anogeissus* forest with semi-permanent water pools which expand greatly in the wet season. The wadi is surrounded by grassy areas which are heavily grazed by domestic and semi-feral livestock and the area around the pools is extremely disturbed by human recreational activities, despite unseasonal late rains earlier this year, at the time of my fieldwork the area was extremely dry and degraded with large areas of bare soil and a depauperate ground flora largely consisting of pernicious weeds such as *Solanum incanum*.

Ayn Razat - This spring has had gardens associated with it for some time and the accompanying human impacts, but where one edge of the stream was contained by a concrete wall the other side

remained natural substrate and was relatively undisturbed habitat. Worryingly while there I noticed piles of vegetation as if the area were being “weeded” and on further inspection upstream it became clear that the whole area is being systematically stripped of its native vegetation, to what end is unclear.

The latter half of my collecting trip was carried out without field assistance and consequently I was not able to range too far afield, although due to time constraints it is unlikely that remote sites would have been investigated. The inhospitable weather conditions made extended collecting difficult and so I decided to concentrate on areas where collections had been made in the past or where there were known wetland habitats. This approach was not unsuccessful but it would be valuable to explore, for example, those areas where water can be seen from aerial photographs but where there has apparently been little botanical surveying.

Wadi Al Khod - Situated close to Oman Botanic Garden this wadi has a broad gravel bed and usually has flowing water all year, though its volume increases dramatically after rain.

Ayn A’Thawwarah - These hot springs near Nakhal fort are an extremely popular local resource for bathing, picnicking and washing clothes and cars and is therefore quite a highly disturbed site. Nevertheless it proved to be one of the richest wetland sites visited, as well as providing potentially a new record for Oman.

Wadi Tiwi - A deep gorge opening on the coast this wadi has permanent flowing water but, despite being the site of a village, has not been subject to the over-development that has afflicted so many wetland sites in Oman.

Collections

Please see Appendix 1 for a full list of herbarium specimens collected.

The specimen of *Kyllinga brevifolia* I believe to be a new record for Oman. I have not confirmed this with herbaria but I have not found any published record of this genus in Oman.

Stuckenia filiformis has previously been recorded from Socotra but I believe this collection from Al Ain is a new record for the Arabian Peninsula mainland.

Outcomes

The original aims from the project proposal were as follows:

- To make targeted field collections, in collaboration with OBG staff, of wetland dependent and aquatic species from Oman in order to improve the herbarium collections held at RBGE and to provide material for floristic accounts.
- To make field targeted collections, in collaboration with OBG staff, of wetland dependent and aquatic species from Oman according to the requirements of OBG herbarium.
- To record distribution and habitat data for all collections for production of distribution maps to be used in *The Flora of the Arabian Peninsula and Socotra* accounts.
- To study the existing herbarium specimens held at OBG to collect information to expand the current information for *The Flora of the Arabian Peninsula and Socotra*.
- To collect leaf samples in silica as DNA material.

- A family account of Juncaceae (9 species) and draft accounts of the following genera from Cyperaceae: *Bulbostylis*, *Kyllinga*, *Schoenoxiphium* and *Scleria* (approximately 12 species) to be included in the *Flora of the Arabian Peninsula and Socotra*.
- Existing *Flora of the Arabian Peninsula and Socotra* accounts of aquatic taxa to be reviewed and revised with reference to information collected during course of fieldwork.
- Duplicated herbarium material to be deposited in RBGE and OBG herbaria.
- All collected material to be pressed, dried and mounted for inclusion in RBGE herbarium.
- Leaf samples in silica to be deposited at RBGE as DNA material to be available for further studies.

Completed outcomes:

- Unfortunately due to last minute scheduling conflicts field collaboration with OBG staff was not possible but fieldwork was planned with information and assistance from OBG staff and the specimens collected have broadened the distribution records and significantly expanded the RBGE and OBG collections for several species. The lack of assistance in the field had little impact on the outcome of the fieldwork as time was the most restricting criterion; sites were therefore chosen based on prior knowledge of the likelihood of successful collection of target species. Although I would have felt more confident that each site was thoroughly investigated if there had been more people looking, due to the specialised and ephemeral nature of the target taxa it is unlikely that the range of taxa collected would have been significantly different.
- Duplicates for most collections were deposited with the Oman Botanic Garden herbarium along with the collection information and final identifications.
- Herbarium specimens from OBG and the Oman National Herbarium were studied.
- DNA was collected for all specimens, as well as good collection data, and is currently being held by the Centre for Middle Eastern Plants. Photographs were taken for most collections.
- Floristic accounts of the Juncaceae and *Bulbostylis*, *Kyllinga*, *Schoenoxiphium* and *Scleria* have been completed (see Appendix 2). I have not made any taxonomic changes but I have chosen to recognise some ambiguous *Juncus* specimens as *Juncus maritimus* which has previously not been recognised *sensu strictu* from the Arabian Peninsula. The most common species from the region, *J. rigidus*, has in the past been described as a variety of *J. maritimus* but has been recognised as a distinct species in all the major flora works of the region in recent decades and I felt that there were significant and consistent enough morphological differences to justify the recognition of *J. maritimus* in Arabia. I would be very interested in a genetic comparison of these two species and with *J. socotranus* which can also be quite morphologically variable to determine how well the morphology supports the current taxonomy.
- Due to delays in fieldwork commencement and troublesome identifications on my return to RBGE there was not time to make significant progress in the review and editing of the existing aquatic taxa accounts.
- All collections made during this trip are fully mounted and databased in both BG-base and Padme and are awaiting image capture before being incorporated into the Area 2A Arabia collections.

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And finally my heartfelt gratitude to my supervisor Dr Sabina Knees, without whom this project would not have happened and whose patience and kindness know no bounds, she managed to make a 12 hour drive actually enjoyable and ice cream is absolutely a legitimate part of field provisions.

Appendix 1: Collection notes

Coll no.	species	family	description	coll dt.	collected by	Country	locality	habitat	GPS	alt
342	<i>Fimbristylis ferruginea</i>	Cyperaceae	Graminaceous herb to ~60cm; dark blue/grey colour to foliage; culm slightly flattened on both sides; leaves to ~15cm.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Fujairah, Wadi Wurayah, ~20m below permanent pools.	Wadi with permanent water source. Growing beside fresh running water.	N25 23 47.3 E56 16 09.3	46m
343	<i>Fimbristylis cymosa</i>	Cyperaceae	Low growing graminaceous herb to ~20cm; inflorescence and leaves of similar height.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Fujairah, Wadi Wurayah, ~20m below permanent pools.	Wadi with permanent water source. Growing beside fresh running water.	N25 23 47.3 E56 16 09.3	46m
344	<i>Fimbristylis ferruginea</i>	Cyperaceae	Graminaceous herb to ~20cm; leaves to ~10cm; culm terete, smooth; foliage with reddish tint.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Fujairah, Wadi Wurayah, ~10m below permanent pools.	Wadi with permanent water source. Growing at base of rocks below pools (presumably seasonal waterfall), dry ground close to water.	N25 23 47.3 E56 16 09.3	46m
345	<i>Fimbristylis ferruginea</i>	Cyperaceae	Graminaceous herb to ~50cm; leaves to ~30cm; foliage green; culms terete, smooth.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Fujairah, Wadi Wurayah, ~10m below permanent pools.	Wadi with permanent water source. Growing at base of rocks below pools (presumably seasonal waterfall), in mud.	N25 23 47.3 E56 16 09.3	46m
346	<i>Cladium mariscus</i>	Cyperaceae	Graminaceous herb to ~2m; leaves to @1.5m, blueish.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Fujairah, Wadi Wurayah, ~5m below permanent pools.	Wadi with permanent water source. Growing between rocks below pools (presumably seasonal waterfall).	N25 23 47.3 E56 16 09.3	46m
347	<i>Cyperus aucheri</i>	Cyperaceae	Graminaceous herb to ~40cm; leaves and inflorescence about equal in length; foliage pale green; culm terete.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Sharjah, Dubai road (E102), at side of road.	Inland red sand dunes beside road.	N25 10 04.9 E55 47 03.1	139m
348	<i>Cyperus aucheri</i>	Cyperaceae	Graminaceous herb to ~40cm; leaves to ~30cm.	06 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Sharjah, Dubai road (E102), at side of road.	Inland red sand dunes beside road.	N25 10 04.9 E55 47 03.1	139m
349	<i>Cyperus aucheri</i>	Cyperaceae	Graminaceous herb to ~1m; leaves and inflorescence about equal length; foliage blue-ish.	07 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Abu Dhabi, Western region, south of Tarif on road to Liwa Oasis (E45)	Inland area of coastal white sand dunes close to edge of Sabkha area.	N23 54 58.2 E53 52 00.7	33m
350	<i>Tribulus arabica</i>	Zygophyllaceae	Perennial, woody-based herb to ~1m; leaves blue-green; flowers yellow. Variably ascending or erect. Flowers upright; fruit pendent, very hairy.	07 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Abu Dhabi, Western region, south of Tarif on road to Liwa Oasis (E45), after forestry project.	Inland red sand dunes, road verges.	N23 43 59.3 E53 42 54.4	64m
351	<i>Cyperus aucheri</i>	Cyperaceae	Graminaceous herb to ~20cm; foliage blue-green.	07 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Abu Dhabi, Western region, south of Tarif on road to Liwa Oasis (E45), south of Madinat Zayed.	Inland red sand dunes, roadside verge, disturbed, dry ground.	N23 22 33.9 E53 45 59.5	159m
352	<i>Stuckenia filiformis</i>	Potamogetonaceae	Filiform freshwater aquatic plant, forming mats at surface of water around pool margins, rooting in sediment; ~30cm deep, ~50cm long.	08 jun 13	Lorna MacKinnon and Lisa Banfield	United Arab Emirates	Abu Dhabi, Zakher Lake, outskirts of Al Ain.	Pools formed by dumping of water from water treatment plant, natural colonisation.	N24 05 17.8 E55 37 35.8	222m
353	<i>Najas marina</i>	Hydrocharitaceae	Aquatic freshwater herb; angular green stems with dark red-brown spines. Fully	08 jun	Lorna MacKinnon	United Arab	Abu Dhabi, Zakher Lake, outskirts of Al	Pools formed by dumping of water from water treatment plant, natural colonisation.	N24 05 17.8 E55 37 35.8	222m

			submerged, probably rooted in deeper water and floating to surface after disturbance	13	and Lisa Banfield	Emirates	Ain.			
354	<i>Cyperus aucheri</i>	Cyperaceae	Graminoid herb to 40cm, foliage blue-green	10-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Al Wusta, approx. 30km South of Muhut junction on Duqm road.	Wide desert wadi, at time of collection very green after unusual May rains.	N20 29 26.9 E57 54 10.2	53m
355	<i>Cyperus conglomeratus</i>	Cyperaceae	Graminoid herb to 20cm, leaves curling	10-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Al Wusta, approx. 50km South of Muhut junction on Duqm road, low hills to either side of road.	East facing rocky wadi, sedimentary rocks.	N20 17 04.4 E57 46 31.5	73m
356	<i>Juncus rigidus</i>	Juncaceae	Graminoid herb to 1.5m, population fruiting and flowering, leaves and culms smoothly cylindrical, fleshy, without joints, inflorescence without subtending bracts, overtopped by stem/single pointed bracts.	11-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Ash Shuwaymiyah, Wadi Shuwaymiyah, below waterfall	Sandstone cliff seepage/spring, water running at time of collection, large population of Phoenix dactylifera	N17 56 02.9 E55 31 37.2	83m
357	<i>Schoenus nigricans</i>	Cyperaceae	Graminoid herb to 1m, leaves and culm hollow and smoothly cylindrical, inflorescence compact.	11-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Ash Shuwaymiyah, Wadi Shuwaymiyah, at edge of shallow watercourse above waterfall.	Sandstone cliff seepage/spring, water running at time of collection, large population of Phoenix dactylifera	N17 56 02.9 E55 31 37.2	83m
358	<i>Chara</i> sp.	Characeae, Chlorophyta	Branched alga to 25cm, stems brittle.	12-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Wadi Hinna, permanent pools above concrete cistern, and below in shallow wash.	Lime rich water, verdant and shaded habitat with <i>Adansonia digitata</i> population and <i>Tamarindus indica</i> .	N17 02 21.36 E54 36 47.7	115m
359	<i>Cyperus ? rotundus</i>	Cyperaceae	Graminoid herb to 20cm, culm and stem trigonous.	12-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Wadi Darbat, growing at edge of permanent pools.	Wadi with permanent pools, rich soil and mud substrate.	N17 06 19.9 E54 27 12.0	93m
360	<i>Commelina</i> sp.	Commelinaceae	Rhizomatous herb to 30cm, population sterile, abundant in and at edge of water.	12-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Ayn Tobrook, growing in and at edges of flowing water.	Spring with briskly flowing water, in <i>Ficus</i> woodland, picnic site further upstream but relatively little human disturbance.	N17 05 56.3 E54 19 35.0	127m
361	<i>Potamogeton nodosus</i>	Potamogetonaceae	Fully submerged aquatic herb, foliage reddish-green, sterile. Submerged leaves only.	12-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Ayn Razat, growing in pool close to weir.	Natural spring surrounded by garden and fruit trees, one edge bounded by concrete but far edge natural rock and soil substrate.	N17 07 44.16 E54 14 18.6	110m
362	<i>Eleocharis geniculata</i>	Cyperaceae	Graminoid herb to 20cm, leaves reduced, culms delicate with single round terminal inflorescence.	12-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Ayn Razat, growing in mud at base of rocks and in cracks in rocks beside water.	Natural spring surrounded by garden and fruit trees, one edge bounded by concrete but far edge natural rock and soil substrate.	N17 07 44.16 E54 14 18.6	110m
363	<i>Schoenoplectus litoralis</i>	Cyperaceae	Graminoid herb to 1.6m, foliage dark green, rhizomatous.	13-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Rakhyut, Khor Rakhyut	Coastal lagoon of upwelling seawater, water brackish.	N16 44 59.3 E53 25 35.5	27m
364	<i>Cyperus</i>	Cyperaceae	Graminoid herb to 20cm, leaves with	13-	Lorna	Oman	Dhofar, Mughsayl,	Sand dunes between Khor and sea, grasses and	N16 52 48.9	16m

	conglomeratus		inrolled edges, culm solid, trigonous, not articulated, dark blue-green.	jun-13	MacKinnon and Sabina Knees		Khor Mughsayl, dunes beside sea.	Ipomoea pes-caprae.	E53 46 39.2	
365	Eleocharis geniculata	Cyperaceae	Graminoid herb to 30cm, leaves reduced, culm with single, round, terminal inflorescence. Large population, flowering and fruiting.	13-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Near Raysut, Ayn (?) Growing around pool at bottom of quarry.	Spring or seepage at bottom of quarry, water not stagnant.	N16 59 43.7 E53 49 03.6	164m
366 (not E)	Typha domingensis	Typhaceae	Graminoid herb to 1.5m, population sterile.	13-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Near Raysut, Ayn (?) Growing around pool at bottom of quarry.	Spring or seepage at bottom of quarry, water not stagnant.	N16 59 43.7 E53 49 03.6	164m
367	Fimbristylis cymosa	Cyperaceae	Graminoid herb to 40cm, population fruiting.	13-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Near Raysut, Ayn (?) Growing around pool at bottom of quarry.	Spring or seepage at bottom of quarry, water not stagnant.	N16 59 43.7 E53 49 03.6	164m
368	Cyperus ? rotundus	Cyperaceae	Graminoid herb to 30cm.	13-jun-13	Lorna MacKinnon and Sabina Knees	Oman	Dhofar, Salalah, in lawn of holiday apartments, beside sprinkler nozzle.	Lawn of holiday apartments, thin layer of soil above original beach sand.	N16 59 10.9 E54 01 31.6	156m
369	Typha domingensis	Typhaceae	Graminoid herb to 2m, flattened and growing parallel to the ground due to recent flooding. Population fruiting.	18-jun-13	Lorna MacKinnon	Oman	Muscat, Al Khod, Wadi Al Khod, close to road, growing at edge of wadi where trees start to occur.	Large gravel-based wadi, water present.	N23 34 26.3 E 58 07 02.9	6m
370	Schoenoplectus litoralis	Cyperaceae	Graminoid herb to 1.5m, leaves reduced, sheathing base of culm, culms fleshy, slightly trigonous, glabrous, green.	18-jun-13	Lorna MacKinnon	Oman	Muscat, Al Khod, Wadi Al Khod, close to road, growing at edge of wadi where trees start to occur.	Large gravel-based wadi, water present.	N23 34 26.3 E 58 07 02.9	6m
371	Juncus socotranus	Juncaceae	Graminoid herb to 1m, clump forming, leaves and culms stiff and spinescent, deeply rooted and partially buried in gravel due to water action.	18-jun-13	Lorna MacKinnon	Oman	Muscat, Al Khod, Wadi Al Khod, close to road, growing at edge of wadi where trees start to occur.	Large gravel-based wadi, water present.	N23 34 26.3 E 58 07 02.9	6m
372	Cyperus rotundus/longus	Cyperaceae	Graminoid herb to 50cm, leaves in basal rosette, stem and culm trigonous, dense population of individual plants.	18-jun-13	Lorna MacKinnon	Oman	Muscat, Al Khod, Wadi Al Khod, close to road, growing at edge of wadi where trees start to occur.	Large gravel-based wadi, water present.	N23 34 26.3 E 58 07 02.9	6m
373	Kyllinga brevifolia	Cyperaceae	Graminoid herb to 20cm, glossy green foliage, inflorescence terminal with large subtending bracts, .	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing on grassy area beside wadi.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in soil moist with seepage from Falaj.	N23 22 32.4 E57 49 40.6	335m
374	Cyperus laevigatus	Cyperaceae	Graminoid herb 30cm, culms smoothly cylindrical, green, single subtending bract and overtopping bract as continuation of stem.	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing on grassy area beside wadi.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in soil moist with seepage from Falaj.	N23 22 32.4 E57 49 40.6	335m
375	Eleocharis geniculata	Cyperaceae	Graminoid herb to 20cm, leaves reduced, culm with single, round, terminal inflorescence.	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing on	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in gap in	N23 22 32.4 E57 49 40.6	335m

							concrete ledge below car park wall.	concrete moist with seepage from Falaj.		
376	<i>Fimbristylis ferruginea</i> (v. <i>sieberiana</i>)	Cyperaceae	Graminoid herb to 30cm, leaves to 20cm.	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing on concrete ledge below car park wall.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in gap in concrete moist with seepage from Falaj.	N23 22 32.4 E57 49 40.6	335m
377	<i>Typha domingensis</i>	Typhaceae	Graminoid herb to 70cm, evidence of pruning.	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing in water at base of wall beside car park area.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural.	N23 22 32.4 E57 49 40.6	335m
378	<i>Fimbristylis ferruginea</i> (v. <i>sieberiana</i>)	Cyperaceae	Graminoid herb to 10cm, inflorescence with fluffy appearance	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing on concrete ledge below car park wall.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in gap in concrete moist with seepage from Falaj.	N23 22 32.4 E57 49 40.6	335m
379	<i>Fimbristylis cymosa</i>	Cyperaceae	Graminoid herb to 10cm, foliage very low growing almost cushion forming.	19-jun-13	Lorna MacKinnon	Oman	Nakhal, Ayn A'Thawwarah (hot spring), growing in grassy area below trees opposite car park area.	Gravel-based wadi below hot springs, development of car parking and paths etc but vegetation largely natural. Growing in area regularly disturbed by cars, water and people forming lawn-like appearance.	N23 22 32.4 E57 49 40.6	335m
380	<i>Fimbristylis ferruginea</i> (v. <i>sieberiana</i>)	Cyperaceae	Graminoid herb to 25cm, inflorescence a loose cyme	20-jun-13	Lorna MacKinnon	Oman	Wadi Al Muaydin	Gravel-based wadi. rowing in grass beside date palm grove, soil moist.	N22 59 21.1 E57 40 17.8	339m
381	<i>Cyperus laevigatus</i>	Cyperaceae	Graminoid herb to 25cm, stems green, glabrous, smoothly cylindrical, inflorescence pseudolateral with single overtopping bract, leaves fleshy with proximal channel.	21-jun-13	Lorna MacKinnon	Oman	Muscat, Wadi Iday	Gravel-based wadi with swiftly flowing water and slower pools, much <i>Prosopis juliflora</i> , popular local car-washing spot.	N23 32 24.8 E58 30 51.4	259m
382	<i>Typha domingensis</i>	Typhaceae	Graminoid herb to 3m, population fruiting.	21-jun-13	Lorna MacKinnon	Oman	Muscat, Wadi Iday	Gravel-based wadi with swiftly flowing water and slower pools, much <i>Prosopis juliflora</i> , popular local car-washing spot.	N23 32 24.8 E58 30 51.4	259m
383	<i>Juncus socotranus</i>	Juncaceae	Graminoid herb to 1m, stems blue-green, spinescent, deeply rooted and partially buried due to water action.	21-jun-13	Lorna MacKinnon	Oman	Muscat, Wadi Iday	Gravel-based wadi with swiftly flowing water and slower pools, much <i>Prosopis juliflora</i> , popular local car-washing spot.	N23 32 24.8 E58 30 51.4	259m
384	<i>Cyperus ? rotundus</i>	Cyperaceae	Graminoid herb to 50cm, flowering	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, in gravel.	N22 48 14.0 E59 14 45.3	46m
385	<i>Equisetum ramossissimum</i>	Equisetaceae, Pteridophyta	Rhizomatous fern to 40cm, lacking braches, teeth dark, .	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing over gravel and rocks where water is flowing over.	N22 48 14.0 E59 14 45.3	46m
386	<i>Schoenoplectus litoralis</i>	Cyperaceae	Graminoid herb to 1.2m, leaves reduced to sheaths, flowering.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing in standing water with gravel base.	N22 48 14.0 E59 14 45.3	46m
387	<i>Fimbristylis ferruginea</i> (v. <i>sieberiana</i>)	Cyperaceae	Graminoid herb to 60cm, flowering.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing on bedrock in moist soil at edge of wadi.	N22 48 14.0 E59 14 45.3	46m
388	<i>Eleocharis geniculata</i>	Cyperaceae	Graminoid herb to 50cm, flowering and fruiting.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing in moist soil pockets in bedrock at edge of wadi.	N22 48 14.0 E59 14 45.3	46m

389	<i>Fimbristylis cymosa</i>	Cyperaceae	Graminoid herb to 40cm, fruiting, seeds dark.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing on bedrock in moist soil at edge of wadi.	N22 48 14.0 E59 14 45.3	46m
390	<i>Fimbristylis cymosa</i>	Cyperaceae	Graminoid herb to 40cm, fruiting, leaves more elongated and flexible.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing on bedrock in moist soil at edge of wadi.	N22 48 14.0 E59 14 45.3	46m
391	<i>Fimbristylis cymosa</i>	Cyperaceae	Graminoid herb to 15cm, fruiting and flowering, black seeds.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, close to road before ascent into village.	Wadi with limestone gravel and large rocks, growing on bedrock in moist soil at edge of wadi.	N22 48 14.0 E59 14 45.3	46m
392 (not E)	<i>Najas marina</i>	Hydrocharitaceae	Fully submerged aquatic herb to 15cm, spines dark red. Sterile.	21-jun-13	Lorna MacKinnon	Oman	Wadi Tiwi, ocean end, below bridge.	Wadi with sand and soil base, water may be brackish, growing submerged 10 to 30cm depth, rooted in mud.	N22 49 17.8 E59 15 29.2	9m
393	<i>Najas marina</i>	Hydrocharitaceae	Fully submerged aquatic herb to 15cm, spines dark red. Sterile.	21-jun-13	Lorna MacKinnon	Oman	Wadi Daykah, small pool beside main flow.	Wadi below dam, small pool, water kept fresh by flow but current not strong, rooted in mud, growing 15 to 20cm depth.	N23 05 00.4 E58 51 01.3	32m

Appendix 2: Floristic accounts

Schoenoxiphium Nees

Graminaceous perennial herbs, caespitose or with short rhizomes. Leaves produced from base and on culm, ligulate. Inflorescences a panicle of many spikelets, subtended by bracts. Female flowers enclosed by a persistent utricle, trifid style. Male flowers with three anthers. Fruit a nutlet.

1. *Schoenoxiphium sparteum* (Wahlenb.) C.B. Clarke Kew Bull., Addit. Ser. 8: 67 (1908)

Graminaceous herbs to 50cm, monoecious. Leaf margins and midrib minutely serrate-scabrous, ligules a line of short dense hairs. Inflorescence a narrow panicle, subtending bracts foliose, female flowers produced at base of spikelets, male flowers produced at apex. Glumes acute, midrib green to pale yellow. Female flowers with distinctly striate utricle, pale green to yellow, style exerted from beak of utricle. Nutlet almost colourless to brown.

Montane grassland, Jebel Ta'kar. 3100m.

Yemen. (Single specimen recorded from Yemen and usually only found in East and Southern Africa, I suspect this is a one-off occurrence or a mis-identification but cannot confirm as specimen not seen)

Bulbostylis Kunth

Graminaceous herbs, annual or perennial. Leaves flat or filiform, near base of stem only. Leaf sheaths with long hairs at mouth; ligules absent. Inflorescence a congested head or reduced panicle of spikelets. Bracts present, often glume-like or shorter than inflorescence. Spikelets with spirally arranged glumes. Flowers bisexual. Perianth absent. Stamens 1 or 3. Styles 2/3-branched, swollen at base, the style base sometimes persisting as a small projection on the nutlet.

1. Glumes dark to blackish, caespitose perennial, to 40cm, leaves sparsely pilose.

1. **B. atrosanguinea**

+ Glumes not black, caespitose annual, plants smaller, leaves otherwise. 2.

2. Leaves densely hairy, style base not persistent on nutlet, glumes red-brown, nutlet transversely wrinkled. 2. **B. hispidula**

+ Leaves glabrous or scabrous on margins, style base persistent on nutlet, glumes brown or green, nutlet smooth or striate. 3.

3. Leaves with scabrous margins, nutlet smooth, anthers usually 1, style trifid. 3. **B. barbata**

+ Leaves glabrous, nutlet striate, anthers 3, style bifid 4. **B. humilis**

1. B. atrosanguinea (Boeckeler) C.B. Clarke Consp. Fl. Afric. 5: 611 (1894)

Densely caespitose perennial to 40cm, stem bases swollen. Leaves filiform, sparsely pilose. Inflorescence a head of 2 to 15 dark brown/black spikelets, spikelets up to 6mm long. Glumes ovate, acute, keeled, uniformly dark. Nutlet trigonous, grey, almost smooth, style base persistent.

Montane grassland, 2000m.

Yemen

2. B. hispidula (Vahl) R. Haines Sedges & Rushes E. Afr. App. 3: 1 (1983) Syn.: *Fimbristylis hispidula* (Vahl) Kunth

Slender, caespitose annual to 11cm. Leaves up to 5cm, flat or canaliculate, densely hairy. Inflorescence a head of 1 to 3 sessile spikelets and sometimes 1 or 2 stalked spikelets. Spikelets up to 6 x 3mm, reddish brown. Stamens 3. Nutlet obovate, trigonous, c.1 x 1mm, light reddish brown, transversely wrinkled; style base deciduous.

Habitat details not available.

Socotra

3. *B. barbata* (Rottb.) C.B.Clarke Fl. Brit. India 6: 651 (1893)

Slender, delicate, caespitose annual to 15cm. Leaves up to 6cm, filiform, margins scabrous. Culm glabrous. Inflorescence a head of 1 to 4 sessile spikelets. Spikelets lanceolate, to 4 x 1.5mm, brownish. Glumes to 2mm long, spirally arranged, brown with paler margins and usually green mid-rib. Stamen usually 1. Nutlet obovoid, triangular, up to 0.8 x 0.6mm, light brown, smooth; style base persistent.

Damp sandy soil by wadis running through date gardens, 20–50m.

Socotra

4. *B. humilis* (Kunth) C.B.Clarke Consp. Fl. Afric. 5: 614 (1894) Syn.: *Bulbostylis striatella*
C.B.Clarke

Small caespitose annual to 20cm. Leaves up to 10cm long, glabrous. Inflorescence a head of 1 to 2 green-brown spikelets, spikelets up to 8mm long. Glumes ovate, mucronate, margins light brown, keel bright green. Nutlet biconvex, pale green, finely striate, style base persistent.

Montane grassland, 2800 to 3200m.

Yemen

***Scleria* P.J. Bergius**

Graminaceous perennial herbs with foliose leaves. Leaves with closed sheaths, ligule present or absent. Inflorescence spicate, few to many spikelets. Flowers bisexual, anthers 1 to 3, style trifid. Nutlet textured, hypogynium present.

1. *Scleria bulbifera* Hochst. ex A.Rich. Tent. Fl. Abyss. 2: 510 (1850)

Rhizomatous herb to 80cm, stem bases swollen and ±bulb-like. Leaves to 25cm long, foliose, keeled, ligule ±absent but ring of dense hairs at mouth of sheath. Inflorescence

spicate, up to 20cm. Spikelets reddish, few to many, sessile, glomerate. Glumes with scabrid midrib. Nutlet white or otherwise pale, tuberculate, hypogynium brown.

Montane grassland, Jebel Thallamlan, 1900m.

Yemen

Note: Recorded from single location in Yemen, identification confirmed. Mechanism of distribution unclear, possibly a solitary distribution event.

Kyllinga Rottb.

Perennial herbs with a creeping rhizome or stolons; stems triangular or ridged. Leaves grass-like, arranged in 3s; ligules absent. Spikelets in globose heads, 1 or 2 flowered. Glumes 2-ranked. Flowers bisexual, perianth absent. Style branches 2. Stamens 1 or 2. Nutlets flattened.

- | | |
|---|---------------------------|
| 1. Inflorescence dark brown to black | 1. K. chlorotropis |
| +Inflorescence not blackish | 2. |
| 2. Rhizome indistinct, leaves filiform, plants to 12cm, inflorescence white to yellowish | 2. K. microstyla |
| + Rhizome developed, leaves >2mm wide, plants larger, inflorescence white to green | 3. |
| 3. Glumes distinctly white with pale green midrib, plants ±fragrant | 3. K. odorata |
| + Glumes green with dark green midrib (fading to white in dried specimens but midrib remaining green) | 4. K. brevifolia |

1. K. chlorotropis Steud. Flora 25: 598 (1842) Syn.: *Cyperus chlorotropis* (Steud.) Mattf. & Kük.

Slender, caespitose, rhizomatous perennial herb to 25cm, the base ±bulbous, remains of old leaf sheaths persistent. Leaves basal, sparsely pilose with scabrid margins and midrib, to 20cm long, 0.5-1mm wide. Inflorescence of 1 to 4 congested, sessile, dark red-brown to blackish spikes, lateral spikes smaller than central, central to 7mm long. Bracts usually 3 or

4, the longest to 9cm long, margins scabrid. Spikelets single flowered. Glumes ovate and mucronate with green midrib. Nutlet yellowish, minutely papillose.

Damp or wet ground, 2000 to 3200m.

Saudi Arabia, Yemen

2. *K. microstyla* C.B.Clarke Bull. Misc. Inform. Kew 1895: 229 (1895) Syn.: *Cyperus microstylus* (C.B.Clarke) Mattf. & Kük.

Slender, delicate, tufted perennial to 12cm, base surrounded by fibrous remains of old leaf bases. Leaves filiform, <2mm wide, slightly scabrid. Inflorescence a white to yellowish head of usually 3 congested spikes with numerous spikelets, central spike 2.5 to 3.5 x 1.5 to 2mm, bracts usually 3, leaf-like, much exceeding spikes, <2cm. Spikelets elliptic, c.1 x 0.5mm, 2-flowered. Glumes c.0.8mm. Stamens 2. Stigmas 2. Nutlets c.0.9 x 0.5mm, elliptic, yellowish, minutely papillose. (No specimens seen.)

Wet ground by wadis, 50-1100m.

Socotra

3. *K. odorata* Vahl Enum. Pl. 2: 382 (1805)

Caespitose, rhizomatous perennial herb, aromatic. Stems erect, to 30cm high. Leaves basal, glabrous, prominently keeled, to 20cm long, 3 to 4mm wide. Inflorescence of 1 to 4 congested, sessile, white spikes, lateral spikes smaller than central, central to 12mm long. Bracts usually 3 or 4, the longest to 12cm long, margins scabrid. Glumes with a prominent green keel, ovate, acute but not mucronate. Nutlet yellowish, minutely papillose.

Damp grassland, 2000m.

Yemen

4. *K. brevifolia* Rottb. Descr. Icon. Rar. Pl. 13 (1773)

Slender perennial herb to 25cm, stems triangular. Rhizome spreading, usually with internodes of at least a few mm. Leaves scabrid at least on margins, basal leaves without developed lamina. Inflorescence usually a single sessile, congested, globose spike, 4 to 6mm in diameter, occasionally producing 3 to 4 smaller, sessile, lateral spikes, yellowish to green (colour often fading in herbarium specimens so glumes appear almost white and may be confused with *K. odorata* which has, however, distinctly white bracts even when fresh, and more elongate spikes). Bracts usually 3 to 4, spreading, the longest often \pm erect. Spike with numerous spikelets. Spikelets single flowered, 2 to 3 x c.1mm, glumes usually 2, <3mm, with a green spinulose midrib. Stamens 3, caducous so sometimes appearing fewer. Nutlet <1.2 x 0.8mm, obovoid, yellowish.

In gravel or wet ground by wadis, 300-600m.

Oman, Socotra

Family: JUNCACEAE

L. MACKINNON

Annual or perennial herbs, usually caespitose. Leaves glabrous, basal or cauline, sheathing, sheaths open, margins membranous, auricles present or absent. Inflorescence terminal or pseudo-lateral, subtended by bracts, basal bract often leaf-like or appearing as a continuation of the stem. Flowers in compact or diffuse panicles or cymes, bisexual, actinomorphic. Tepals 6, free, \pm scarious margined. Stamens 6. Ovary superior, 1 or 3-celled; stigmas 3. Fruit a many-seeded, \pm beaked, loculicidal capsule.

Juncus L.

Description as for the family.

1. Plants annual, with small root system; leaves filiform; inflorescence generally lax with flowers often emerging low on culm, either singly or in small clusters; plants generally soft, up to 30cm 1. **J. bufonius**
- +Plants perennial, with developed root system or rhizomes; leaves terete; inflorescence paniculate with flowers in clusters; plants very robust, up to 1.5m tall 2.
2. Leaves or bracts with transverse septations, leaf and bract sheaths distinctly auriculate 3.
- + Leaves or bracts without transverse septations, leaf and bract sheaths not auriculate 4.
3. Cauline leaves multiple; plant often producing side shoots from leaf nodes (stolons); tepals green to green and pink; inflorescence a compound cyme with head-like clusters of several (up to ~20) flowers; rhizome generally indistinct 2. **J. fontanesii**
- + Cauline leaf absent or solitary; plant not producing side shoots; tepals beige to brown; inflorescence a compound panicle with lax to densely globose clusters of many (up to ~100) flowers; rhizome generally distinct 3. **J. punctorius**
4. Leaves all basal, reduced to sheaths; tepals narrowly lanceolate and acute with scarious margin narrow or indistinct 4. **J. inflexus**

+ Leaves basal, rigid, terete, pungent; tepals with distinct scarious or hyaline margins often broadening towards the apex 5.

5. Inner tepals with distinct scarious margins widening into auricles at apex, rarely notched, bracteoles and tepal midribs often with spots and streaks of pink to brown and/or a darkened margin of the tepal midrib; plants not rhizomatous; capsule dark coloured, \pm obtuse, about as long as tepals 5. **J. socotranus**

+ Inner tepals with scarious margins, often widening toward apex but not auriculate, tepals without spots or streaks, straw coloured to green, sometimes with pinkish to orange-brown flush of colour; plant with rhizome usually distinct; capsule straw coloured to orange-brown, obtuse to acute, as long as or longer than tepals 6.

6. Anthers not more than twice as long as filaments; capsule about as long as tepals; tepals greenish often with pink to orange-brown flush from the apex 6. **J. maritimus**

+ Anthers more than twice as long as filaments; capsule distinctly longer than tepals; tepals \pm straw coloured 7. **J. rigidus**

1. J. bufonius L. Sp. Pl. 328 1753 Syn.: *J. hybridus* Brot. (**Note:** In synonymy at least for the purposes of this flora. I cannot find consistent features to distinguish these based on Arabian material but find it likely that there may be more differentiation across the full ranges of these species)

Slender \pm caespitose annual herb up to 30cm, occasionally taller. Population usually forming a dense group, mat-like when plants are smaller. Stems ascending to erect, branching from the base. Leaves soft, filiform. Inflorescence an open polychasial cyme occupying most of the plant. Tepals up to 8mm long with a green herbaceous midrib and scarious margins. Capsule oblong, blunt, about as long as tepals, yellowish to deep red-brown.

Damp sand and mud, 1200 to 2700m.

Saudi Arabia, Yemen, Socotra

2. J. fontanesii J.Gay ex Laharpe Essai Monogr. Jonc. 42 1825

Perennial herb up to 80cm tall, erect or ascending, often producing stolons from cauline leaf bases, rhizome generally lacking. Basal leaves reduced to sheaths, cauline leaves terete with transverse septations within, septations becoming clearly visible when dried but apparent to the touch in fresh material. Inflorescence an open polychasial cyme with flowers in capitate clusters of up to 20. Tepals narrowly acute, to 4mm long, green, often with pink margins. Capsule acute, brown, as long as or longer than tepals.

Damp ground and standing water, 1800-2800m.

Saudi Arabia, Yemen, Oman.

Note: There are possibly two subspecies present in this region; *J. fontanesii* subsp. *fontanesii* and *J. fontanesii* subsp. *pyramidatus* (Laharpe) Snogerup Fl. Iran. 75: 25 1971, historically material from the region has been considered to be exclusively the latter; however I am not confident that there is enough material available to determine if this is the case, so for the purposes of this revision the species is treated in the wider context.

3. *J. punctorius* L.f. Suppl. Pl. 208 1781

Perennial, rhizomatous herb usually around 1m tall, occasionally reaching up to 2m. Stems erect, terete, with basal leaves reduced to sheaths and either a single cauline leaf or a large bract. Leaf/bract with transverse septations within, septations becoming clearly visible when dried but apparent to the touch in fresh material. Inflorescence an open corymbose cyme with flowers in ±globose clusters of up to 100. Tepals up to 3mm long, narrowly acute, beige to brown with darker margins. Capsule ovoid, dark brown, slightly longer than the tepals.

Wet ground or standing water, 1800-3000m.

Saudi Arabia, Yemen

4. *J. inflexus* L. Sp. Pl. 326 1753

Perennial, caespitose, rhizomatous herb to around 1m. Rhizome with short internodes, shoots arising close together; stems often glaucous, striated; leaves reduced to basal sheaths. Inflorescence a spray-like pseudolateral pleiochasium with a single overtopping bract

appearing to be a continuation of the stem; each flower with at least a short pedicel. Tepals up to 4mm long, narrowly acute to subulate, light to dark brown. Capsule dark brown, ovate, as long as tepals.

Wet ground, 2400m.

Saudi Arabia, Yemen.

5. *J. socotranus* (Buchenau) Snogerup Willdenowia 23: 49 1993 Syn.: *J. maritimus* subsp. *socotranus* Buchenau

Robust caespitose perennial herb to 2m. Rhizome inconspicuous, stems densely tufted, often forming a hemispherical clump. Leaves and bracts stiff, terete, pungent. Inflorescence a lax many-flowered polychasium, subtended by an erect pungent bract that continues in the direction of the stem. Tepals to 3mm, scarious margin distinctly broadening at apex into auricles, particularly the inner tepals which are consequently often longer than the outer tepals, somewhat cucullate, bracteoles and tepals usually with pink to brownish spots and streaks. Capsule subglobose, as long as tepals, dark glossy-brown.

In or near water, usually freshwater, 0-1400m

Saudi Arabia, Yemen, Socotra, Oman, UAE

6. *J. maritimus* Lam. Encycl. 3: 264 1789

Robust caespitose perennial to 1m. Rhizome stout, horizontal, producing dense rows of stems. Leaves and bracts stiff, terete, pungent, the lowest leaves reduced to sheaths. Inflorescence a many-flowered polychasium, subtended by an erect, pungent bract that continues in the direction of the stem. Tepals to 4mm long, acute, scarious margin \pm broadening at apex but not auriculate, straw coloured to green with a blush of pink particularly towards apex. Anther not more than twice as long as filament, anther and filament often equal lengths or anther slightly longer. Capsule acute to obtuse, about as long as tepals, straw coloured to orange-brown.

Damp or wet ground, 0-1700m

Yemen, Oman

7. **J. rigidus** Desf. Fl. Atlant. 1: 312 1800 Syn.: *J. maritimus* var. *arabicus* Asch. & Buchenau, *J. arabicus*(Asch. & Buchenau) Adamson

Robust caespitose perennial to 1.5m. Rhizome stout, horizontal, producing dense rows of stems. Leaves and bracts stiff, terete, pungent, the lowest leaves reduced to sheaths. Inflorescence a polychasial cyme, subtended by an erect pungent bract that continues in the direction of the stem. Peduncles occasionally with pinkish spots or streaks but markings not on bracteoles or tepals. Tepals to 5mm, acute, scarious margin \pm broadening at apex but not auriculate, straw coloured. Anthers not less than 2.5 times as long as filament. Capsule narrowly acute, to 5mm long, straw coloured to brown, exerted from tepals.

Damp or wet habitats, often saline or coastal, 0-1500m

Saudi Arabia, Yemen, Socotra, Oman, Bahrain, UAE

Note: Some specimens of *J. rigidus* had some characteristics in common with *J. socotranus* and on further study I have concluded these to belong to *J. maritimus* which is widely distributed in the countries surrounding the Arabian Peninsula. I feel that *J. socotranus*, although originally described as a subspecies of *J. maritimus*, is a distinct species, certainly in the region covered by this flora. *J. rigidus* however may be a subspecies of *J. maritimus*, which it has also occasionally been described as, but has been treated as a distinct species in so many sources and for so long that any change to the taxonomy could cause significant confusion and should not be considered without further taxonomic and, if possible, genetic research.