Preliminary report on a survey of *Utricularia* (LENTIBULARIACEAE) in the Howard River – Shoal Bay area.

I.D.Cowie

Summary

A short field study of Utricularias in the Howard River catchment – Shoal Bay area was undertaken during 2001 so that options for conservation could be evaluated. A numer of endemic or near endemic Utricularia species regarded as of conservation significance were found to be relatively common on sand sheet habitats in the upper parts of the Howard River floodplain and catchment and on western parts of the Adelaide River Floodplain margin. The western margin of the Adelaide River floodplain was regarded as more suitable as a reserve than much of the Howard River system. The longer term viability of the latter is in doubt because of potential habitat modification linked to the proximity of extensive subdivision for rural residences and horticulture, and sand mining. The East Howard Bore Field area was found to contain some areas occupied by sand sheet Utricularias, essentially some parts of the Howard River Floodplain and parts of the "East Howard" system. Much of the suitable habitat in the Bore Field has been mined, although pockets of good quality habitat remain.

Utricularia dunstaniae remains the rarest of the species detected during the survey and was only recorded at three locations, two on the Howard River Floodplain and at one location on the western Adelaide River Floodplain margin.

Although other field work during the year resulted in sizeable extensions of the known range of several sand sheet species, details of the distribution and abundance of most sand sheet taxa in areas of the NT away from the study area remain sketchy.

Introduction

The bladderworts are a group of carniverous plant belonging to the genus Utricularia. A total of 214 species are recognized, extending through tropical and temperate regions of the world (Taylor, 1989). All species posses specialised traps for the capture of small aquatic invertebrates as they move past. Two main life forms are evident. About 30 species are free floating aquatics generally found in still or slow flowing water and have finely divided leaves with filiform lobes. The remaining species are lithophytic, epiphytic or terrestrial herbs, have flattened leaves and occur on wet substrates. The traps of these species are located in wet soil or in the shallow water layer on top of the substrate (soil, rock, tree). As Taylor (1989) notes, the majority of terrestrial species occur in open vegetation in the seasonally wet tropics such as the Aripo savannas of Trinidad, the sterile white sand savannas of Guianas and Brazil, and the 'mbugas' of the *Brachystegia* woodland of southern Tanzania. As for these other regions rich in terrestrial Utricularias, the Top End is characterised by many areas of near flat, poorly drained, acid, infertile fine sand over a less permeable substrate (clay, laterite or sandstone) so that the soil is wet or inundated for at least part of the year.

The northern NT, with 34 named species, is one of the richest areas of the world for the genus (Taylor, 1989). Twenty eight terrestrial species are known from the NT while the

other species six species are aquatic. This diversity is nowhere better evident than on the extensive sand sheets of the so-called Koolpinyah land surface found in the Darwin Rural area. Here, on seasonal seepage zones along the margins of drainage floors, depressions and floodplains a layer of pure sand, of variable thickness, which has been leached by laterally flowing water overlies an impermeable clay layer close to the ground surface. Up to 14 species can be found on an area of no more than 0.1 ha, with 26 species found on a variety of seasonally waterlogged substrates and aquatic habitats within a few km. Unfortunately for *Utricularia*, this special hydrological situation also provides probably the most readily (and cheaply) extractable source of clean building sand in the Darwin area.

Nine species of *Utricularia* in the NT had previously been identified as of some conservation significance (Leach et al., 1992) ranging from endangered to rare or poorly known (Table 1). For the most part these species are sand sheet specialists endemic to the Top End of the NT with some extending to the Kimberley region of WA. The other two species of significance are endemic to sand sheet habitats in western Arnhem Land.

The aim of this study was to identify areas rich in Urticularia spp (especially those endemic or near endemic species favouring sand sheet habitats) in the Howard River catchment – Shoal Bay area, so that options for conservation could be evaluated and to improve knowledge especially of the distribution, abundance and habitat preferences of rare or endemic species. Particular attention was paid to the Shoal Bay Reserve and East Howard borefields areas

Methods

Sampling was undertaken using standard 20 x 20 m floristic quadrats used by the NT Herbarium and was planned according to land units identified in various Land System/Land Unit mapping studies of the area (Wells & Harrison, 1978; Fogarty et al., 1979,1984; Lucas & Czachorowski, 1980; Van Cuylenberg & Czachorowski, 1984; and Lynch, 1985). Previous field experience and herbarium records indicated that land units mapped as ‘upland depressions and floodways’ and ‘broad lowland plains’ contained areas of *Utricularia* habitat. On geological maps of the area, these units corresponded to areas mapped as Quaternary colluvium (sand, silt, clay), deposited by unconcentrated sheetwash in broad drainage areas and on very gentle slopes marginal to estuarine and littoral areas (e.g. Pietsch, 1985). Land units were searched on foot, using a quad bike and by vehicle along existing tracks and roads. Quadrats were located in representative areas where *Utricularia* species were found, with a view to achieving good geographic coverage of the area and sampling all habitat types occupied. At each quadrat, location was recorded with a GPS, a range of environmental variables was assessed and the presence of all identifiable plant species recorded.

Preliminary analysis of NT Herbarium records suggested that there can be some seasonal progression in flowering during the wet - early dry season period when Utricularias are most evident. Species such as *Utricularia hamiltonii*, *U.kimberleyensis* and *U.lasiocaulis* have been collected as early as February while *U.triflora* was quite late in the season with collections only from May to August. Also, there can be considerable variation in the onset, duration, and intensity of the wet season from year to year and the peak flowering time for highly moisture dependant annual herbs such as *Urticularia* could be expected to vary also (Taylor and Tulloch, 1985). Thus, field work was spread over 12 days from early March

through to the end of April, 2001 to try to sample as many species as possible, and minimise the risk that all field work would fall too late in the season for significant populations of Utricularias to still be present. Data collection in the 2001 season was designed to extend geographically that data collected using an identical methodology in the Shoal Bay reserve at the end of the wet season the previous year.

To gain a broader perspective on the distribution and habitat preferences of *Utricularia* species outside the survey area, additional plots were located on colluvial drainage floors during a number of other surveys conducted during the wet - early dry season of 2001. Thus, *Utricularia* habitat was sampled to a greater or lesser extent during floristic and vegetation surveys of Bathurst Island, Nitmiluk NP, Sturt Plateau wetlands and part of Arafura Swamp catchment.

Results and Discussion

Many areas of high richness in sand sheet *Utricularia* species were located. These were generally along the mid to upper parts of the Howard River floodplain (Whitewood Rd to Goode Rd) and along the western margin of the Adelaide River floodplain (Fig. **). Conversely, sites on much of the mid to lower Howard River floodplain (north of Whitewood Rd) and drainage lines to the north of the Gunn Point Road (e.g. the 'East Howard' system) were lower in *Utricularia* species, and suitable habitat was more sparsely distributed. However, some species (*U.triflora*, *U.involvens* and *U.circumvoluta*) were only recorded in these more northerly areas during the survey. Many sites on the west side of the Howard River floodplain including the formerly rich McMinns Lagoon area were likewise depauperate in Urticularias, probably because of habitat modification linked to surface mining and rural residental subdivision.

Shallow surface mining has affected extensive areas of formerly suitable habitat in the study area as well as adjacent colluvial lower slopes formerly dominated by Eucalyptus woodland. The 'East Howard' system to the south of the Gunn Pt Rd has been extensively mined with more limited areas mined to the north. Much of this system to the north has probably been less suitable for sand sheet Utricularias, as it consists of extensive area of shallowly flooded drainage floor with limited areas of pure sand along the margins.

<u>Relative abundance of species of conservation significance</u>

Of those species recorded during the survey and regarded as of conservation significance (Leach et al., 1992), U*tricularia dunstaniae* remains by far the rarest, despite intensive searching. It was located at only three sites, all with other sand sheet species, including *U.holtzei* and *U.hamiltonii*. Two of these sites were in the middle parts of the Howard River floodplain (between Girraween Rd and Gunn Pt Rd) and the third was on the western margin of the Adelaide River floodplain north of Black Jungle. Taylor (1989) gives three other records for the species - from McMinns lagoon (although it was not relocated there during the survey), from near Jabiru and from northern Kimberley. The type collection is from the Howard River although the exact location is not known.

U.holtzei and *U.hamiltonii* were found to be widespread, and locally abundant in the mid to upper Howard River area (Whitewood Rd south to Goode Rd) and along the western margin of the Adelaide River floodplain (north of Black Jungle). More localised populations

were found in the middle parts of the Howard River floodplain (Whitewood Rd to Gunn Pt Rd) and to the north of the Gunn Point Rd on the 'East Howard' system.

Utricularia leptorhyncha was found at two sites in the middle part of the Howard River floodplain (Girraween Rd to Gunn Pt Rd), but was recorded on Bathurst Island and incidentally at Litchfield NP during the time of the field work. Additional collections have also been made since 1992 (when the Leach et al study was published) in Charles Darwin NP, Kakadu NP and near the Elizabeth River - all significant additions to the known distribution of the species.

Utricularia triflora was located at only one site during the survey, to the north of the Gunn Point Rd. However, during other field work in June, 2001 the species was recorded at three sites on the Sturt Plateau, one not far from Dunmarra extending the known range by almost 500 km. These and other collections made near Oenpelli, Maningrida and near the Goyder River over the past 5 years have greatly extended the known range of the species. It apparently has different habitat requirements than many other species, flowering after water receeds from the margins of flooded sandy swamps.

Utricularia singeriana remains among the rarest of the Australian endemic *Utricularia* species found in the NT. It was not located during the survey despite being one of the more conspicuous species (C.Michell pers. comm.). It is know in NT from historical collections from '4 miles north east of Darwin' which are now probably under suburban Darwin or the Darwin airport and from a recent collection from near Edith River.

Species Richness and Habitat

Species Richness. It was apparent that the more sandy sites with more open ground layer tended to have a greater number of species than did more clayey sites with a denser grass layer. Although the attached Utricularias all occurred in seasonally waterlogged habitats, the composition and richness of species on such sites appeared to be related to subtle variations in moisture and substrate conditions both in terms of micro and macro topography and in a temporal sense. Although limited data were collected on soil texture, the sand sheet Utricularias appeared to favour *Melaleuca nervosa* woodland with an open ground layer dominated by *Dapsilanthus spathaceus* on very sandy colluvium and obvious ground water seepage (e.g. *U.dunstaniae, U.holtzei, and U.hamiltonii*). The sandy sites with *U.dunstaniae* had the greatest number of species (mean = 8 species). As the density of the ground layer increased, usually with an increase in grasses and apparent higher soil silt or clay content, the number of species of *Utricularia* appeared to decline.

Microtopography. On sandy sites, the distribution of sand sheet Utricularias on a site appears to be intricately connected to the system of hummocks and depressions ('debil debil') caused through the activities of the terrestrial worm (???). In the seasonally swampy country they inhabit, these worms build low hummocks of soil a few cm or more high around the bases of *Dapsilanthus* or grass tussocks, apparently to maintain elevation above the surrounding water during the wet season. Typically *U. dunstaniae, U.lasiocaulis, U. holtzei, U. capilliflora, and U. hamiltonii* inhabit the shallow water (a few mm to a few cm deep) in the depressions whilst *U.quinquedentata,* U.*chrysantha, U.odorata, U.caerulea* and U.*kamienskii* inhabit the drier mounds (or the moist sand in areas that have already

dried further). As these sites dried out the proportion of mound dwelling species appeared to increase.

Habitat preferences of Individual species. Although many of these 'sand sheet' Utricularias appear to be at their peak when water is seeping out of the ground, *U.limosa* appeared to be more tolerant of stagnant water. The small white form of U.caerulea, inhabited perhaps the most ephemerally moist sites, and was found even in less well drained areas in *Eucalyptus tetrodonta* forest. *Utricularia kimberleyensis* occurred in *E.alba* woodland that was waterlogged only in the wet season whilst *U.uliginosa* and *U.caerulea* (large form) frequently occupied seepage areas that remained waterlogged for most of the year. *Utricularia odorata* and *U.chrysantha* tended to be at their peak once water levels had receeded, with the former often found on more grassy sites. *U.leptoplectra* appeared to be most abundant on finer textured substrates further down the slope where grasses were more prevalent, surface water was deeper and ground water seepage was not evident (the classic 'debil debil' country).

Details of the distribution and abundance of most sand sheet taxa in areas of the NT away from the study area remains sketchy. Although there have been flora surveys in much of the Top End these have generally been extensive in nature covering a broad range of habitats, large geographic areas and have often been carried out at times of year unsuitable for detection of *Utricularia*. Targetted collection of data during other field work during the year resulted in sizeable extensions of the known range of several sand sheet *Utricularia* species. Further habitat specific surveys during the March to May period are required to better understand the distribution and abundance of *Utricularia* spp in the NT.

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Table 1. Summary of distribution and conservation status of *Utricularia* species found in NT

Species	former ROTAP Coding (Leach et al., 1992)	proposed IUCN Coding (Kerrigan & ?Cowie, in prep.)
NT Endemic		
Utricularia arnhemica	-	LC
Utricularia capilliflora	-	NT
Utricularia cheiranthos	1K	NT
Utricularia fulva	-	LC
Utricularia hamiltonii	3RC-	NT
Utricularia holtzei	3RC-	NT
Utricularia kamienskii	-	LC
Utricularia rhododactylos	1KC-	NT
Utricularia triflora	2K	NT
NT-Kimberley Endemic		
Utricularia dunlopii	-	lc
Utricularia dunstaniae	3e	e(b1,2;d)
Utricularia kimberleyensis	-	lc
Utricularia leptoplectra	-	lc
Utricularia leptorhyncha	3KC-	nt
Utricularia singeriana	3K	e(d)
NT-Qld or NT-New Guinea		
Utricularia circumvoluta	-	nt
Utricularia muelleri (Aquatic)	-	lc
Tropical Australia		
Utricularia chrysantha	-	lc
Utricularia lasiocaulis	-	lc
Utricularia quinquedentata	-	nt
Utricularia tubulata (Aquatic)	3RC-	dd
Australia-Asia or Pantropical		
Utricularia aurea (Aquatic)	-	lc
Utricularia australis (Aquatic)	-	dd
Utricularia bifida	-	lc
Utricularia caerulea	-	lc
Utricularia foveolata	-	dd
Utricularia gibba (Aquatic)	-	lc
Utricularia involvens	-	nt
Utricularia limosa	-	lc
Utricularia minutissima	-	lc
Utricularia odorata	-	lc
Utricularia stellaris (Aquatic)	-	dd
Utricularia subulata	-	e(b1,2)
Utricularia uliginosa	-	lc

Appendix 1. A Synopsis of *Utricularia* species occurring in NT

Utricularia arnhemica P.Taylor

Type: c. 65 km NE of Pine Creek, N.T., P.Taylor 17156 (K: holo; CANB, DNA, L, MEL, NSW, NT, PERTH: iso.)

Distribution: endemic to N.T., occurring on the western Arnhem Land plateau, in adjacent parts of Kakadu NP and Nitmiluk NP.

Habitat: on sandy stream banks and beds, or on seepage areas on sandstone in water a cm or two deep.

Flowering: mostly Feb. - June.

Abundance: relatively common within its limited range.

Proposed IUCN category: LC.

Utricularia aurea Lour.

Type: Vietnam.

Distribution: India to Japan and Australia (W.A., N.T. Qld, N.S.W.); widespread in the Top End.

Habitat: free-floating aquatic; in lagoons and billabongs.

Flowering: Jan.-Sept.

Abundance: common.

Proposed IUCN category: lc.

Utricularia australis R.Br.

Type: Australia, N.S.W., between Hawksbury and Paramatta, *R.Brown* s.n. (holo: BM.).

Distribution: Europe, Africa, Asia, Australia (most states except Qld); in NT known from Arafura Swamp.

Habitat: free-floating aquatic; in billabongs

Flowering: May, July.

Abundance: rarely collected in NT

Proposed IUCN category: dd(a).

Utricularia bifida L.

Type: China, Guandong, 'on the Danish island off Canton', *Osbeck* s.n. (holo: LINN; iso: C.).

Distribution: India to Japan and Australia (tropics); in NT known from Kakadu NP

Habitat: attached; associated with sandstone country in damp sand besides flowing water.

Flowering: Jan.-July.

Abundance: common within a restricted range.

Proposed IUCN category: lc

Utricularia caerulea L.

Type: Ceylon, *Hermann* s.n. (holo: BM.).

Distribution: Madagascar to western India, Japan and Australia (W.A., NT, Qld, northern NSW); widespread in the Top End.

Habitat: In water a cm or two deep on organic and sandy substrates in permanently wet, boggy areas associated with spring-fed streams or in damp sand near flowing water. The small flowered, white form occurs on seepage areas in wet, open sedgeland, grassland or woodland on sandy or lateritic substrates during the wet season.

Flowering: Most Months.

Abundance: relatively common in the Top End.

Proposed IUCN category: lc.

Notes: Two forms of this species complex are known in the NT. One is a taller herb with many mauve flowers crowded towards the apex of the inflorescence; the other is a short herb to c. 10 cm tall with few, small white flowers. In NT, intermediates between the two forms are not recorded.

Utricularia capilliflora F.Muell.

Type: Adelaide River [probably Koolpinyah], N.T., N.Holtze 1176 (MEL: holo; K. NSW: iso.)

Distribution: endemic to N.T.; known from Darwin rural area, Bathurst Island, base of western Arnhem Land escarpment, and east of Ramingining.

Habitat: sandy swamps and seepage areas with Dapsilanthus and Melaleuca or at the edge of small streams, in water to a few cm deep or on damp sand. Apparently more tolerant of clayey substrates than many species.

Flowering: Mar.- June.

Abundance: relatively common in the Darwin Rural area.

Proposed IUCN category: NT

Utricularia cheiranthos P.Taylor

Type: c. 33 km SW of Oenpelli, N.T., *P.Taylor* 17145 (K: holo.).

Distribution: endemic to N.T. occurring at base of western Arnhem Land plateau and in adjacent parts of Kakadu NP.

Habitat: wet grassland near streams.

Flowering: Mar. - May.

Abundance: rare.

Proposed IUCN category: NT.

Utricularia chrysantha R. B r.

Type: Qld, Point Lookout, *Banks & Solander* (holo: BM).

Distribution: southern New Guinea and Australia (WA, NT, Qld); widespread in the Top End.

Habitat: in wet grassland and sedgeland, sometimes beside streams.

Flowering: all months.

Abundance: common.

Proposed IUCN category: lc.

Utricularia circumvoluta P.Taylor

Type: E of McMinns Lagoon, c. 33 km SE of Darwin, N.T., *P.Taylor* 17123 (K: holo.).

Distribution: N.T., QLD; in NT, near McMinns Lagoon, near Gunn Pt Rd, Yirrkala, Nitmiluk NP; two localities in Qld.

Habitat: in swamps and on the margins of streams and lagoons, usually in shallow water among tall grasses and sedges; on sandy substrates (C.Michell, pers. comm.).

Flowering: Mar.-June.

Abundance: uncommon

Proposed IUCN category: NT

Utricularia D 127178 rubra

Distribution: Darwin Rural area.

Habitat: wet grassland.

Flowering: May.

Abundance: known from only one collection, but extremely inconspicuous.

Proposed IUCN category: dd(a)

Utricularia dunlopii P.Taylor

Type: Little Nourlangie Rock, N.T., C.R.Dunlop 4737 (K: holo; DNA, NT: iso.).

Distribution: endemic to northern W.A.and N.T.; in N.T. known from the western Arnhem Land plateau, Fitzmaurice River area and at Nitmiluk NP; and from two localities near Darwin. Also known from several collections from North Kimberley, W.A.

Habitat: in damp depressions on sandstone pavement, on seepage areas, along sandy creeks or on damp sand, in seasonally swampy areas with Dapsilanthus.

Flowering: Feb. - May.

Abundance: common in sandstone areas, rare in Darwin Region.

Proposed IUCN category: lc.

Utricularia dunstaniae F.E.Lloyd

Type: Howard River, N.T., N.Holtze 1340 (MEL: holo; BM, K, NSW: iso.).

Distribution: endemic to northern W.A. & N.T.; in NT in McMinns Lagoon area (but apparently no longer extant there), two localities on Howard River Floodplain, W margin of Adelaide River floodplain, one locality near Jabiru. In W.A., known from a single record from North Kimberley.

Habitat: in wet sand or on sand in shallow water with Dapsilathus, prefering slightly wetter microhabitats than U.capilliflora. Apparently prefers sandsheet areas that continue to seep water until longer in the dry season than do other species.

Flowering: Mar.(near Jabiru); Apr. - May (near Darwin).

Abundance: rare.

Proposed IUCN category: e(b,1,2;d)

Utricularia foveolata Edgew.

Neotype: India, N.Bengal, Titalya, *S.Kurz* (CAL)

Distribution: widespread in the Old World tropics from west Africa to Australia (NT, Qld); known only from a few locations near Jabiru in NT.

Habitat: seasonally wet grassland.

Flowering: Mar.

Abundance: rarely collected in NT

Proposed IUCN category: dd(a)

Utricularia fulva F.Muell.

Type: NT, near Macadam Range, *F.Mueller* (holo: MEL; iso: K.).

Distribution: endemic to the NT; Arnhem Land – Kakadu, Nitmiluk NP, Litchfield NP, Fitzmaurice River area.

Habitat: in or at the edges of stream beds on sand or sandstone substrates.

Flowering: Mar. - Oct.

Abundance: common

Proposed IUCN category: LC

Utricularia gibba L.

Type: U.S.A., Virginia, *Clayton* s.n. (holo: BM.).

Distribution: pantropical, also extending into temperate areas; widespread in the Top End.

Habitat: aquatic; often intertwined with dead organic matter at edges of lagoons and billabongs.

Flowering: Apr. – Oct.

Abundance: common.

Proposed IUCN category: lc.

Utricularia hamiltonii F.E.Lloyd

Type: near Adelaide River [probably Koolpinyah], N.T., *Holtze* 1161 (MEL: holo; BM: iso.).

Distribution: endemic to N.T.; Fitzmaurice River to Maningrida; Koolpinyah (W margin of Adelaide R floodplain), mid to upper Howard River floodplain, McMinns Lagoon [probably no longer extant], c. 77 km E of Mary River.

Habitat: Wet sandy swamps with *Dapsilanthus* and *Melaleuca nervosa*, usually in water to a few cm deep.

Flowering: Feb.-May.

Abundance: relatively common in the Darwin Rural area.

Proposed IUCN category: NT.

Utricularia holtzei F.Muell.

Type: near Adelaide River [probably Koolpinyah], N.T., *M. & N.Holtze* 1164 (MEL: holo; AD, K: iso.).

Distribution: N.T. endemic; mid to upper Howard River floodplain, Koolpinyah, McMinns Lagoon [no longer extant there], base of western Arnhemland escarpment near Mudginberry.

Habitat: Sandy swamps and flats with *Dapsilanthus* and *Melaleuca nervosa*, usually in depressions between mounds, in water a few cm deep. Frequently with *U.hamiltonii*, *U.kamienskii*, *U.capilliflora* and *U.lasiocaulis*.

Flowering: Mar.-June.

Abundance: locally common in suitable habitat in the Darwin Rural area.

Proposed IUCN category: NT.

Utricularia involvens Ridl.

Type: Malay Peninsula, Kedah Peak (Gunong Jerai), *Ridely* (holo: SING).

Distribution: SE Asia and northern Australia (NT); in NT western Arnhem Land - Kakadu, Litchfield NP, mid Howard River floodplain, Melville Island.

Habitat: wet grassland on drainage flats or along creeks.

Flowering: Jan. – May.

Abundance: uncommon in NT

Proposed IUCN category: nt.

Utricularia kamienskii F.Muell.

Type: near the Adelaide River [probably Koolpinyah], N.T., *M. & N.Holtze* 1158 (MEL: holo; AD, K: iso.)

Distribution: endemic to N.T.; Howard River to Kakadu NP; Koolpinyah (W margin of Adelaide River floodplain), mid to upper Howard River floodplain, McMinns Lagoon (probably no longer extant), base of western Arnhem Land plateau.

Habitat: in wet sand in swamps and seepage areas with open *Dapsilanthus* and *Melaleuca nervosa*, usually on the drier margins or mounds rather that in shallow water. Frequently with *U.hamiltonii*, *U.holtzei*, *U.capilliflora* and *U.lasiocaulis*.

Flowering: Mar.-May.

Abundance: locally common.

Proposed IUCN category: lc.

Utricularia kimberleyensis C.A.Gardner

Type: W.A., Charnley River, C.A.Gardner 1412 (PERTH: holo; NSW: iso.).

Distribution: endemic to northern W.A. & N.T.; in NT, Litchfield NP to near Maningrida (Darwin, Arnhem Land, Nitmiluk NP, Jabiru and widely distributed in the Kimberley Region of W.A).

Habitat: *Eucalyptus alba*, *E.bigalerita* or *E.tectifica* woodland with grasses or with *Dapsilanthus* on the margins of drainage depressions, usually in water a few cm deep.

Flowering: Feb. – Aug, but mainly during the wet season.

Abundance: common.

Proposed IUCN category: lc.

Utricularia lasiocaulis F.Muell.

Type: near Darwin, N.T., M.Holtze 477 (MEL: holo).

Distribution: northern parts of tropical W.A., N.T. QLD; widespread in the Top End from Darwin to Arnhem Land to Katherine. Widespread in E. Qld with a few collections from W.A. (Taylor).

Habitat: wet swampy depressions and seepage areas with *Dapsilanthus* or *Eriachne burkittii*, usually in water a few cm deep; on sand or more clayey substrates.

Flowering: Feb.-Sept.

Abundance: common in suitable habitat in the Darwin Rural area and in Kakadu.

Proposed IUCN category: lc.

Utricularia leptoplectra F. Muell.

Type: Northern Territory, near Port Darwin, *M.Holtze* 508 (holo: MEL).

Distribution: endemic to northern W.A., NT; widespread in the Top End and known from a single collection in W.A.

Habitat: wet grasslands, in water to 20 cm deep. Tolerant of deeper flooding and more clayey substrates than most other attached species.

Flowering: late wet season and early dry season.

Abundance: very common in the Top End.

Proposed IUCN category: lc.

Utricularia leptorhyncha O.Schwarz

Type: near Berry Springs, N.T., Adams 1722 (neo: K).

Distribution: endemic to northern W.A. & N.T.; in NT from Litchfield NP to Darwin (at Berry Springs, Howard River floodplain), Bathurst Island to Kakadu. One collection from Mitchell Plateau in W.A.

Habitat: Wet sandy seepage areas with *Dapsilanthus* and grasses, sand lenses on sandstone outcrops, *Pandanus* woodland with grasses; in water to a few cm deep or on wet sand.

Flowering: Feb.-Mar.

Abundance: occasional in Darwin Rural area and western Top End.

Proposed IUCN category: nt.

Utricularia limosa R.B r.

Type: Qld, Endeavour River, *Banks and Solander* s.n. (holo: BM).

Distribution: SE Asia and northern parts of tropical Australia (W.A., N.T., Qld); widespread in the Top End.

Habitat: wet sedgelands and open grasslands in water to a few cm deep or on damp sand. Tolerant of more stagnant water and more clayey substrates than many other attached species.

Flowering: mostly Feb. – July.

Abundance: common.

Proposed IUCN category: lc.

Utricularia minutissima Vahl

Type: Malay Peninsula, 'Malacca', *Koenig* s.n. (holo: C)

Distribution: India to Japan and Australia (W.A., N.T., Qld); Litchfield NP to eastern Arnhem Land.

Habitat: wet sandy soil in open sedgeland or grassland.

Flowering: mostly Feb. – Mar.

Abundance: relatively common.

Proposed IUCN category: lc.

Utricularia muellerii Kamienski

Type: N.T., Darwin, *M.Holtze* 474 (lecto: MEL).

Distribution: northern parts of tropical Australia and New Guinea; widespread in Top End.

Habitat: free-floating aquatic; flooded Melaleuca swamps, lagoons and billabongs.

Flowering: Feb. – Oct.

Abundance: common

Proposed IUCN category: lc.

Utricularia odorata Pell.

Type: Indochina, Cambodia, Kampot, *Geoffray* 464 (holo: P).

Distribution: SE Asia to northern Australia (NT); Darwin area to central Arnhem Land to Katherine area.

Habitat: wet sedgelands and grasslands, after water has receeded to ground level.

Flowering: Feb. – Nov.

Abundance: common, often abundant.

Proposed IUCN category: lc.

Utricularia quinquedentata F.Muell. ex P.Taylor

Type: near Adelaide River [probably Koolpinyah], N.T., *M. & N.Holtze* 1177 (MEL: holo; BM: iso.)

Distribution: W.A., N.T. QLD; known from Darwin rural area, Kakadu, Arnhem Land, Katherine Gorge. Widespread in E Qld with three collections from W.A.

Habitat: sandy swamps and seepage areas, usually with *Dapsilanthus*, on moist sand.

Flowering: Apr.- June.

Abundance: uncommon.

Proposed IUCN category: nt.

Utricularia rhododactylos P.Taylor

Type: Mt Gilruth, Deaf Adder Gorge, N.T., *C.R.Dunlop* 4414 (K: holo; DNA: iso.).

Distribution: N.T. endemic; western Arnhem Land plateau and adjacent parts of Kakadu NP.

Habitat: in shallow sandy depressions (in water) on sandstone pavement.

Flowering: Feb. - Mar.

Abundance: locally common in western Arnhem Land.

Proposed IUCN category: NT.

Utricularia singeriana F. Muell.

Type: Port Darwin, N.T., *M.Holtze* 1026 (MEL: holo; K, NSW: iso.)

Distribution: endemic to northern N.T. and W.A.; in NT, one locality near Edith Falls; also near Kununurra in W.A.

Habitat: wet sandy flats and swamps with short grasses and sedges (C.Michell, pers. comm.).

Flowering: Mar. - May.

Abundance: Rare in W.A. and N.T. Historically found 4 miles NE of Darwin [near Rapid Creek], but this locality is probably now under Darwin Airport or suburban Darwin.

Proposed IUCN category: e(d).

Utricularia stellaris L. f.

Type: East India, Koenig s.n. (holo: BM; iso: LD).

Distribution: Africa, tropical Asia from India to Vietnam, northern Australian (W.A., N.T., Qld); ??

Habitat: free-floating aquatic; in billabongs and lagoons.

Flowering: June.

Abundance: rarely collected in N.T.

Proposed IUCN category: dd(a).

Utricularia subulata L.

Type: U.S.A., Virginia, *Clayton* 31 (holo: BM).

Distribution: almost pantropical extending to temperate areas; in Australia in N.T. & Qld; in NT known from Bathurst Island and near McMinns Lagoon.

Habitat: wet open grassland on the margins of drainage depressions.

Flowering: Mar.

Abundance: rare in NT.

Proposed IUCN category: e(b1,2)

Utricularia triflora P.Taylor

Type: McMinns Lagoon, SE of Darwin, N.T., *Must* 702 (K: holo; CANB, DNA,NT: iso.).

Distribution: endemic to N.T.; patchily distributed in the Top End (near Howard Springs, McMinns

Lagoon, near Maningrida, near Mataranka, near Dunmarra).

Habitat: amongst short grasses and sedges in sandy seasonal swamps. Apparently in areas inundated to 20 cm or more during the wet season, flowering once water has dried almost to ground level.

Flowering: May - Aug., later than most other species in seasonally dry habitats.

Abundance: uncommon.

Proposed IUCN category: NT.

Utricularia tubulata F.Muell.

Type: Cashmere, Qld, *Armit* 222 (MEL: holo; BM, BOG, K: iso.).

Distribution: W.A., N.T., Qld; in NT from Mary River to western Arnhem Land. One collection from W.A.

Habitat: suspended aquatic, in still or slow flowing pools, rivers and floodplains.

Flowering: Apr.-May.

Abundance: rarely collected.

Proposed IUCN category: dd(b)

Utricularia uliginosa Vahl

Type: East India, *Koenig* s.n. (holo: C; iso: LD).

Distribution: India to Australia (W.A., N.T., Qld, N.S.W.); widespread in the Top End.

Habitat: on organic and sandy substrates in permanently wet, boggy areas associated with spring-fed streams.

Flowering: all months.

Abundance: relatively common.

Proposed IUCN category: lc.