National Recovery Plan for the Curly Sedge *Carex tasmanica*

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Australian Government

State Government Victoria
Department of Sustainability and Environment

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Published by the Victorian Government Department of Sustainability and Environment (DSE) Melbourne, February 2010.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

ISBN 978-1-74208-774-0

This is a Recovery Plan prepared under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999, with the assistance of funding provided by the Australian Government.

This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Citation: Carter, O. 2010. National Recovery Plan for the Curly Sedge *Carex tasmanica*. Department of Sustainability and Environment, Victoria.

Cover photograph: *Carex tasmanica* by Oberon Carter.

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Summary

The Curly Sedge *Carex tasmanica* is a small, perennial, clumping sedge endemic to Victoria and Tasmania, growing in seasonally damp sites in grassland or grassy woodland. The species is currently known from about 60 sites and perhaps 500,000 or more plants. However, most plants occur in just two populations, with the remainder generally small and isolated. Much of its habitat has been converted to agriculture, and other populations have been lost to industrial and urban development. Major threats include heavy grazing, weed invasion, land use change and climate change. The Curly Sedge is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999. This national Recovery Plan for the Curly Sedge is the first recovery plan for the species, and details the species' distribution and biology, conservation status and threats, and recovery objectives and actions necessary to ensure its long-term survival.

Note:
The Curly Sedge is no longer considered threatened in Tasmania (S. Bryant, DPIW Tas pers. comm.). It was previously listed as Vulnerable under State legislation, but numerous populations have been discovered since the early 1990s. A subsequent assessment concluded that the Curly Sedge did not warrant listing as Vulnerable or Rare under Tasmanian legislation, and the species was subsequently removed from the schedules of the Tasmanian *Threatened Species Protection Act 1995*. As such, Tasmanian authorities do not consider there is justification to participate in a national recovery program for the Curly Sedge. Therefore, recovery actions in this plan refer to Victoria only.

Species Information

Species description

The Curly Sedge *Carex tasmanica* Kük. is a wiry, densely tufted, perennial sedge growing to 50 cm high. Culms are erect, terete, smooth, 15–20 cm long and 0.8 mm wide. Leaves are 1.5 mm wide, exceed the culms and are typically curled at the apex (hence the common name); the leaf-sheath is pale red-brown and the ligule spotted with red. The inflorescence is narrow and erect, 5–25 cm long, with 2–4 spikes solitary at nodes, the lowest spike often distant from the rest. The lowest involucral bracts exceed the inflorescence. Spikes are sessile or on short pedicels, distant, erect at maturity and 15–20 mm long. The upper 1–2 spikes are male; the lower 2–3 are female. Glumes are red-brown with a paler midrib, and have a rounded to notched apex that is often shortly mucronate. Female glumes are 2.2–3.5 mm long. Utricles (fruits) are 3 mm long, including the beak, 1.5 mm wide and ellipsoid. Leaves are glabrous, pale green to brown with red spots and have many faint parallel veins. Nuts are ellipsoid to obovoid, triangular in cross-section and dark-yellow brown. The species can produce a long rhizome (description from Wilson 1994). Very little is known of its ecology. The Curly Sedge apparently requires some disturbance for seed germination and/or seedling establishment, and there is anecdotal evidence that it may resprout after fire (Gilfedder & Kirkpatrick 1996). Persistence of populations at some sites may be mainly via division of adult plants or spread via rhizomes.

Distribution

The Curly Sedge occurs in Victoria, near Melbourne and in the far south-west, in the Victorian Volcanic Plain IBRA bioregion; and in south-eastern Tasmania, in the Tasmanian Northern Midlands and Tasmanian Southern Ranges IBRA bioregions (*sensu* DEH 2000) (Figure 1).

The precise distribution of Curly Sedge in Victoria is unclear due to confusion in identification with other similar species. Scattered records of Stream Sedge *Carex brownii* and Tussock Sedge *Carex iynx* from south-western Victoria might also include Curly Sedge, as the species are superficially similar (Cheal 1990). However, 19th century records of Curly Sedge from Whitestone Swamp (near Ballarat), Lake Jollicum Wildlife Reserve (near Streatham) and from Lake Omeo (near Benambra in far eastern Victoria) have been attributed to an undescribed species *Carex* sp. aff. *bichenoviana* (Morcom 1999).

Maps showing the distribution of the Curly Sedge in Victoria are available from the Department of Sustainability and Environment.

Habitat

The Curly Sedge grows in seasonally damp sites in grassland or grassy woodland. Mean annual rainfall across the known geographic range is generally in the 300–600 mm range, (rarely to 800 mm in the Portland area and the Tasmanian midlands) (Cheal 1990).

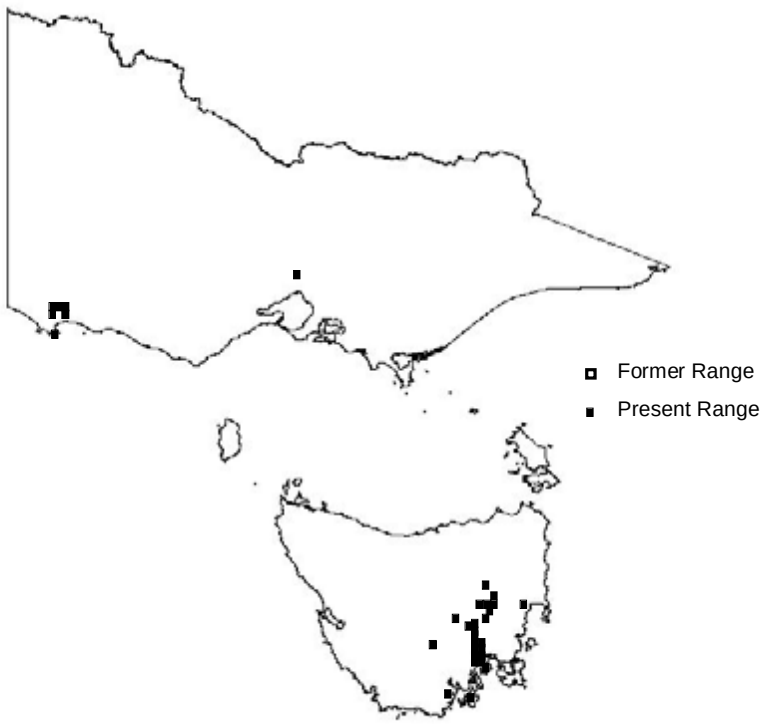

Figure 1. Distribution of Curly Sedge in Victoria and Tasmania.

In Victoria, Curly Sedge occurs in seasonally wet, fertile, heavy basalt clay soils, usually around the margins of slightly saline drainage lines or freshwater swamps. The dominant vegetation type varies, but is often grassy/sedgy and generally lacks trees, although Woolly Tea-tree *Leptospermum lanigerum* occurs close to a number of sites in the south-west. Native species commonly associated with Curly Sedge include *Eleocharis acuta*, *Isolepis cernua*, *Schoenus nitens* and *Selliera radicans.* Habitat is usually too wet to support otherwise dominant grasses such as *Poa labillardierei*. Curly Sedge is often restricted to a narrow ecological range on the margins of drainage depressions or swamps (Morcom 1999; see photo 1). These areas may correspond to optimal (or tolerable) soil moisture, drainage or flooding conditions, or an inability to compete with associated species at other topographic positions (eg. *Poa* species at higher, drier sites, or *Triglochin procerum* s.l. in lower, wetter sites). Curly Sedge can tolerate complete submersion, at least for short periods (see photo 2). Most Curly Sedge sites presently contain a high cover of introduced plants, including numerous introduced weed species such as *Arctotheca calendula*, *Critesion marinum*, *Holcus lanatus*, *Hypochoeris radicata*, *Juncus acutus* subsp. *acutus*, *Leontodon taraxacoides*, *Lolium* species, *Plantago coronopus*, *Ranunculus muricatus*, *Sonchus* species and *Trifolium fragiferum.*

In Tasmania, Curly Sedge is found in soaks and seepage lines on sandy clay loam soils within grasslands or grassy woodlands (Gilfedder 1991), usually in two broad floristic groupings (Gilfedder & Kirkpatrick 1996). One grouping occurring at higher elevation (mean 278 m ASL) is characterised by the presence of native species *Acaena novae-zelandiae*, *Veronica gracilis* and *Geranium solanderi*, and the introduced *Lolium perenne* and *Cirsium vulgare*. The second grouping comprises sites at lower elevation (mean 95 m ASL) and is characterised by the

presence of *Carex gunniana* and the introduced *Dipsacus sylvestris*. Commonly associated plants across most sites include *Poa labillardierei*, and many introduced species including *Holcus lanatus*, *Agrostis capillaris*, *Hypochoeris radicata*, *Leontodon taraxacoides*, *Sonchus asper* and various *Plantago* species.

Recovery actions include the survey and mapping of habitat critical to the survival of the species.

Photo 1. Curly Sedge occupying narrow belts of vegetation along both sides of Curly Sedge Creek at Craigieburn Nature Conservation Reserve (photo by O. Carter).

Photo 2. Completely submerged and living Curly Sedge at Craigieburn Nature Conservation Reserve (photo by O. Carter).

Population Information

The Curly Sedge is currently known from about 60 sites, 40 in Tasmania and 20 in Victoria, with a total of perhaps 0.5–1 million plants. The number of plants and extent of each population are difficult to estimate at some sites, due to the difficulty distinguishing between Curly Sedge and other sedges outside the flowering period. Plants can also spread by rhizomes, so some 'clumps' of plants may in fact just be a single clone. In Victoria, the species is still numerically abundant, but almost all plants occur in just two populations, both on private land in south-western Victoria (Table 1). Most sites in Victoria are on private land, with a few on roadsides and only one in a conservation reserve – Craigieburn Nature Conservation Reserve. Many Tasmanian sites are on roadsides or private land, with a few populations in conservation reserves and in council reserves.

Important sites necessary to the long term survival and recovery of the Curly Sedge have been identified for Victoria, but not for Tasmania (Table 1). Attributes used to determine importance include the likelihood of long-term ecological viability such as evidence of regeneration, population size, land tenure, patch and landscape condition and geographic location. It is important to note, however, that this does not imply that the remainder are not important, especially as little is known about the current condition of most populations.

Table 1. Important sites for conservation of the Curly Sedge in Victoria

Location	Land status	Comments
Victoria		
Macarthur	private land	est. 300,000+ plants (A. McMahon Ecology Australia, 2001)
Branxholme	private land	est. 22,000–330,000+ plants across 11 ha (pers. obs. 2003); estimate based on range of densities of adult plants (0.2–3 plants per m^2); estimated in 1 ha and extrapolated across site
Inverary Lane (east of Branxholme)	road reserve (DSE)	est. 1,000–5,000 plants across c. 1 ha (pers. obs. 2003)
Heywood	crown reserve (DSE)	est. 200–400 plants across c. 0.5 ha (pers. obs. 2003)
Hotspur-Condah Rd	95% private land 5% roadside (Portland Shire Council)	est. 50,000 plants (A. Pritchard DSE, 2003)
Lake Condah	private land (aboriginal community)	Pop. size unknown; cover-abundance of 1 is given in Appendix 1 of Aboriginal Affairs Victoria (1993)
Craigieburn Nature Conservation Reserve (NCR)	reserve (Parks Victoria)	est. 2,000–10,000+ plants along Curly Sedge Creek (pers. obs. 2003)
Craigieburn	private land	est. <100 plants; along Curly SedgeCreek south of Craigieburn NCR

Decline and Threats

The former abundance of Curly Sedge is not known, although it is reasonable to assume it was once common to abundant across its range, especially in south-western Victoria. The species occurs within areas heavily modified by agriculture, and much of its preferred habitat of seasonally damp sites in native grassland and grassy woodland has been lost or severely degraded since European settlement, due to agriculture and, to a lesser extent, urban and industrial development. Remaining sites where the species occurs invariably contain a high cover of introduced plants, and have been severely altered through vegetation clearing and altered drainage. Although the species remains numerically abundant, most plants occur in just two very large populations, both on private land in south-western Victoria. Most populations are small (>100 plants) and occur on private land and roadsides, with few populations and small numbers of plants occurring in any form of reserve (Table 1).

In Tasmania, prior to 1992, only 10 sites were known. However, over 40 new sites have been discovered since then (Ball 1995; L. Gilfedder & W. Potts DPIW pers. com.). The Curly Sedge was previously listed as Vulnerable under State legislation in Tasmania but was removed from State listing in the mid 1990s.

The main current threats to Curly Sedge are summarised as follows:

Weed invasion: Most Curly Sedge sites presently contain a high cover of introduced plants, both pasture grasses and weeds, and weed invasion is the greatest threat. The most problematic weeds include Sharp Rush *Juncus acutus* subsp*. acutus*, Cape Weed *Arctotheca calendula*, Artichoke Thistle *Cynara cardunculus*, needle-grasses *Nasella* species, Gorse *Ulex europaeus*, Boxthorn *Lycium ferocissimum*, Hawthorn *Crataegus monogyna*, Briar *Rosa rubiginosa*, Blackberry *Rubus fruticosus*, Silverweed *Potentilla anserina* and broadleaved flat weeds (e.g. *Hypochoeris radicata*). Pasture grasses such as Tall Wheatgrass *Lophopyrum ponticum* and Toowoomba Canary-grass *Phalaris aquatica* are also serious problems, although both are promoted as suitable pasture grasses in wet and/or saline discharge areas (Warn & Hunter 1996), despite being highly invasive in Victoria (Carr *et al*. 1992). Light grazing may control competition from introduced grasses, and cessation of grazing at presently grazed sites may be deleterious where introduced species are expected to subsequently increase and form closed swards upon release from grazing.

Altered hydrological regimes: Further modifications to drainage patterns or flooding regimes at sites supporting Curly Sedge are likely to be detrimental, since the species is usually confined to a narrow ecological range on the damp margins of drainage depressions or swamps (Morcom 1999). The Curly Sedge has also been observed completely submerged (pers. obs.), although it is not known how long plants can tolerate such inundation. Permanent drying (or flooding) of creeks and swamps inhabited by Curly Sedge are likely to destroy populations, given their apparent habitat specificity to certain soil moisture and/or drainage conditions.

Grazing: The issue of grazing and Curly Sedge conservation is a complex one. In Tasmania, the species does persist, and sometimes even thrives, on degraded sites under certain livestock grazing regimes (W. Potts DPIW Tas Pers. comm.). Curly Sedge appears to tolerate some level of grazing by sheep but not cattle grazing (Gilfedder & Kirkpatrick 1996). At one of the two largest known populations, on private land at Branxholme, plant numbers have steadily increased for at least the last 23 years under controlled grazing (David Fenton Branxholme; pers comm.). This site (which has not been plowed for at least 60 years) is seasonally grazed lightly by sheep (average of c. 9 sheep/ha). Curly Sedge may have flourished at that site because the sheep preferentially graze introduced pasture grasses and clovers over Curly Sedge, reducing competition, and grazing is mostly excluded over summer, allowing new seedlings of Curly Sedge to establish. Craigieburn Nature Conservation Reserve is also lightly grazed at low stocking rates by sheep (c. 2.5 sheep/ha) and kangaroos (c. 0.25 kangaroos/ha), to reduce competition from pasture grasses and other weedy species, and promote maintenance of a diverse open native grassland community. Seedling establishment has been observed at both the Branxholme and Craigieburn sites under prevailing grazing regimes.

It is likely that light seasonal grazing creates a degree of disturbance that is apparently necessary for Curly Sedge regeneration (L. Gilfedder DPIW pers. comm.), as well as reducing competition from pasture grasses and weeds. Cessation of grazing at presently grazed sites may be deleterious to Curly Sedge, as introduced species will subsequently increase and possibly form closed swards upon release from grazing.

Conversely, heavy grazing, especially by cattle, is detrimental. During winter, soil pugging is likely to severely degrade habitat and trample first-year plants, and summer grazing is likely to reduce seedling recruitment. At the Macarthur (Vic.) site, a section of land where Curly Sedge occurred was compulsorily acquired to permit a gas pipeline development. Plants were removed from the site prior to the pipeline being built, and were re-introduced to the site after the pipe was completed. However, cattle grazing subsequently destroyed most of the re-introduced plants. Investigation of suitable grazing regimes for persistence of Curly Sedge and its wetland habitat is included as an action in this Recovery Plan.

Changing land use: While some grazing regimes may be compatible with (and indeed desirable for) Curly Sedge conservation, changing agricultural activities such as from grazing to cropping may pose a severe threat. Cropping (especially raised bed agriculture) is likely to disturb the soil, destroy plants and habitat, and alter drainage regimes.

Roadworks: Many populations are found on or close to roadsides, and are at risk from works such as road maintenance or widening, vehicle movement, fence construction and maintenance, and cable installation and servicing. Gravel dumping on roadsides, or firebreak construction can also damage populations.

Climate change: Virtually all of the range of the Curly Sedge is likely to be affected by climate change, through increased temperatures, increased evaporation rates and decreased rainfall. This will lead to further loss of habitat, as the seasonally wet sites favoured by the species gradually dry out. This is likely to reduce opportunities for growth, flowering, seed set and especially recruitment, which will to lead to long-term population declines and local extinctions. Loss of habitat caused by greenhouse gas emissions is listed as a Key Threatening Process under the EPBC Act.

Recovery Information

Existing Conservation Measures

Several initiatives to conserve the Curly Sedge are already occurring, including:

- Fencing, sympathetic grazing and weed control at the Branxholme (Vic) private land site and Craigieburn Nature Conservation Reserve.
- Several private land sites in Tasmania where Curly Sedge occurs are under conservation covenant or being managed under conservation management agreements with landowners.
- Invasive willow *Salix* species removal at the Heywood township site.
- Revegetation of several roadsides in the Portland area using Curly Sedge.
- An ecological study of the species was conducted in the mid-1990s (Gilfedder & Kirkpatrick 1996).

Recovery Objectives

The **overall objective** of recovery is to minimise the probability of extinction of the Curly Sedge in the wild and to increase the probability of the smaller important populations becoming self-sustaining in the long term.

Within the life span of this Recovery Plan, the **specific objectives** of recovery for Curly Sedge are to:

1. Determine distribution, abundance and population structure
2. Identify habitat requirements
3. Ensure that important populations and their habitat are protected and managed appropriately
4. Manage threats to populations
5. Identify key biological functions
6. Determine the growth rates and viability of populations
7. Build community support for conservation

Program Implementation

This Recovery Plan guides recovery actions and will be managed by the Department of Sustainability and Environment in Victoria and Department of Primary Industries and Water Resources in Tasmania. A Threatened Flora Recovery Team, consisting of scientists, land managers and field naturalists will be established to oversee threatened flora recovery in south-eastern Australia. Technical, scientific, habitat management or education components of the Recovery Plan will be referred to specialist sub-committees on research, *in situ* management,

community education and cultivation. Regional Recovery Teams will be responsible for preparing work plans and monitoring progress toward recovery.

Program Evaluation

The Recovery Team will be responsible for annual assessments of progress towards recovery. This Recovery Plan will be reviewed within five years of the date of its adoption under the EPBC Act.

Recovery Objectives, Actions and Performance Criteria

No.	Action	Performance Criteria
Specific Objective 1: Determine distribution, abundance and population structure		
1.1	Determine the identity of doubtful records of *Carex* species to enable an accurate assessment of distribution. **Responsibility: DSE/RBG**	• The taxonomic identity of *Carex* species at Whitestone Swamp, Lake Jollicum and Lake Omeo (Vic) confirmed to determine possible new populations of *C. tasmanica.*
1.2	Acquire baseline population data by conducting detailed field surveys including (a) identification of the area and extent of populations; (b) estimates of the number, size and structure of populations and (c) inference or estimation of population change. **Responsibility: DSE**	• Surveys of populations determine area occupied/number of plants.
1.3	Map existing and new populations. **Responsibility: DSE**	• Population maps prepared and used in conservation management.
Specific Objective 2: Identify habitat requirements		
2.1	Survey known habitat and collect floristic and environmental information describing community ecology and condition. **Responsibility: DSE**	• Habitat critical for survival identified and defined.
2.2	Identify and survey potential habitat, using ecological and bioclimatic information indicating habitat preference. **Responsibility: DSE**	• Predictive model for potential habitat developed and tested.
2.3	Map areas of important and potentially suitable habitat. **Responsibility: DSE**	• Habitat critical for survival and potential habitat mapped.
Specific Objective 3: Ensure that important populations and their habitat are protected and managed appropriately		
3.1	Incorporate protective actions in relevant park or reserve management plans. **Responsibility: DSE/PV**	• Actions to protect species incorporated in relevant management plans.
3.2	Negotiate land management agreements, including Conservation Covenants, with private landowners for the protection of important populations on private land, and incorporate actions to protect important populations on private land into local government documents and procedures. **Responsibility: DSE/LGA**	• Voluntary conservation agreements negotiated conservation covenants on the most important populations. • Important populations on private land have effective statutory protection.
3.3	Negotiate Public Authority Management Agreements for important populations on public land. **Responsibility: DSE**	• Important populations on public land have effective statutory protection.

Specific Objective 4: Manage threats to populations		
4.1	Identify current and potential threats to the species and its habitat. **Responsibility: DSE**	• Prescriptions prepared for threat abatement.
4.2	Control threats from pest plants including woody weeds and introduced grasses at key sites. **Responsibility: DSE/PV/LGA/landowners**	• A measurable reduction in the area impacted by weeds and Curly Sedge population sizes maintained (or increased) at treated sites.
4.4	Identify appropriate disturbance regimes (especially grazing and fire) to maintain habitat and promote Curly Sedge population maintenance or increase. **Responsibility: DSE/PV**	• Preparation and implementation of grazing and fire management prescriptions for persistence of key populations and habitat.
Specific Objective 5: Identify key biological functions		
5.1	Evaluate current reproductive and regenerative status, including seed bank status, of each population and determining longevity, fecundity and recruitment levels. **Responsibility: DSE**	• Seed bank/regenerative potential quantified for each population.
5.3	Investigate impacts of soil disturbance, fire, salinity and soil moisture on flowering, seed set and recruitment. **Responsibility: DSE**	• Management strategies identified to maintain, enhance or restore processes fundamental to reproduction and survival.
Specific Objective 6: Determine the growth rates and viability of populations		
6.1	Develop population monitoring protocols. **Responsibility: DSE**	• Techniques for monitoring developed and implemented.
6.2	Monitor population trends and responses against recovery actions at key sites including Craigieburn, Macarthur and Branxholme. **Responsibility: DSE**	• Annual census data collected, population growth rates determined and Population Viability Analysis completed.
Specific Objective 7: Build community support for conservation		
7.1	Identify opportunities for community involvement in the recovery plan. **Responsibility: DSE**	• Presentation(s) to community nature conservation groups. • Inform private landholders of fencing incentives provided by DSE and the threatened species network. • Educate local shires, including contractors of roadside work.

Abbreviations: DSE –Department of Sustainability and Environment (Vic); LGA – local government authorities; PV – Parks Victoria; RBG – Royal Botanic Gardens, Melbourne

Affected interests

Important populations of Curly Sedge are managed by Parks Victoria, DSE, and private landholders. These managers have been contacted and have approved the actions outlined in this recovery plan subject to availability of sufficient funding.

Role and interests of indigenous people

Indigenous communities on whose traditional lands the Curly Sedge occurs in Victoria are being advised, through the relevant DSE Regional Indigenous Facilitator, of this Recovery Plan. Indigenous communities in Victoria will be invited to be involved in the implementation of the Recovery Plan.

Benefits to other species/ecological communities

The Recovery Plan includes a number of potential biodiversity benefits for other species and vegetation communities in Victoria. Principally, this will be through the protection and management of habitat. The adoption of broad-scale management techniques and collection of baseline data will also benefit a number of other plant species growing in association with Curly Sedge, particularly those species with similar life forms and/or flowering responses. In south-western Victoria Curly Sedge grows near the nationally threatened Gorae Leek-orchid *Prasophyllum diversiflorum* (Ingeme & Govanstone 1999). Protection of Curly Sedge habitat is also likely to benefit Adamson's Bent *Lachnagrostis adamsonii* at Craigieburn Nature Conservation Reserve (Morcom 1999). Other threatened species recorded near Curly Sedge in similar habitat include Tough Scurf-pea *Cullen tenax*, Plump Swamp Wallaby-grass *Amphibromus pithogastrus* and Plains Yam-daisy *Microseris* species. Stands of Curly Sedge at Craigieburn, Victoria are also within or surrounded by Western Basalt Plains Grassland, a community Listed as threatened under the Victorian *Flora and Fauna Guarantee Act* 1988. The Recovery Plan will also provide an important public education role as threatened flora have the potential to act as 'flagship species' for highlighting broader nature conservation and biodiversity issues such as land clearing, grazing, weed invasions and habitat degradation.

Social and economic impacts

The implementation of this Recovery Plan is unlikely to cause significant adverse social and economic impacts. Most sites where the species occurs, including the two biggest sites, occur on private land. One of these two sites is already being managed in a manner consistent with conservation of the Curly Sedge, and the manager of the second site is aware and supportive of the protection of Curly Sedge. Voluntary agreement for conservation will be sought with landowners and managers for populations identified as important. Financial and other incentives made available through various schemes provide assistance which will help offset costs such as fencing and/or reduced grazing opportunities. Social issues may be overcome at least partly by extension work that educates landholders of wider conservation issues and contributes to positive changes in landholder perceptions of biodiversity conservation.

Management Practices

On-ground site management will aim to mitigate threatening processes and thereby insure against extinction. Major threats requiring management include accidental destruction and competition from pest plants. Further modifications to drainage patterns or flooding regimes at sites supporting Curly Sedge are likely to be especially detrimental, given the apparently narrow ecological band on the margins of drainage depressions or swamps in which the species occurs. A range of strategies will be necessary to alleviate these threats including protective fencing, signage, weed control, and fire management. Broadscale protection measures applicable to all populations include legal protection of sites, habitat retention and liaison with land managers including private landholders. In addition, searches of known and potential habitat should continue to better define the distributions and size of populations.

The Recovery Plan also advocates strategies to fill some of the major gaps in our knowledge to date. These include an understanding of the mechanisms underlying recruitment and regeneration. Successful *in situ* population management will be founded on understanding the

relationships between Curly Sedge and associated flora, and its response to environmental processes. Demographic censusing will be necessary to gather life history information and to monitor the success of particular management actions. In addition, *ex situ* conservation measures will be a useful adjunct and will include seed storage. Community participation in recovery actions will be sought, particularly in regard to recovery team membership and implementation of on-ground works.

Management practices required for conservation of the Curly Sedge include:

- Identification and protection of remnant populations in highly vulnerable locations.
- Management of grazing to enable populations to persist and flourish.
- Control of pest plants.
- Identification and protection of populations in instruments such as public land management plans and planning overlays under local government procedures.
- Investigation of the biology and ecology of the species to enable better targeted conservation management actions.

Acknowledgments

The author would like to thank Judy Bush (Merri Creek Management Committee); David Fenton (Branxholme); Fiona Coates, Mike Duncan, Andy Govanstone, Andrew Pritchard and Michelle Tumino (Department of Sustainability and Environment); Sally Bryant, Louise Gilfedder, Eve Lazarus and Wendy Potts (Department of Primary Industries and Water, Tasmania) and Rod Hill (Parks Victoria).

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Priority, Feasibility and Estimated Costs of Recovery Actions

Action	*Description*	*Priority*	*Feasibility*	*Responsibility*	*Cost estimate*					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	**Distribution, abundance**				$0	$0	$0	$0	$0	$0
1.1	Clarify taxonomic identity	1	100%	DSE, RBG	$5,000	$5,000	$0	$0	$0	$10,000
1.2	Collect baseline data	1	100%	DSE	$10,000	$10,000	$10,000	$10,000	$10,000	$50,000
1.3	Map populations	1	100%	DSE	$5,000	$5,000	$5,000	$5,000	$5,000	$25,000
2	**Habitat requirements**				$0	$0	$0	$0	$0	$0
2.1	Survey known habitat	1	100%	DSE	$10,000	$10,000	$0	$0	$0	$20,000
2.2	Identify, survey potential habitat	1	75%	DSE	$0	$10,000	$10,000	$0	$0	$20,000
2.3	Map habitat	1	100%	DSE	$10,000	$10,000	$10,000	$0	$0	$30,000
3	**Habitat protection**				$0	$0	$0	$0	$0	$0
3.1	Protect public land habitat	1	75%	DSE	$30,000	$30,000	$0	$0	$0	$60,000
3.2	Protect private land habitat	1	50%	DSE	$30,000	$30,000	$30,000	$30,000	$30,000	$150,000
3.3	PAMAs	1	100%	DSE/LGA	$0	$8,000	$0	$0	$0	$8,000
4	**Threat management**				$0	$0	$0	$0	$0	$0
4.1	Identify current threats	1	75%	DSE/PV	$30,000	$20,000	$20,000	$0	$0	$70,000
4.2	Control threats	1	75%	DSE/PV	$20,000	$20,000	$20,000	$10,000	$10,000	$80,000
4.3	Identify disturbance regimes	1	75%	DSE	$0	$20,000	$20,000	$20,000	$0	$60,000
5	**Biology, ecology**				$0	$0	$0	$0	$0	$0
5.1	Evaluate reproduction, fecundity	2	75%	DSE	$0	$10,000	$10,000	$10,000	$0	$30,000
5.2	Investigate flowering factors	2	75%	DSE	$0	$10,000	$10,000	$10,000	$0	$30,000
6	**Growth rates, viability**				$0	$0	$0	$0	$0	$0
6.1	Develop monitoring protocols	1	100%	DSE	$2,000	$0	$0	$0	$0	$2,000
6.2	Monitor population trends	1	100%	DSE	$3,000	$3,000	$6,000	$6,000	$8,000	$26,000
7	**Community support**				$0	$0	$0	$0	$0	$0
7.1	Community extension	1	100%	DSE	$4,000	$4,000	$4,000	$4,000	$4,000	$20,000
				TOTALS	$159,000	$205,000	$155,000	$105,000	$67,000	$691,000