The fauna of buttongrass moorland

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Buttongrass moorland: a World Heritage ecosystem

The buttongrass moorland ecosystem is unique to Tasmania and has only recently been recognised as having World Heritage value. Three key features of this ecosystem contribute to its World Heritage status. Firstly, it comprises the only extensive vegetation type dominated by a hummock-forming tussock sedge known as buttongrass (*Gymnoschoenus sphaerocephalus*) (Balmer *et al.,* 2004). Secondly, the peats are primarily formed from sedges and shrubs (Hannan *et al.,* 1993), whereas the vast majority of the world's peatlands are formed from *Sphagnum* moss (Gore 1983a, b). Thirdly, the presence of burrowing crayfish living in the acidic peats is highly unusual world-wide (Pemberton *et al.*, 2005). Another important feature of the buttongrass moorland ecosystem is that much of it is largely undisturbed by the impacts associated with post-European settlement of Tasmania.

Buttongrass moorland vegetation

Buttongrass moorland vegetation covers more than half a million hectares, primarily in western Tasmania where it is a significant landscape feature. Buttongrass moorland is a treeless sedgey vegetation typically dominated by (but not always containing) buttongrass (Jarman *et al.,* 1988). Nearly two-thirds of all buttongrass moorland in Tasmania is protected within the Tasmanian Wilderness World Heritage Area (Balmer *et al.,* 2004). It is a variable vegetation type with 25 communities currently recognised (Jarman *et al.,* 1988). There are two main types, blanket moor and eastern moor. Blanket moor (Figure 1), as its name suggests, 'blankets' the landscape extending from flats onto slopes, ridges and plateaux, and occurs widely across western Tasmania. Blanket moor typically contains more shrubs than eastern moor and is associated with low fertility soil types. Eastern moor (Figure 2) is restricted to poorly drained flats and gentle slopes on more fertile soil types, and has its largest extent on the Central Plateau.

Buttongrass moorland habitat

As habitat, buttongrass moorland is a challenging place for animals to live.

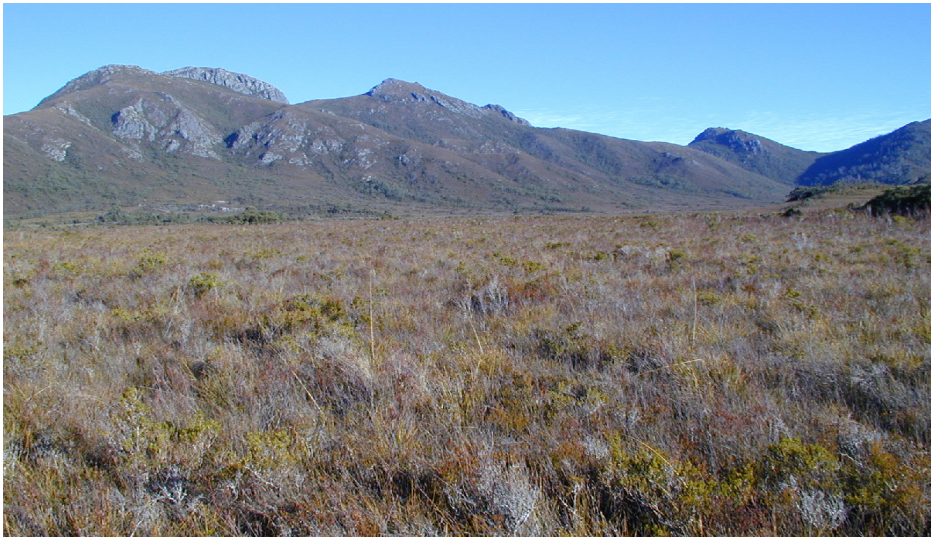

Figure 1. Blanket moor. Photo: M. Driessen.

Figure 2. Eastern moor. Photo: M. Driessen.

The peat is highly acidic (pH 3.5-4.5; Hannan *et al.,* 1993) and the soil surface may be dry cracked and hard in summer and inundated with water in winter. Hard-leafed plants that are low in nutrient value dominate the vegetation; indeed, buttongrass itself has the lowest recorded phosphorous levels in its foliage of any plant species (MacLean, 1978; Bowman *et al.,* 1986). Buttongrass moorland vegetation is highly flammable and may be the most flammable vegetation type in the world (Marsden-Smedley *et al.,* 1999) and was probably frequently burnt by Aborigines prior to European settlement (Marsden-Smedley, 1998). The lack of structural and floristic diversity of the vegetation further limits the habitat for fauna. As a result the diversity and abundance of fauna in this habitat is relatively low yet it has its own characteristic elements.

Fauna

Vertebrate fauna

Few of Tasmania's vertebrate animals are known to spend their entire lifecycle within buttongrass moorland (Table 1) and most of these species also occur in other habitats. Buttongrass moorland is the primary habitat in Tasmania for four species of vertebrate, the broad-toothed mouse (*Mastacomys fuscus* - Figure 3), the ground parrot (*Pezoporus wallicus*), the striated fieldwren (*Calamanthus fuliginosus*) and the southern emu-wren (*Stipiturus malachurus*).

Figure 3. Broad-toothed mouse *Mastacomys fuscus*. Photo: M. Driessen.

Table 1. Native vertebrates of buttongrass moorlands. List excludes rarely occurring species that have limited association with buttongrass moorland. D = species occurrence in Tasmania is dependent or largely dependent on buttongrass moorland. L = species that spend their entire life-cycle in buttongrass moorland. M = migratory species. E = species endemic to Tasmania. Bird data modified from Brown *et al*. (1993) and with additions provided by T. Chaudhry, University of Tasmania (unpublished data).

Swamp antechinus	*Antechinus minimus*	L
Eastern quoll	*Dasyurus viverrinus*	E
Bennett's wallaby	*Macropus rufogriseus*	
Broad-toothed mouse	*Mastacomys fuscus*	D, L
Swamp rat	*Rattus lutreolus*	L
Tasmanian devil	*Sarcophilus harrisii*	E
Echidna	*Tachyglossus aculeatus*	
Wombat	*Vombatus ursinus*	
Tasmanian thornbill	*Acanthiza ewingii*	E
Richard's pipit	*Anthus novaeseelandiae*	
Sulphur-crested cockatoo	*Cacatua galerita*	
Striated field wren	*Calamanthus fuliginosus*	D, L
Marsh harrier	*Circus approximans*	M
Forest raven	*Corvus tasmanicus*	
Brown falcon	*Falco berigora*	
Latham's snipe	*Gallinago hardwickii*	M
Welcome swallow	*Hirundo neoxena*	M
Tree martin	*Hirundo nigricans*	M
Yellow-throated honeyeater	*Lichenostomus flavicollis*	E
Superb fairy-wren	*Malurus cyaneus*	
Dusky robin	*Melanodryas vittata*	E
Orange-bellied parrot	*Neophema chrysogaster*	D, M
Ground parrot	*Pezoporus wallicus*	D, L
New Holland honeyeater	*Phylidonyris novaehollandiae*	
Crescent honeyeater	*Phylidonyris pyrrhoptera*	
Beautiful firetail	*Stagonopleura bella*	
Southern emu-wren	*Stipiturus malachurus*	D, L
Black currawong	*Strepera fuliginosa*	E
She-oak skink	*Cyclodomorphus casuarinae*	L, E
White-lipped snake	*Drysdalia coronoides*	L
Metallic skink	*Niveoscincus metallicus*	L
Tiger snake	*Notechis scutatus*	L
Southern grass skink	*Pseudemoia entrecasteauxii*	L
Common froglet	*Crinia signifera*	L
Tasmanian froglet	*Crinia tasmaniensis*	L, E
Smooth froglet	*Geocrinia laevis*	L
Tasmanian tree frog	*Litoria burrowsae*	L, E
Brown tree frog	*Litoria ewingii*	L
Swamp galaxias	*Galaxias parvus*	D, L, E

In addition, the endangered, migratory orange-bellied parrot (*Neophema chrysogaster*) is dependent on buttongrass moorland for feeding during its breeding season and nests in adjacent forest vegetation (Brown and Wilson, 1984). The ground parrot is a particularly remarkable inhabitant of these moorlands, being one of only three ground-dwelling parrots in the world and buttongrass moorland is its stronghold in Australia (Bryant, 1991). The broad-toothed mouse is the only mammal species that is restricted to western Tasmania where it occurs primarily in buttongrass moorland from sea level to 1000 m (Driessen, 2002). Although the swamp antechinus (*Antechinus minimus*) occurs in other habitats in Tasmania, notably coastal heathland, buttongrass moorland is the stronghold for the species in Australia. Nearly half of Tasmania's frogs are also recorded. The brown tree frog (*Litoria ewingi*), Tasmanian froglet (*Crinia tasmaniensis*) and common froglet (*Crinia signifera*) are widely distributed in buttongrass moorland. The endemic Tasmanian tree frog (*Litoria burrowsae*) is restricted to western Tasmania and has its greatest population densities in buttongrass moorland.

Several mammal and bird species, such as wombat (*Vombatus ursinus*), Bennetts wallaby (*Macropus rufogriseus*), eastern quoll (*Dasyurus viverrinus*), echidna (*Tachyglossus aculeatus*), wedge-tailed eagle (*Aquila audax*), black currawong (*Strepera fuliginosa*) and New Holland honeyeater (*Phylidonyris novaehollandiae*), use buttongrass moorland habitat for feeding and typically shelter in other habitats. Copses growing on peat mounds and other dry vegetation copses within buttongrass moorlands may be particularly important for many of these species as they provide vegetation cover and/or dry soil for nesting and shelter within the habitat mosaic. Other vertebrate species, including southern brown bandicoot (*Isoodon obesulus*), brushtail possum (*Trichosurus vulpecula*), eastern pygmy possum (*Cercatetus nanus*), fan-tailed cuckoo (*Cacomantis flabelliformis*), masked lapwing (*Vanellus miles*) and white-breasted sea-eagle (*Haliaeetus leucogaster*) are rare users of, or visitors to, buttongrass moorland.

Invertebrate fauna

Until recently, there has been little systematic survey of invertebrate fauna in buttongrass moorland. Over the past seven years knowledge of the terrestrial invertebrate fauna has substantially improved (Greenslade and Smith, 1999; Driessen and Greenslade, 2004; Mallick and Driessen, 2005; M. Driessen, DPIW unpublished data). A monthly survey of invertebrates in buttongrass moorlands over 12-months resulted in a collection of nearly 60 000 invertebrates representing 27 major taxa (typically Order level), 233 families and over 1100 species/morphospecies (M. Driessen, DPIW unpublished data). Within

the limits of the sampling methods used in this survey (pitfall traps and sweep nets), the terrestrial invertebrate fauna of buttongrass moorland is numerically dominated by springtails (Collembola: Katiannidae, Isotomidae, Bourletiellidae Katianninae), flies (Diptera: Chironomidae, Muscidae, Ceratopogonidae, Sciaridae), spiders (Araneae: Tetragnathidae, Araneidae, Thomisidae), mites (Acarina: Parakalummatidae, Uropodidae), crickets (Orthoptera: Gryllidae) and ants (Hymenoptera: Formicidae, subfamily Dolichoderinae). The most diverse groups recorded, in terms of number of families and morphospecies, are flies, wasps, spiders, mites, beetles, moths, bugs and springtails (Table 2).

Unlike many other habitats the diversity and abundance of beetles (98 species) and ants (11 species) is relatively low. Presumably the limited number and diversity of trees and shrubs and a poorly developed litter layer restricts their diversity. The acidic and poorly drained soils also limit nesting opportunities for ants, as well as other insects with a soil dwelling life-stage, however jack jumper (*Myrmecia* sp.) nests, raised above the water level, are a conspicuous feature in some areas of buttongrass moorland.

Table 2. An indication of family and morphospecies diversity of terrestrial invertebrate taxa most commonly recorded in sweep and pitfall samples taken from buttongrass moorland. Data based on 12 months of monthly samples from 40 pitfall samples and 8 sweep net samples (M. Driessen, DPIW, unpublished data).

Taxon	No. Families	No. Species/Morphospecies
Diptera (flies)	36	290
Acarina (mites)	35	68
Hymenoptera (wasps/ants)	31	266
Araneae (spiders)	29	290
Coleoptera (beetles)	25	98
Lepidoptera (moths/butterflies)	17	62
Hemiptera (bugs)	13	23
Collembola (springtails)	12	51

Only about 10-15% of the species/morphospecies summarised in Table 2 have been assigned formal species names. Although some of the morphospecies are certainly new to science (several of the sampled spiders and caddis-flies have been described as new species), it is not known what proportion are new species and what proportion simply could not be assigned to a named species by the specialists identifying the specimens.

Freshwater invertebrates of buttongrass moorland have probably received greater attention than their terrestrial counterparts with the burrowing crayfish rightly taking centre stage. Until recently one species of burrowing crayfish (*Parastacoides tasmanicus* - Figure 4) was considered to be widespread and typical of buttongrass moorland, but a taxonomic revision of this species has split this crayfish taxon into two genera and about twelve species (Hansen and Richardson, in press).

Figure 4. The burrowing crayfish *Parastacoides tasmanicus*. Photo: M. Driessen.

Burrowing crayfish have been recognised as keystone species in buttongrass moorland because of their fundamental role in this ecosystem (Brown *et al.,* 1993). Their burrowing activity has significant effects on the whole ecosystem through its influence on soil condition, and subsequently on plant growth and habitat formation for other animals. The large surface area of underground burrows represents an important avenue of gas exchange for plant roots in peat soils, which are often waterlogged and otherwise anaerobic (Brown *et al.,* 1993). The metabolism of the peat immediately surround-

ing the burrow is enhanced, though this effect dies away within a few centimetres of the tunnel (Richardson, 1983). The burrows also carry water from the subsoil to the surface, or occasionally the reverse (Brown *et al.,* 1993). In summer and early autumn, when water levels drop and surface waters disappear, crayfish burrows represent the only available water for aquatic species.

Crayfish burrows provide habitat for a discrete fauna, the pholeteros (Lake, 1977), which is numerically dominated by nematodes, oligochaetes, copepods, isopods and amphipods (Brown *et al.,* 1993). Two species of syncarid crustaceans, *Allanaspides hickmani* and *A. helonomus* that have a close association with crayfish burrows are of particular scientific interest because: they are very primitive among the higher crustaceans, they possess an unusual structure called the 'fenestra dorsalis', they have Gondwanic origins, and their present day distributions may help understand past hydrological features and processes in the region.

Pools in buttongrass moorland also provide habitat for the rare, endemic dragonfly *Synthemiopsis gomphomacromioides*. This species, which is the only member of its genus, is of scientific interest as it is the most primitive member of its family and because of its Gondwanic origins.

Rare or Threatened Species

Buttongrass moorland provides habitat (shelter, nesting, and/or food) for several species listed as rare or threatened under the Tasmanian Threatened Species Protection Act 1995: orange-bellied parrot, wedge-tailed eagle, Tasmanian devil (*Sarcophilus harrisii*), swamp galaxias (*Galaxias parvus*), *Allanaspides hickmani* and two species of caddis-fly (*Taskiria mccubbini*, *Taskiropsyche lacustris*). Of these species, only swamp galaxias, *Allanaspides hickmani* and the caddis-flies are restricted to buttongrass moorland and the orange-bellied parrot is dependent on this habitat for food during its breeding season. *Allanaspides hickmani* occurs only in pools in buttongrass moorland near Lake Pedder and Lake Gordon in southwest Tasmania and it has been estimated that 85-95% of its habitat was lost with the flooding of buttongrass moorland for hydro-electric power generation (Driessen *et al.,* in press). The total extant area of occupancy for *Allanaspides hickmani* is only 21 km^2. The two threatened caddis-flies were thought to be extinct following the flooding of the original Lake Pedder, but surveys in 1998 and 1999 found both species in buttongrass moorland adjacent to Lake Pedder (Jackson, 2000). The swamp galaxias is restricted to slow-flowing swampy streams and soft-bottom pools near Lake Pedder (Jackson, 2004). Like the *Allanaspides hickmani*, the caddis-flies and swamp galaxias have naturally restricted distributions and have lost significant areas of habitat through inun-

dation. The orange-bellied parrot breeds only in southwest Tasmania during summer and migrates to the Australian mainland during winter. Since 1991 the size of the wild population has not exceeded 200 mature birds (Orange-belled Parrot Recovery Team, 1998). Threats include loss of critical winter habitat and food supply, and competition with and predation by introduced animals.

Endemism

It would appear that there are relatively few fauna species that are entirely restricted to buttongrass moorland. No vertebrate species is entirely restricted to buttongrass moorland, although few of Tasmania's vertebrate species are restricted to any one particular habitat, reflecting the State's small size, glacial history and relatively recent isolation from the Australian mainland. Similarly, few invertebrates are currently known to be restricted to buttongrass moorland; however, this may be due to taxonomic identification issues and limited systematic invertebrate surveys. But it is also possible that this is because the origins of this habitat are relatively recent or its extent was very restricted in the past. Little is known about the palaeo-origins and past extent of buttongrass moorland vegetation because fossil cyperaceous pollen has often not been identified beyond the family level. There is some evidence to suggest that a community similar in structure and ecology to modern buttongrass moorland occurred in the Oligocene-Miocene period (ca 38 mya) (Blackburn, 1985). The earliest pollen of buttongrass to have been identified from the fossil record was dated from the most recent glacial, in the Lake Ooze deposit (ca 18 kya) (Macphail and Colhoun, 1985), and 1.6 million year old leaf fragments of buttongrass have been found in Victoria (G. Jordan, University of Tasmania, pers. comm.).

Management

Buttongrass moorland is well reserved in Tasmania, with 66% in secure conservation reserves and much of its distribution within the Tasmanian Wilderness World Heritage Area (Balmer *et al.,* 2004). As a consequence there is only a limited number of management issues relating to buttongrass moorland, but these include fire, disease, and global warming.

Fire

Buttongrass moorland is very flammable and occurs adjacent to fire-sensitive vegetation (eg rainforest), and is underlain by peat that will also burn, and be lost, when soil moisture is low. Although buttongrass moorland may be the climax vegetation in some situations (Pemberton, 1989), its current extent appears to represent an anthropogenic disclimax with fire extending

its distribution far beyond its natural edaphic limits (Jackson, 1968). There is substantial evidence that Aborigines must have regularly burned parts of western Tasmania for a considerable period of time (Thomas, 1993) to encourage game and to increase their ease of movement. It is argued that burning was probably performed during wetter seasons in moorland vegetation and that this frequent low intensity fire regime would have minimised the probability of broad-scale fire events and so avoided the burning of fire-sensitive vegetation (Marsden-Smedley, 1998; Marsden-Smedley and Kirkpatrick 2000). Since European settlement, there has been a reduction in fire frequency leading to increased biomass in buttongrass moorlands. Major regional-scale conflagrations in the 1890s and 1930s followed long periods without fire, resulting in very large areas of buttongrass being burnt at one time and the loss of fire sensitive vegetation (Marsden-Smedley and Kirkpatrick, 2000).

Several options for fire management in buttongrass moorland of western Tasmania have been summarised (King, 2004). The first option is to do nothing or 'benign neglect' (Brown, 1996) which allows the build up of fuels to high levels. This runs the risk of major 'hot' wildfires during summer (ignited either by lightning strikes or accidentally or illegally lit fires) which cannot be controlled, and which may lead to the loss of fire-sensitive vegetation and peat. A second option would be to contain all summer fires as soon as possible after they occur - an option not practical in the remote and inaccessible areas typical of most of western Tasmania. The third option would be to impose a regime of prescribed burning to minimise the risk to fire-sensitive vegetation, property and lives during wildfire events. Marsden-Smedley and Kirkpatrick (2000) proposed a combination of broad-scale ecosystem-management burning, with the intent of developing a mosaic of fire sizes and moorland vegetation ages, together with tactical hazard-reduction burning and wildfire suppression zones. This proposal provides a compromise between maintaining buttongrass moorland biodiversity extensively across most areas whilst simultaneously protecting fire sensitive vegetation. They suggest that broad-scale ecosystem-management burning on about a 20-year rotation has a high probability of maintaining ecological values in buttongrass moorlands, and would have strong similarities with what they understand to have been indigenous fire regimes.

Currently, limited areas of buttongrass moorland (estimated to be less than 2%) are subject to tactical hazard reduction burning and are strategically targeted to protect nearby fire-sensitive vegetation, life and property. The Parks and Wildlife Service is currently considering strategies for broad-scale management burning in buttongrass moorland, taking into account recent research on the effects of fire on

plants, animals and soils (currently undertaken by the Department of Primary Industries and Water, the University of Tasmania and the University of Melbourne).

Phytophthora

Phytophthora cinnamomi belongs to a primitive group of fungus-like organisms called water moulds. It is a soil borne pathogen that causes death in a wide range of native plant species resulting in floristic and structural changes in susceptible plant communities. *Phytophthora* can be spread by water, wildlife and humans, as well as autonomously, and is widely distributed throughout most areas of Tasmania at altitudes below about 700 m (Rudman, 2004). Buttongrass moorland is recognised as a vegetation type that is highly susceptible to the pathogen and likely to have the largest diseased area of any vegetation type in Tasmania (Schahinger *et al.,* 2003). Plant species likely to be eliminated from infected areas are the shrubs banksia (*Banksia marginata*), white waratah (*Agastachys odorata*) and the lily Christmas bells (*Blandfordia punicea*) (Schahinger *et al.,* 2003). A number of other plant species have suffered a reduction in density rather than complete loss from a particular site, leading to the suggestion that, over the long term, plants will develop better genetic resistance to the pathogen (Tim Rudman, DPIW, pers. comm). Few management options are available to control *Phytophthora* and prevent further inevitable spread (Rudman, 2004). The focus of management is on the protection of significant values that are at risk (e.g, threatened species) and large areas of buttongrass moorland free of the pathogen that are known to occur in remote areas of the Tasmanian Wilderness World Heritage Area. Prescriptions aimed at minimising the chances of spread by people have been established to protect these areas (Schahinger *et al.,* 2003; Rudman, 2004).

Chytrid fungus

Chytrid fungus causes an infection in frogs called chytridiomycosis and is recognised as a major threatening process worldwide (DEH, 2006). It was probably introduced to Australia in the 1970s and was first recorded in Tasmania in 2004 by the Central North Field Naturalists (Obendorf, 2005). Surveys by the Central North Field Naturalists have shown that the disease is present in various locations in southern and northern Tasmania. Not all frog species are at risk from chytrid, however concern has been raised about the status of the Tasmanian tree frog, a species which is restricted to western Tasmania and is most common in limited areas of buttongrass moorland. Initial chytrid surveys in the World Heritage Area indicate that significant areas may be free of the disease (M. Pauza, DPIW, unpublished data). The challenge is to keep these areas free from chytrid; this may be difficult, as there are likely to be a number

of agents involved in its spread. People can minimise the spread of the disease by not moving around water, tadpoles or frogs and ensuring all gear and equipment are clean (or simply dry, since the fungal spores cannot survive drying) before undertaking trips into the Tasmanian Wilderness World Heritage Area.

Introduced animals and weeds

Few introduced animals and very few weeds are known from buttongrass moorland, probably because of the difficult conditions under which buttongrass moorland occur and because much of the habitat has remained undisturbed. The only introduced animals regularly using buttongrass moorland are European wasps (*Vespula germanica*), bumblebees (*Bombus terrestris*) and honey bees (*Apis mellifera*). Other introduced animals recorded in moorland are cat (*Felis catus*), hedgehog slug (*Arion intermedius*), and a springtail (*Ceratophysella* sp.). The impacts of these introduced species on buttongrass moorland ecosystems are unknown. Weeds are rarely an issue in buttongrass moorland and only occur where disturbance has been a problem (Tim Rudman, DPIW, pers. comm). Some rehabilitation sites along the edges of the Gordon River Road have been invaded by *Erica lusitanica*, and European gorse (*Ulex europea*) has invaded disturbed moorland south of Zeehan, west coast Tasmania.

Climate change

The buttongrass moorland ecosystem of southwest Tasmania is at the climatic limit for peat formation due to the relatively dry and mild summers (Bridle *et al.,* 2003; Pemberton *et al.,* 2005). Climate change projections for southeast Australia indicate that average annual temperature will increase and rainfall will decrease during spring, summer and autumn (CSIRO, 2001). This scenario is likely to be detrimental to peat formation and the buttongrass moorland ecosystem, although it has been suggested that orographic effects may mediate the projected declines in rainfall for southwest Tasmania (Bridle *et al.,* 2003). Future changes in climate may have implications for fire, disease and exotic species management in buttongrass moorland.

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