# Conservation Assessment of Floyd's Grass *Alexfloydia repens* Simons, 1992 (Poaceae)

Rachael Collett 17/05/2022
NSW Department of Planning and Environment

## Floyd's Grass *Alexfloydia repens* Simons, 1992 (Poaceae)

*Distribution*: Endemic to the mid-north coast of New South Wales (NSW).
*Current EPBC Act Status*: Not listed
*Current NSW BC Act Status*: Endangered

## Summary of Conservation Assessment

Floyd's Grass, *Alexfloydia repens*, was found to be eligible for listing as Endangered under Criteria B1ab (i, ii, iv, v) and B2ab (i, ii, iv, v).

The main reasons for this species being eligible are i) it has a highly restricted geographic range; ii) it occurs at three locations; iii) there are projected continuing declines in extent of occurrence, area of occupancy, number of locations and number of mature individuals.

## Description and Taxonomy

*Alexfloydia repens* is the only species in the genus *Alexfloydia* (Simon 1992). *Alexfloydia repens* is a creeping grass described by Simon (1992) as: "Plants stoloniferous, sparingly branched, terminated by a solitary inflorescence, 3-4-noded. Internodes shorter than the associated leaf sheaths. Sheaths compressed. Ligule a fringe of hairs. Leaf blades flat, linear, glabrous, smooth, with smooth margins and a prominent white midrib. Inflorescence a panicle of 3-6 spikelets and a short main axis, smooth. Pedicels not distinctly angled, smooth, straight. Disarticulation at the base of the spikelet. Callus not differentiated and not prolonged into a stipe. Spikelets adaxial (with the lower glume facing the pedicel), laterally compressed, elliptic in outline. Glumes unequal, chortaceous, smooth: lower glumes ovate, 5-7 nerved, glabrous, acute; upper glume long, elliptic, 9-nerved, rounded on the back. Rachilla not pronounced between the glumes. Lower floret male, anthers 3: lemma elliptic, 9-nerved, chortaceous, glabrous, acute; palea elliptic, 2-nerved. Upper floret perfect: lemma oblong, obscurely 5-nerved, glabrous, yellow, firmly membranous or thinly cartilaginous, striate, acute; palea oblong, with texture similar to lemma, entire, smooth. Lodicules 2, free, membranous, anthers 3."

## Distribution and Abundance

*Alexfloydia repens* is found on the NSW mid-north coast from Coffs Harbour to Scotts Head (NSW Government 2018). It is currently known from two disjunct areas: a northern distribution centred around Sawtell and a southern distribution at Warrell Creek. *Alexfloydia repens* is generally located on floodplain alluvial deposits, 1 - 2 m above the mean sea level, although there are two atypical headland occurrences at Coffs Harbour and Sawtell (NSW Government 2018). Between 2008 and 2011, Andren and Cameron (2012) searched for and mapped patches of *A. repens* from Woolgoolga to Scotts Head. Patches were mapped by walking their boundaries with a hand-held GPS and all patches greater than 1 $m^2$ were recorded. Andren and

Cameron (2012) mapped a total of 293 patches, encompassing 32.5 ha of *A. repens* habitat. Ninety-three percent of the species habitat occurs in the Sawtell area, within a distributional range of 8 km north to south, and within 5 km of the coast (Andren & Cameron 2012). Across its distribution, *A. repens* patch size ranges from 0.0001 ha to 4.18 ha and 81% of patches are <0.1 ha. *Alexfloydia repens* habitat is intrinsically patchy. Even prior to European settlement, areas of swamp forest on rich alluvial substrates suitable for *A. repens* would have been sporadically distributed along the lower reaches of watercourses (Andren & Cameron 2012).

NSW National Parks and Wildlife Service reserves contain 54% of the mapped habitat and an additional 37% of habitat occurs in environmental protection zones applied by local government (Andren & Cameron 2012). Therefore, 91% of known habitat has some level of protection and this includes most of the large (>0.1 ha) patches identified by Andren and Cameron (2012). However, 10 of the large patches (comprising 1.3 ha collectively) fall wholly or partly on private land (Andren & Cameron 2012).

*Alexfloydia repens* has a 312 $km^2$ Extent of Occurrence (EOO), calculated as a minimal convex polygon containing all known occurrences (IUCN 2019). The Area of Occupancy (AOO) is estimated to be 76 $km^2$ based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019).

Population size of *Alexfloydia repens* is unknown. *Alexfloydia repens* is a stoloniferous grass that forms large mats. There is no knowledge of whether the mats are clonal or genetically diverse, so the number of individuals is currently impossible to quantify (G. Phillips and M. Andren pers. comm. February 2022).

Since 2013, monitoring of *Alexfloydia repens* has been carried out at Diggers Headland, Pine Creek and Warrell Creek, encompassing 46 sites (60% of known habitat). At these sites, *A. repens* cover and condition is monitored using 5 x 5 m floristic plots, currently undertaken every five years. Some sites are also subject to ongoing weed control. Weed management has resulted in an increase in crown cover of *A. repens* across monitoring plots in two national parks near Coffs Harbour, and the species distribution is expected to continue expanding with continued weed management. At Warrell Creek, *A. repens* was severely impacted by drought in 2019. The grass experienced above ground die back and was heavily grazed by native herbivores at some sites. However, by the end of March 2020 it had begun to recover (NSW Government 2021).

## Ecology

*Alexfloydia repens* favours areas with moderate to high sunlight exposure in this habitat. The species is a spreading, stoloniferous perennial that typically forms a dense groundcover (to about 50 cm) beneath the low-lying swamp sclerophyll forest. The species does not tolerate very high salinity levels and most of its distribution is between 1 m and 2 m above the mean tide level, immediately above the zone of king tide inundation, and above the zone dominated by highly salt-tolerant plants. The most vigorous and extensive examples of *A. repens* are found on rich alluvial floodplain terraces. However, the grass can grow on a wide variety of substrates, and it also occurs on two coastal headlands. *Alexfloydia repens* is generally found in riparian zones within 5 km of the coast but reaches inland along Warrell Creek as far as Macksville, over 7 km from the coast (Andren & Cameron, 2012).

Flowering has been observed throughout the year, but usually occurs in spring (NSW Government 2018). *Alexfloydia repens* only produces a small number of seeds. Germination attempts have been unsuccessful, suggesting that the seed may be non-viable and that *A. repens* largely relies on vegetative reproduction (G. Phillips and M. Andren pers. comm. February 2022). Many aspects of the species life history, including generation length, are unknown. *Alexfloydia repens* is the sole larval food plant known for the butterfly *Ocybadistes knightorum* (Sands 1997).

**Threats**

*Sea level rise* associated with climate change

*Alexfloydia repens* is low-lying and highly susceptible to any rise in sea level because it is 1-2m above mean sea level. There is strong indication that *A. repens* is unable to tolerate highly saline conditions (Andren & Cameron 2014). Andren and Cameron (2014) used a detailed digital elevation model to show that 85% of the species current distribution will be inundated or become too saline for *A. repens* to persist by 2100, based on a predicted 0.9 m sea level rise on the NSW north coast (DECCW 2009).

Although the 0.9 m sea level rise estimate used by Andren and Cameron (2014) is from 2009, the 2021 IPCC report predicts a similar mean increase in sea level rise. On the NSW central coast, sea level is predicted to increase between 0.21 m and 1.06 m by 2100, and this will be highest in the north of the state. These projections do not include processes associated with melting ice sheets, which could result in a NSW sea level rise of up to 2.3 m by 2100 (IPCC 2021). Even a slight rise in sea level will result in the loss and degradation of *A. repens* patches, and this may have already occurred in some areas (M. Andren pers. comm. March 2022).

It is highly unlikely that *Alexfloydia repens* will be able to migrate to higher elevations with sea level rise, because i) the alluvial terraces that the species currently occupies will not have time to reform at higher elevations; and ii) there are many instances where higher elevations are occupied by weeds that readily outcompete *A. repens* and will restrict migration (Andren & Cameron 2014).

Inundation from more frequent and severe storms

Rising average temperature in NSW is increasing the likelihood of extreme weather events such as heavy rainfall, thunderstorms, and storm surges near the coast (Hennessy *et al.* 2004). East coast lows are the main cause of extreme storms along the NSW coast and climate modelling predicts there will be an increase in extreme low-pressure systems during the warmer months. When combined with projected sea level rise, more frequent and severe coastal storms and floods are likely to be even more damaging (Wilby & Keenan 2012), as erosion and flooding will occur further up the shoreline (NSW Government 2022; IPCC 2021). An increase in frequency and magnitude of storm surges, in conjunction with sea level rise, will lead to increased events of extended and frequent inundation of *Alexfloydia repens* patches from the sea. This will cause loss or decline of *Alexfloydia repens* patches (Andren and Cameron 2014).

Increased frequency, height and duration of floods

The frequency, height and extent of flood events are predicted to increase under DECCW climate estimates (DECCW 2010), and this is likely to impact the low-lying riparian habitat occupied by *Alexfloydia repens*. In 2009, one small patch of *A. repens* was largely lost and another severely impacted by a major flood. The small size of patches makes *A. repens* particularly vulnerable to local extirpations caused by stochastic events like floods (Andren & Cameron 2014).

More frequent and intense drought

*Alexfloydia repens* is sensitive to dry conditions. Drought in 2019 severely impacted sites at Warrell Creek, and above ground die back was exacerbated by native herbivore grazing. Positively, the grass had partly recovered by the end of March 2020 (NSW Government 2021). Droughts in northern NSW are predicted to become more frequent and intense under climate change (Herold *et al*. 2018).

Weeds

Invasion by introduced weeds, particularly *Lantana camara* and *Paspalum mandiocanum*, have been identified as a major threat to *Alexfloydia repens*, as the species is readily outcompeted (Sands & New 2002). Historical decline has not been documented but can be inferred from the observed extent of weed invasion in habitat patches (Andren & Cameron 2014). Andren and Cameron (2014) assessed weed invasion in the Sawtell region and recorded *L. camara* in 102 patches (63%) and *P. mandiocanum* in 72 patches (45%). *L. camara* was abundant in 64 (40%) of patches and *P. mandiocanum* in 43 (27%) of patches. Other weeds recorded less frequently included *Ochna serrulata*, *Senna pendula*, *Tradescantia fluminensis, Plantago lanceolata* and *Chloris gayana*. These surveys were conducted ~10 years ago, and since 2017 there has been ongoing weed control at Diggers Creek, Pine Creek and Warrell Creek, encompassing 60% of known *A. repens* habitat. Weed control has re-established areas of high-quality habitat throughout the species distribution. Areas of grass have expanded, and grass condition has improved at managed sites (NSW Government 2021). However, there are some large, unmanaged *A. repens* patches where weeds are continuing to increase, causing ongoing population decline. This problem is particularly severe on private land along Warrell Creek and Boambee Creek. Across all sites, cessation of weed management programs due to funding constraints would lead to a rapid increase in weed invasion and abundance. Weeds continue to remain a major threat to *A. repens* (M. Andren pers. comm. March 2022).

**Assessment against IUCN Red List criteria**

For this assessment it is considered that the survey of *Alexfloydia repens* has been adequate and there is sufficient scientific evidence to support the listing outcome.

*Criterion A* *Population Size reduction*

Assessment Outcome: Data deficient.

Justification: Generation length is unknown. Increased frequency, severity and duration of extreme events associated with climate change, including drought, flood and inundation from the sea, have already caused some loss and degradation of *Alexfloydia repens* patches (M. Andren pers. comm. March 2022). Extreme events associated with climate change are likely to lead to ongoing *A. repens* population decline, however there is insufficient data available to quantitatively assess this under criterion A3. Similarly, there is insufficient data to determine the extent of past population reduction over a relevant time period.

*Criterion B* *Geographic range*

Assessment Outcome: Endangered under Criterion B1ab (i, ii, iv, v) and B2ab (i, ii, iv, v).

Justification: *Alexfloydia repens* has a 312 $km^2$ Extent of Occurrence (EOO <5000 $km^2$ = EN), calculated as a minimal convex polygon containing all known occurrences (IUCN 2019). The Area of Occupancy is estimated to be 76 $km^2$ (AOO<500 $km^2$ = EN) based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019).

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: Sub criterion met – 3 locations (EN). There are three locations when considering loss of *Alexfloydia repens* patches through increased frequency, severity and duration of extreme events associated with climate change, which meets the Endangered threshold. It is not known whether the species is severely fragmented.

Justification: Increased frequency, height and duration of floods and increased inundation from the sea are predicted to impact all low-lying patches of *Alexfloydia repens* by 2100, and these are therefore defined as a single location. Only the two headland occurrences, located at Boambee Headland and Diggers Headland, will not be impacted by these threats. Each small headland occurrence could easily be affected by a single threat, including more frequent and intense drought, changes in frequency and seasonality of fire or weed invasion (Andren & Cameron 2014).. Therefore, there are a total of three *A. repens* locations. As there are less than five locations, *A. repens* qualifies as Endangered under this sub criterion.

It is not possible to ascertain whether the population is severely fragmented, as there is no knowledge of the species genetic diversity, dispersal between patches or what constitutes a viable subpopulation (M. Andren pers. comm. March 2022).

b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

Assessment Outcome: Sub criterion met - continuing decline is projected in (i) extent of occurrence, (ii) area of occupancy, (iv) number of locations, and (v) number of mature individuals.

Justification:

Increased frequency, severity and duration of extreme events associated with climate change, including flood, inundation from the sea, and drought are predicted to cause continuing decline in extent of occurrence, area of occupancy, number of locations and number of mature individuals (Andren and Cameron 2014).

Weed invasion is estimated to be causing ongoing decline in area and quality of large *Alexfloydia repens* patches, and this is particularly apparent on private land where management is not possible (M. Andren pers. comm. March 2022). This has led to a loss of mature individuals and may result in a future reduction in extent of occurrence and/or area of occupancy.

c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: There is no evidence of extreme fluctuations.

*Criterion C Small population size and decline*

Assessment Outcome: Data deficient.

Justification: Number of mature individuals is unknown.

At least one of two additional conditions must be met. These are:

C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CR); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data deficient.

Justification: Generation length and rates of decline are unknown.

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Sub criterion met.

Justification: A large proportion of the species current distribution will be impacted by sea level rise and increased frequency, severity and duration of extreme events associated with climate change (Andren & Cameron 2014). Therefore, there is a projected continuing decline in the number of mature individuals.

In addition, at least 1 of the following 3 conditions:

a (i). Number of mature individuals in each subpopulation ≤50 (CR); ≤250 (EN) or ≤1000 (VU).

Assessment Outcome: Data deficient.

Justification: The number of mature individuals in each subpopulation is unknown.

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: Data deficient.

Justification: The number of mature individuals in each subpopulation is unknown. However, 93% of the species distribution is found in the Sawtell area, occurring across a range 8 km from north to south (Andren & Cameron 2012).

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met.

Justification: There is no evidence of extreme fluctuations.

*Criterion D Very small or restricted population*

Assessment Outcome: Data deficient.

Justification: The number of mature individuals is unknown. The species has a 76 $km^2$ Area of Occupancy, and there is no clear future threat to *Alexfloydia repens* that would contribute to the extinction of the species in a very short time.

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Data deficient.

Justification: The number of mature individuals is unknown.

D2. Restricted Area of Occupancy (typically <20 $km^2$) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: Not met.

Justification: While *Alexfloydia repens* only occurs at three locations, the species has a 76 $km^2$ Area of Occupancy, and there is no clear future threat to that would contribute to the extinction of the species in a very short time.

*Criterion E Quantitative Analysis*

Assessment Outcome: Data deficient.

Justification: Sufficient data are not available to conduct a quantitative analysis.

**Conservation and management actions**

This species is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Planning and Environment under the Saving our Species program. The conservation project identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Alexfloydia repens* sits within the site-managed species management stream of the SoS program and the conservation project can be viewed here (https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10036).

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**Expert Communications**
Mick Andren – NSW Government, Department of Planning and Environment
Gavin Phillips - NSW Government, Department of Planning and Environment

## APPENDIX 1

**Assessment against NSW Biodiversity Conservation Act criteria**
The Clauses used for assessment are listed below for reference.

**Overall Assessment Outcome:**
*Alexfloydia repens* was found to be Endangered under Clause 4.3 (b)(d)(e, i, ii, iv).

**Clause 4.2 – Reduction in population size of species**
**(Equivalent to IUCN criterion A)**
**Assessment Outcome:** Data deficient

| | | | |
|---|---|---|---|
| **(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:** | | | |
| | (a) | for critically endangered species | a very large reduction in population size, or |
| | (b) | for endangered species | a large reduction in population size, or |
| | (c) | for vulnerable species | a moderate reduction in population size. |
| **(2) - The determination of that criteria is to be based on any of the following:** | | | |
| | (a) | direct observation, | |
| | (b) | an index of abundance appropriate to the taxon, | |
| | (c) | a decline in the geographic distribution or habitat quality, | |
| | (d) | the actual or potential levels of exploitation of the species, | |
| | (e) | the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites. | |

**Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)**
**Assessment Outcome:** Endangered under clause 4.3 (b)(d)(e, i, ii, iv)

| | | | |
|---|---|---|---|
| **The geographic distribution of the species is**: | | | |
| | (a) | for critically endangered species | very highly restricted, or |
| | (b) | for endangered species | highly restricted, or |
| | (c) | for vulnerable species | moderately restricted, |
| **and at least 2 of the following 3 conditions apply**: | | | |
| | (d) | the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations, | |
| | (e) | there is a projected or continuing decline in any of the following: | |
| | | (i) | an index of abundance appropriate to the taxon, |
| | | (ii) | the geographic distribution of the species, |
| | | (iii) | habitat area, extent or quality, |
| | | (iv) | the number of locations in which the species occurs or of populations of the species, |
| | (f) | extreme fluctuations occur in any of the following: | |
| | | (i) | an index of abundance appropriate to the taxon, |
| | | (ii) | the geographic distribution of the species, |
| | | (iii) | the number of locations in which the species occur or of populations of the species. |

**Clause 4.4 - Low numbers of mature individuals of species and other conditions**
**(Equivalent to IUCN criterion C)**
**Assessment Outcome:** Data deficient

| |
|---|
| **The estimated total number of mature individuals of the species is:** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (a) | for critically endangered species | | | very low, or | |
| | (b) | for endangered species | | | low, or | |
| | (c) | for vulnerable species | | | moderately low, | |
| **and either of the following 2 conditions apply:** | | | | | | |
| | (d) | a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species): | | | | |
| | | (i) | for critically endangered species | | very large, or | |
| | | (ii) | for endangered species | | large, or | |
| | | (iii) | for vulnerable species | | moderate, | |
| | (e) | both of the following apply: | | | | |
| | | (i) | a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and | | | |
| | | (ii) | at least one of the following applies: | | | |
| | | | (A) | the number of individuals in each population of the species is: | | |
| | | | | (I) | for critically endangered species | extremely low, or |
| | | | | (II) | for endangered species | very low, or |
| | | | | (III) | for vulnerable species | low, |
| | | | (B) | all or nearly all mature individuals of the species occur within one population, | | |
| | | | (C) | extreme fluctuations occur in an index of abundance appropriate to the species. | | |

**Clause 4.5 - Low total numbers of mature individuals of species (Equivalent to IUCN criterion D)**
**Assessment Outcome:** Data deficient

| **The total number of mature individuals of the species is:** | | | |
|---|---|---|---|
| | (a) | for critically endangered species | extremely low, or |
| | (b) | for endangered species | very low, or |
| | (c) | for vulnerable species | low. |

**Clause 4.6 - Quantitative analysis of extinction probability (Equivalent to IUCN criterion E)**
**Assessment Outcome:** Data deficient

| **The probability of extinction of the species is estimated to be:** | | | |
|---|---|---|---|
| | (a) | for critically endangered species | extremely high, or |
| | (b) | for endangered species | very high, or |
| | (c) | for vulnerable species | high. |

**Clause 4.7 - Very highly restricted geographic distribution of species– vulnerable species**

**(Equivalent to IUCN criterion D2)**
**Assessment Outcome:** Not met

| | |
|---|---|
| For vulnerable species, | the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period. |