NATIONAL RECOVERY PLAN FOR *Boronia quadrilata* and *Boronia viridiflora* IN THE NORTHERN TERRITORY OF AUSTRALIA

Boronia quadrilata

Boronia viridiflora

Northern Territory Government
Department of Natural Resources, Environment and the Arts

Australian Government

Parks and Wildlife Service of the Northern Territory
Conservation and Natural Resources Division
Department of Natural Resources, Environment and the Arts
PO Box 496
Palmerston, N.T. 0831

National recovery plan for *Boronia quadrilata* and *Boronia viridiflora* in the Northern Territory of Australia

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A Recovery Plan prepared under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of threatened species. The attainment of objectives and the provision of funds necessary to implement actions is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Approved Recovery Plans are subject to modification as dictated by new findings, changes in species' status and completion of recovery actions.

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Front cover: *Boronia quadrilata* and *Boronia viridiflora* by Kym Brennan

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1. SUMMARY

Boronia quadrilata and *Boronia viridiflora* are listed as vulnerable under Commonwealth and Northern Territory legislation. Both species are known from single populations of very restricted extent on the north-western portion of the sandstone Arnhem Plateau in the Northern Territory. This area is Aboriginal land in western Arnhem Land.

The overall objective of this recovery plan is to improve the long-term conservation status of *Boronia quadrilata* and *Boronia viridiflora* and their habitats. Specific objectives of the recovery plan are to:

1. Improve management of the species through increased knowledge of the species distribution, abundance, biology, habitat requirements and population response to disturbance.
2. Improve management of the species by developing and implementing a program of fire management at or adjacent to the populations.
3. Improve management of the species through involving landowners, landholder representatives and the broader community in the conservation of the wild populations and their habitat.
4. Provide a safety net against extinction by establishing *ex-situ* populations and investigating options for commercial enterprises based on the species.
5. Provide ongoing refinement of management of the species through timely evaluation of this recovery plan.

Recommended recovery actions include:

- Conducting field surveys to refine knowledge of the distribution, population status and habitat requirements of the two species.
- Establishing long-term population monitoring plots.
- Undertaking an assessment of the plant population response to fire.
- Developing and implementing a program for the management of fire.
- Consulting with and reporting back to landholders and the broader community.
- Conducting a trial to examine aspects of seed biology and cultivation from seed and cuttings.
- Establishing and maintaining an *ex-situ* population, subject to permission from Aboriginal Traditional Owners.
- Undertaking a timely review and revision of this recovery plan.

Consultation with, and involvement of, local Aboriginal people is an essential component of the implementation of this recovery plan. The proposed actions require collaboration between a broad range of interested parties including the local Aboriginal people, Northern Land Council, Northern Territory Department of Natural Resources, Environment and the Arts, Bushfires Council of the Northern Territory, Charles Darwin University and Community Groups.

2. INTRODUCTION

2.1 Species subject to management

This recovery plan is for *Boronia quadrilata* and *B. viridiflora* which are listed as vulnerable under the Northern Territory (NT) *Territory Parks and Wildlife Conservation Act 2000* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* Taxonomic, ecological and distribution details for these threatened plant species are provided by Kerrigan et al. (2002a; 2002b) (Appendix 1).

2.2 Distribution and location

Boronia quadrilata and *B. viridiflora* are endemic to the Northern Territory, occurring in very restricted locations on the north-western portion of the Arnhem Plateau (Fig. 1). Boronia quadrilata occurs on rocky sandstone slopes in the upper Magela Creek system and *B. viridiflora* on sandstone cliffs or boulders south of Nabarlek.

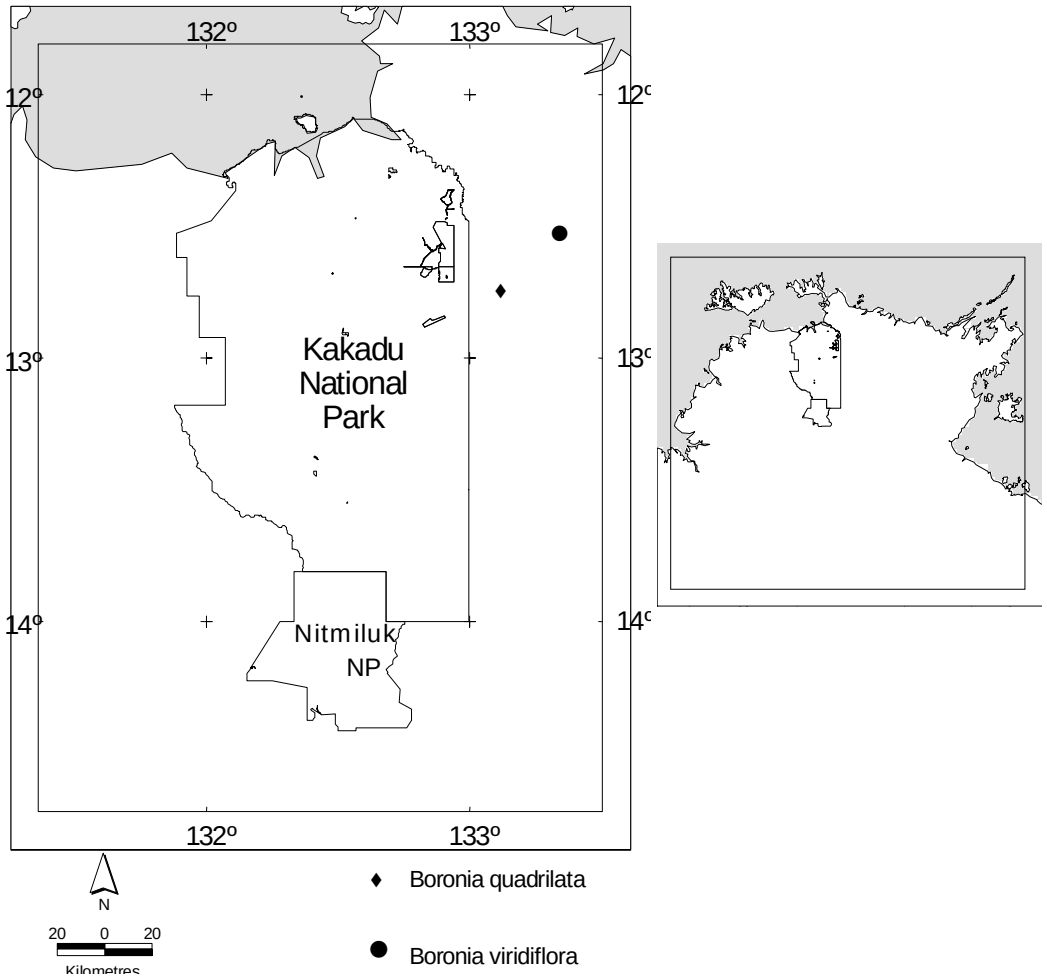

Figure 1: Location of *Boronia quadrilata and B. viridiflora* in western Arnhem Land near Kakadu National Park, Northern Territory.

2.3 Responsible authority

The Parks and Wildlife Service of the Northern Territory is located within the Northern Territory Department of Natural Resources, Environment and the Arts and has carriage of obligations under the *Territory Parks and Wildlife Conservation Act 2000* for the administration of listed threatened species in the Northern Territory.

Parks and Wildlife Service of the Northern Territory
P.O. Box 496
Palmerston, Northern Territory
AUSTRALIA 0831

Telephone: 08 8944 8453
Facsimile: 08 8944 8455

2.4 Legislation and international obligations

2.4.1 Northern Territory

Boronia quadrilata and *B. viridiflora* are listed as vulnerable under the *Territory Parks and Wildlife Conservation Act 2000*. Both species quality for listing under IUCN (2001) criteria D1+2: the estimated number of mature individuals is <1000 and the species has a restricted distribution estimated to be <20 km^2 (Kerrigan et al., 2002a, b).

2.4.2 Other States and Territories

Boronia quadrilata and *B. viridiflora* do not occur in any other States or Territories of Australia.

2.4.3 Commonwealth

Boronia quadrilata and *B. viridiflora* are listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999.*

2.5 Social and economic impacts

Collaboration between Aboriginal people holding traditional knowledge and non-Aboriginal people with a background in western science provides an opportunity for mutual cultural exchange and increased understanding. Proposed actions include introduction of *B. quadrilata* and *B. viridiflora* to cultivation. If successful, this may provide small scale business opportunities for local Aboriginal people. There are no adverse social or economic impacts expected from implementation of recovery actions.

2.6 Affected interests

B. quadrilata and *B. viridiflora* occur on Aboriginal land in western Arnhem Land. The Aboriginal people of western Arnhem Land are represented by the Northern Land Council, with the Caring for Country Unit having a particular interest in land management issues such as fire, weed and feral animal management. The Northern Land Council has been involved in discussions about management of *B. quadrilata* and *B. viridiflora* and this involvement will be formalised through joint participation in recovery actions. *Boronia quadrilata* and *B. viridiflora* are not known to be of particular significance to Aboriginal people.

Continuing consultation with and involvement of local Aboriginal people is essential to the recovery process. The clans with ties to the lands within which known populations of *B. quadrilata* and *B. viridiflora* occur are the Warddjak/Worrgorl, Badmardi, Danek and Maddalk.

2.7 Benefits to other species/ecological communities

The sandstone plateau within which *B. quadrilata* and *B. viridiflora* occur supports a high concentration of endemic plant taxa (Woinarski et al., submitted). These sandstone habitats are generally remote from human habitation or at most sparsely inhabited. Accordingly, land management tends to be of low intensity and broad-scale in nature. Detailed ecological knowledge on which to base management recommendations is lacking for most sandstone species. The increased ecological knowledge for the target species and their habitat, along with collaboration between stakeholders required to implement this recovery plan will improve the capacity to manage these sandstone landscapes. These Boronia species will act as a flagship to focus attention on management of issues such as fire in these sandstone landscapes. An underlying assumption is that achieving appropriate management for these threatened taxa will also benefit a broader suite of species and their habitat.

3. THREATS

3.1 Biology and ecology relevant to threatening processes

The knowledge of the ecology of these species is very limited with current recommendations for management derived from general ecological knowledge rather than specific information about the species, their population dynamics or associated threats. To refine this recovery plan it is important to increase understanding of: flowering and fruiting times; recruitment rates and strategies; population status and extent; and regeneration responses to fire and other disturbance.

3.2 Identification of threats

With the current level of knowledge, it is impossible to say with certainty which, if any, threatening processes may be impacting on *B. quadrilata* and *B. viridiflora*. The species

are listed due to their small population size and restricted distribution. Rather than being the result of any particular threatening process these restricted distributions may reflect the narrow range niches, or that similar niches are separated by impassable barriers such as gorges or the often barren plateau surface (Duretto and Ladiges, 1997).

The ecology of these species and of the sandstone escarpment habitat is poorly understood. Priority for maintenance of these species includes research into the status of the populations, extent of their distributions and understanding of habitat requirements. Long-term monitoring is needed to detect any future change in population numbers. Inappropriate fire regimes are the most likely immediate threat to the populations.

3.2.1 Stochastic events

The small population size and very restricted distribution of *B. quadrilata* and *B. viridiflora* makes them vulnerable to stochastic events such as cyclones and fire.

3.2.2 Altered fire regimes

Fire is a major management issue in the sandstone Arnhem Plateau in which these species occur. Historical evidence supports the widespread use of fire by Aboriginal people in adjoining lands to the east (Haynes, 1985, 1991; Yibarbuk et al., 2001) and west (Russell-Smith et al., 1997), however, historical evidence of past fire history for the plateau itself is limited. Despite the paucity of historical records, decline in fire sensitive cypress pine (Bowman and Panton, 1993) and rainforest (Russell-Smith et al., 1993; Bowman, 1994) indicate changes in fire regime since the arrival of European people in northern Australia.

Contemporary fire regimes at a regional level display a prevalence of extensive late dry season fires (Russell-Smith et al., 2003). In contrast to this regional trend, in Kakadu National Park which includes a part of the western side of the sandstone Arnhem Plateau, in the period from 1980 to 1994, there has been a significant shift in fire regime from extensive late dry season fires to management-imposed smaller early dry season fires (Russell-Smith et al., 1998). Despite this trend, on the sandstone Arnhem Plateau that falls within Kakadu National Parks, contemporary fires commonly occur at a frequency that prevent obligate seedling shrubs from producing seed, leading to concern that species-rich heath vegetation is being converted to grass-dominated savanna (Russell-Smith et al., 1998).

A major concern is that in the absence of the deliberate and relatively well resourced fire management applied in Kakadu National Park, a fire regime of extensive, high intensity late dry season wildfires at frequent intervals still prevails on the sandstone Arnhem Plateau. Such a regime is likely to have an adverse impact on the population of *B. quadrilata.* The situation is less clear for *B. viridiflora* which appears to occupy relatively fire protected sites in the landscape. There is a possibility that intense fire may negatively impact on *B. viridiflora* occurring near the margin of its habitat where adjoining country supports higher fuel loads.

3.3 Area under threat

All areas in which *B. quadrilata* and *B. viridiflora* occur are impacted by the prevalence of extensive late dry season fire (Russell-Smith et al., 1998; Edwards et al., 2001; Russell-Smith et al., 2002).

3.4 Populations under threat

All known populations are potentially threatened by the prevalence of extensive late dry season fire in the sandstone habitats of the Arnhem Land Plateau (Russell-Smith et al., 1998; Edwards et al., 2001; Russell-Smith et al., 2002).

4. OBJECTIVES, ACTIONS AND PERFORMANCE CRITERIA

4.1 Recovery Objectives

The overall objective of this recovery plan is to improve the long-term conservation status of *Boronia quadrilata* and *Boronia viridiflora* and their habitats.

The specific objectives of the recovery plan are to:

1. Improve management of the species through increased knowledge of the species distribution, abundance, biology, habitat requirements and population response to disturbance.

2. Improve management of the species by developing and implementing a program of fire management at or adjacent to the populations.

3. Improve management of the species through involving landowners, landholder representatives and the broader community in the conservation of the wild populations and their habitat.

4. Provide a safety net against extinction by establishing *ex-situ* populations and investigating options for commercial enterprises based on the species.

5. Provide for ongoing refinement of management of the species through timely evaluation of this recovery plan.

4.2 Performance Criteria

4.2.1 Increased knowledge

- Completion of additional field survey by the end of the first year of plan.
- Establishment of population monitoring plots by the end of the first year of the plan.
- Completion of a report detailing existing and new biological information by the end of the second year of plan.
- Reassessment of population monitoring plots by the end of the second year of the plan.
- Completion of a report on monitoring methodology and short-term population trends by the end of the second year of the plan.
- Completion of an investigation of the availability and suitability of remotely sensed data to document fire history to assist in interpreting population trends, by the end of the second year of the plan.
- Completion of a report on population response to fire management by the end of the fifth year of the plan.

4.2.2 Development and implementation of a fire management program

- Develop recommendations for fire management by the end of the second year of the plan.
- On-ground fire management implemented by the end of the third year of the plan.

4.2.3 Involve landholders and the broader community

- Completed initial phase of consultations with Traditional Owners by the end of the first year of the plan.
- Involvement of Aboriginal people in survey of wild populations.
- Report results of surveys to Aboriginal Traditional Owners.
- Involvement of Community group in field survey.
- Report results in public forum.

4.2.4 Ex-situ

- Collection of propagating material by the end of the first year of the plan.
- Complete report on cultivation techniques by the end of the second year of the plan.
- Report oil content of plants to Traditional Owners by the end of the second year of the plan.

4.3 Actions

4.3.1 Conduct surveys and establish population monitoring.

Given the paucity of information about the biology and ecology of the species an adaptive management approach will be adopted for this recovery plan. Initial actions include field survey to refine knowledge of distribution, abundance and habitat requirements.

To monitor and evaluate the population response to contemporary land management a series of long-term monitoring plots will be established. In the initial phase, the plots will be assessed when established and again one year later. This initial snapshot of population change after one annual seasonal cycle will then be used to refine a regime for further sampling. Ongoing sampling may be targeted to capture the population response to significant events such as fire.

Information arising from the survey and initial population monitoring will be used to develop recommendations for fire management. Consideration will be given to applying a burn treatment to part of the population of *B. quadrilata*, in which case the population response to the fire treatment will be monitored. Due to the remote nature of the field locations, annual on-ground assessment of fire occurrence is impractical. The availability and suitability of remotely sensed data to document fire history will be investigated. An ongoing record of disturbance by fire is likely to be important for interpreting population trends.

4.3.2 Develop and implement a fire management program

Given contemporary fire regimes whereby extensive late dry season wildfires are common on the sandstone Arnhem plateau, recommendations will be developed for fire management in and adjacent to the *Boronia* populations. Knowledge gained in the first two years of survey and population monitoring conducted under this recovery plan, will be applied in developing a fire management program. Consultation with Aboriginal Traditional Owners will form an important component of developing recommendations for ongoing fire management. Implementation of the fire program will commence in the third year of the plan. The response to fire management will be assessed as part of the schedule of population monitoring.

4.3.3 Involve landholders and the broader community

Involvement of Aboriginal landholders on whose land these *Boronia* species occur is essential to the success of this recovery plan. Ongoing consultation with and permission from Traditional Owners will be required before on-ground actions are implemented under this plan. Where possible, Aboriginal people from the area will be involved in field surveys.

The involvement of parties with an interest in the management of the sandstone Arnhem Plateau will be encouraged. Consultation on fire management will include the

Adjumarllarl Rangers, the Northern Land Council and the Bushfires Council of the Northern Territory. Implementation of fire management in vicinity of the Boronia populations is expected to complement activities conducted under the Arnhem Land Fire Abatement Project facilitated by the Northern Land Council and the Bushfires Council of the Northern Territory. Broader community support for conservation of these *Boronia* species and the sandstone habitat within which they occur will be encouraged through the involvement of community groups. Research and management outcomes will be publicised through the media and public presentations.

In preference to establishing a formal recovery team focused on *B. quadrilata* and *B. viridiflora*, an effort will be made to ensure all stakeholders are kept informed about the recovery of the species. Avenues will be explored to increase consultation and collaboration between parties with an interest in conservation of the biodiversity of the sandstone Arnhem Plateau.

4.3.4 Ex-situ cultivation

To provide security against extinction, *ex-situ* populations of *B. quadrilata* and *B. viridiflora* will be explored. An initial step in this process is to investigate cultivation techniques from both seed and cuttings. Sourcing sufficient quantities of propagating material to trail cultivation techniques may be a significant issue. To address this issue, non-threatened *Boronias* will be included in the propagation trials. Successful techniques for non-threatened species can then be adapted to the threatened taxa. In addition, a comparison of success between common and rare northern Australian *Boronias* is expected to increase understanding as to whether germination or propagation is a significant factor contributing to the restricted distribution of *B. quadrilata* and *B. viridiflora*. Subject to approval from Traditional owners, should the cultivation trials be successful an *ex-situ* population will be established at George Brown Darwin Botanic Gardens.

The results of the cultivation trials will feed into a preliminary assessment of the potential for local Aboriginal people to develop small scale business enterprises based on the species. Potential exists for introduction of the species to cultivation and for extraction of oils. The oil content is unknown, however, within the Rutaceae plant family a number of taxa are recognised for their oil content. In addition to providing security against extinction, should the potential for small business enterprises based on cultivation be realised, this added value of the species will enhance the interest in maintaining wild populations as a valuable resource.

4.3.5 Evaluation

Evaluation of performance under this recovery plan will be co-ordinated by the Parks and Wildlife Service of the Northern Territory in consultation with the project collaborators. The assistance of relevant experts, including staff from the Northern Territory Herbarium and Charles Darwin University may be sought to evaluate the plan. This review will take be conducted within 5 years of the adoption of this recovery plan.

5. MANAGEMENT PRACTICES

5.1 Fire management

The contemporary Arnhem Plateau fire regime is characterised by late dry season, extensive, frequent fires that have been shown to have significant impacts on fire-sensitive vegetation (Russell-Smith et al., 1998; Edwards et al., 2001; Russell-Smith et al., 2002). At a landscape scale, the preferred fire regime would mimic traditional burning patterns and comprise fine-scale burning in the early to mid dry season with one-third of every clan estate burnt each year, but with locations burnt varying substantially from year to year (Woinarski et al., 2000).

While the specific fire regime requirements for *B. quadrilata* and *B. viridiflora* are unknown, a landscape broken into a mosaic of small patches with varying time since fire will avoid the homogenising effect of widespread late dry season fires. In the absence of further information, the *Boronia* populations should be managed to avoid frequent fire and high intensity fire. Following initial field survey and monitoring, consideration should be given to implementing a low intensity fire over at least part of the population of *B. quadrilata.* Application of a management burn will avoid a situation where the whole population has a similar fire history and becomes susceptible to late dry season and provide the opportunity for feedback on the population response to fire. The occurrence of *B. viridiflora* on boulders and cliffs suggests the requirements of this species may be best met by avoiding fire. For both species, protection from wildfire may require patch burning in adjacent areas.

5.2 Habitat reservation

Boronia quadrilata and *B. viridiflora* occur in a remote region of Arnhem Land with restricted access. No formalised habitat reservation is considered necessary at this time.

6. DURATION AND COSTS

6.1 Duration and costs

The timing and costs for each action proposed to support the recovery objectives are provided in Table 1. The overall cost is $354,000 over 5 years.

6.2 Resource allocation

The actions proposed in this recovery plan build upon previous threatened plant survey work undertaken by the Northern Territory Herbarium (Kerrigan, 2003; Cowie, 2005) and fire and habitat survey work conducted by the Department of Natural Resources, Environment and the Arts.
The attention to fire is in accord with concerns raised about contemporary fire regimes on the sandstone country of the Arnhem Land Plateau (Russell-Smith et al., 1998;

Edwards et al., 2001; Russell-Smith et al., 2002) and complements work conducted by the Bushfire Council of the Northern Territory and the Parks and Wildlife Service of the Northern Territory to address this issue. The proposed actions involve collaboration with the Aboriginal landholders and the Northern Land Council. The involvement of the above groups in implementation of the recovery plan will facilitate complementary actions and the efficient use of funds to address recovery of the species.

Table 1: Implementation and cost schedule for the recovery of *B. quadrilata* and *B. viridiflora*. Costs are expressed in $'000.

Objective	Action	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Improve management through increased knowledge	Refine knowledge of distribution, abundance, population status and habitat requirements	34	32				**66**
	Establish population monitoring and reassess in year 2	34	42				**76**
	Assess population response to fire management			17	25	12	**54**
Fire management	Develop and implement fire management		2	15	15		**32**
Landholder and community involvement	Consultation and reporting back	20	11	11	11	11	**64**
Ex-situ	Cultivation trial	22	10				**32**
	Establish and maintain *ex-situ*		5	5	5	5	**20**
Evaluation	Review and revise recovery plan					10	**10**
Total		**110**	**102**	**48**	**56**	**38**	**354**

7. REFERENCES

Bowman, D.M.J.S. (1994) Preliminary observations on the mortality of *Allosyncarpia ternata* stems on the Arnhem Land Plateau, northern Australia. *Australian Forestry*, **57**, 62-4.

Bowman, D.M.J.S. and Panton, W.J. (1993) Decline of *Callitris intratropica* R.T. Baker & H.G. Smith in the Northern Territory: implications for pre-and post-European colonization fire regimes. *Journal of Biogeography*, **20**, 373-381.

Cowie, I. (2005) Kakadu threatened flora Volume 3. Department of Infrastructure, Planning and Environment, Northern Territory Government.

Duretto, M.F. and Ladiges, P.Y. (1997) Morphological variation within the Boronia grandisepala Group (Rutaceae) and the description of nine taxa endemic to the Northern Territory, Australia. *Australian Systematic Botany*, **10**, 249-302.

Edwards, A., Hauser, P., Anderson, M., McCartney, J., Armstrong, M., Thackway, R., Allan, G., Hempel, C. and Russell-Smith, J. (2001) A tale of two parks: contemporary fire regimes of Litchfield and Nitmiluk National Parks, monsoonal northern Australia. *International Journal of Wildland Fire*, **10**, 79-89.

Haynes, C.D. (1985) The pattern and ecology of *munwag*: traditional Aboriginal fire regimes in north-central Arnhemland. In *Proceedings of the Ecological Society of Australia*, Vol. 13, pp. 203-214.

Haynes, C.D. (1991) Use and impact of fire. In *Monsoonal Australia. Landscape, ecology and man in the northern lowlands* (eds C.D. Haynes, M.G. Ridpath and M.A.J. Williams), pp. 61-71. Balkema, Rotterdam.

IUCN (2001) IUCN red list categories: version 3.1. Prepared by the IUCN Species Survival Commission, Gland, Switzerland and Cambridge, UK. 23p.

Kerrigan, R. (2003) Threatened flora report. Department of Infrastructure, Planning and Environment, Darwin.

Kerrigan, R., Cowie, I. and Baker, B. (2002a) Threatened species of the Northern Territory *Boronia quadrilata* Duretto, pp. 3. Parks and Wildlife Commission of the Northern Territory.

Kerrigan, R., Cowie, I. and Baker, B. (2002b) Threatened species of the Northern Territory *Boronia viridiflora* Duretto, pp. 3. Parks and Wildlife Commission of the Northern Territory.

Russell-Smith, J., Lucas, D., Gapindi, M., Gunbunuka, B., Kapirigi, N., Namingam, G., Lucas, K. and Chaloupka, G. (1997) Aboriginal resource utilisation and fire management practice in western Arnhemland, monsoonal northern Australia. Notes for prehistory, lessons for the future. *Human Ecology*, **25**, 159-196.

Russell-Smith, J., Lucas, D.E., Brock, J. and Bowman, D.M.J.S. (1993) *Allosyncarpia*-dominated rain forest in monsoonal northern Australia. *Journal of Vegetation Science*, **4**, 67-82.

Russell-Smith, J., Ryan, P.G. and Cheal, D.C. (2002) Fire regimes and the conservation of sandstone heath in monsoonal northern Australia: frequency, interval, patchiness. *Biological Conservation*, **104**, 91-106.

Russell-Smith, J., Ryan, P.G., Klessa, D., Waight, G. and Harwood, R. (1998) Fire regimes, fire-sensitive vegetation and fire management of the sandstone Arnhem Plateau, monsoonal northern Australia. *Journal of Applied Ecology*, **35**, 829-46.

Russell-Smith, J., Yates, C., Edwards, A., Allan, G.E., Cook, G.D., Cooke, P., Craig, R., Heath, B. and Smith, R. (2003) Contemporary fire regimes of northern Australia, 1997–2001: change since Aboriginal occupancy, challenges for sustainable management. *International Journal of Wildland Fire*, **12**, 283 - 297.

Woinarski, J., Brennan, K., Hempel, C., Firth, R. and Watt, F. (2000) Biodiversity conservation on the Tiwi Islands: plants, vegetation types and terrestrial vertebrates on Melville Island. Report to the Tiwi Land Council. PWCNT, Darwin.

Woinarski, J.C.Z., Hempel, C., Cowie, I., Brennan, K., Kerrigan, R., Leach, G. and Russell-Smith, J. (submitted) Distributional patterning of restricted range plant species in the Northern Territory, Australia.

Yibarbuk, D., Whitehead, P.J., Russell-Smith, J., Jackson, D., Godjuwa, C., Fisher, A., Cooke, P., Choquenot, D. and Bowman, D.M.J.S. (2001) Fire ecology and Aboriginal land management in central Arnhem Land, northern Australia: a tradition of ecosystem management. *Journal of Biogeography*, **28**, 325-343.

APPENDIX 1: *Boronia quadrilata* and *Boronia viridiflora* in the Northern Territory

Boronia quadrilata Duretto

Conservation status
Commonwealth: *Environment Protection and Biodiversity Conservation Act 1999* - Vulnerable.
Northern Territory: *Territory Parks and Wildlife Conservation Act 2000* - Vulnerable.

Description
Erect slender shrub to 1.5 to 3 m or thick multi-stemmed shrub. Stems distinctly 4-angled with small wings undulating longitudinally along stem. Leaves can be upright and appressed against stem or as in photograph. *Boronia quadrilata* is very distinct with bright green new growth becoming blue/green and waxy with age.

Distribution
Endemic to the Northern Territory. Known only from the type locality at Magela Creek on the Arnhem Land plateau to the east of Kakadu National Park. Current population count is around 800 mature individuals from surveyed area of approximately 4ha.

Conservation reserves where reported: None.

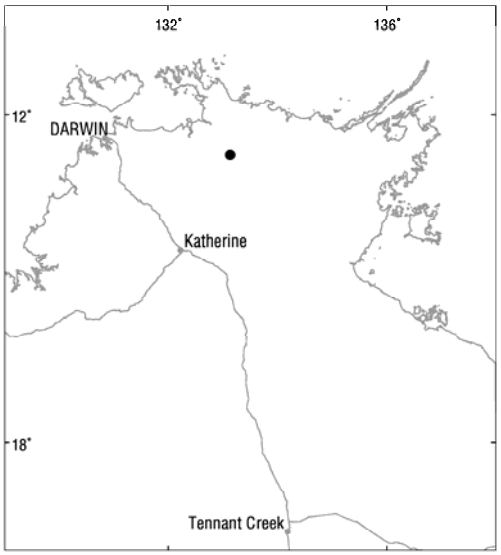

Fig. A1.1 Known location of *Boronia quadrilata.*

Ecology
Very little is known about the ecology of this species. Collection notes record it as occurring in open shrubland on a rocky sandstone slope next to *Allosyncarpia* forest.

Boronia quadrilata was observed to resprout after fire with strong and vigorous new growth in a 2003 survey. The majority of resprouting individuals were flowering/fruiting in this population. Unburnt individuals were large and spindly with foliage only present distally on stem. No seedlings and very few potentially juvenile individuals were seen in this population.

Conservation assessment

This species is only known from one locality, where it was collected in 1991 and revisited in 2003. Due to inaccurate geocode data, previous search efforts had failed to relocate this species.

It has a status of **Vulnerable** (under criterion D1+2) based on:

- a population size of < 1000 individuals and
- an area of occupancy < 20km^2.

Given the survey effort in this area current data is believed to reflect the very restricted distribution of this species.

Threatening processes

Although individuals have been observed to respond vigorously to fire the impact of frequent burning on the longevity of individuals and their perennial root stocks is unknown. The lack of seedlings and the extremely restricted distribution of this species suggest the population is at best static and not recruiting. Although sporadic/random recruitment events may be enough to maintain this population, this species is in a fire prone habitat and the factors behind its restricted distribution and abundance are not clear.

Conservation objectives and management

Research into the role of fire and other ecological processes in the distribution and abundance of the species is required. Collection of propagation material and translocation to botanic gardens may protect the species from stochastic fire events.

Compiled by

Raelee Kerrigan
Ian Cowie
Bryan Baker
[June 2002]

References

Duretto, M.F. (1999). Systematics of *Boronia* section *Valvatae sensu lato* (Rutaceae). *Muelleria* **12:** 90.

Boronia viridiflora Duretto

Conservation status
Commonwealth: *Environment Protection and Biodiversity Conservation Act 1999* - Vulnerable.
Northern Territory: *Territory Parks and Wildlife Conservation Act 2000* - Vulnerable.

Description
Shrub, growing perpendicular or slightly upward from vertical rock faces; stems to 1.5-2 m long, 4-angled. Leaves simple, elliptic to oblanceolate, red tipped. *Boronia viridiflora* differs from *B. quadrilata* by its horizontal habit, smaller, oblanceolate, subsessile leaves and smaller flowers and fruits.
Flowering and fruiting: Apr, June.

Distribution
Endemic to the Northern Territory, where it is known from two populations south of Nabarlek in Arnhem Land.

Conservation reserves where reported: None.

Ecology
Grows from vertical surfaces of cliffs or boulders on the sandstone plateau.

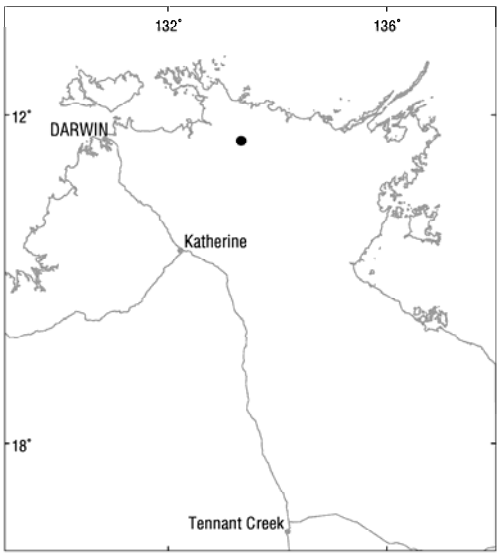

Fig. 2. Known locations of *Boronia viridiflora.*

Conservation assessment
The population is estimated at approximately 700 mature individuals (K. Brennan, pers. comm.). This species thus qualifies as **Vulnerable** (under criteria D1+2) as:
- the estimated number of mature individuals is <1000 and
- the species has a restricted distribution estimated to be <20 km^2.

Threatening processes
With a small population of restricted distribution, this species is susceptible to stochastic events. The habitat it occurs in suggests an intolerance of fire and thus an expansion of the population into areas exposed to fire is unlikely. Its recruitment potential is likely to be low given the availability of suitable sites and probability of successful dispersal to these sites.

Conservation objectives and management

Further research and monitoring are required to establish the extent of occurrence, stability of the population and the impact of fire. Propagation of material and translocation to a botanic gardens may be required.

Compiled by

Raelee Kerrigan
Ian Cowie
Bryan Baker
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References

Duretto, M.F. (1999) Systematics of *Boronia* section *Valvatae sensu lato* (Rutaceae). *Muelleria* **12:** 91.