



Adaptive Fire Management: Interim Guidelines for Forest Populations of Quokka (*Setonix brachyurus*)

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1. Introduction

The quokka (*Setonix brachyurus*) is endemic to the south-west of Western Australia. While a high population persists on Rottnest Island, there is evidence that the mainland population has declined since European settlement, especially in the northern jarrah forest (Hayward *et al.* 2003). The species is declared threatened under the WA Wildlife Conservation Act 1950 and is ranked as 'vulnerable' according to IUCN Red List Categories and Criteria.

The conservation status of the quokka requires that particular attention be paid to protecting extant populations and managing habitat. Controlling introduced predators, especially the fox, and the wise use of fire, are fundamental to quokka conservation. There is increasing evidence that feral pigs may also be adversely impacting on quokka habitat. Fire plays an important role in protecting and maintaining quokka habitat, but inappropriate fire regimes, including intense wildfires, can threaten quokka populations and other values.

In many circumstances fire management for quokka conservation, albeit important, is one component of integrated fire management that aims to deliver a broad range of environmental, social and economic outcomes. The quokka is recognized as one of a small group of forest dwelling organisms that are known to be fire regime specific (or fire sensitive) and it often shares its habitat with other organisms (plants and animals) that have similar fire regime requirements. Current knowledge suggests that a managed fire regime based on the requirements of fire regime specific taxa such as the quokka, is likely to benefit other organisms (Abbott and Burrows 2003).

A recent systematic rapid survey of quokka populations in the southern forests (Warren Region and southern portion of the South West Region) revealed a surprisingly high number of active quokka populations compared with *ad hoc* surveys undertaken in the late 1970s and early 1980s. In the most recent survey, a total of 1 030 sites were surveyed for quokkas. Of those, 500 showed signs of quokka habitation, which is very encouraging. However, the survey also revealed management issues with respect to the impacts of feral pigs on quokka habitat and the need to manage fire to both protect quokka populations and to manage quokka habitat.

1.1 Adaptive management

Management decisions will continue to be made in the absence of complete knowledge. Adaptive management is a framework that recognizes biological uncertainty, while accepting a mandate to proceed on the basis of the best available scientific knowledge. Adaptive management and the more intensive "active" adaptive management have been defined by the British Columbia Ministry of Forests (2004) as;

"Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form, "active" adaptive management, employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed".

As suggested by the definitions, adaptive management can range in complexity and sophistication from careful documentation of management activities, monitoring the outcomes

and adjusting policies and management accordingly, to operational-scale carefully designed experimental research (“active” adaptive management). Whether complex or simple, successful adaptive management requires managers to complete the six steps illustrated in Figure 1.

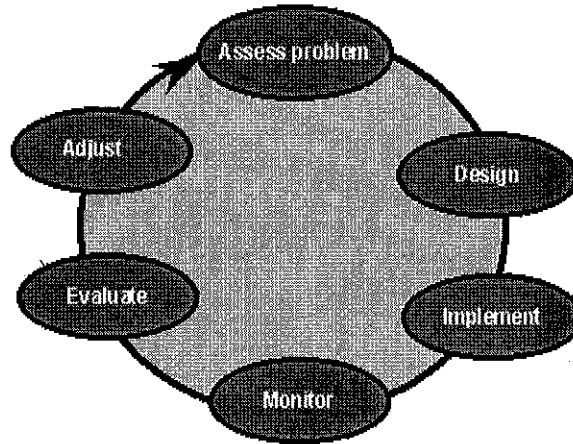


Figure 1: Six-step cycle of successful adaptive management (source: British Columbia Ministry of Forests 2004).

While southern forest and south coast populations have not been studied in detail and population trajectories are not known, recent surveys and field observations suggest that these populations are not in such a parlous state of decline as reported for drier northern jarrah forest populations (Graeme Liddelow and Tony Friend pers. comm.). Possible reasons for this include less habitat fragmentation (so better fox control and better opportunities for recolonisation), better habitat quality (more mesic, better cover) and lower impact of feral pigs in southern forests.

Given this, and the number and distribution of quokka populations throughout the more mesic southern forests and adjacent coastal habitats, it is not considered feasible or necessary at this stage to intensively manage each of the more than 1 000 or so known quokka populations or potential habitats distributed throughout the region using an “active” adaptive management approach.

2. Purpose and Application of This Guideline

This interim guideline aims to assist managers to make expeditious decisions about fire management practices for protecting and managing quokka populations and habitat while meeting other fire management objectives.

The guideline is a practical adaptive management technique that uses available scientific information to help formulate management strategies in order to learn so that subsequent improvements can be made in formulating practices. Hence, the guideline is interim until more knowledge is available from management, research and monitoring.

The guideline will apply to all mainland quokka populations and potential habitat in the Swan, South-West and Warren Regions, except at specific research sites where an intensive “active” adaptive management approach will be applied to answer specific questions about quokka ecology. As a result of the alarming decline in quokka populations in the northern jarrah forest,

which Hayward *et al.* (2003) describe as, “*terminal remnants of a collapsing metapopulation*”, research through an “active” adaptive management approach is appropriate and will focus on specific sites in parts of the northern jarrah forest.

3. Assessing the Fire Management Problem

Fundamentally, the problem is how to use fire to protect extant populations of quokka and to manage quokka habitat, whilst protecting other environmental, social and economic values from unacceptable damage by inappropriate fire regimes, including wildfire. Fire management must be cost-effective, feasible and beneficial, acknowledging constraints and uncertainty about what policy or practice is best.

4. Designing and Implementing Fire Management Practices

Christensen and Kimber (1975) studied some effects of fire on quokka habitat and populations in three swamps in the northern jarrah forest. They concluded that quokkas require mature but not senescent (swamp and riparian) vegetation (5 to 12 years since fire) for diurnal refuge. They reported that quokkas abandoned older, senescing vegetation that did not provide good cover, some 15 years after fire. They also reported that quokkas utilized (browsed) recently burnt vegetation. Similarly, Hayward *et al.* (2003), also working in the northern jarrah forest, concluded that quokkas prefer a mosaic of long unburnt and relatively recently burnt (<10 years) vegetation in swamp/riparian systems. A mosaic of mature vegetation (for diurnal cover and refuge) and recently burnt vegetation (for food) appears to provide optimal habitat.

A recent rapid survey of some 1 030 potential quokka habitat sites in the southern forests (south of Collie) found that quokkas were mostly resident in swamp/riparian systems where the vegetation was in an intermediate to late seral stage (5-25 years) (Graeme Liddelow unpublished). Quokkas were generally absent or at low densities in very recently burnt (<2 years old) and long unburnt (senescing) vegetation, or in habitat occupied by feral pigs. Liddelow also reported that quokkas utilised (browsed) very recently burnt vegetation, but sheltered in nearby older vegetation. He also noted that in some karri forests, quokkas were occasionally active further upslope over the winter months. He concluded that time since last fire was not as important as habitat structure (quality), which although related to time since last fire for specific vegetation associations, varied across the range of quokka distribution. Large and intense summer wildfires can impact severely on quokka populations (Middelton 2001, Graeme Liddelow pers. comm.) both acutely and indirectly by predisposing them to predation.

In addition to the quokka survey carried out by Liddelow and various district staff, the forest Fauna Distribution Information System (FDIS) developed by Christensen provides a basis for predicting the likely distribution of vertebrate forest fauna, including the quokka. The system, based on local expert knowledge and museum records, is a useful planning tool when assessing the likelihood of quokka occurrence and habitat in locations not covered by Liddelow's survey.

Based on this summary of knowledge of quokka distribution, habitat preference and threatening processes, the following fire management practices are recommended as an interim measure until better information is available from research, monitoring or the “active” adaptive management planning process underway in northern jarrah forests.

4.1 Management categories

Category 1. Fire management units that contain one or more moderate to high density quokka populations (Liddelow rating), or contain quokka habitat that has been characterized as “healthy” or “suitable” (Liddelow rating) but is unoccupied or has low density quokka populations:

Fire management aim: To protect extant quokka populations and/or suitable habitat.

- Review the fire history of the management unit over the last 20-30 yrs. Invoking the precautionary principle, continue to manage these populations the way they have been managed over the last 20-30 yrs, based on the argument that this has worked for these populations to this point, and unless there are compelling reasons to do otherwise, it could be risky to change.
- If it is impractical or undesirable to maintain historical management practices, then implement a program of normal rotation low intensity spring burning to reduce the likelihood of swamps/creek systems (quokka habitat) burning.
- Plan ignition pattern and time of ignition to avoid burning quokka habitat.
- Maintain Western Shield fox control. Increase to 6 baitings per year for 12 months post-fire if within 5 km of farmland/private property.
- Address the issue of feral pig control and determine the necessity and feasibility of doing so.

(Note: A guide to assist with characterizing the quality of quokka habitat will be provided by Science Division in the near future).

Expected outcomes

- Protection and conservation of extant quokka populations and habitat.
- Protection of other values from wildfire.

Risks and uncertainties:

- The trajectory of the quokka population(s) is unknown; it may be increasing, decreasing or stable.
- Risk of inadvertently burning the habitat under mild spring conditions, or of re-ignition later in the season. On the other hand, not burning the surrounding landscape for extended periods may expose people, property, quokkas and other values to intense wildfire, with far greater negative consequences.
- Risk of predation in the absence of effective fox control.
- Risk of feral pig invasion and subsequent habitat damage

Category 2: Fire management units that contain potential quokka habitat that is unoccupied, or has very low levels of activity because the habitat has degenerated (unsuitable) through natural senescence, feral pig damage or other factors.

Fire management aim: To regenerate and protect suitable quokka habitat.

- Burn under higher Soil Dryness Index (SDI) in late spring or early autumn to regenerate the swamps and creek systems, and then revert to normal rotation of low intensity spring burning to protect these habitats.
- Plan ignition pattern and time of ignition to control fire intensity within the low to moderate range.
- Maintain Western Shield fox control. Increase to 6 baitings per year for 12 months post-fire if within 5 km of farmland/private property.
- Address the issue of feral pig control and determine the necessity and feasibility of doing so.

Expected outcomes

- Regeneration of quokka habitat, eventual recolonisation by quokkas.
- Protection of other values from wildfire.

Risks and uncertainties:

- Unsuccessful regeneration of habitat.
- Barriers to recolonisation of regenerated habitat.
- Risk of predation in the absence of effective fox control.
- Risk of feral pig habitat damage/predation.
- Risk of fire escape.

Category 3: Fire management units that contain a mixture of quokka habitat conditions ranging from suitable/healthy to degenerated, or a mixture of quokka population densities ranging from absent to high density.

Fire management aim: To protect extant quokkas and/or suitable habitat, or to regenerate and protect quokka habitat.

- Where feasible (using existing roads/track, or by minimal new roadwork), separate habitats/populations for fire management. Implement normal rotation low intensity spring burn to protect healthy occupied habitat and regenerate degenerated habitat by burning in late spring or autumn.
- Where it is not feasible or desirable to physically separate habitats for fire management, implement normal rotation spring burn if the larger proportion of habitat is healthy, or implement an autumn burn if reverse is true, then revert to normal rotation spring burn.
- Plan spring ignition pattern and time of ignition to reduce risk of burning quokka habitat.
- Plan autumn ignition pattern to control fire intensity within the low to moderate intensity range.
- Maintain Western Shield fox control. Increase to 6 baitings per year for 12 months post-fire if within 5 km of farmland/private property.
- Address the issue of feral pig control and determine the necessity and feasibility of doing so.

Expected outcomes

- Protection and conservation of quokka populations and habitat.
- Regeneration of quokka habitat, eventual recolonisation by quokkas.
- Protection of other values from wildfire.

Risks and uncertainties

- The trajectory of the currently healthy population(s) is unknown; it may be increasing, decreasing or stable.
- Autumn burning of healthy habitat will have (short-term?) adverse impact on extant quokkas.
- Inadvertently burning the healthy habitat under mild spring conditions, or of re-ignition later in the season. On the other hand, not burning the surrounding landscape for extended periods may expose people, property, quokkas and other values to intense wildfire, with far greater negative consequences.
- Unsuccessful regeneration of habitat (autumn burn).
- Barriers to recolonisation of regenerated habitat
- Predation in the absence of effective fox control.
- Feral pig habitat damage/predation.
- Fire escape.
- Introduction of predators, weeds or disease with new road works.

5. Monitoring and Evaluation

Select a representative sample of the situations described above and monitor quokkas using the rapid survey technique developed by Liddelow (quokka presence /absence and activity level), and habitat condition before and at regular intervals after burning.

Record prescribed burn information including SDI, FDI, lighting pattern, time of ignition, fuel, weather and fire behaviour conditions.

Use satellite imagery to map post-burn patchiness (burnt and unburnt) and broad intensity classes.

Record feral pig activity and where resources permit, establish sand pads to monitor fox activity (see FORESTCHECK protocol).

Analyse, record and report on the monitoring data and compare with expected management outcomes.

6. Reviewing and Adjusting Management

Incorporate the results of monitoring, research and adaptive management into future guidelines, policy and practices.

Maintain comprehensive and accurate records of management actions, monitoring data and decision making processes.

This guideline should be formally reviewed at least every 5 years, or when new information is to hand.

References

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