

Worksheet answers**Part 1: Effects of bushfire****Kimberley**

1. Watch the video on the **Fire in the Kimberley** page then go to the **Kimberley** quadrat page. This page simulates effects of low and high intensity bushfires on common Kimberley savannah plants and animals. Which plants provide most fuel for the bushfire?

spear grass

2. Look at the plant distribution four years after the bushfire. Which plant shows most variation in the way it recovers after low intensity fires, compared with high intensity fires?

Spear grass shows the greatest change in the way it recovers. It has a marked increase in plant cover after four years for a high intensity fire.

3. Look at the effect of fire on fauna in the Kimberley study site, after 12 years. Does the intensity of a bushfire change the way bandicoots and native mice are affected? Why is this?

Intensity of a fire has a big effect on animals. High intensity fires destroy habitats and food sources. During and after a low intensity fire some plants remain, providing some protection during the fire, and shelter and food afterwards.

4. The Kimberley region has frequent large bushfires. This is partly because spear grass grows quickly and provides a massive fuel load, so fires spread fast and are more intense in dry months.

- a) Over a 12-year timespan, what is unusual about recovery of spear grass from low intensity fire compared to high intensity fire?

Spear grass has completely recovered by four years after an intense fire, but takes longer after a low intensity fire.

- b) Low intensity fires take place during or at the end of the wet season (summer) in the Kimberley, while high intensity fires occur during the dry season (winter). Spear grass grows from seed produced at the end of the wet season. Does this explain the answer for a), above? Give reasons for your answer.

Yes. Low intensity fires tend to occur in wet months, or early dry season, when grass is green and fire kills seed, whereas high intensity fires occur in the dry season when seed has already been distributed.

- c) How might this affect fire management strategies?

Controlled burning in the wet season or early dry season keeps grass growth under control so there's less fuel load. This reduces chances of an out-of-control bushfire in the dry season.

Western Desert

5. Watch the video on the **Fire in the Western Desert** page then go to the **Western Desert** quadrat page. Which plants provide most fuel for the bushfire?

spinifex

6. One way to describe biodiversity is the variety of species in an ecosystem. Based on the quadrat data, which study site has the greater plant biodiversity: the Kimberley or Western Desert?

Western Desert

7. Fire in the Western Desert affects the central military dragon and central netted dragon differently. Look at the data and predict what kinds of habitats or conditions each might prefer.

The central military dragon decreases in number immediately after a fire but the central netted dragon increases. This is because the military dragon prefers a habitat with a lot of plant cover, whereas the netted dragon prefers higher temperatures and sparse cover.

8. The bush tomato is an important food source for Martu people, traditional owners of the Western Desert region. Describe bush tomatoes' pattern of regrowth after low intensity and high intensity fire.

After both low and high intensity fires, bush tomatoes grow back vigorously reaching maximum cover after four years, after which plant cover diminishes. There's a greater percentage cover after a more intense fire.

9. The bush tomato is a small shrub that produces seed after 1 - 3 years, resprouts after fire and has a life span of about 30 years. Why does it grow back so strongly after an intense fire?

An intense fire removes competing vegetation. Bush tomato can resprout immediately after a fire and colonise an area. It doesn't have to regrow from seed (that may have been destroyed by fire anyway).

10. Traditionally Martu people managed their land in the Western Desert with fire. They lit low intensity fires, at regular time intervals.

- a) Explain how this benefitted the people.

Food plants, such as bush tomatoes, are most abundant about four years after a fire so the Martu needed regular fires to ensure food. Martu people also ate lizards, which were easier to spot and catch when the ground was bare after a fire.

- b) How did it benefit the ecosystem?

Regular low intensity fires maintained biodiversity and prevented large wildfires by removing fuel.

- c) Why didn't they light high intensity fires?

Large wildfires leave nothing immediately after the fire and can wipe out lizards and other fauna forever.

South West

11. Watch the video on the **Fire in the South West** page then go to the **South West** quadrat page. What plants provide most fuel for the bushfire?

Trees and plants close to the ground both provide fuel for the fire.

12. Which plant species in the South West take longest to recover from a high intensity fire?

karri and oak-leaved banksia

13. Why might frequent intense fires endanger these plant species?

Frequent fires that are hot enough to kill these plants before they have flowered and produced seed could lead to their decline.

14. Which type of fires benefit quokkas and honey possums?

Low intensity, patchy fires benefit quokkas and honey possums.

15. Quokkas prefer to eat fresh green shoots that sprout soon after a fire. Honey possums live on nectar from flowers of mature trees and shrubs. Explain why quokka numbers gradually decrease after a low intensity fire, while honey possum numbers increase steadily and remain relatively high.

Quokkas eat fresh shoots, which appear soon after a fire. Once larger plants have grown back fresh shoots become scarce so quokkas haven't enough food, and look elsewhere. They also need thick vegetation for cover from predators and the weather.

Honey possums eat nectar from flowers of mature trees so they can remain and breed in a burnt area, feeding on nectar from flowers of surviving mature trees and shrubs.

Part 2: Patch burning

Kimberley

16. Cypress pines are said to be at risk of extinction due to frequent fires in the late dry season in the Kimberley (about every two to three years).

- a) Does the patch burning data support this? Explain how.

Yes. Cypress pines are absent from areas frequently or occasionally burnt.

- b) Cypress pines have thin bark grow from seeds of mature trees, whereas bloodwoods resprout after fire. Use this information to explain why frequent fires endanger cypress pines.

Cypress pines are easily killed by fire. They don't re-sprout and only grow from seed produced by mature trees. If they keep getting burnt they never get a chance to set seed and reproduce.

- c) How could a patch burning strategy be used to prevent extinction of cypress pines?

Patch burning leaves some areas unburnt so cypress pines in those areas have time to mature and set seed.

- d) How might patch burning help to maintain biodiversity (plants and animals) in the Kimberley?

Both fauna and flora are badly affected by frequent burning. Patch burning could provide sanctuaries for fauna in rarely burnt areas.

Western Desert

17. The following questions look at how fire frequency affects flora in the Western Desert.

a) What differences are there between frequently and rarely burnt patches?

Frequently burnt patches only contain wire grass and bush tomatoes whilst rarely burnt patches mainly contain both species of spinifex and wattle.

b) Which patches show the greatest plant biodiversity? Why is this.

Frequently burnt patches have lower vegetation cover, lower vegetation height and lower biomass, but have a greater number of plant species than long unburnt patches. In general, there is greatest biodiversity in patches that are burnt occasionally (not rarely and not frequently).

c) How might patch burning be an advantage to people living on the land?

Possible answer:

Different patches contain different amounts of each species but overall there are a wide variety of plants and animals available. People could move between patches to find food and shelter they need.

c) Some animals prefer areas where vegetation is frequently burnt; some prefer unburnt areas; others have no preference. How might patch burning be an advantage to animals?

Patch burning creates a mosaic of vegetation where there are differences in time since patches were last burnt and frequency of burning. This provides the greatest diversity of habitats and food sources for animals.

South West

18. The following questions look at how fire frequency affects flora in the South West.

a) Give examples of plants that benefit from frequent burning.

annual herbs, grasses, some species of orchid and wattle

b) Give examples of plants that benefit from rarely being burnt.

any of these: sword grass, karri, jarrah, oak-leaved banksia

c) Are there any plants that tolerate a variety of burning conditions? Explain.

There are similar amounts of little kangaroo paw in all patches, regardless of fire regime.

19. Oak-leaved banksia (*Banksia quercifolia*) does not resprout after fire. It only grows from seeds. These are contained in tough capsules, only opened by fire. After a fire passes through an area, capsules open and release seeds onto ground that has just been fertilised by ash, increasing their chances of survival.

a) Use the patch burning data to describe how frequent fires affect oak-leaved banksia.

There are no oak-leaved banksias in frequently burnt patches.

- b) Oak-leaved banksia trees start producing seed when they are about six years old. They have a life span of about 30 years. What type of fire management practice do you think would best ensure survival of oak-leaved banksia?

Fire is required at intervals of between 6 and 30 years. A minimum of six years is necessary to allow plants to produce seed; a maximum of 30 years because fire is needed for seeds to germinate before plants and seeds start to die. It is possible for fire to be more frequent, as long as it is of low intensity and doesn't kill banksia plants.

Thinking about patch burning

If patch burning is to be used as a land management strategy, careful planning is needed to decide on which patches to burn and when to burn them. Consider the two scenarios below:

In scenario 1, frequently burnt and infrequently burnt patches are spread around, but in scenario 2 they're clustered together.

20. Which scenario would be preferable if a sudden lightning strike caused a wildfire? Explain.

The first scenario would be preferable. If a sudden fire began in an unburnt patch it couldn't spread far quickly because unburnt patches are surrounded by frequently burnt patches that have less fuel.

In the second scenario, if a fire started in one of the adjoining unburnt patches, all three would burn fast due to the high fuel load, creating a large high intensity fire.

21. Is patch burning the best fire strategy for all three areas studied? Explain.

Yes. In all three regions, patch burning creates the greatest biodiversity because different species flourish with different fire regimes.

22. Explain why intervals between frequent burning are different for the South West compared with the Kimberley or Western Desert regions.

Fire is less frequent in the South West than the Kimberley or Western Desert due to a moist climate and associated flora, rather than drier climates of the Western Desert and Kimberley.

Summary

'Bushfires reduce biodiversity'

'Bushfires maintain biodiversity'

23. Describe situations where these statements might be true.

Frequent, high-intensity fires that extend over large areas are very destructive. They reduce biodiversity by destroying fire-sensitive species and reducing habitat diversity.

Patch-burning has potential to maintain or increase biodiversity by providing a wide range of habitats that suit different plants and animals. Some plants depend on fire for reproduction. Patch burning reduces the impact of unplanned fires (eg those caused by lightning) by restricting the spread of fire across a landscape.

24. Experts who manage bushfire-prone landscapes develop fire management plans. Many factors need to be considered and guiding principles have been established in Western Australia to develop plans. Explain why the factors below (based on fire management in the WA rangelands) are important in developing a regional fire management plan.

climate (annual weather patterns)	<i>Rainfall will determine when controlled burning can be undertaken. If the bush is too wet it will not burn; too dry and controlling fires will be difficult.</i>
presence of natural resources (eg bush foods, tourism sites)	<i>Certain sites may have to be protected and burnt less often than otherwise desired.</i>
presence of communities, farms	<i>Protection of infrastructure and lives may override other concerns.</i>
animals and plants in the area	<i>Surveys of animals and plants will be needed before a fire management plan can be made, so that impacts can be assessed.</i>
Aboriginal knowledge, past practices	<i>Information from past practices, including traditional Aboriginal knowledge, demonstrates impacts of different fire management regimes.</i>
scientific research into plant and animal populations	<i>Scientific research is needed to understand how plant and animal populations respond to fire and ecological change. This includes understanding their needs for food, shelter and reproduction.</i>
size and intensity of fires	<i>Fires of different size and intensity have different impacts on plants and animals of a region.</i>
frequency of fires	<i>Different plants and animals respond differently to fire frequency: some are very sensitive to frequent fires; others may be more tolerant. Diversity is important.</i>
patch burning: size and connections between patches	<i>The size of patches and way they interconnect will be important for some animals' survival.</i>
stakeholders (Government, fire and emergency services, land care groups, lobby groups)	<i>Different people will have different opinions and not all can be met simultaneously. A fire management plan has to balance competing interests.</i>
presence of endangered or significant species	<i>Rare or significant species may require a higher level of protection.</i>
long term climate predictions (climate change)	<i>Possible changes to weather patterns will need to be taken into account when planning long-term fire management. For example making allowances for a drying climate.</i>
budget (cost and availability of staff and equipment)	<i>Resources are limited. Plans have to be take into account available resources which may be expensive, such as helicopter access to remote areas.</i>