



POSITION STATEMENT ON

Mountain Biking in Australia's Protected Areas

The National Parks Australia Council

Formed in 1975, the National Parks Australia Council (NPAC) is the national body that coordinates and represents state and territory non-government organisations concerned with protecting the natural environment and furthering national parks. NPAC has six member organisations: the National Parks Association of Queensland, the Victorian National Parks Association, the National Parks Association of New South Wales, the National Parks Association of the Australian Capital Territory, the Tasmanian National Parks Association, and the Nature Conservation Society of South Australia. Member groups represent over 50,000 members and supporters. NPAC provides a forum for regular communication between these organisations and acts as a united voice supporting conservation of the National Reserve System (NRS) across Australia. NPAC's mission is to protect, promote and extend national park systems within Australia.



Acknowledgements

This Position Statement was coordinated by the National Parks Australia Council (NPAC). It was developed by the Mountain Biking Working Group established by NPAC for the purpose of producing this Statement. The Mountain Bike Working Group consists of:

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Executive summary

- The Position Statement on Mountain Biking in Australia's Protected Areas (the Statement) provides a clear and consistent direction and unified understanding among member organisations of the National Parks Australia Council of the compatibility of mountain biking in different protected area categories within Australia's National Reserve System (NRS).
- The Statement has been developed in response to increasing demands for access to protected areas for mountain biking. Its purpose is to inform the decision-making process regarding mountain bike trail development and activities, in a way that aims to ensure the conservation integrity of the NRS.
- Data and other information show an increasing number and diversity of mountain bike riders in Australia. This information, combined with that on the top-rated trails and competition events, highlights four important features of mountain biking in Australia.
 1. To meet the needs of the diverse types of riders, there is a demand for a diversity of trails for beginners through to experts.
 2. While many trails in Australia are in purpose-built bike parks, the majority are in natural areas, many of which are in the NRS.
 3. Trails are being sought in natural settings, both close to urban centres and in remote locations.
 4. Mountain bike riding is an active recreational activity, rather than a passive or nature conservation one.
- Mountain biking in protected areas can result in significant environmental impacts, including fragmented landscapes, vegetation reduction, loss of habitats, soil erosion, reduced carbon storage and sequestration, and disrupted water flows. Degraded protected areas diminish the physical, mental, social and economic health of Australian communities and the nation through the loss of ecosystem services and the reduction of our ability to meet international conservation agreements.
- The establishment of unauthorised mountain biking trails is a great threat to protected areas and causes extensive impacts on them. A zero-tolerance approach to unauthorised trails in the National Reserve System must be enforced. Riders have created many additional or interconnecting trails without authorisation, using unacceptable techniques and unsafe features that are not conducive to conservation values. Unauthorised trails create more adverse effects than carefully designed and managed authorised trails. Unauthorised trails are more likely to increase erosion, create user conflict, damage high conservation value areas, increase costs for land managers, and undermine the reputation of the mountain biking industry.
- Social conflict around mountain biking generally involves goal interference, where the physical presence of one individual or group interferes with the goals of another individual or group. In addition, different user groups may disapprove of each other, perceiving that they don't share the same values or norms, regardless of whether they encounter each other or not.
- The location and design of a trail across the landscape (e.g. single or double trail, fire service roads, trail with technical features, dense or dispersed networks, user facilities), and how a trail is ridden, strongly influences the type and magnitude of environmental and social impacts on protected (and adjacent) areas. Well-maintained authorised trails can play an important role in reducing these impacts.
- Situating new trails on repurposed, cleared, degraded or low conservation value lands will protect high conservation value areas while meeting the increasing demand for mountain biking. Fire and service roads; non-native forests and plantations; cleared paddocks and previous agricultural land; old road/rail alignments; land already utilised for other active recreational pursuits, such as skiing, horse riding or motorised sport; abandoned mine and quarry sites; private properties; and areas adjacent to the NRS that are set aside as buffer zones all provide good opportunities for mountain biking.
- This Position Statement on Mountain Biking in Australia's Protected Areas consists of three components: 1) the Mountain Bike Zoning Compatibility Matrix; 2) a set of Principles for Mountain Biking in Protected Areas; and 3) a Code of Conduct for Mountain Biking in Protected Areas.

- The Mountain Bike Zoning Compatibility Matrix provides an assessment as to which mountain biking features or facilities are conditionally compatible with different IUCN protected area categories in the NRS. However, this assessment is not a replacement for detailed planning. Every jurisdiction across Australia has its own specific laws and regulations that establish protected areas, and they vary from state to state and even place to place. For detailed planning purposes, the legal tenure, reserve objectives, management zoning (if any) and permitted uses for specific protected areas need to be considered on a case-by-case basis.
- The nine Principles for Mountain Biking in Protected Areas provide supporting, evidence-based principles to apply when mountain bike trails are being proposed, promoted, designed, constructed or ridden. They include:
 1. Trail approval and determination
 2. Evidence-based collaborative planning
 3. Environmental impact considerations
 4. Trail location
 5. Trail design
 6. Zero tolerance for unauthorised trails
 7. Social impact considerations
 8. Education and awareness of social and conservation values
 9. Restoration and rehabilitation.
- The Code of Conduct for Mountain Biking in Protected Areas expands on those developed by the International Mountain Bicycling Association to include best conservation practice. It is recommended the Code of Conduct developed by the National Parks Australia Council be promoted by federal and state agencies and cycling organisations to ensure riders understand their responsibilities when riding in protected areas.



Mountain biking in Glenrock State Conservation Area, New South Wales. JOHN SPENCER/DPE

Purpose and application

The Position Statement on Mountain Biking in Australia's Protected Areas (the Statement) provides a clear and consistent direction and unified understanding among member organisations of the National Parks Australia Council of the compatibility of mountain biking in different protected area categories within Australia's National Reserve System (NRS). The Statement has been developed in response to increasing demands for access to protected areas for mountain biking, and with the purpose of informing the decision-making process regarding mountain bike trail development and activities in a way that ensures the conservation integrity of the NRS.

The Statement can serve as a tool for governments at all levels, as well as for the mountain biking industry (trail planners, designers, and developers) and private landowners. It is forward-looking and intended to be applied during:

- strategic planning
- park management planning
- land acquisition
- capital and budget planning
- sustainable service delivery
- compliance and enforcement
- collaboration and partnership opportunities.

This document first provides the background information and evidence-base that supports the Position Statement on Mountain Biking in Australia's Protected Areas, and then presents the Statement. The Position Statement consists of three components:

1. the Mountain Bike Zoning Compatibility Matrix
2. a set of nine Principles for Mountain Biking in Protected Areas
3. a Code of Conduct for Mountain Biking in Protected Areas.

The Statement does not discuss the technical details of trail development and design, which are documented in depth in guidelines developed by the International Mountain Bicycling Association and AusCycling. These guides were developed by experts in mountain biking and provide comprehensive profiles of the activity, trail design and planning from an industry perspective. Industry guidelines give little attention, however, to the objectives of reserved land tenure, especially those in our NRS, which are dedicated to protecting Australia's natural and cultural assets.

The Position Statement on Mountain Biking in Australia's Protected Areas aims to fill this gap and complement existing industry guidelines by providing an evidence-based conservation perspective on when, where, and how mountain biking activities are compatible with protected areas in Australia's NRS. The components of the Statement presented in this document are to be implemented in a manner consistent with overarching policies, legal requirements and strategic plans applicable to local, state and federal governments.

Background information

Mountain biking is one of the fastest-growing recreation and tourism activities in Australia, and globally (GHD Advisory 2021). To meet this increase in demand, across Australia there has been an increase in mountain bike trails proposed and constructed by the cycling industry, state and local governments and the private sector (GHD Advisory 2021). While many of these trails are in purpose-built bike parks, there is increasing demand for mountain bike access to natural and protected areas.

There are many benefits to mountain biking, such as improved physical and mental health, bonding with family and friends, economic benefits to local communities, increased regional and state tourism, and increasing riders' connections to and concern for the natural environment (Pretty et al. 2006, Gilchrist and Weaton 2017, GHD Advisory 2021, AusCycling 2023a). However, mountain biking in protected areas has environmental and social impacts – such as fragmented landscapes, vegetation reduction, loss of habitats, soil erosion, disrupted water flows, and conflict with other users – resulting from the development and use of authorised and, especially, unauthorised trails.

As the world faces a biodiversity and climate crisis, the protection of areas of natural and cultural significance is of utmost importance. Australia's National Reserve System (NRS) is the pinnacle of our nation's protected area system, conserving natural and cultural assets of the highest importance.

Australia's protected areas

The NRS is Australia's network of public, private and Indigenous terrestrial protected areas (Australian Government 2009). It aims to protect the diversity of all Australian native landscapes and flora and fauna through strategic habitat protection and ensuring natural resources are effectively managed (Australian Government 2009). Areas within the NRS contain some of Australia's most significant natural and cultural heritage assets (Department of Biodiversity, Conservation and Attractions 2019).

Under Australia's Strategy for the National Reserve System 2009–2030, all state and territory governments and the Australian Government agreed to adopt the international definition and standards for protected areas and the management categories developed by the International Union for Conservation of Nature (IUCN) (Australian Government 2009b).

BOX 1: The IUCN protected area management categories (IUCN 2008)

Category Ia: Strict nature reserve

Strictly protected for biodiversity and possibly geological/geomorphological features, where human visitation, use and impacts are controlled and limited to ensure protection of the conservation values.

Category Ib: Wilderness area

Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, protected and managed to preserve their natural condition.

Category II: National park Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

Category III: Natural monument or feature

Areas set aside to protect a specific natural monument, which can be a landform, sea mount, marine cavern, geological feature such as a cave, or a living feature such as an ancient grove.

Category IV: Habitat/species management area

Areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category.

Category V: Protected landscape or seascape

Where the interaction of people and nature over time has produced a distinct character with significant nature conservation and other values, and where safeguarding the integrity of interaction is vital to protecting and sustaining the area and its associated ecological, biological, cultural and scenic values.

Category VI: Protected areas with sustainable use of natural resources

Areas that conserve ecosystems, together with associated cultural values and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non-industrial natural resource use that is compatible with nature conservation is seen as one of the main aims.

The IUCN identifies six management categories with different conservation objectives that form the basis of the NRS. The protected area categories are listed in Box 1. For a protected area to be included in the NRS, it must fit into one of these categories.

Under each category, asset management and protection are afforded for different reasons and priorities – for example, rare, endangered or threatened species, high scenic amenity, Indigenous cultural values, European history, important ecological processes, recreational potential or natural monuments. Areas within the various categories are afforded different degrees of protection under the federal government's *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* and state and territory government conservation acts.

The degrees of protection operate along a continuum from high to low levels, based on reserve tenure objectives that define the types of activities compatible or permitted within, or adjacent to, an area's boundaries. Ownership and management of these protected areas are variable and may be federal or state and territory governments, Indigenous communities, or private property owners (Department of Climate Change, Energy, the Environment and Water 2023).

While state and territory governments have agreed to adopt the IUCN's definition of a protected area and the overarching six protected area categories, these categories have not been consistently applied. Furthermore, what the states protect, and how they protect it in different areas that do not contain Matters of National Environmental Significance (hence don't fall under the EPBC Act), is at their discretion.¹ Thus, tenures given to protected areas under each category differ across each state and territory.

While Australia and many states and territories have fantastic networks of national parks and conservation reserves, there are gaps. To achieve the goals set out in Australia's Strategy for the National Reserve System 2009–2030, and to meet Australia's global commitment to increase levels of protection to 30% across land and sea by 2030, additions to protected areas and the NRS will be required (see Box 2).

“As the world faces a biodiversity and climate crisis, the protection of areas of natural and cultural significance is of utmost importance.”

BOX 2: Global commitments and 30x30x30

State governments have agreed to work collectively and with the Australian Government to achieve a national target to protect and conserve 30% of Australia's landmass and 30% of marine areas by 2030 (the 30 by 30 target).

The importance of protecting and conserving areas with high biodiversity is recognised internationally. In December 2022, Parties to the Convention on Biological Diversity (CBD) adopted a new global strategy and targets to halt and reverse biodiversity loss – the Kunming-Montreal Global Biodiversity Framework (GBF). The GBF has four long-term goals for 2050, which are underpinned by 23 targets to guide action over the years to 2030, including Target 3 (the 30 by 30 target).

The Australian Government is developing a roadmap that sets out the pathway for national efforts towards the 30 by 30 target on land. It is an overarching framework that complements Australia's Strategy for the National Reserve System 2009–2030, the National Other Effective area-based Conservation Measures Framework, and relevant policies in each state and territory. The contributions of the Australian, state and territory governments towards achieving the 30 by 30 target will be guided by these documents and reflect their individual circumstances, priorities and resources.

¹ The *Environment Protection and Biodiversity Conservation Act 1999* protects certain nationally significant animals, plants, habitats or places. These are termed Matters of National Environmental Significance.

Maintaining the integrity of protected areas

Due to the global biodiversity and climate crisis, it is of utmost importance to maintain and protect areas in the NRS as scientific reference sites, for future options, to mitigate and adapt to changes in climate, and for intergenerational equity (Australian Government 2009). The long-term provision of ecosystem services that contribute to Australia's economy, and to the health of Australian and global communities, is underpinned by the ecological processes occurring within and across these valuable areas. The physical, mental, social and economic health of communities and the nation would diminish were these areas not protected. Australia would also not be able to meet international agreements, such as the Convention on Biological Diversity, Kunming–Montreal Global Biodiversity Framework, Ramsar Convention on Wetlands, China–Australia Migratory Bird Agreement (CAMBA), Japan–Australia Migratory Bird Agreement (JAMBA), the UN's Sustainable Development Goals, or the Paris Agreement.

This Statement focuses only on the activity of mountain biking, but there are many other recognised threats to the longevity and integrity of Australia's protected areas. Other threats include recreational and tourism activities (such as hiking, horse riding, or tourist accommodations), climate change, inappropriate land-use planning, bushfires, pests and disease, timber extraction, mining and even politics (for example, changes in government position or policy). These threats and their impacts vary in magnitude and may occur over long or short timeframes and at local or global scales. While we must pay attention to and manage individual impacts, accumulated threats are most concerning, as together they are greater than the sum of their parts.

Protected areas do not function in isolation but are part of broader environmental, social, cultural and economic landscapes, and they should be managed in this context (Australian Government 2009). Large numbers of people travel interstate and internationally to Australia's protected areas to experience their natural and cultural wonders. Species migrate, pollination occurs, and water flows across protected area boundaries. Protected vegetation sequesters and stores carbon, helping mitigate global climate change. Therefore, when protected areas are negatively impacted, a flow-on effect occurs in areas external to them.

Protected areas are vulnerable to edge effects due to adjacent land-use activities, as much as they are to activities within their boundaries. Inappropriate land-use near protected areas can alter ecological processes such as the regulation of water or nutrients. Climate change also threatens to change habitat composition within protected areas, potentially leading to more frequent bushfires. Timber extraction fragments landscapes, creating edge effects and enabling weed and pest species to further colonise protected areas.

If lost or degraded, protected areas can be cost-prohibitive to replace – if they are replaceable at all. This Statement takes a proactive approach to addressing requests for access to the NRS for mountain biking. While some Australian states and territories have long been addressing this issue, such as New South Wales, it is an emerging issue in other states and territories such as Queensland. These guidelines adopt a whole-of-system, Australia-wide approach to addressing this threat, with the aim of maintaining the longevity and integrity of the NRS.



Wineglass Bay, Freycinet National Park, Tasmania. *TASMANIAN.KRIS/FLICKR*

Mountain bike riding in Australia

Mountain biking made its way to Australia in the 1980s and is now one of the fastest-growing recreational activities in Australia and globally (GHD Advisory 2021, Australian Sports Commission 2023). Membership to organised cycling associations has also grown, with Mountain Bike Australia (now AusCycling) reporting a membership increase of 60% from 2014 to 2020 (GHD Advisory 2021). Mountain bikes now account for the most bicycle sales in Australia, surpassing the sale of racing bikes, sport/racer bikes, and touring bikes (National Museum of Australia 2020, GHD Advisory 2021).

AusPlay, the Australian Sports Commission's survey, while not a complete overview of participation, provides the most comprehensive national, state and territory data on mountain biking in Australia (Australian Sports Commission 2023). Figure 1 shows the increasing number of people mountain biking in Australia from 2016 to 2022 (Australian Sports Commission 2023). According to AusPlay, an estimated 453,228 people participated in mountain biking in Australia in 2022, compared to around 200,000 just 6 years prior (Australian Sports Commission 2023).

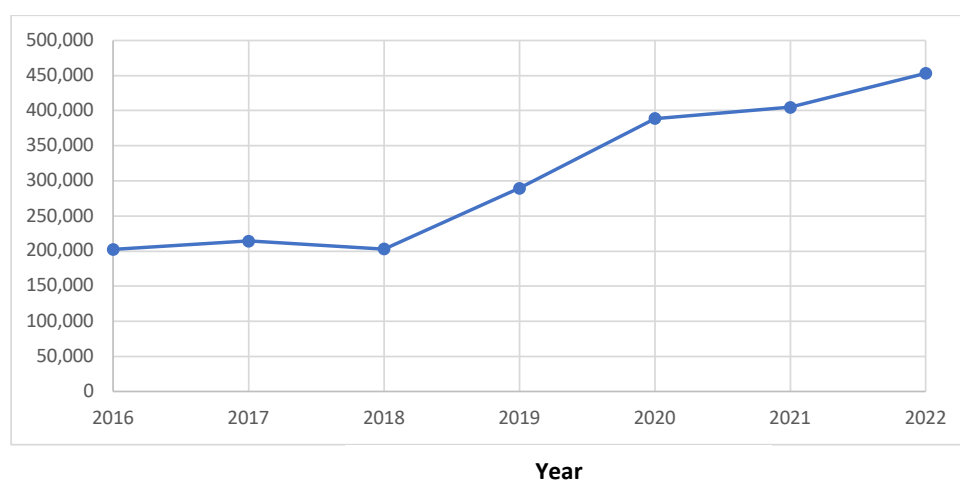


Figure 1: Estimate of the number of people mountain biking in Australia from 2016 to 2022 (Australian Sports Commission 2023)

Table 1 shows a breakdown by state and age group of Australia's mountain bike riders who are receiving the direct benefits of participation. In 2022, the most people who were mountain biking were in New South Wales, Queensland, and Victoria (Australian Sports Commission 2023). In all states except NSW, SA, and the ACT, the most common age bracket for mountain bike riders was 35–44 years, followed by 45–55 years (Australian Sports Commission 2023). In NSW, SA, and the ACT, the most common age was 45–55 years, followed by 25–34 years (Australian Sports Commission 2023). The number of males participating in mountain biking far exceeded females. Of the estimated 453,228 people participating in mountain biking in Australia, 356,952 were male and 96,276 were female (Australian Sports Commission 2023).

Table 1: Estimated number of people participating in mountain biking by age group in each state, and across Australia, as of 2022 (Australian Sports Commission 2023)

| Age Group | WA | Vic | Tas | SA | Qld | NT | NSW | ACT | Nation-wide |
|-----------|--------|--------|--------|--------|---------|-------|---------|--------|-------------|
| 15–17 | 1,644 | 5,200 | n/d | n/d | 3,907 | n/d | 6,648 | n/d | 17,399 |
| 18–24 | 2,434 | 8,243 | 6,267 | 605 | 11,817 | n/d | 12,220 | 2,268 | 43,855 |
| 25–34 | 3,478 | 20,401 | 3,526 | 4,859 | 12,834 | n/d | 16,217 | 6,131 | 67,446 |
| 35–44 | 14,293 | 32,816 | 10,623 | 7,670 | 30,941 | 3,792 | 30,170 | 1,328 | 131,632 |
| 45–54 | 12,345 | 18,625 | 5,216 | 8,183 | 26,586 | 1,970 | 35,651 | 2,839 | 111,414 |
| 55–64 | 8,242 | 9,095 | 3,507 | 3,127 | 13,572 | 3,093 | 20,587 | 2,436 | 63,659 |
| 65+ | n/d | 2,063 | 1,750 | 1,570 | 8,588 | n/d | 3,304 | 548 | 17,823 |
| Total | 42,436 | 96,443 | 30,889 | 26,014 | 108,245 | 8,854 | 124,797 | 15,550 | 453,228 |

n/d = no data

Figure 2 (below) shows the demographics of national mountain bikers by employment, education level and household income. Across Australia, most people who mountain bike work full-time and have a university degree or higher (Australian Sports Commission 2023). Although many people participating in the survey did not state their household income, those who did mostly came from households earning more than \$200,000 a year. The second highest income was \$150,000 per year, with the third highest being \$100,000 per year (Australian Sports Commission 2023). The cost of mountain bikes, bike maintenance and repairs, along with the need for suitable transport to access trails, appears to deter lower socio-economic income groups from participating in the activity.

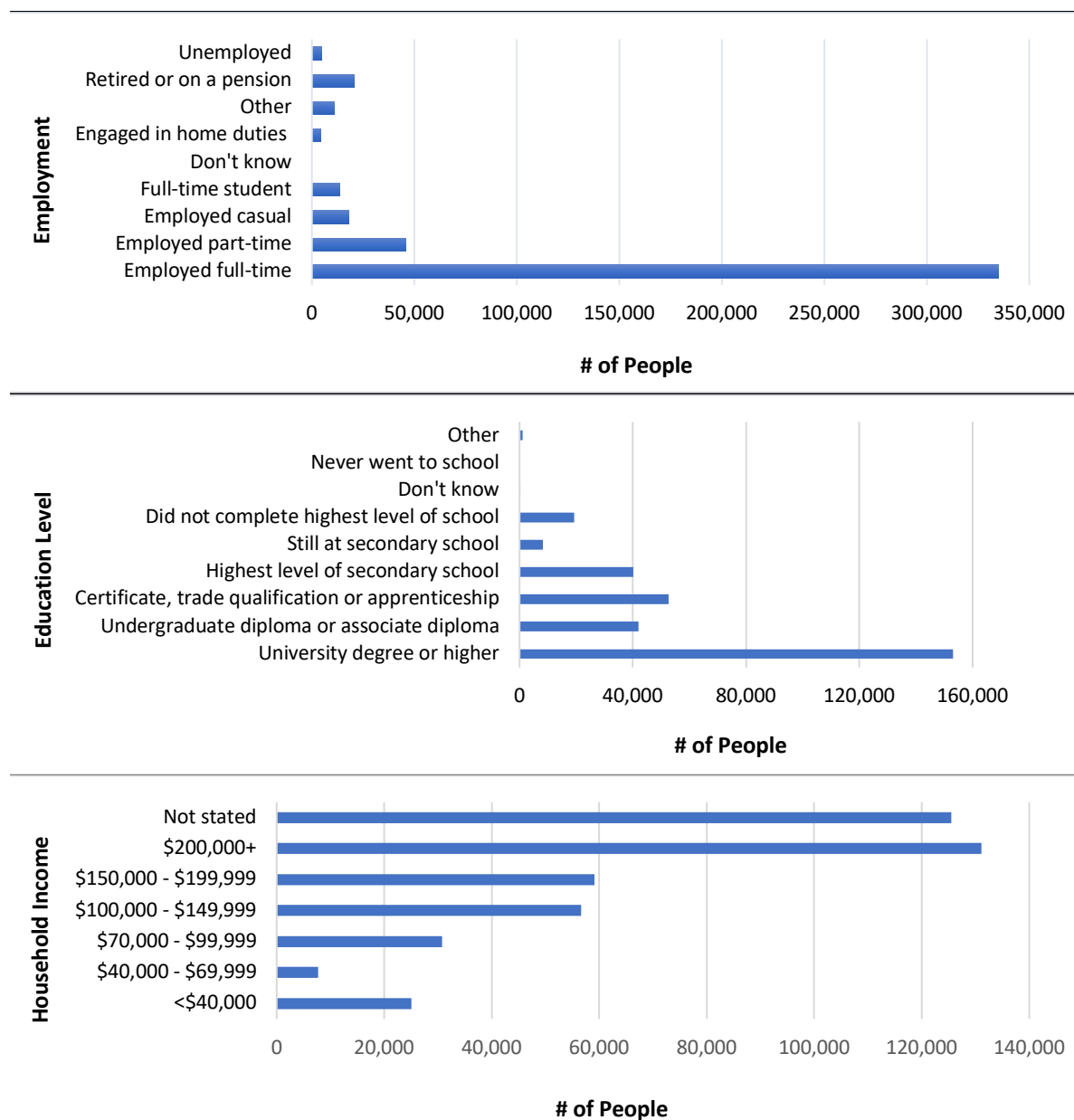


Figure 2: Demographics of national mountain bike participants by employment, education level and household income

The Australian Mountain Bike Trails Guideline (AusCycling 2023a) identify five general types of mountain bike riders, as listed below. Generally, the more advanced a rider, the greater the pursuit of steep technical descents and high incline climbs.

- **Leisure:** includes riders of all ages and abilities. They are not usually members of clubs, typically ride infrequently, and often have limited skills. Leisure riders are more likely to use highly accessible routes close to home or to make the journey to trail facilities that have amenities and services such as bike hire, cafes, and toilets.



Mountain biking has documented health benefits. YURI ACURS/DREAMSTIME

“It is not surprising more people are turning to the activity of mountain biking considering the benefits of participation, which are well documented by the mountain biking industry, medical sporting institutes, and academics.”

- **Enthusiast:** recreational mountain bikers with moderate skills and variable fitness, who ride weekly. They form the majority of mountain bike riders. Typically, enthusiasts don't compete in events and prefer not-too-challenging trails with good signage and easy technical features. Enthusiast mountain bikers are the most likely to take short breaks to bike in different areas.
- **Sport:** competition riders who ride regular routes multiple times a week and are members of mountain bike clubs. They seek less accessible trails, have high fitness levels, and are technically proficient. They ride a very wide variety of trails.
- **Independent:** skilled outdoor enthusiasts who are technically proficient, have a good level of fitness, and ride once a week on a very wide variety of trails. The adventurous aspect is more important than the technical challenge for independent mountain bikers, who typically seek more remote trails.
- **Gravity:** highly skilled technical riders who seek very challenging trails, typically ride at least once a week, and are often members of clubs. They require purpose-built trails with the highest classification.

It is not surprising more people are turning to the activity of mountain biking, considering the benefits of participation, which are well documented by the mountain biking industry, medical sporting institutes, and academics. The benefits of mountain biking can accrue to individuals, communities, government, and the environment and are presented below in Box 3.

BOX 3: The potential benefits of mountain biking accrued to individuals, communities, government and the environment

- **Individual:** weight loss, muscle building, joint health, disease prevention, improved balance, better coordination and concentration, healthier heart, improved sleep, confidence building and improved mental well-being (Pretty et al. 2006, Hill and Gomez 2020, Idaho Sports Medicine Institute 2023).
- **Societal:** greater cohesion between family members or members of the community when riding in groups. When riding together, mountain bikers share experiences, receive a sense of belonging and are overall safer (Gilchrist and Weaton 2017).
- **Economic:** accrued to private businesses when riders visit a trail and stop for refreshments or require accommodation, hence contributing to local, regional and state economies. In 2021, through riding at their local trails, mountain biking participants were estimated to directly spend \$630.8 million and support a total of 6,095 full time equivalent employees (GHD Advisory 2021).
- **Environmental:** spending time in nature can improve nature awareness and foster an appreciation of natural surrounds (Pickering and Rossi 2016, Cherrington 2020). Signage and experience can educate people on the need to conserve, protect and respect nature (AusCycling 2023a). The establishment of trails on existing degraded land can provide links between fragmented habitats and offer opportunities for protecting plant and animal species (GHD Advisory 2021).

Types of mountain biking

Mountain bike riding is an active recreational activity, rather than a passive or nature conservation one (Wildflower Society of Western Australia 2022). Despite mountain bikes sharing similarities with on-road bicycles, their features are adapted to enhance durability and performance for off-road riding and rough terrain (Outdoor Queensland 2020). Generally, mountain bike design incorporates air or coil-sprung shocks for suspension, larger and wider wheels and tyres, stronger frame materials, and mechanically or hydraulically actuated disc brakes (Department of Biodiversity, Conservation and Attractions 2019).

Each style of mountain biking comes with its own set of challenges and thrills, requiring specific skills, trail designs, bike types, and equipment to excel (Bicycle Odyssey 2023). Table 2 presents the eight most common styles of mountain biking as well as their focus, trail requirements and preferred bike designs. While other specialty styles exist – for example slopestyle and pump track – this Statement focuses on those most relevant in Australia.² Although there are cross overs between styles, and riders may participate in more than one, the table provides a useful guide to understanding the needs and motivations of different styles of riders (IMBA 2007).

Mountain biking styles and technologies have significantly developed over the years, making the sport available to a wider range of age groups, abilities, skillsets, and riding preferences (O'Donnell and Carroll 2003, White et al. 2006). Two of the greatest advancements to mountain biking inclusivity are the development of adaptive mountain bikes and electric-assist mountain bikes (or e-bikes). Adaptive mountain biking attracts a broad range of riders who typically cannot ride a standard mountain bike and require adapted equipment and trails to suit their physical, intellectual, neurological and sensory abilities (Break the Boundary undated).

E-mountain bikes have small motors that provide extra power as the rider pedals. They are generally heavier than non-motorised bikes and are best suited to cross-country and touring mountain biking styles. As electric bikes do a lot of the work for the rider, they open the market to less-skilled riders, older persons, or those with physical limitations. They are perfect for those seeking a more leisurely experience or for allowing riders to travel greater distances and cover steeper terrain than they could on a standard mountain bike. The ability of e-bikes to open the market to those less likely to ride mountain bikes, enabling riders to cycle further or descend steeper trails, potentially increases traffic on trails and results in more extensive impacts per rider.

Other forms of e-bikes (electric-powered, rather than merely motor-assisted pedalling) are becoming increasingly sophisticated and powerful. In some cases, they are more like motorbikes in terms of power and performance. Road and vehicle registration rules vary between jurisdictions in Australia, but this emerging technology poses a new threat to the integrity of natural areas, beyond just power-assisted bikes. NPAC's position is that e-powered bikes should not be considered mountain bikes and require a new regulatory approach similar to that of motorbikes.

Table 2: The different styles of mountain biking, their focus, trail requirements and bike design (Bicycle Odyssey 2023, Davies et al. 2009, GHD Advisory 2021, Rewilding Earth 2021)

| MTB style | Focus | Trail requirements | Bike design |
|---------------|---|---|---|
| Cross-country | Endurance and technical skills. Varies from inexperienced gentle riders to avid riders. | Most mountain bike riding can fit into this category. Involves off-road riding from point-to-point or on a circuit. Primarily single track oriented. Includes both uphill and downhill sections on various terrains and diverse landscapes. Trails are traditionally narrow and meandering, so the trail density in an area can be high depending on the size of the area available to the trail builder. Trails tend to cross slopes with no more than a 5–8% slope to be ridden in both directions for maximum variety. Rides can be anywhere from an hour to several days. | Bikes are designed with efficiency and control in mind. They are some of the lightest mountain bikes (7–16 kg). Generally lockable front suspension optimised for pedalling and climbing; can be hardtail or full suspension. |

² Slopestyle takes place on downhill courses and is an aerial trick competition with riders judged on their technical ability, execution, originality and flow (Bicycle Odyssey 2023). Pump track trails are synthetic in design and construction. They are usually built in urbanised areas and can be considered playgrounds for people on bikes, similar to skate parks (Bicycle Odyssey 2023).

| | | | |
|--------------------------|--|---|---|
| Trail riding | A more aggressive experience than cross-country, pushing skills and endurance to the limit. | Off-road cycling on various terrains and diverse landscapes – from flat to steep and technical trails. Trail riding is generally on rugged single track with large obstacles and technical features. | Full suspension bikes. Often enduro mountain bikes due to their strong wheels and tires, ultra-responsive brakes, and wider handlebars for extra control. |
| Downhill | Speed and adrenaline, aerial manoeuvres are performed. | Trails are predominantly point-to-point single tracks made for speed and with technical challenges such as steep descents, rough terrain, specially constructed jumps, and ramps. Traditionally meant to be ridden in one direction. Trail designers seek out mud, rocks and roots as technical features. | Downhill mountain bikes are generally too heavy for serious climbing, so riders usually travel to the start of the descent by car or ski lift, requiring supporting infrastructure. Bikes have full suspension uniquely designed for high-speed descents. A frame shape that optimises rider positioning. Protective gear is usually worn (e.g. full-face helmets, body plates, goggles). |
| All-mountain | Biking to the extreme – a quest for adventure. | All-mountain riding is a more technical form of cross-country riding that can include more advanced technical challenges and steeper hill sections. Primarily single track, like cross-country, but with technical descents (e.g. natural obstacles, jumps, drops) and non-technical climbs. All-mountain trails are often used for timed competitive events. | All-purpose trail bikes. Lightweight with dual suspension. Protective gear is usually worn (e.g. helmets, knee pads, elbow pads). |
| Gravity/Enduro | Like all-mountain biking, with technical skills, descents, and endurance. | Like all-mountain riding but with greater emphasis on steep, fast, technical descents. Trails appeal to experienced riders who enjoy technical descents but are still happy to ride back to the top of the trail. Trails can cater for timed competitive events. | Bikes are built for strength and typically have medium-to long-travel dual suspension. |
| Touring | Long distance, destination-oriented. | Long distance riding on reasonably uniform surface conditions and lower grades. Touring trails are dual direction linear trails or long-distance circuits with a focus on reaching a destination. Trails can include rail trails, access/fire roads and single track. | For short sections or day trips, most mountain bikes are suitable. Some bikes carry panniers, and these are more robust with limited suspension. |
| Freeride | Related to downhill biking, technical skills, creative tricks, artistic stunts, aerial manoeuvres. | Riding involves doing stunts that require more skill and involve more technical features than cross-country. Some free riders prefer riding in standalone challenge parks or skills areas, while others prefer trails that combine cross-country and downhill trail features. Custom-built challenging courses that are descent-focused with technical trail features (e.g. berms), natural features (e.g. logs, rocks) and specially constructed jumps and ramps. These are wider than cross-country yet are meant to be ridden in one direction, like downhill. | Similar to downhill bikes. Full suspension and compact designs. |
| Adaptive mountain biking | Quest for adventure. Various degrees of technical features. | Adapted mountain bikes are for riders who cannot ride a standard mountain bike. These trails are purposefully designed to support these riders' physical, intellectual, neurological and sensory abilities. | Bikes are adapted to fit riders' abilities. Adaptive equipment may include: handcycles, recumbent leg-cycles, and tandem bikes. |

Mountain bike trails

Australia has many world-class mountain bike parks and trails. However, it is unclear just how many other mountain bike parks and trails exist in each state or across Australia, or how many kilometres they cover. Trailforks data estimates that in 2021 there were 8,605 mountain bike trails covering a total distance of 15,322 km (GHD Advisory 2021), but it may be assumed that unauthorised or illegal trails at least double the existing number of trails currently documented (Rewilding Earth 2021).

Trails can be designed specifically for mountain-biking purposes or for multiple purposes whereby riders share the trail with hikers, horse riders, service vehicles and other users. AusCycling has developed the Australian Mountain Bike Trail Guidelines aimed at providing an overarching, standardised framework for the planning, development and management of mountain bike trails across Australia (AusCycling 2023a). AusCycling describes three common types of mountain bike trails, which are presented in Box 4. Adaptive mountain biking also requires a certain type of trail construction.

Most mountain bike trails in Australia are graded using the Trail Difficulty Rating System developed by the International Mountain Bicycling Association (IMBA 2018). The Trail Difficulty Rating System uses a standardised method to categorise the relative technical difficulty of trails, helping beginners and experts make informed decisions about a trail's suitability for their experience or preferences (IMBA 2018). Trails are rated from easy to extremely difficult, based on the trail width, tread surface, average trail grade, maximum trail grade, and obstacles and technical trail features (IMBA 2018). Figure 3 shows the associated difficulty symbol for the seven categories under the Trail Difficulty Rating System and gives a short description. In short, white represents very easy trails (usually sought by leisure and independent riders), green represents easy trails (usually sought by leisure, enthusiast, sport and independent riders), blue is intermediate (usually sought by enthusiast, sport, independent and gravity riders) and black is difficult or extreme (usually sought by sport, independent and gravity riders).

A separate trail rating system has been devised for the adaptive mountain biking community. The main difference between the two systems is that the adaptive rating system includes identification of different obstacles and whether the rider may require assistance to tackle the trail (Trailforks 2023).

Balancing the length and density of a trail network within a confined area, while ensuring maximum enjoyment for riders and that conservation values are maintained, is a conundrum land managers and trail designers often face. Dense trails can appear crowded when riders can see each other on parallel paths, and lots of sharp turns reduce trail flow (Singletracks 2010). Natural features and topography can also influence trail density (Singletracks 2010). For example, planners may take advantage of a solitary hill by running the trail up and down it several times, or a trail may bunch up in forested areas before running straight across open fields (Singletracks 2010). Dense trails, as opposed to dispersed ones, generally necessitate removing more vegetation per hectare, which can expose more soil to erosion and intrude into, or take over, wildlife habitats (Singletracks 2010). However, dispersed trails mean more of the landscape becomes fragmented and often over a large area.

Bike parks are a sensible option for trail location. Bike parks are dedicated areas managed for the specific purpose of mountain biking. They can be designed for beginners, experts or competition activities and are commonly found on municipal properties in towns and cities. Like skate parks, bike parks are considered

BOX 4: Three common types of mountain bike trails (AusCycling 2023a)

- **Single tracks:** can be developed specifically for mountain biking or be multipurpose and shared with other users. They usually don't have human-made features, although they can. The terrain may vary from a smooth, gently winding path to a highly technical, feature-filled route. They cater to a range of mountain biking styles and expertise. Common to all single tracks is that they are narrow and only wide enough for one bike or user at a time.
- **Double or multi-use tracks:** often less adventurous than single track trails, these generally have fewer technical features and obstacles. They are spacious enough to ride two abreast or to pass walkers or other trail users.
- **Fire or management roads:** these trails are primarily used for emergency or logging vehicles. They are wide and can be dirt or gravel.

playgrounds for people on bikes (Rewilding Earth 2021). Trails in these parks can vary in substrate, and technical trail features can be natural or artificial. Bike parks usually include a dense network of trails, usually of differing grades, but they rarely provide for the rider seeking a longer cross-country experience or the experience of riding in nature. Riders looking for a cross-country experience are more likely to seek remote natural areas.

Several mountain-biking related organisations (such as industry groups, travel agencies, or bike sales companies) provide detailed web-based destination guides, including Trailforks, Australian Cycle Tours, and Flow Mountain Bikes. Even more rank Australia's trails specifically for marketing them to national and international mountain bike riders (for example, AllTrails, Crooze, Discovery Holiday Parks, Lonely Planet, Red Bull, Single Tracks Holiday Park, or Trailforks). Some of the trails listed as the best in Australia are described in Table 3, which also highlights how these parks are marketed to national and international mountain bike enthusiasts. The marketing focuses mostly on the thrill and challenge of the trail, and, in some cases, on the ecosystem types riders can expect to experience.

| <i>Difficulty Symbol</i> | <i>Short Description</i> |
|---|--|
|  | Very easy Wide trail with a gentle gradient smooth surface and no obstacles Suitable for beginner cyclists with basic bike skills, and most bikes |
|  | Easy Wide trail with a gentle gradient smooth surface Some obstacles such as roots, logs and rocks Suitable for beginner cyclists with basic mountain bike skills, and off-road bikes |
|  | Easy with Intermediate Sections Likely to be single track with a moderate gradient, variable surface and some obstacles Some obstacles such as roots, logs and rocks Suitable for mountain bikers with mountain bikes |
|  | Intermediate Single trail with moderate gradients, variable surface and obstacles May include steep sections Suitable for skilled mountain bikers with mountain bikes |
|  | Intermediate with Difficult Sections Suitable for competent mountain bikers, used to physically demanding routes Expect large and unavoidable obstacles and features Challenging and variable with some steep climbs or descents and loose surfaces |
|  | Difficult Suitable for experienced mountain bikers, used to physically demanding routes Navigation and personal survival skills are highly desirable Expect large, dangerous and unavoidable obstacles and features Challenging and variable with long steep climbs or descents and loose surfaces Some sections will be easier to walk |
|  | Extreme Suitable for highly experienced mountain bikers, used to physically demanding routes Navigation and personal survival skills are highly desirable Severe constructed trails and/ or natural features, all sections are challenging Includes extreme levels of exposure and / or risk Expect large and unavoidable obstacles and features Some sections will be easier to walk |

Figure 3: The Trail Difficulty Rating System developed by the International Mountain Bicycling Association and implemented in Australia (IMBA 2018)

Table 3: Some of the trails listed as best in Australia and how they are marketed to national and international mountain biking participants (Red Bull 2023)

| Location | State | Trail Description |
|-------------------------------|-------|---|
| Smithfield Mountain Bike Park | Qld | 'There's more than 60 km of trail ... with all three difficulty ratings accounted for, meaning there's something for everyone ... one of the most picturesque parks in the country with dense rainforest and elevation that gives you postcard-level views of the Great Barrier Reef ... an international draw like nothing else in Australia ... it joined the Crankworx World Tour for 2023.' |
| The Alpine Epic | Vic | 'How are your quads feeling? Bit sore? You're going to need every sinew and twitch fibre to power through Victoria's infamous Alpine Epic ... jewel in Mt Buller's mountain bike crown and the first IMBA-accredited Epic trail in the Southern Hemisphere ... 40 km of pristine alpine track, climbing to over 1600 m above sea level ... pass[ing] through snow gum woodlands, granite valleys and ferny glades, all the way up to meadows of wild heather ...' |
| Mawson Trail | SA | '... a bit of everything ... 900 km of rough-cut fire track, national park trail, outback scrub and dirt road, running all the way from Adelaide to Blinman, right up in the sun-beaten Flinders Ranges. This is remote, brutal country, particularly in summer, but you don't have to do the full, two-week journey in one go ...' |
| Simpsons Gap Bike Path | NT | 'a sealed, cross-country track ... great for beginners and anyone who wants to explore the Central Australian Desert in comfort ... elevation is only 84 m over a length of 16.5 km ... riding through the shadow of the Western MacDonnell Ranges, through River Red Gum forests and groves of Witchetty Bush and Mulga, all the way to the gorge at Simpsons Gap ...' |
| Stromlo Forest Park | ACT | 'Open to the public since 1967 ... only 15 minutes from the city centre ... double black diamond tracks, log rides, gravity mountain bike and 50 km of well-maintained, professionally designed trails.' |
| Blue Derby | Tas | '... 125 km of webbing trails were cut through the surrounding wilderness, creating the Tasmanian mountain biking equivalent of Disneyland ... park is open 365 days a year and it's completely free ...' |
| Munda Biddi Trail | WA | '... a bit more challenging ... a 1000 km trail snaking all the way from Perth to Albany ... Munda Biddi means "path through the forest" ... in all those thousand kilometres, your wheels will hardly touch tarmac ... the full trail takes around 3-4 weeks, depending on your fitness level ... by day you'll pedal through eucalypt scrub and granite outcrops ... by night, you'll kip in remote shelters ...' |
| Margaret River Trails | WA | '... the unofficial home of mountain biking ... a good variety of technical single tracks in Margaret River itself, with "Middle Earth" being the most famous ... check out towns like Busselton and Dunsborough ... you'll find good intermediate trails full of jumps, berms, logs and roll-overs ...' |



Mountain bike riding. ALEX PROIMOS/FLICKR

Technical trail features and facilities

Whether in dedicated bike parks or protected areas, many types of technical features can be incorporated into trails, and these can be natural, enhanced, or constructed. The objectives of technical trail features vary. Sometimes, they might improve environmental sustainability or rider safety, enhance a technical challenge, or be just for the thrill of the manoeuvre, creating exciting and challenging adventures for mountain bikers.

Natural technical trail features (for example, a berm or a step-up) make use of the terrain, soil, rocks, roots, logs, ditches and natural ledges that occur on the trail. Enhanced technical trail features still make use of natural features on the trail, but, as the name suggests, are enhanced with natural or artificial materials to achieve their design objective. Constructed features are human-made and are built or placed on the trail. Some of the more common technical trail features include those in Box 5.

Technical trail features may attract riders to certain locations, but other facilities can also improve the rider experience before and after a ride; hence, these features enhance the environmental, social and economic benefits described in the previous sections. The most obvious of these are facilities like car parks or toilets near the access trails. Day-use and picnic areas are also important, as they provide opportunities for relaxation and nature appreciation, as well as for social gatherings. Competition events require open space for rider preparation and for observers, and day-use and picnic areas provide such spaces.

Bike wash stations allow riders to rinse mud, soil and seeds off their bikes after their ride, and thus protect the environment while maintaining their equipment. Some mountain bike trails also have hygiene stations with an antifungal solution, which are purpose-built to stop the spread of root rot (*Phytophthora cinnamomi*). Root rot lives in topsoil and can get stuck in the tread of mountain bike tyres, spreading and causing devastation in protected and natural areas. If transferred, root rot can infect other areas and kill native plants (Friends of the Prom 2023, Tourism and Events Queensland 2023).

BOX 5: Common technical trail features

Berms: where the outside of a corner or bend in the trail is higher than the inside.

Flat cornering: a normal corner or bend in the trail, which requires weighting the bike properly to avoid the tyres losing grip.

Switchbacks: where a trail will turn 180 degrees in a tight corner.

Drops: where the trail falls away sharply and both wheels need to hit the ground at the same time on landing.

Rolldown: where the trail drops significantly but riders can roll down on both wheels.

Doubles: a jump with a take-off and landing, but the middle ground has been dug out. There is no safe rolling option, so a jump is not optional. This is an advanced technical feature.

Table top: like a double, but the middle is not dug out, so rolling over the top is an option. It is a platform where jumps can be practised.

Boardwalk: sections of the trail that have been raised, often made of wood, to avoid a boggy spot.

Step ups: often a fallen tree or rock in the middle of the trail that requires front and rear wheel lifting to step up and over the feature.

Rock gardens: where rocks have been spilled onto the trail. They can be fixed or move under the bike.

Water bars or drainage ditches: designed to allow water to efficiently drain off the trail. They are often found on climbs and descents and require the ability to lift front and rear wheels to avoid punctures.

“The location and design of the trail across the landscape ... user facilities, and how a trail is ridden, will strongly influence the type and magnitude of environmental and social impacts on protected (and adjacent) areas.”

Appropriate signage specific to mountain biking has many benefits. Information provided on signs can include important natural and cultural conservation information, the trail difficulty rating, or trail technical features immediately ahead, and can also alert riders to other trail users, improving safety. Often, the sign also provides a map of the trail.

Mountain biking involves skill, coordination, balance and practise, especially to protect the environment and keep riders and other park users safe. Skills training areas are specially designed parks for beginners, or to help experts hone their abilities. The location and design of the trail across the landscape (for example, single or double track, fire service roads, technical trail features, and dense or dispersed networks), the user facilities, and how a trail is ridden, strongly influence the type and magnitude of environmental and social impacts on protected (and adjacent) areas.

Mountain bike competitions in Australia

Due to our world-class mountain bike trails, Australia is fast becoming a mecca for mountain biking events and championships (Red Bull 2023b, Rocky Trail Entertainment undated). Events can be of local, state, national or international significance and occur over one or many days. Usually, events occur over multiple days and in multiple states or destinations. They combine mountain-biking activities with camping opportunities, music or bands, and food stalls to encourage a carnival-like community atmosphere. Examples of such events are listed below.

- **AusCycling Championships** are major events that are held in each state or territory. Riders can earn AusCycling Mountain Bike National Cup points aimed at encouraging national participation and recognising rider achievements across the disciplines of cross-country, downhill, marathon, gravity enduro and e-mountain biking.
- **AusCycling Mountain Bike Championships** are where cross-country downhill, trials, and pump track national titles are up for grabs.
- **Crankworx** is a premier mountain bike festival and world tour that takes place annually, featuring a variety of styles, including downhill, slopestyle, enduro and pump track.
- **Cape to Cape** is an annual four-day mountain bike race that covers 220 km and takes riders through a variety of habitats, including beaches, forest trails and rocky terrain.
- **Fox Superflow** is the fastest-growing gravity enduro racing series in the country, spanning Queensland, New South Wales, Victoria and the Australian Capital Territory.

Impacts of mountain biking in protected areas

Although there are many potential benefits of mountain biking in protected areas, there are also negative impacts, both environmentally and socially. Identifying the negative impacts of mountain biking does not downplay or ignore other activities or uses that have been proven to be of equal or worse impact in protected areas – such as horse riding, hiking, tourism, or inappropriate land-use adjacent to protected areas (Chiu and Kriwoken 2003, Marion and Wimpey 2007, Mountain Bike Santa Cruz 2019, GHD Advisory 2021, Rewilding Earth 2021, Pickering 2022). However, these other activities are not the focus of this Position Statement.

Research reveals that the greatest threats to, and impacts on, protected areas from mountain biking are the establishment of unauthorised trails, and actual or perceived conflict with other users (Marion and Wimpey 2007, Mountain Bike Santa Cruz 2019, Norman and Pickering 2019, Smith and Pickering 2024). When mountain bike riders are not content with officially constructed trails, they create unauthorised trails, trail networks, or even new technical trail features on existing tracks (Rewilding Earth 2021). Unauthorised trails are created without permission from appropriate landowners or land managers (such as government, Indigenous communities or private landholders) and hence are often poorly planned and located. A case study of the impacts of unauthorised trails is presented in Box 6 (p. 23).

The extent or magnitude of impacts from constructing and riding on unauthorised and illegal trails varies. Impacts depend on the trail design, the protection or conservation status of trail locations, the soil type and species (fauna and flora) present at the location, the presence of waterways, the amount of water on the trail, the style of mountain biking, and the environmental and social knowledge and ethics of the rider themselves (Marion and Wimpey 2007, Evju et al. 2010, Pickering 2016 & 2022, Quinn and Chernoff 2010). The reported impacts of unauthorised and illegal trails are extensive (Pickering 2010b and 2022, Marion and Wimpey 2007, Mountain Bike Santa Cruz 2019, Rewilding Earth 2021, Smith and Pickering 2024); however, they are summarised below:

- damage to high conservation value areas
- increased risk of erosion (often steeper, no fall lines, or formal drainage)
- fragmentation of intact landscapes
- creation of a dense “spaghetti” network of trails
- disturbance to flora and fauna
- reduction in scenic amenity
- increased spread of biological threats like dieback (*Phytophthora cinnamomi*)
- increased spread of weed species
- conflict with other recreational activities and trail users
- conflict with other land uses (such as for public drinking water, harvesting operations or mining)
- impact on sites of heritage or cultural significance
- increased pressure on landowners and land managers, with more exposure to risk or potential liability
- increased costs for land managers to remove and rehabilitate unauthorised trails, diverting limited resources from sanctioned trail maintenance
- damage to the reputation of the mountain-biking industry and the positive benefits it delivers.

“Research reveals that the greatest threat to, and impacts on, protected areas from mountain biking are the establishment of unauthorised trails and actual or perceived conflict with other users.”

Of course, many of these impacts also occur from authorised trail development and use; however, research shows the impacts are exacerbated on unauthorised trails (Pickering et al. 2010, Pickering 2022, Wildflower Society of Western Australia 2022, Smith and Pickering 2024). These effects are largely due to unauthorised trails being poorly planned or located. Unauthorised trails are also sometimes located on land better suited for other uses, or even designated for the conservation of nature or culture. Best practice guidelines for trail

design are not applied during unauthorised trail development; they are not created with rider or user safety, or the conservation and protection of nature and culture in mind (Smith and Pickering 2024).

Even authorised, well-maintained mountain biking trails in protected areas have environmental and social ramifications, such as those listed in Table 4. The environmental impacts on flora, fauna, water flows and catchments, soil, and landscapes, as well as the social impacts on other users and on cultural heritage, are discussed in more depth below. Table 4 provides a useful structure for demonstrating the impacts of mountain biking; however, it is essential to recognise that there are also connections, feedbacks, and synergies between the impacts listed.

Table 4: Environmental and social impacts of mountain biking (Marion and Wimpey 2007, Evju et al. 2010, Quinn and Chernoff 2010, Pickering 2022, Rewilding Earth 2021, Wildflower Society of Western Australia 2022, Smith and Pickering 2024).

| | | |
|-----------------------|-----------------------|---|
| Environmental impacts | Flora | Introduction and spread of weeds via bikes and equipment. |
| | | Spread of disease via bikes and equipment (e.g. <i>Phytophthora</i>). |
| | | Loss of trees, shrubs, herbs and grasses from vegetation clearing or trampling. |
| | | Destruction and removal of threatened or sensitive species. |
| | Fauna | Disturbance and loss of native animals through land clearing, noise and fear of human presence. |
| | | Interference with breeding cycles of native animals. |
| | | Changes in wildlife behaviour, including avoidance of area and use of trails. |
| | | Possible reduced food sources through the introduction and spread of weeds and disease via bikes and equipment. |
| | Water flows | Changes in waterways due to trail development and design. |
| | | Sedimentation of waterways through streambank erosion and waterway crossings. |
| | | Changes in water flow through obstruction and sedimentation. |
| | | Effect on waterway biota due to sedimentation and changed water flows. |
| | Soil | Soil erosion through braking and cornering. |
| | | Soil compaction. |
| | | Creation of bogs by riding on wet tracks. |
| | Landscapes/catchments | Reduction in high conservation values or representative plant communities. |
| | | Fragmentation of forests into patches, degrading habitat. |
| | | Large scale soil loss. |
| | | Changes in water flow and waterways. |
| | | Reductions in intake wildlife habitat. |
| | | Increased light and wind. |
| Social impacts | Other users | Reduced safety of hikers through potential collision. |
| | | Disturbance of peaceful surroundings with fast-travelling bikes, bike bells, e-mountain bikes, etc. |
| | | Damage to views and landscapes through fragmented landscapes and more open space (e.g. tree clearing for trails). |
| | | Litter. |
| | Cultural heritage | Destruction of, and interference with, sacred sites, especially on mountain peaks (e.g. tagging). |

The Leave No Trace Australia Centre for Outdoor Ethics has developed the Green Guide to Mountain Biking for recreational and commercial mountain bikers, tour operators and clients. The guide is aimed at improving environmental management and reducing riders' environmental impact on land (Leave No Trace Australia Centre for Outdoor Ethics 2023). The guide has seven principles:

1. Plan ahead and prepare.
2. Dispose of waste properly.
3. Travel and camp on durable surface.
4. Leave what you find.
5. Minimise the impact of fire.
6. Respect wildlife.
7. Be considerate of your hosts and other visitors.

NPAC endorses the Green Guide to Mountain Biking.

BOX 6: Case study – Illegal bike tracks

Unauthorised mountain bike tracks threaten the biodiversity and heritage values of Box–Ironbark Forest in the Greater Bendigo public land estate in central Victoria (Victorian National Parks Association 2024).

According to calculations from crowd-sourced trail network sites, parts of the mountain bike community have illegally constructed at least 177 km of tracks throughout Greater Bendigo National Park, Bendigo Regional Park, and nearby public land – many of them over the past 10 years. The One Tree Hill and Wildflower Drive areas of Greater Bendigo National Park, in particular, are riddled with such tracks.

There are already plenty of formal tracks through the forest for cyclists to enjoy. Some of the unauthorised tracks are even used for mountain bike sporting events, despite national and regional parks being highly inappropriate venues. Clearing of native habitat and heritage sites within a national park for sporting purposes – to install a football oval or cricket pitch, for example – would never be acceptable, but the area of native vegetation lost to unauthorised bike tracks affects a much larger area. Vegetation loss from 177 km of tracks is equivalent to the loss of at least 17 ha of bushland – all in places that have been protected for their biodiversity and heritage values.

The clearing of vegetation and rocks, and the land's subsequent use for riding, creates damage to biodiversity and habitat by fragmenting vegetation and causing erosion.

Key aims of Box–Ironbark Forest conservation and management are the recovery of native wildlife and habitat, and the protection of those that are not threatened. Greater Bendigo National Park and Bendigo Regional Park are home to many notable rare or endangered species, such as the Eltham copper butterfly (*Paralucia pyrodiscus lucida*), pink-tailed worm-lizard (*Aprasia parapulchella*), brush-tailed phascogale (*Phascogale tapoatafa*), powerful owl (*Ninox strenua*) and Mclvor spider orchid (*Caladenia audasii*).



Illegal bike tracks, Greater Bendigo National Park, Victoria. NORM STIMSON

Environmental impacts

The research on recreational ecology is quite conclusive, determining that most environmental impacts from mountain biking occur when an authorised or unauthorised trail is first developed or constructed (Pickering 2010, Quinn and Chernoff 2010); this is largely due to the loss of functional vegetation during clearing. The ecological structure and processes that maintain essential habitat, species, and ecosystem services are lost, which fragments landscapes and habitats, exposes soil (leaving it vulnerable to erosion), reduces the filtering effects that regulate nutrients, and alters the rate of water flows.

While some of the impacts can be minimised with well-designed trails and networks, others will remain, and can continue throughout the life of the trail and beyond – for example, ruts, soil displacement, and compaction (Quinn and Chernoff 2010, Mountain Bike Santa Cruz 2019, Smith and Pickering 2024). A review of research on mountain bike impacts, conducted by Pickering (2010), determined several factors that affect the severity of environmental impacts from visitor use in protected areas, including:

- the conservation value of the site
- the site's resistance to use
- the site's recovery from use
- the site's susceptibility to soil erosion
- the severity of direct impacts associated with specific activities
- the severity of indirect impacts
- the extent of use
- the ecological dimensions to the timing of use, and
- the total area affected.

The following sections discuss some of the environmental impacts listed in Table 4.

Impacts on flora

Research on the vegetation impacts of mountain biking across the full range of ecosystems within Australia's NRS is not available, as very few ecosystem types have been studied. However, mountain biking has been shown to reduce vegetation height, cover, and species richness, expose roots, change species composition, and increase litter and soil compaction (Pickering et al. 2010b & 2011, Quinn and Chernoff 2010). Undoubtedly, the more fragile and sensitive plants are to disturbance, the more susceptible they are to trampling by off-trail users and to the introduction of non-native species (Quinn and Chernoff 2010, Pickering 2022).

“Landscape fragmentation, skidding, hard or sudden braking, and the construction of unauthorised trails, jumps, bridges and other trail technical features, create the most impact on vegetation.”

The introduction and spread of invasive species threaten native vegetation, which can have flow-on affects to wildlife, hydrology, and fire regimes (Quinn and Chernoff 2010, Pickering 2022). Landscape fragmentation, skidding, hard or sudden braking, and the construction of unauthorised trails, jumps, bridges and other trail technical features, create the most impact on vegetation (Pickering et al. 2010b). The impacts to vegetation can be minimised by limiting off-trail use, rerouting trails to avoid sensitive plants, undertaking comprehensive vegetation surveys prior to any new trail development, and constructing riding trails across slopes, rather than riding up and down them (Pickering et al. 2011, Mountain Bike Santa Cruz 2019).

Impacts on fauna

There have been few studies in Australia on animal encounters and mountain bikers, or on the potential impacts on wildlife, the majority having been undertaken in the United States or Europe. Most studies, however, recorded some repercussions on wildlife from mountain bike riding, such as California red-legged frogs being displaced if a trail was within 100 m of their habitat (Bulger et al. 2003), or decreased bird nest survival, increased predation, or lower nest density in areas fragmented by trails (Miller et al. 1998, Reidy et al. 2009). Box 7 highlights the costs of poor early planning, and the potential impacts trails have on fauna.

Some species use trails to their advantage for travel or foraging; hence the presence of trails can affect the local composition of species (Mountain Bike Santa Cruz 2019). Landscape fragmentation and the behaviour of trail users (for example, noise levels or interference with wildlife) have been recorded as the greatest threats to wildlife from mountain biking and from other recreational users (Marzano and Dandy 2012, Mountain Bike Santa Cruz 2019). As Australia has many nocturnal animals, to avoid affecting these creatures, and for the safety of riders, mountain biking should be constrained to daylight hours. Liddle (1997) suggests recreational activities affect wildlife in three main ways, and the latest research on recreational ecology supports these findings.

- **Stress/disturbance:** wildlife becomes stressed by human activity, altering behaviour, avoiding or fleeing areas of activity, or confronting/attacking humans. This can affect the fitness of an individual or of a population. Displacement of animals may be short-term or permanent.
- **Alteration of habitat:** The presence of human activity and/or infrastructure removes or fragments habitat or can create artificial habitat, which elicits changes in population dynamics or encroachment of new species/populations.
- **Collision/mortality:** Wildlife is struck by humans or their vehicles, resulting in injury or death to either.



Noisy Pitta, D'Aguilar National Park (Mt Mee – Northern section), Queensland. TATTERS/FLICKR

BOX 7: Case study – Warburton mountain bike destination

In July 2022, Victoria's Planning Minister rejected key sections of the proposed Warburton Mountain Bike Destination, labelling them 'unacceptable' for construction within Yarra Ranges National Park.

About 12 per cent of the total 177 km proposed new track network was to be placed in Yarra Ranges National Park, about 107 km north-east of Melbourne. Conservation groups and locals were deeply concerned about how these sections of track might impact the integrity of the national park and the values it was established to protect, including key species such as the critically endangered Mount Donna Buang wingless stonefly (*Riekoperla darlingtoni*) – an endemic species that occurs only in a small range in the area – and some prime patches of Cool Temperate Rainforest.

Following an extensive and costly Environmental Effects Statement (a process involving days of hearings, lengthy submissions, expert witnesses and legal representation), the Victoria Planning Minister ruled on the advice of an expert panel that 12 per cent of track be ruled out due to an '...unacceptable risk of significant effects particularly on Cool Temperate Rainforest and Cool Temperate Mixed Forest and the Mount Donna Buang wingless stonefly, which are of high conservation value.'

The rest of the proposed 150 km network, located mostly in adjacent state forest, was approved with conditions.



Mount Donna Buang wingless stonefly. EDDIE TSYRLIN

Impacts on water flows

The impact of mountain biking on waterways is related to the trail's proximity to streams, the slope or gradient of the trail, the existence of any riparian buffers, and the weather conditions prior or during a ride – for example, rain or drought events (Marion and Wimpey 2017, Rewilding Earth 2021). Trails crossing waterways or near the edge of streambanks can create soil erosion, as do steep trail gradients that increase the need for braking (Marion and Wimpey 2017, Evju et al. 2021, Rewilding Earth 2021). Soil erosion creates sedimentation in waterways, which in turn can create turbidity, obstruct or change water flows, reduce water quality and impact habitat for aquatic species (Rewilding Earth 2021). Riparian buffer zones are important for reducing runoff that moves sediment from trails to waterways. Soils are more erodible when very dry or very wet, which alters the bond between soil particles (Marion and Wimpey 2017, Evju et al. 2021).

“Soil erosion creates sedimentation in waterways which in turn can create turbidity, obstruct or change water flow, reduce water quality and impact habitat for aquatic species.”

Impacts on soil

Soil is both compacted and eroded through the use of mountain bike trails, but the degradation is most severe when a trail is first developed or constructed. The ongoing severity depends on the trail grade, slope alignment angle, water drainage, the levels and type of use, the soil properties, and the amount of rock in tread substrates (Marion and Wimpey 2017, Mountain Bike Santa Cruz 2019). Water in the landscape exacerbates the environmental impacts of mountain bike trails and their use.

Research by Evju et al. (2021) showed that when mountain bikers stayed on-trail they had relatively limited overall effects on trail widening, but the enhanced use of trails in wet areas resulted in greater trail degradation, including deepening – and more so with higher mountain bike usage. The literature review on environmental impacts, conducted by Mountain Bike Santa Cruz (2019), also concluded that rut creation by erosion is accelerated when trails are wet. They suggest riding should be strongly discouraged during rain events.

Impacts beyond the trail

The Wildflower Society of Western Australia (2022) notes that the impacts of mountain biking, and associated trails, do not stop at the edge of the trail but extend as a halo for at least 10 m either side of the physically cleared area. Further research by Ballantyne and Pickering (2015), Ballantyne et al. (2016), Pickering (2022) and Smith and Pickering (2024) is depicted in Figure 4, which shows the range of impacts on the trail (Zone A), the edge of the trail (Zone B) and further away (Zone C).

Some of the impacts listed in Table 4 can occur on the trail, at the edge, or further away, including loss of vegetation; soil compaction; erosion; changes in light, wind, and wildlife behaviour; and changes to waterways (Pickering 2022, Smith and Pickering 2024). On the edge of trails, there can be reduced vegetation cover and litter layer, increased wind and light, and noise disturbance to wildlife. The width of these edge effects varies with the amount of use, how the trail is constructed, and the topography, soil type and vegetation (Smith and Pickering 2024), but impacts on wildlife, such as disturbance from people using trails, can be extensive. For many species of Australian birds, flight initiation distances can be 30 m or more from people (Weston et al. 2012), extending the impacts from Zone B (the edge of trails) into Zone C.



Figure 4: Impacts of mountain biking on the trail (Zone A), on the edge of trails (Zone B) and further away (Zone C). Based on data in Ballantyne and Pickering (2015), Pickering (2022), Smith and Pickering (2024).

Fragmentation

In addition to impacts close to trails, networks of trails can have broader issues due to fragmentation of large areas of natural vegetation (Ballantyne and Pickering 2015, Ballantyne et al. 2016, Smith and Pickering 2024). Fragmentation increases the ratio of edge to area, reducing the amount of undisturbed habitat for birds and other wildlife. Trail networks also increase the potential area affected by the spread of weeds and pathogens, isolate floral and faunal species – reducing cross-breeding possibilities and population resilience – and affect animal migration and movement for hunting purposes (Ballantyne and Pickering 2015, Wildflower Society of Western Australia, 2022). Siegel et al. (2023) concluded that forest fragmentation disrupts important species interactions and is a grave threat to biodiversity.

“Trail networks also ... isolate floral and faunal species – reducing cross-breeding possibilities and population resilience – and affect animal migration and movement for hunting purposes.”

Ecosystem functions occurring across ecosystems and landscapes can also be impaired, particularly those related to water regulation, soil retention and maintaining micro-climates. Maintaining ecosystem functions is important to the continued provision of ecosystem services, such as disturbance regulation, pollination and pest management services, water quality, flood retention, and other forms of recreation (for example, birdwatching) and ecotourism (Maynard et al. 2010, Petter et al. 2013). Additionally, scarred landscapes reduce scenic amenity, therapeutic appeal, and aesthetic inspiration for the arts.

Social impacts

Most of the literature on social conflict is based on the outcomes of surveys with mountain bikers, hikers and horse riders, but not with other users of protected areas (such as photographers, birdwatchers, scientific researchers, or Indigenous landholders) or conservation managers (for example, rangers) and their attitudes, perceptions and experiences of conflict with other users. Under the science of recreational ecology, conflict is generally defined in terms of:

- **goal interference (or interpersonal conflict):** where the physical presence of one individual or group interferes with the goals of another individual or group; for example, a photographer missing a shot when a mountain bike rider scares the animal away (Caruthers and Vaske 2001).
- **social values:** where different user groups do not even have to encounter each other but just don't share the same norms; for example, hikers being concerned about duck hunting even if they never see a deceased duck or meet a hunter (Caruthers and Vaske 2001).

It is important to note that both negative and positive attitudes and experiences have been recorded from mountain bike riders to other users, and from other users to mountain bike riders (Caruthers and Vaske 2001, Chiu and Kriwoken 2003, Pickering and Rossi 2016). For example, Chiu and Kriwoken (2003) surveyed mountain bike riders and other users in Wellington Park in Tasmania (an IUCN category II protected area) and found the greatest concern of other users was the perceived damage mountain bike riding does to the environment, the speed of bikes, and riders not giving an approach warning. Perceived and actual conflict with mountain bike riders was recorded for both shared-use and unauthorised trails, but most were related to sections of track with poor sight distances, such as sharp corners (Chiu and Kriwoken 2003). Pickering and Rossi (2016), however, surveyed mountain bike riders in three national parks in peri-urban Queensland and recorded strong positive perceptions by riders towards hikers and runners.

Leave No Trace Australia Centre for Outdoor Ethics (2023) says that minimal impact techniques are not only important to environmental protection and to the future of wilderness areas but also to the satisfaction and positive experience of outdoor enthusiasts. In the Green Guide to Mountain Biking for recreational and commercial mountain bikers, tour operators and clients, which was developed by the Leave No Trace Australia Centre for Outdoor Ethics, the seventh principle reminds riders to be considerate of hosts and other visitors (Leave No Trace Australia Centre for Outdoor Ethics 2023).

Position Statement on Mountain Biking in Protected Areas

To ensure the protection of Australia's natural and cultural assets, maximise the benefits of mountain biking, and meet riders' expectations, it is important that mountain bike trails are located in areas where they are compatible with nature conservation objectives. This would result in mountain biking leaving little or no impact on the protected area or broader landscape. It would also mean that riders have access to a diversity of trails matching their skill levels and preferred style of riding.

This Position Statement on Mountain Biking in Protected Areas should be implemented in a manner consistent with overarching policies, legal requirements and strategic plans applicable to local, state and federal governments. This Position Statement should also be considered in conjunction with mountain biking trail guidelines developed by the mountain biking industry, which has extensive expertise in trail design. It consists of three components, which are presented and discussed in the following sections:

1. The Mountain Bike Zoning Compatibility Matrix, which provides an assessment as to which types of mountain bike trails, mountain biking features or facilities are compatible with different IUCN categories applied to the NRS.
2. Principles for Mountain Biking in Protected Areas, which provide nine supporting, evidence-based principles for application when mountain bike trails are being proposed, promoted, designed, constructed or ridden.
3. A Code of Conduct for Mountain Biking in Protected Areas to be promoted by federal and state agencies and cycling organisations to ensure riders understand their responsibilities when riding in protected areas.

“To ensure the protection of Australia's natural and cultural assets, maximise the benefits of mountain biking, and meet riders' expectations, it is important that mountain bike trails are located in areas where they are compatible with nature conservation objectives.”

Mountain Bike Zoning Compatibility Matrix

The Mountain Bike Zoning Compatibility Matrix has been informed by the background information contained elsewhere in this document, and through extensive conversations and deliberations between members of the Mountain Biking Working Group.

The first two columns in the matrix list key attributes of mountain biking. Each subsequent column lists one of the six IUCN categories under which protected areas in Australia's National Reserve System are categorised. The specific detail of the protected areas assigned to each IUCN category in each state and territory is nominally available on the CAPAD website. However, this listing of which protected areas correspond to which IUCN category is currently internally inconsistent and/or has errors and so cannot be relied upon alone to identify reserves appropriate for mountain biking or otherwise.

Coloured cells show the compatibility of each mountain biking attribute with the different IUCN categories; that is, whether the listed attribute of mountain biking should be sited or allowed in that particular type of protected area. The coloured cells represent the following compatibilities:

- **generally compatible (green):** mountain-biking attributes generally considered to be compatible with the objectives of the IUCN category, subject to normal assessment and approval processes.
- **conditionally compatible (orange):** mountain-biking attributes only considered to be compatible with the objectives of the IUCN category under certain circumstances and under special conditions and controls, to be determined on a case-by-case basis.
- **incompatible (red):** mountain-biking attributes considered to be incompatible with the objectives of the IUCN category.

Table 5: Mountain Bike Zoning Compatibility Matrix

The six IUCN Protected Area categories represent the full range of protected area objectives, from strict preservation to sustainable use. The Compatibility Matrix provides an assessment of mountain biking attributes against these various protected area objectives. 1

| | | <i>IUCN Protected Area Category</i> | | | | | | |
|--------------------|----------------------------|-------------------------------------|----------------------------|---------------------------|---|---|---|--|
| | | <i>Ia: Strict nature reserve</i> | <i>Ib: Wilderness area</i> | <i>II: National park</i> | <i>III: Natural monument or feature</i> | <i>IV: Habitat/ species management area</i> | <i>V: Protected landscape or seascape</i> | <i>VI: Protected areas with sustainable use of natural resources</i> |
| Trail construction | Fire track/service road | Essential only | Essential only | | | | | |
| | Walking trail | Essential only | Essential only | | | | | |
| | Shared use trail | | | | | | | |
| | Dedicated MBT trail | | | | | | | |
| | Technical trail features | | | | | | | |
| | Dense trail network | | | | | | | |
| | Dispersed trail network | | | | | | | |
| Trail access | Mountain bikes | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only |
| | E-bikes | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only | On authorised trails only |
| Trail facilities | Parking | | | | | | | |
| | Toilets | | | | | | | |
| | Day-use/picnic area | | | | | | | |
| | Camping | Essential only | Essential only | | | | | |
| | Signage | Essential only | Essential only | | | | | |
| | Bike wash station | | | | Trail head only | Trail head only | Trail head only | Trail head only |
| | Skills training areas | | | | | | | |
| Trail events | Mountain biking & e-biking | | | | | | | |

| | |
|---------------------------------|---|
| Conditionally compatible | Mountain-biking attributes only considered to be compatible with the objectives of the IUCN category under certain circumstances and under special conditions and controls, to be determined on a case-by-case basis. |
| Generally compatible | Mountain-biking attributes generally considered to be compatible with the objectives of the IUCN category, subject to normal assessment and approval processes. |
| Incompatible | Mountain-biking attributes considered to be incompatible with the objectives of the IUCN category. |

1. This assessment does not purport to replicate the legal tenure, reserve objectives, or permitted uses for specific protected areas in each state and territory. NPAC recognises that protected areas can vary significantly in size and importance and may not fall neatly into a single IUCN category. Furthermore, NPAC acknowledges that some protected areas may have been assigned to an incorrect IUCN category or may have evolved since the original assignment and may now be better suited to a different IUCN category. The Compatibility Matrix should be interpreted accordingly.

Matrix rationale

The six IUCN Protected Area categories represent the full range of protected area objectives, from strict preservation to sustainable use. The Compatibility Matrix has been developed by NPAC as a broad assessment of mountain-biking attributes against these various protected area objectives. This assessment does not purport to replicate the legal tenure, reserve objectives, or permitted uses for specific protected areas in each state and territory.

NPAC recognises that protected areas can vary significantly in size and importance and may not fall neatly into a single IUCN category. Furthermore, NPAC acknowledges that some protected areas may have been assigned to an incorrect IUCN category or may have evolved since the original assignment and may now be better suited to a different IUCN category. The Compatibility Matrix should be interpreted accordingly.

NPAC holds the view that:

- Mountain biking in protected areas should only occur on trails authorised for such purposes. There should be zero tolerance for unauthorised mountain biking in protected areas. Fire or service roads, however, should be authorised for mountain biking.
- No new mountain bike trails should be sited or constructed in protected areas assigned as IUCN categories Ia or Ib. These are the most highly protected categories, where conservation should not be jeopardised. Trail builders should look to lesser protected areas and/or other lands (local government, private, etc.) for new mountain bike trails. NPAC acknowledges that, in some situations, mountain bike trails may have already been constructed in areas designated as IUCN categories Ia or Ib. Where such trails were authorised at the time of construction, NPAC accepts that those trails may be retained, but not expanded. However, where such trails were NOT authorised at the time of construction, NPAC is seeking to have such trails closed and rehabilitated as a priority.
- Mountain bike trails in protected areas should be thoughtfully designed and sensitively located, so as to facilitate reasonable access to and appreciation of protected areas while minimising environmental impacts, user conflicts and ongoing maintenance costs.
- Steep and challenging mountain bike trails typically only appeal to a limited market, involve higher speed and risk, and are less conducive to protected area appreciation. Consequently, NPAC would only conditionally support the construction of such trails in IUCN categories V or VI.

The following set of Principles complement the Mountain Bike Zoning Compatibility Matrix and should be adhered to when considering, assessing, constructing, maintaining or riding mountain bike trails. The Code of Conduct for Mountain Biking in Protected Areas, presented after, expands on those developed by the International Mountain Bicycling Association to include best conservation practice. These Principles should be promoted by federal and state agencies and cycling organisations to ensure riders understand their responsibilities when riding in protected areas.



Wooditjup National Park, Western Australia. THOMAS HULSE

Principles for Mountain Biking in Protected Areas

1. Trail approval and determination

The Australian government and state government agencies, as the assessors and regulators of protected areas, are responsible for upholding the protection of natural and cultural sites; hence they should carefully consider the necessity and/or suitability of various mountain bike facilities. Government agencies should actively discourage the establishment of new mountain bike trails within high conservation value protected areas, as noted in the Mountain Bike Zoning Compatibility Matrix. They should also not be the proponent for such facilities.

New mountain bike trails in protected areas should not be considered where there is no existing park management plan, or where an existing park management plan does not already envision mountain bike trails. Nor should mountain bike trails for the purpose of events be allowed in protected areas, as these increase impacts exponentially. Any proposal by private parties to construct mountain bike trails in a protected area must undergo environmental and social impact assessments and be open to public consultation and submissions. The clearing of native vegetation to accommodate mountain bike trails should be minimised (Wildflower Society of Western Australia 2022). Ecological offsets should be “like for like” and only be considered for low conservation significance vegetation and as an absolute last resort. Restoration and rehabilitation of habitat should be priority parts of the project development and lead to a net gain/nature positive.

Where possible, mountain bike trails should be built on repurposed, already cleared and/or degraded land, or areas with low conservation value (Wildflower Society of Western Australia 2022). Fire and service roads can provide good opportunities for mountain biking, specifically cross-country and touring.

2. Evidence-based collaborative planning

A carefully designed mountain bike master plan informed by the latest research, environmental and cultural surveys, and consultations with stakeholders (such as Traditional Owners and local communities) is required before the construction of any proposed mountain bike trails in a protected area (Department of Biodiversity, Conservation and Attractions 2019, Wildflower Society of Western Australia 2022). Independent consultants must conduct the surveys, rather than the proponent or government, to avoid any real or perceived conflict of interest (Wildflower Society of Western Australia 2022). The team evaluating the environmental and social impact assessments or master plan must be independent of the proponent.

Details of who is responsible for the management, rehabilitation (especially of unauthorised trails), and enforcement of trail activities, along with the required budget, are essential in the mountain bike master plan. The master plan should also include information on trail maintenance programs, how and when mountain bike activities will be monitored and actively enforced, and clear instruction that any unauthorised trails will not be tolerated and will be quickly removed (see section on Zero tolerance for unauthorised trails). Regular site monitoring and evaluation of environmental and social impacts is necessary, and an updated plan and ongoing management should reflect the outcomes of these assessments.

3. Environmental impact considerations

The environmental impacts of mountain bike riding in natural areas were presented in Table 4, and factors that affect the severity of environmental impacts of visitor use in protected areas were provided. These factors require consideration during the environmental impact stage when determining whether a mountain bike trail should be allowed in a protected area, for design and construction planning, and in the monitoring and evaluation stages of mountain bike master plans. Pickering (2010) states that consideration of these factors will allow area managers to:

- make more informed assessments of the potential severity of impacts
- assist in identifying where monitoring may be required

- identify where and when restoration may be required
- identify what new infrastructure, or maintenance of old infrastructure, is required
- introduce or update educational programs
- indicate where additional site- or activity-specific research may be appropriate and assist in ensuring that the decision-making process is transparent and defensible.

Water in the landscape exacerbates the environmental impacts of mountain bike trails and their use. It is recommended that mountain bike riding be strongly discouraged during rain events (such as through seasonal access or trail closure after high rainfall). Rider behaviour can also reduce environmental impacts associated with wet conditions (Marion and Wimpey 2007, Mountain Bike Santa Cruz 2019, Evju et al. 2021, Wildflower Society of Western Australia 2022), which include:

- riding only on the designated riding surfaces
- not cutting corners (hence not widening exiting trails)
- dismounting and walking around obstacles to avoid creating detours
- braking gently before corners and avoiding skidding to protect the riding surface from erosion
- not riding when a substantial portion of the trail is excessively wet
- staying on the trail when encountering wet areas or puddles, to avoid creating detours
- dismounting and walking around wet areas or puddles with soft entrances and exits to reduce erosion
- avoiding regeneration areas and places where high user impact is starting to show.

The National Parks Australia Council supports the seven “Leave No Trace” principles detailed in the Green Guide to Mountain Biking (Leave No Trace Australia Centre for Outdoor Ethics 2023). The “Leave No Trace” principles have informed the Code of Conduct for Mountain Biking in Protected Areas, which we recommend be promoted widely by the mountain biking industry, mountain park managers and governments at all levels.

“New mountain bike trails in protected areas should not be considered where there is no existing park management plan, or where an existing park management plan does not already envision mountain bike trails.”



Brachina Gorge, Ikara-Flinders Ranges National Park, South Australia. RON KNIGHT/FLICKR

4. Trail location

Focusing the location of new trails on repurposed, cleared, degraded or low conservation value lands ensures protection of high conservation areas while ensuring land is available to meet the increasing demands for mountain biking. Siting mountain bike trails in cleared areas that have been revegetated or in areas of non-native vegetation has numerous benefits, some of which include using currently degraded, under-utilised areas; restoring native vegetation; carbon capture and storage; delivering tourist attractions; and creating custom-designed trails. Some examples of appropriate land for mountain biking (Department of Biodiversity, Conservation and Attractions 2019, Wildflower Society of Western Australia 2022) include:

- non-native forests and plantations
- cleared paddocks and previous agricultural land
- old road/rail alignments
- fire and service roads
- land that has already been used for other active recreational pursuits, such as skiing, horse riding or motorised sport
- abandoned mine and quarry sites
- private properties
- areas adjacent to those in the NRS that are set aside as buffer zones.

Should a trail be proposed in a protected area, the proponent should demonstrate why the proposed trail development would not cross the ecological threshold for environmental impacts and that alternative sites outside the protected area are unsuitable or unavailable. Proposed mountain bike trails must not be established in areas prone to land degradation, and future expansion of trails should not be permitted where they might impact high environmental, cultural, or historic values (Wildflower Society of Western Australia 2022). The number of mountain bike trails permitted in any one area should be minimised, as fragmentation impacts whole of ecosystems, including soil, vegetation, wildlife and hydrological regulation.

5. Trail design

The Australian Mountain Bike Trail Guidelines developed by AusCycling (2023a) provide a standardised framework for the planning, development, and management of mountain bike trails across Australia, hence can act as a benchmark from which monitoring and evaluation of trails can be conducted and outcomes can then inform best practice. Regular updating of these standards to reflect new information developed through monitoring and evaluation, and in consultation from the conservation sector, will ensure the integrity of these guidelines and reduce environmental and social impacts.

Mountain bike trails have environmental and social impacts, some of which can be minimised with well-designed trails and networks (Smith and Pickering 2024). Other impacts, however, can continue throughout the life of the trail and beyond; thus, some protected or natural areas are simply not appropriate for mountain bike trails (Quinn and Chernoff 2010, Mountain Bike Santa Cruz 2019).

Key issues to consider when designing trails include that shared trails result in more social conflict; that the smaller the area, the greater the density (and hence the impact) of more numerous trails; and that high-gradient and fast downhill trails result in greater environmental impacts.

Monitoring, evaluation, education and awareness play a significant role in reducing impacts (see Principle on Education and awareness of social and conservation values). A mixed methods approach is required to address the environmental and social impacts listed in Table 4; it should not be assumed that best practice trail design can mitigate all impacts.

6. Zero tolerance for unauthorised trails

A zero-tolerance approach to unauthorised/illegal/informal trails in the NRS must be enforced. There should be no formalisation of unauthorised trails. Mountain bike riders must only ride on authorised trails, and to be authorised, proposed trails must undergo environmental and social assessments and a mountain bike master plan must be developed. Introducing authorised trails, however, may lead to unauthorised trails developing as local riders lose interest in riding the same trail repeatedly. Riders have created many unacceptable additional or interconnecting trails without authorisation, using unacceptable techniques. These have resulted in features that are unsafe and not conducive to conservation values.

Research shows unauthorised trails create greater impact than carefully designed and managed authorised trails (Pickering 2010, Mountain Bike Santa Cruz 2019, Rewilding Earth 2021). Unauthorised trails are more likely to be subject to erosion (as they are often steeper and have no fall lines or formal drainage), create user conflict, and damage high conservation value areas (Pickering 2010, Department of Biodiversity, Conservation and Attractions 2019). Unauthorised trails create greater costs for land managers and undermine the reputation of the mountain biking industry (Department of Biodiversity, Conservation and Attractions 2019, Wildflower Society of Western Australia 2022, Smith and Pickering 2024).

7. Social impact considerations

Understanding where different user groups will interact on the trail, or when using facilities, is important for minimising user conflict and collisions and for helping provide safe and enjoyable experiences for all (AusCycling 2023a). Avoiding and minimising actual and perceived conflict between trail users requires careful planning, education, and awareness, as well as consideration in the assessment stage of proposals. If a trail is approved, social impacts require consideration when developing and implementing the mountain bike master plan. There can be limited conflict among different user groups, even at times of high usage, when multi-use wide trails are installed (Pickering and Rossi 2016). Adequate signage that identifies which user gives way to other users and reminds users to respect other's goals and values, should be placed on any multi-use trails.

Staggering access times, or providing seasonal access to different users so they can meet their goals, is an option where wide trails are not appropriate (for instance, due to sensitive soils, vegetation, wildlife or terrain). Trail operators and managers (such as industry, government and private landowners) are responsible for rider education and awareness promotion onsite and through their websites (that is, through promoting the Code of Conduct). The Green Guide to Mountain Biking provides guidance on social etiquette for riders that can be used by trail operators and managers (Leave No Trace Australia Centre for Outdoor Ethics 2023). The literature provides numerous recommendations on trail etiquette for mountain bikers that can reduce user conflict, including:

- Be considerate of your hosts. Check with landowners/managers for permission and permits.
- Respect signage and follow rules. Abide by relevant laws or regulations.
- Respect other visitors and the quality of their experience. Alert others of your presence while approaching, be courteous, and give way to other users.
- Clear unintended obstacles off riding surfaces that present hazards to riders when safe to do so (e.g. newly fallen branches or rocks).
- Travel in small groups.
- Ride carefully and in control.
- Slow down where there are blind spots (reduce speed to allow a short braking distance).
- Stop, talk quietly and move off the track if there are horseback riders. Confirm with horseback riders the safest means of passing.
- Don't race on recreational tracks.
- Take breaks and camp away from tracks and other visitors, but in dedicated areas.
- Let nature's sounds prevail. Avoid loud voices and noises.

8. Education and awareness of social and conservation values

Educating riders and creating awareness of conservation values must start at the industry level. By working collaboratively with Indigenous and local communities and the conservation and government sectors, the mountain biking industry can set a standard. Doing so would highlight the importance of creating common understanding and collaboration to ensure the longevity and integrity of Australia's natural and cultural assets, as well as the industry.

Creating awareness and educating the next generation of mountain bike riders is important to proactively managing our protected areas. This can be achieved through the deployment of Activity Leaders established by mountain bike associations and through dedicated educational activity days for children. Activity Leaders with knowledge of social and conservation issues and best practice trail riding can educate all riders and create awareness.

Adequate signage onsite is important to educating riders about social and conservation best practice riding, as is providing appropriate information on relevant websites. Onsite and online signage stating legal and preferred conservation approaches is the responsibility of landowners and bike parks' management.

A Code of Conduct for mountain bikers has been developed by the International Mountain Bicycling Association (IMBA). However, this Code of Conduct is inadequate for the purpose of mountain biking in protected areas due to its limited consideration of the environment. A revised Code of Conduct has been developed by the NPAC. The Code of Conduct takes into account the one developed by IMBA but expands on it to include best conservation practice in mountain bike riding. It is recommended that the Code of Conduct developed by the NPAC be promoted by federal and state agencies and cycling organisations to ensure riders understand their responsibilities when riding in protected areas.

9. Restoration and rehabilitation

Existing, new, and disused mountain bike trails all require a rehabilitation and restoration plan. Included in this plan should be a budget that estimates the cost of restoration activities, such as labour, tree purchase, and equipment. The financier of restoration activities (that is, mountain bike organisations or government) requires identification in this plan.

Innovative approaches to funding restoration activities that improve environmental consciousness and best practice trail riding should be sought. For example, user pays for access to trails can reinforce the conservation or cultural value of the location (Morey et al. 2002). Mountain bike restoration groups recruiting volunteer labour to build and maintain trails, or even collect litter, can create a sense of ownership of the trail and encourage users to ride more respectfully (Department of Biodiversity, Conservation and Attractions 2019).



Wattamolla Beach, Royal National Park, New South Wales. *RICHARD RYDGE/FLICKR*

Code of Conduct for Mountain Biking in Protected Areas

National parks and other protect areas exist to protect nature but also welcome visitors. It is important that while we enjoy the great outdoors we all respect these places and the creatures that live there.

Planning and preparing your ride

- Get to know the protected area you are riding in. Check the agency website prior to riding to learn about the natural and cultural values of the area and the rules for the specific park or protected area. Read the educational signs onsite.
- Check the weather and dress for the conditions. Weather can be unpredictable, so carry enough water for a hot day and take a coat for a rainy or cold one.
- Be prepared and self-sufficient. Carry what you need for the ride you are undertaking and take it out with you to be disposed of properly.
- Know how to make minor repairs, including how to fix a flat tyre.
- Download a map, download a GPS trail app on your phone for navigation, or carry a map in unfamiliar locations.
- Share your riding plan, especially if you're heading out solo. Organise to ride with a partner whenever you can, and/or have an emergency contact.

When riding in protected areas

- Live and let live. Never frighten the wildlife. Slow down to let animals pass, and don't try to touch them.
- Respect habitat. Don't break branches, pick flowers, move logs or trample vegetation – because animals depend on them for food and habitat.
- Do not ride muddy trails, to avoid rutting and deep erosion that creates small streams and advances runoff.
- Ride through standing water to avoid further disturbing aquatic ecosystems, habitats and species.
- Ride or walk technical features, rather than go around them, which creates wider or new trails that trample vegetation and prohibit regrowth.
- Don't create unauthorised new tracks or add unauthorised new trail features. By staying on track, you do not reduce vegetation or damage important habitats. Thinned vegetation reduces aesthetics. Erosion can permanently damage the landscape and habitats. Unauthorised trails and trail features can lead to park closures and undermine the reputation of mountain bikers and the mountain biking industry. Poorly built features could also seriously injure other mountain bikers. Respect your local trail builder by staying on the trail they built for you.
- Give way to other users. Speed, inattentiveness and rudeness are the primary sources of trail conflict among user groups. Use extra caution around horses, as they are unpredictable.
- Ring a bell or verbally announce yourself. If you need to pass, slow down and wait until the other trail user is out of the path. Do not use trails that are not designed or designated for bikes.
- Hear what is going on around you. Be extra aware when using trails with poor sight lines and/or steep or blind corners.
- Carry out rubbish. Imagine the cumulative effect of all our rubbish scattered in our natural areas.

After your ride

- Wash your bike offsite or in designated areas to avoid the dispersal of weed seeds and disease to sensitive environments.
- Be a steward for protected areas. Help spread the word about good stewardship when mountain biking in protected areas. Educate other mountain bikers on best practice riding by applying the Code of Conduct.
- Get involved in your local club/trail care alliance. Help maintain and construct authorised trails.

Glossary

Berm: a banked corner or artificial ridge to help riders take turns at higher speeds.

Dense trail network: trails that wind tightly throughout an area, usually with lots of tight bends

Dispersed trail network: trails that loosely meander throughout an area.

E-bikes: cycles equipped with an auxiliary electric motor. The cyclist is not necessarily required to pedal.

Fire management road: a road that is maintained to facilitate management activities and is not available for public motorised vehicle use (except for e-bikes); licensed access to in-holdings, apiary sites or similar may be allowed.

IMBA: International Mountain Bicycling Association, the international peak body for mountain biking.

Mountain bike: a bicycle that has a design for off-road use.

Mountain biking: riding a bicycle off-road, with a major element being the need to negotiate obstacles. This may be either on a trail or a riding surface where there is no indicated path to follow.

Multi-use (or shared-use) track: a track that is available for walkers and cyclists and may also be available for other users, such as horse riders

Single track: a narrow track that is only wide enough to accommodate riders in single file

Single-use track: a track that is only available for one type of use

Technical trail features: objects that have been introduced to a trail to add technical challenge.

Trail difficulty riding system: a system used to grade trails with similar levels of technical difficulty. Trails are graded on width, grade (maximum and average), surface, natural obstacles and Technical Trail Features (TTFs). Other factors such as enclosure and exposure can also influence classification.

Unauthorised trails: trails created without authorisation or permission from appropriate landowners and managers (e.g. government, Indigenous communities or private landholders).

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