< Photograph of a flock of seabirds on the beach at the water’s edge under a cloudy sky. Copyright Chris Jones

Risks to the Region’s values

Chapter 9

*‘an assessment of the risks to the ecosystem…’*  within the Great Barrier Reef Region, Section 54(3)(d) of the *Great Barrier Reef Marine Park Act 1975*

*‘an assessment of the risks to the heritage values…’* of the Great Barrier Reef Region, Section 116A(2)(b) of the *Great Barrier Reef Marine Park Regulations 1983*

2014 Summary of assessment

|  |  |  |
| --- | --- | --- |
| **Overall risk to ecosystem** | The Region’s ecosystem continues to be at serious risk and the threats likely to affect it in the future are increasing and compounding. The most serious risks arise from climate change, land-based run-off, coastal development and some aspects of direct use (particularly fishing). Other threats relating to direct use are more effectively managed and of less overall risk to the Reef. | **High, Increased, Increasing** |
| **Overall risk to heritage values** | The close connections between the Region’s ecosystem and many of its heritage values mean that the projected risk of almost all threats is the same in both assessments. As a result, the most serious risks to the Region’s heritage values are similarly climate change, land-based run-off, coastal development and some aspects of direct use. | **High,**  **Increasing** |

Full assessment summary: see Section 9.4

# Risks to the Region’s values

**Outlook Report 2009: Overall summary of risks to the Reef**

*The greatest threats facing the Great Barrier Reef ecosystem are from climate change. The individual threats of increasing sea temperature, ocean acidification and rising sea level are assessed as very high risk to the ecosystem and they will act across the entire Region. Their impact will be compounded by each other and by other existing regional and local threats. The most serious, regional-scale risks are catchment runoff, coastal development and some aspects of extractive use. These threats have the potential to work in combination to weaken the resilience of the Great Barrier Reef and therefore its ability to recover from serious disturbances (such as major coral bleaching events) that will become more frequent in the future. While climate change will affect all parts of the Great Barrier Reef, the compounding effects of threats associated with catchment runoff, coastal development and some extractive use means that the nearshore environment next to developed areas is the most at risk.*

## Background

Key message: The threats to the Region’s values have changed over time.

Key message: Threats to the Region’s ecosystem and heritage values are assessed.

Management of the Great Barrier Reef Region (the Region), including establishing future management priorities, focuses on addressing the threats predicted to be of greatest risk to the Region’s values, but must also recognise the cumulative contribution of the full range of threats. It is informed by systematic assessments of the current and future risks presented by known threats, developed using the most up-to-date information.

The threats to the Region’s values, and understanding of them, have changed over time. The development of a comprehensive management framework, integrated management arrangements and improved scientific knowledge reduced risk levels for many of the early identified threats. During the 1990s, management evolved to focus on emerging issues such as water quality, coastal development, fisheries, tourism and recreation.1,2 The comprehensive risk assessment contained in the *Great Barrier Reef Outlook Report 2009*3identified climate change, land-based run-off, coastal development and some aspects of extractive use as the areas of most serious risk and has guided subsequent decision making and the setting of management priorities.3,4 The impacts of climate change on the Reef ecosystem, linkages between terrestrial and marine systems, improvements in land-based run-off and cumulative impacts of coastal development and other activities have become key areas of additional management focus.

The risk assessment for threats to the Region’s values described below is based on the information presented in the previous chapters. In addition to an examination of the level of risk various threats pose to the Region’s ecosystem, which updates the assessment presented in the Outlook Report 2009, a new assessment looks at the risks those threats pose to the Region’s heritage values.

## Identifying and assessing the threats

### Identifying the threats

Key message: Forty-one threats from all sources are assessed.

The current and potential threats to the Region’s ecosystem and heritage values considered in this risk assessment are based on the evidence presented in Chapters 5 and 6. The 41 threats considered are listed in Appendix 5, including a comparison with those assessed in the Outlook Report 2009. As far as possible, the threats and their descriptions are consistent with those used in 2009. The changes made reflect improved understanding of the threats affecting the Region’s values and, in some cases, a merging of closely related threats. For key threats discussion is provided on post-2009 changes in risk where reasonable comparison is possible. Examples include illegal fishing and poaching (an amalgamation) and the now separate threats of dredging and disposal and resuspension of dredge.

The threats identified are relevant to both the assessments of risks to the ecosystem and heritage values. Advice collected in 2013 from the Great Barrier Reef Marine Park Authority’s Local Marine Advisory Committees, Reef Guardian councils, teachers from Reef Guardian schools, Reef scientists, as well as the outcomes of various community surveys were also considered in refining the set of threats.

An additional threat, ‘incompatible uses’, has been included in relation to heritage values to address the conflicts between uses that can arise. This threat is likely to be the result of many different direct uses of the Region and relates to activities undertaken that disturb or exclude other users. For example, where recreational use occurs in areas important for cultural activities, or where the nature of a commercial activity reduces access for recreational users.

The list of threats includes direct and indirect threats plus several ‘consequential threats’ that result from other threats. For example, the indirect threat of increased nutrients from land-based run-off affects the environmental process of primary production, which in turn can contribute to the threat of crown-of-thorns starfish outbreaks.5

It is important to note that the threats considered in this assessment can only be those that are known and identified. There are likely to be more unknown and unanticipated threats that have not been considered in the assessment. As these are identified they will be assessed in future reports.

Some threats have been combined and others added or redefined since the Outlook Report 2009 (see Appendix 5).

[Photograph of an urban coastal scene — forested mountains and cleared farmland in the background, with a marina, boats and city buildings in the foreground. Caption: Threats to the Reef from coastal development are part of the risk assessment.]

### Assessing threats

Key message: A standard risk assessment method is used, based on likelihood and consequence.

Two separate risk assessments are presented, one for the Region’s ecosystem and one for its heritage values. The Australian Standard for Risk Assessment (AS/NZS ISO 31000:2009)6 was followed.

The likelihood and consequence of each threat are ranked on the five-point scale set out in Appendix 6. An overall risk level for each threat is determined, based on a combination of its likelihood and consequence. There are different criteria for ranking consequence in relation to the ecosystem and to heritage values. Risk is considered to be residual — that which remains once existing management has been taken into consideration.

The assessment is based on information in Chapters 2 to 8 of this report, including the current state of the Region’s ecosystem and heritage values, current use patterns, factors influencing the Region’s values, effectiveness of management and current resilience.

Because of the size and complexity of the Region and because many threats affect its values over different time and spatial scales, at different intensities and interact in many different ways, the assessment presented is high level. Several important broad assumptions were made in undertaking the assessment:

* Each threat was initially assessed in isolation from others; compounding effects are discussed separately (Section 9.3.8)
* Each threat was assumed to be possible at any geographic location within, or adjacent to, the Region
* Threats were assessed as they are today (for example, current fishing catch amounts and techniques) or on the basis of documented trends (for example, trends in sea temperature and ocean acidification)
* Threats were assessed with existing, but not any future, management measures in place.

In ranking the consequence of a threat to the ecosystem, variations in the extent of its likely effect are taken into account by having different criteria for broad-scale and local-scale effects (see Appendix 6). For each threat, the higher consequence grade is adopted in determining the overall risk.

For heritage values, definitions for consequence levels acknowledge variations in the extent of a threat’s likely effect by encapsulating into a single criterion both the geographic scale of effects and the range of heritage values affected (see Appendix 6).

### Understanding community views

Key message: Community views informed the risk assessment.

The structured risk assessment process also takes into consideration input from Reef scientists and community views on the risks to the Great Barrier Reef. These were canvassed during 2013 through a number of avenues:

* As part of an Outlook scientific consensus workshop, 31 members of the Great Barrier Reef scientific community provided advice on likelihood and consequence for a supplied list of threats.7
* Respondents to national opinion survey8 were asked to rank a provided list of threats.
* Residents of the Great Barrier Reef catchment as well as members of the fishing sector and the tourism sector (both tourists and tourism operators) were surveyed regarding the three most serious threats.8
* Members of the Great Barrier Reef Marine Park Authority’s Local Marine Advisory Committees (32 respondents) as well as representatives of Reef Guardian councils (18 respondents) ranked a provided list of threats.
* Teachers from Reef Guardian schools completed an online survey and identified the five threats people should be keeping an eye on within the next five years and 25 years. Responses up to November 2013 (54 schools) are included.

The outcomes of these surveys are summarised in Section 9.3.2.

Community views on risks to heritage values have not been surveyed.

## Outcomes of risk assessment

### Level of likely risk

The outcomes of the risk assessment for the Region’s ecosystem and heritage values are presented in Figure 9.1 and Figure 9.2 respectively. Appendix 7 provides a summary of the risk assessment of each of the 41 threats.

The close connections between the Region’s ecosystem and its heritage values mean that the projected risk of almost all threats is the same in both assessments — although for some threats the likelihood of the threat having an effect and the consequence of the effect differ between the two assessments.

Two threats are assessed as presenting a different level of risk to heritage values compared to the ecosystem:

* Extraction of herbivores (excluding illegal fishing and poaching) is assessed as of lower risk for heritage values because, when performed by Traditional Owners, the activity has a positive effect on Indigenous cultural values.
* Wildlife disturbance is assessed as a higher risk for heritage values because predicted increases in use of the Region could cause increased localised effects on attributes specifically identified as contributing to the property’s Outstanding Universal Value such as the natural phenomena of seabird and marine turtle nesting. In addition, changes to animal behaviour caused by the presence of boats or people can change the nature of customary practice and change storylines, especially as the species disturbed are often totemic animals for Traditional Owners.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **LIKELIHOOD** | | | | | | **CONSEQUENCE** |
| **Rare** | **Unlikely** | **Possible** | **Likely** | **Almost certain** |  |
|  |  |  |  | * Ocean acidification * Sea temperature increase | **Catastrophic** |
|  | * Altered ocean currents * Spill — large chemical * Spill — large oil |  |  | * Altered weather patterns (^) * Illegal fishing and poaching (^) * Incidental catch of species of conservation concern (^) * Modifying coastal habitats (^) * Nutrient run-off * Outbreak of COTS (^) * Sea level rise * Sediment run-off (^) | **Major** |
|  |  | * Acid sulphate soils * Grounding large vessel | * Disposal of dredge material * Extraction from spawning aggregations * Outbreak of disease (^) | * Barriers to flow (^) * Discarded catch * Extraction of predators * Marine debris * Pesticide run-off (v) | **Moderate** |
|  |  | * Atmospheric pollution | * Artificial light * Dredging * Exotic species * Extraction of herbivores * Outbreak of other species (^) * Vessel strike | * Damage to seafloor * Damage to reef structure * Extraction of particle feeders * Illegal activities — other * Noise pollution * Terrestrial discharge * Vessel waste discharge | **Minor** |
|  |  |  |  | * Grounding small vessel * Spill — small * Wildlife disturbance | **Insignificant** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Low risk |  | Medium risk |  | High risk |  | Very high risk |

Figure 9. Risks to the Great Barrier Reef Region’s ecosystem

This risk matrix has been developed in accordance with the Australian Standard (AS/NZS ISO 31000:2009)6 using terms and definitions detailed in Appendix 6. The assessment is based on current or documented future trends in the identified threats and existing management measures. The compounding effects of threats are not considered. (^) and (v) indicate the assessed risk has increased or decreased since the Outlook Report 2009. The full wording for each of the identified threats is provided in Appendix 5 and the assessment for each threat is summarised in Appendix 7.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **LIKELIHOOD** | | | | | | **CONSEQUENCE** |
| **Rare** | **Unlikely** | **Possible** | **Likely** | **Almost certain** |  |
|  |  |  |  | * Ocean acidification * Sea temperature increase | **Catastrophic** |
|  | * Altered ocean currents * Spill — large chemical * Spill — large oil |  |  | * Altered weather patterns * Illegal fishing and poaching * Incidental catch of species of conservation concern * Modifying coastal habitats * Nutrient run-off * Outbreak of COTS * Sea level rise * Sediment run-off | **Major** |
|  |  | * Acid sulphate soils * Damage to seafloor * Grounding large vessel | * Disposal of dredge material * Extraction from spawning aggregations * Outbreak of disease | * Barriers to flow * Discarded catch * Extraction of predators * Incompatible uses * Marine debris * Pesticide run-off | **Moderate** |
|  |  | * Atmospheric pollution | * Artificial light * Dredging * Exotic species * Outbreak of other species * Vessel strike | * Damage to reef structure * Extraction of particle feeders * Illegal activities — other * Noise pollution * Terrestrial discharge * Vessel waste discharge * Wildlife disturbance | **Minor** |
|  |  |  | * Extraction of herbivores | * Grounding small vessel * Spill — small | **Insignificant** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Low risk |  | Medium risk |  | High risk |  | Very high risk |

Figure 9. Risks to the Great Barrier Reef Region’s heritage values

This risk matrix has been developed in accordance with the Australian Standard (AS/NZS ISO 31000:2009)6 using terms and definitions detailed in Appendix 6. The assessment is based on current or documented future trends in the identified threats and existing management measures. The compounding effects of threats are not considered. Risks to heritage values were not assessed in the Outlook Report 2009. The full wording for each of the identified threats is provided in Appendix 5 and the assessment for each threat is summarised in Appendix 7.

### Community views

Key message: Community views closely match the outcomes of the structured assessment.

The views of various community groups in relation to the most serious threats facing the Great Barrier Reef ecosystem are summarised in Table 9.1. Climate change, land-based run-off, shipping, port development, fishing, marine debris and pollution were common responses in many of the groups. This closely matches the outcomes of the structured risk assessment presented in Figure 9.1.

Similar to the community views presented in the Outlook Report 2009, climate change and land-based run-off continue to be viewed as the most serious threats. Community concern about some threats has increased (for example marine debris, shipping and port development).

Table 9. Community views on the threats facing the Great Barrier Reef ecosystem

A range of groups was canvassed about their views on threats to the Great Barrier Reef ecosystem. Various survey methods were used (Section 9.2.3). The responses were generally similar, with climate change and land-based run-off the threats most frequently highly ranked.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Community group** | **Ranking of perceived threats** | | | | |
| **First** | **Second** | **Third** | **Fourth** | **Fifth** |
| Australians generally | Marine debris and beach litter | Climate change | Agricultural  run-off | Shipping | Crown-of-thorns starfish |
| Reef catchment residents | Climate change/global warming | Shipping | Agricultural  run-off | Commercial fishing | Pollution |
| Tourists | Tourism | Climate change/global warming | Commercial fishing | Shipping | Marine debris |
| Commercial fishers | Agricultural  run-off | New ports and port expansions | Shipping | Natural disasters (floods, cyclones, earthquakes) | Government and regulation |
| Marine tourism operators | Climate change | Agricultural  run-off | Boating / Shipping | Poor management/ over-management | New ports and port expansions |
| Scientific community | (in no particular order)  Sediments and nutrients from land-based run-off; ocean acidification; sea temperature rise; climate change effects on ocean currents | | | | |
| Local Marine Advisory Committees | Climate change effects on weather patterns | Clearing or modifying wetlands, mangroves and other coastal habitats | Disposal and resuspension of dredge material | Increased sea temperatures | Nutrients from catchment run-off |
| Reef Guardian councils | Climate change effects on weather patterns | Outbreaks of crown-of-thorns starfish | Nutrients from land-based run-off | Spill — large chemical | Sea temperature rise |
| Reef Guardian schools | (most mentioned)  Climate change (including sea temperature rise and ocean acidification); water quality and land-based run-off; fishing; pollution; marine debris | | | | |

[Photograph from the air of a river discharging a sediment filled plume into the marine environment. Caption: Community members identify land-based run-off as one of the key threats to the Reef]

### Sources, scale and timing

Key message: The highest risk threats are on a Region-wide scale; most are already having an impact.

The identified threats to the Region’s ecosystem and heritage values arise from a number of sources and are highly variable in both scale and timeframe. A better understanding of the individual threats is gained by linking them to their likely causes — the influencing factors identified in Chapter 6, including each of the direct uses — and by grouping them according to the likely timing and extent of their effect (Figure 9.3).

Some of the threats identified as highest risk are affecting the ecosystem and heritage values at a broad, often Region-wide, scale and are happening now (for example, the very high risk threats of sea temperature increase and nutrients and sediments from land-based run-off). Of the very high risk threats, ocean acidification and sea level rise are predicted to show major effects over a longer timeframe (within 10 to 20 years, see Section 6.3), although their effects are already beginning to be documented. The risks associated with a changing climate are likely to increase in the future due to emissions trajectories and an unavoidable lag effect where future change is locked in by past emissions.

The threats that are more localised in their effects are generally rated as having a lower risk and are generally associated with direct use of the Region. Nevertheless, some risks associated with some threats remain high at local or regional scale, as is the case for pesticide run-off.9

[Photograph of bleached staghorn coral. Caption: Coral bleaching is one of the effects of increases in sea temperature]

| **Scale** | **Threats** | **Current risk level and effect timing** | **Influencing factor** | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Climate change** | **Coastal development** | **Land-based run-off** | **Direct use** |
| Region-wide | Altered weather patterns | Now | ⚫ |  |  |  |
| Region-wide | Sea temperature increase | Now | ⚫ |  |  |  |
| Region-wide | Ocean acidification | 10+ years | ⚫ |  |  |  |
| Region-wide | Sea level rise | 10+ years | ⚫ |  |  |  |
| Region-wide | Modifying coastal habitats | Now |  | ⚫ |  |  |
| Region-wide | Nutrient run-off | Now |  |  | ⚫ |  |
| Region-wide | Sediment run-off | Now |  |  | ⚫ |  |
| Region-wide | Outbreak of crown-of-thorns starfish | Now |  |  | ⚫ |  |
| Region-wide | Illegal fishing and poaching | Now |  |  |  | ⚫ |
| Region-wide | Incidental catch of species of conservation concern | Now |  |  |  | ⚫ |
| Region-wide | Barriers to flow | Now |  | ⚫ |  |  |
| Region-wide | Marine debris | Now |  |  | ⚫ | ⚫ |
| Region-wide | Incompatible uses | Now  risk assessed for heritage only |  |  |  | ⚫ |
| Region-wide | Discarded catch | Now |  |  |  | ⚫ |
| Region-wide | Extraction of predators | Now |  |  |  | ⚫ |
| Region-wide | Extraction of particle feeders | Now |  |  |  | ⚫ |
| Region-wide | Altered ocean currents | 10+ years | ⚫ |  |  |  |
| Local or regional | Pesticide run-off | Now |  |  | ⚫ |  |
| Local or regional | Disposal of dredge material | Now |  | ⚫ |  | ⚫ |
| Local or regional | Extraction from spawning aggregations | Now |  |  |  | ⚫ |
| Local or regional | Outbreak of disease | Now | Cumulative effect of many factors | | | |
| Local or regional | Outbreak of other species | Now | Cumulative effect of many factors | | | |
| Local or regional | Terrestrial discharge | Now |  |  | ⚫ |  |
| Local or regional | Acid sulphate soils | Now |  | ⚫ | ⚫ |  |
| Local or regional | Artificial light | Now |  | ⚫ |  | ⚫ |
| Local or regional | Damage to reef structure | Now |  |  |  | ⚫ |
| Local or regional | Damage to seafloor | Now |  |  |  | ⚫ |
| Local or regional | Dredging | Now |  | ⚫ |  | ⚫ |
| Local or regional | Exotic species | Now |  |  | ⚫ | ⚫ |
| Local or regional | Extraction of herbivores | Now  risk assessed as ‘low’ for heritage |  |  |  | ⚫ |
| Local or regional | Grounding large vessel | Now |  |  |  | ⚫ |
| Local or regional | Illegal activities — other | Now |  |  |  | ⚫ |
| Local or regional | Noise pollution | Now |  | ⚫ |  | ⚫ |
| Local or regional | Spill – large chemical | Now |  |  |  | ⚫ |
| Local or regional | Spill – large oil | Now |  |  |  | ⚫ |
| Local or regional | Vessel strike | Now |  |  |  | ⚫ |
| Local or regional | Vessel waste discharge | Now |  |  |  | ⚫ |
| Local or regional | Wildlife disturbance | Now  risk assessed as ‘low’ for ecosystem |  |  |  | ⚫ |
| Local or regional | Grounding small vessel | Now |  |  |  | ⚫ |
| Local or regional | Spill – small | Now |  |  |  | ⚫ |
| Local or regional | Atmospheric pollution | Now |  | ⚫ |  | ⚫ |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Low risk |  | Medium risk |  | High risk |  | Very high risk |

Figure 9. Summary of threats arising from factors influencing the Region’s values, and associated scale and risk level

The figure links threats with the key factors (see Chapter 6) of most influence on them either directly or indirectly. Instances where a factor is likely to be only an insignificant influence on a threat are not displayed. Risk level for each threat is also shown, along with the scale at which the effects of the threat are expected to occur. The figure shows that threats assessed as very high risk to the Region’s values are expected to have an effect over a broad or Region-wide scale and most are already having an effect.

### Highest risk threats

Key message: The highest risk threats arise from climate change, coastal development, land-based run-off and some aspects of direct use.

Based on assessments of the 41 identified threats (Figure 9.1 and Figure 9.2), 10 threats present a very high risk to the Region’s ecosystem and heritage values. A further eight and nine threats present a high risk to the Region’s ecosystem and heritage values, respectively. The threats assessed as very high and high risk (grouped by influencing factor) are:

* **climate change** — sea temperature increase; altered weather patterns; ocean acidification; and sea level rise
* **coastal development** — clearing and modifying coastal habitats; artificial barriers to flow; and disposal and resuspension of dredge material
* **land-based run-off** — nutrients from run-off (including its links to outbreak of crown-of-thorns starfish); sediments from run-off; pesticides from run-off; and marine debris
* **direct use** —illegal fishing, collecting and poaching; incidental catch of species of conservation concern; marine debris; incompatible uses (assessed for heritage values only); effects on discarded catch; retained take (extraction) of predators; disposal and resuspension of dredge material; and retained take (extraction) from unidentified or unprotected spawning aggregations.

Outbreaks of disease, both naturally occurring and introduced, are also assessed as a high risk. Such outbreaks are likely to be an indicator of overall stress in the natural system from the accumulation of impacts arising from many influencing factors.

The lack of understanding of the extent and location of many heritage values (for example wrecks and archaeological sites) means that the risks to heritage values associated with dredging, disposal of dredge material and damage to the seafloor in non-reef areas may be underestimated. A direct interaction with relevant activities may cause significant or permanent damage to sites of particular cultural or historical importance. Assessment processes required during permitting of these activities mitigate this risk, but only for identified values.

### Trends in risks to the Region’s values

Key message: For some threats, management changes have kept the risk stable.

The assessed risk for a number of the threats to the Region’s ecosystem has changed since the assessment presented in the Outlook Report 2009. These variations are indicated in Figure 9.4. The risks to heritage values were not assessed in 2009.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Increased risk** |  | **No change in risk** |  | **Decreased risk** |
|  | Altered weather patterns |  | Nutrients in land-based run-off |  | Pesticides in land-based run-off |
|  | Illegal fishing and poaching |  | Ocean acidification |  |  |
|  | Incidental catch of species of conservation concern |  | Sea level rise |  |  |
|  | Modifying coastal habitats |  | Sea temperature increase |  |  |
|  | Outbreak of crown-of-thorns starfish |  | Discarded catch |  |  |
|  | Sediment in land-based run-off |  | Extraction from unprotected spawning aggregations |  |  |
|  | Barriers to flow |  | Extraction of predators |  |  |
|  | Outbreak of disease |  | Marine debris |  |  |
|  | Outbreak of other species |  | Altered ocean currents |  |  |
|  |  |  | Damage to reef structure |  |  |
|  |  |  | Damage to seafloor |  |  |
|  |  |  | Extraction of herbivores |  |  |
|  |  |  | Extraction of particle feeders |  |  |
|  |  |  | Grounding large vessel |  |  |
|  |  |  | Introduction of exotic species |  |  |
|  |  |  | Spill — large chemical |  |  |
|  |  |  | Spill — large oil |  |  |
|  |  |  | Vessel strike |  |  |
|  |  |  | Vessel waste discharge |  |  |
|  |  |  | Grounding small vessel |  |  |
|  |  |  | Spill — small |  |  |

Figure 9. Trends since 2009 for threats to the Region’s ecosystem

The figure shows the changes in the outcomes of the risk assessment compared to 2009. Nine threats are assessed as having a higher risk than in 2009. Only one threat has a lower risk grading — pesticides in land-based run-off —because more is now known about its effects and spatial extent. Threats that were not assessed in the Outlook Report 2009 or were grouped differently do not appear in this comparison figure,.

**Increases in assessed risk** Generally, increases in the risk grade have been the result of increased understanding of the threat, its distribution and the likely severity of its consequences. For example, in 2009 the risk associated with sediments in land-based run-off was assessed as high (likelihood: almost certain, consequence: moderate), but is now assessed as very high (likelihood: almost certain, consequence: major) based on improved understanding of both the distribution and effects of sediments in the marine system and the likely lag time between decreases in the loads entering the Region and improvements in the Region itself10 (see Section 3.2.4). Similarly, improved understanding of crown-of-thorns starfish outbreaks (see Section 3.6.2), their frequency, causes and effects, has increased the grading of this threat since the Outlook Report 2009. The resulting risk has increased from high to very high. Increases in the assessed risk of clearing and modifying coastal habitats (from high to very high) and artificial barriers to flow (from medium to high) are a reflection of improved understanding of the importance of healthy habitats and ecosystem processes in coastal areas adjacent to the Region (see Section 3.5).

The risk presented by altered weather patterns has also increased since 2009: partly because the threat definition has been broadened from just cyclones to effects on weather more generally; and partly because of improved understanding (see Sections 3.2 and 6.3). Knowledge in this area has grown through both research associated with the extreme weather experienced since 200911 and longer term studies demonstrating the significance of extreme weather in shaping the ecosystem9,12,13.

The risks associated with an outbreak of disease or species other than crown-of-thorns starfish have increased, mostly due to a decline in the overall condition of the ecosystem, making such outbreaks more likely and of greater significance (see Section 3.6.1).

Incidental catch of species of conservation concern has an increased level of risk in the current assessment compared to 2009. The move from high to very high reflects improved knowledge about which species are at risk and the implications for some species of even small numbers of deaths (see Chapter 2 and Section 5.4).

Illegal fishing and collecting was assessed separately from illegal poaching in 2009, but these illegal extraction activities are now considered as a group. The risk of illegal poaching of species such as dugong and turtles is likely to have decreased since the Outlook Report 2009 because of its focus in management (see Sections 5.9.3 and 7.4.2 ). However, the risk associated with illegal fishing and collecting has increased (see Section 5.4.3). The risk grading of very high recognises the serious effects illegal extraction has on the resilience of the ecosystem and reducing the effectiveness of management actions implemented for biodiversity protection.

**Reductions in assessed risk** Improved understanding of the distribution of pesticides in the Region9 (see Section 6.5.1) and of the effects of pesticides on both inshore habitats and adjacent coastal habitats (with flow-on effects on the Region’s values) has decreased the assessed risk associated with pesticides in land-based run-off from very high to high.

**Unchanged risk** **levels** Notably, the risks associated with some threats have remained the same despite an increase in the causes of the threats. For example, because of improvements in the management of shipping in the Region (both implemented and pending as outlined in the draft North East Shipping Management Plan), the likelihood of a serious shipping incident such as a large vessel grounding or a large oil and chemical spill has remained unchanged, despite the significant increase in shipping traffic (see Sections 5.8 and 7.3.7).

The continued strong management of direct uses such as commercial marine tourism has resulted in associated threats, such as small vessel grounding and damage to reef structure from anchoring, snorkelling and diving activities, remaining unchanged (see Section 7.3.1).

The risks associated with the legal extraction of the Region’s resources (for example herbivores and predators) have remained stable overall. For the threat of extraction of predators, the assessed risk is stable; the threat is a combination of two previous threats — extraction of top-order predators and extraction of lower order predators.

There is a worldwide increase in marine debris and increased understanding of domestic contributions and dispersal (see Section 6.6.2). The risk to the Region’s values from marine debris continues to be high and is unlikely to decrease in the immediate future.

[Photograph from the air of a small boat grounded on a coral reef. Caption: The overall risk to the Reef from small vessel groundings remains low]

**Undetermined changes in risk** Dredging and disposal threats were considered together in 2009. These risks were separated for this assessment given the different management approaches and understanding of the effects of each activity. Historically, capital dredging activities did not occur every year. While the permitted amount of dredging has increased since the Outlook Report 2009 and is projected to continue to increase in the coming decade, its consequences to the Region’s ecosystem are constrained to the area around the dredged footprint. The frequency of disposal and resuspension of dredge material (from both capital and maintenance dredging) is likely to increase with continued development and expansion of ports in the coming decade. The risk level of ‘high’ for disposal and resuspension reflects increases in the likely future trends in volume of material requiring disposal, uncertainty of its potential effects on the ecosystem, and the need for strengthened monitoring of the effects of this threat (see Sections 5.5, 6.6, 7.3.4).

### Effectiveness at managing threats

Key message: Management is least effective for some of the highest risk areas.

As was the case in the Outlook Report 2009, the origins of many of the highest risk threats are outside the Region (either global or within the Great Barrier Reef catchment). The effectiveness of their management (Figure 9.5) was independently assessed as some of the weakest, especially in terms of outcomes (see Chapter 7).

Overall risk associated with climate change and land-based run-off has remained very high and high, respectively, since 2009. The effectiveness of management in relation to climate change has weakened in relation to context, planning, inputs, processes and outcomes (see Section 7.3.9), while positive gains have been made in planning, processes and outputs for management around land-based run-off (see Section 7.3.11).

The overall risk associated with coastal development has increased since 2009 because the implications and extent of several key threats (for example modifications to coastal habitats) are now better understood. However, the effectiveness of management in relation to coastal development has not improved overall (see Section 7.3.10).

The overall risk associated with direct use is medium — noting that, as in 2009, fishing stands out as being associated with several threats considered to be high and very high risk. Increased management attention to the remaining impacts of fishing has not yet significantly reduced risk levels (though understanding has improved). There have been reductions in resourcing for fisheries management with flow-on effects on monitoring and reporting. Trawling is known to present significant risks for deep-water skates, several rays and sea snakes, and there is the capacity for trawl activity to increase under existing management arrangements. Additionally, an increase in coastal population and changing demographics could lead to increased risk from recreational fishing, especially given recent information on non-compliance rates (see Section 5.4.3).

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Influencing factor** | **Main origin** | **Activity** | **Impact** | **Effectiveness of existing measures** | | | | | | | | **Risk** |
| **Context** | **Planning** | **Inputs** | **Processes** | | **Outputs** | | **Outcomes** |  |
| Climate change | Global | Greenhouse gas emissions | Very high | Good | Poor | Good | Poor | | Good | | Ineffective | Very high |
| Coastal development | Great Barrier Reef catchment | Agriculture; mining; urban, industrial, port and island development | High | Good | Poor | Poor | Poor | | Poor | | Poor | High |
| Land-based run-off | Great Barrier Reef catchment | Agriculture; mining; urban, industrial, and island development | High | Very good | Very good | Good | Very good | | Very good | | Poor | High |
| Direct use | Great Barrier Reef Region | Commercial marine tourism | Very low | Very good | Good | Good | Good | Very good | | Very good | | Low |
|  |  | Defence activities | Very low | Very good | Very good | Good | Very good | Very good | | Very good | | Low |
| Fishing | High | Good | Good | Partially effective | Good | Good | | Poor | | High |
| Ports | High | Good | Good | Good | Good | Poor | | Good | | Medium |
| Recreation (not including fishing) | Low | Very good | Good | Good | Good | Good | | Good | | Low |
| Research and educational activities | Very low | Very good | Good | Good | Good | Very good | | Very good | | Low |
| Shipping | Low | Good | Good | Good | Good | Good | | Very good | | Medium |
| Traditional use of marine resources | Very low | Very good | Very good | Good | Good | Good | | Very good | | Low |

Figure 9. Management effectiveness, impacts and risk associated with factors influencing the Region’s values

Impact grades (Chapters 5 and 6), the effectiveness of current protection and management (Chapter 7), and overarching risk levels are shown for factors influencing the Region’s values, including for component activities of direct use. The influencing factors that present the highest overall risk to the Region’s values have their origins outside the Region. Higher risk also corresponds with uses and influencing factors that have both higher impact on values and weaker management effectiveness. The effectiveness of management was assessed in an independent assessment (based on the six elements: understanding of context; planning; financial, staffing and information inputs; management systems and processes; delivery of outputs and achievement of outcomes) — see Chapter 7 for a full discussion. The assessment of management effectiveness for the topic of climate change is only in relation to management measures undertaken specifically to protect and manage the Great Barrier Reef.

Port activities are the largest contributor to dredging and disposal of dredge material in the Region (with tourism developments usually a smaller contributor). Proposals to dispose of dredge material on the seafloor are projected to increase with continued port development. The consequences for biodiversity and some heritage values within the footprint of dredging sites are serious and possibly irreversible. There is emerging concern that resuspension of sediment could affect the condition of values over a broad scale and long timeframes (see Section 5.5), adding further pressure to already declining inshore ecosystems and affecting aesthetic beauty and cultural practices.

### Cumulative impacts

Key message: The accumulation of many threats increases the overall risk.

The assessments of individual risks presented in Figure 9.1 and Figure 9.2 do not take into account the cumulative impact of the threats on the Region’s ecosystem and heritage values. None of the threats operate in isolation. They are connected through the geographic areas in which they occur (Figure 9.6), the timeframes in which they act, and the habitats, species, ecosystem processes and heritage values they affect.

Interactions between threats can have variable effects. Many of the threats considered in this report are likely to have synergistic effects, where the impact of two or more threats acting together is much worse than that expected from the sum of their individual impacts.14,15,16

An analysis of cumulative effects takes into account direct, indirect and consequential impacts and the incremental and compounding effects of these threats over time, including past, present and reasonably foreseeable future pressures.

The independent assessment of management effectiveness17 for the Outlook Report 2009 identified the extent to which cumulative impacts are being addressed as the weakest indicator across the entire management effectiveness assessment. It concluded that management effectiveness challenges were most evident for those issues which were broad in scale and complex socially, biophysically and jurisdictionally. The independent assessment of management effectiveness for this report (see Chapter 7) highlighted that managing agencies’ understanding of cumulative and consequential impacts is improving, although this remains problematic for most issuesespecially in achieving outcomes forfishing.

There are several ways to consider the cumulative effect of threats upon the Region’s ecosystem or heritage values. It largely depends on the context for which the examination is occurring and the amount of evidence available for the assessment. Methods range from modelling approaches that use simple, unstructured lists to quantitative mathematical models or spatial approaches that focus on a specific location or component of the ecosystem.

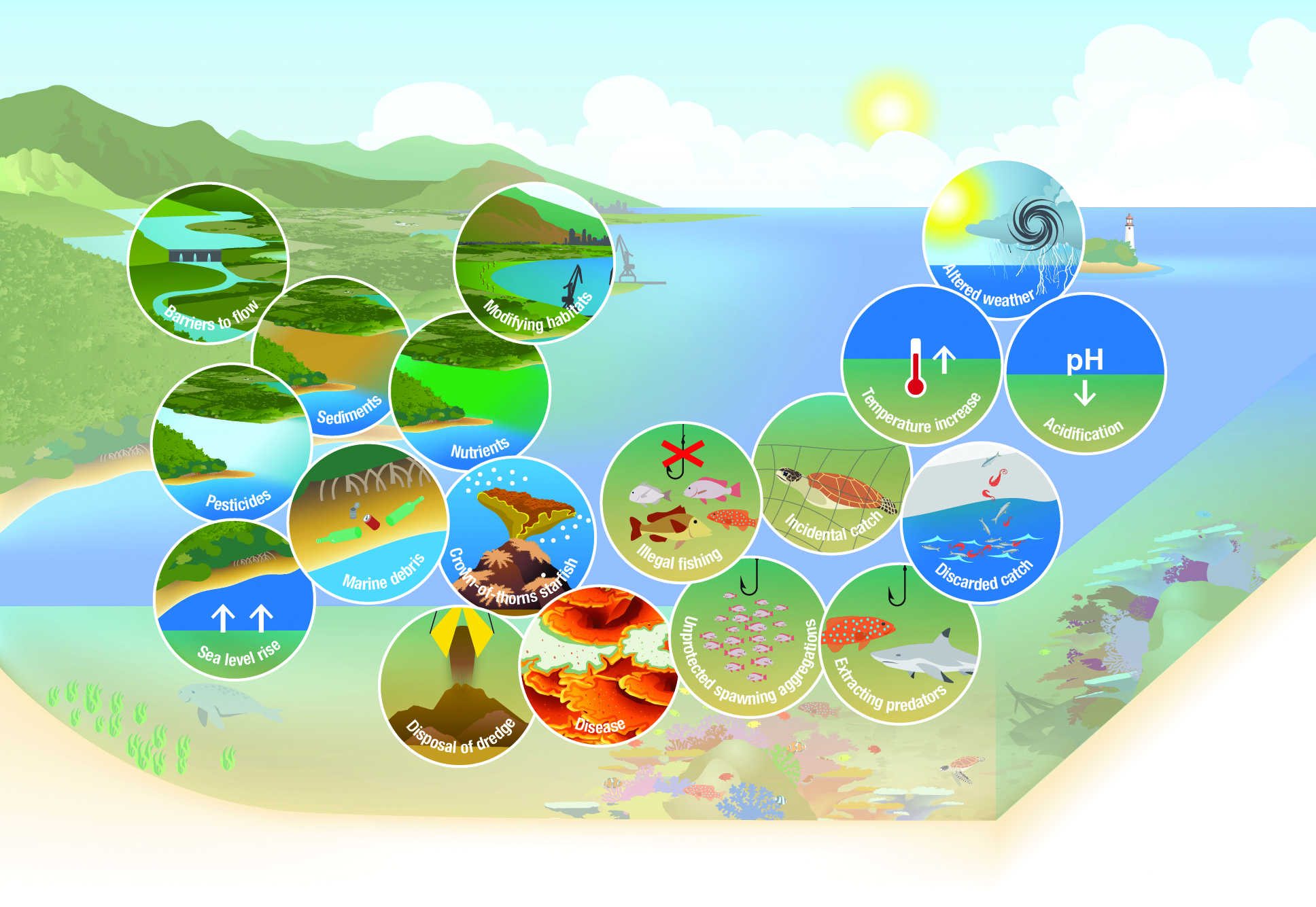


Figure 9. Example of multiple threats to the ecosystem within an area

Multiple threats, including those presenting high and very high risks to the Region’s values, can overlap and interact within an area. They combine to present a serious cumulative risk to local habitats and species.

Another way to consider the cumulative effect of threats is by examining a particular component of the ecosystem or a distinct heritage value, for example coral reef habitats (Figure 9.7). This has generally been done previously at a single species level.18,19 More recently, qualitative models developed for the Region have provided an initial assessment of some of the complexity associated with understanding cumulative effects on coral reef habitats.16 The model shows some cause-and-effect relationships are relatively simple, such as an increase in ocean warming making coral bleaching events more frequent, which then leads to a reduction in hard coral cover. However, other relationships are much more complex. For example, an increase in land-based run-off from agriculture drives four threats identified in the model (toxins, nutrients, turbidity and sedimentation), in turn affecting seven ecosystem variables (predatory fishes, herbivorous fishes, crown-of-thorns starfish, fish and invertebrates, macroalgae, crustose coralline algae and coral recruitment, and coral cover).

Diagram illustrating that multiple threats affect a single habitat type (such as coral reef). Threats are presented grouped by scale (Region-wide or local/regional) and risk level — arranged in an array around a drawing of a coral reef habitat so that higher risk threats are positioned closer to the habitat drawing. Only threats relevant to coral reef habitats are included.
 
Reef-wide threats of very high risk are: outbreak of crown-of-thorns starfish; sea temperature increase; altered weather patterns; nutrient run-off; ocean acidification; sea level rise; and sediment run-off. 
Local/regional threats of high risk are: disposal of dredge material; outbreak of disease; marine debris; and pesticide run-off. 
Reef-wide threats of medium risk are: altered ocean currents.
Local/regional threats of medium risk are: spill — large chemical ; spill — large oil; illegal activities — other; grounding large vessel; dredging; exotic species; outbreak of other species; damage to reef structure; extraction of particle feeders; terrestrial discharge; and vessel waste discharge. 
Local/regional threats of low risk are: grounding small vessel and spill — small.
 


Figure 9. Cumulative effects on coral reef habitats

As noted in Chapter 2, the condition of coral reef habitats is declining. The major causes of this decline (land-based run-off, outbreaks of crown-of-thorns starfish, coral bleaching and cyclones) have been identified at a broad Region-wide scale.14,20,21 However, when considered at the local scale, there are many additional threats that directly affect coral reef habitats. Like any of the Region’s ecosystem and heritage values, consideration of all threats affecting coral reefs, regardless of the level of risk or the scale at which the threat operates, is essential to improving the habitat’s resilience. This is particularly important given the declining trends for coral reef habitats in much of the Region and the central role they play in the Reef ecosystem and its Outstanding Universal Value as a world heritage property.

## Assessment summary – Risks to the Region’s values

Section 54(3)(d) of the *Great Barrier Reef Marine Park Act 1975* requires ‘… *an assessment of the risks to the ecosystem…’* within the Great Barrier Reef Region. Section 116A(2)(b) of the Regulations requires *‘an assessment of the risks to the heritage values…’* of the Great Barrier Reef Region.

Separate assessments are provided for the Region’s ecosystem and its heritage values, based on their current state and trends, the factors influencing them, the effectiveness of protection and management measures and an understanding of their overall resilience.

### Risks to the ecosystem

**Outlook Report 2009: Assessment summary**

*The ecosystem is at serious risk from the compounding impacts of climate change, catchment runoff, coastal development and extractive use. Of the many other threats to the Great Barrier Reef ecosystem, most present a small risk individually, but combine to further reduce ecosystem resilience. Other threats are effectively managed and are now assessed as a much reduced risk.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Assessment component** | **Assessment summary** | **Risk 2009** | **Risk 2014 and trend since 2009** | **Future trend** | **Confidence** | |
| **Grade** | **Trends** |
| **Climate change** | The threats of sea temperature increase, altered weather patterns, ocean acidification and sea level rise continue to be some of the most serious risks to the Reef ecosystem. The risk is likely to increase in the future due to emissions trajectories and unavoidable future change locked in by past emissions. | Very high | Very high, Increased | Increasing | Adequate | Adequate |
| **Coastal development** | Clearing and modifying coastal habitats and artificial barriers to flow are serious risks to the Reef. Increased coastal development increases the likelihood of these threats. Direct use causes demand for some aspects of coastal development. | High | High, Increased | Increasing | Adequate | Adequate |
| **Land-based run-off** | While loads of nutrients and sediments are being reduced, understanding of the detrimental effects on the ecosystem has improved. The continued inputs and the lag between reduced inputs and improved ecosystem condition mean that nutrients, sediments and pesticides in land-based run-off will continue to be a serious long-term risk to the ecosystem. Marine debris from all sources will also remain a high risk. | High | High,  Stable | Decreasing | Adequate | Adequate |
| **Direct use** | Many threats from direct use are localised and of low to medium risk. However, some significant risks remain. Illegal fishing and collecting, extraction of predators, extraction from unidentified or unprotected spawning aggregations, incidental catch of species of conservation concern and effects on discarded catch are rated as high or very high risk. Although overall risk from ports is assessed as medium, increases in port-related activity combined with future projections and a continued incomplete understanding of the potential ecosystem effects have increased the assessed risk for disposal and resuspension of dredge material. | Medium (non-extractive)  High (extractive) | Medium  (overall)  Trend not assessed | Increasing | Adequate | Adequate |
| **Overall risk to ecosystem** | The Region’s ecosystem continues to be at serious risk and the threats likely to affect it in the future are increasing and compounding. The most serious risks arise from climate change, land-based run-off, coastal development and some aspects of direct use (particularly fishing). Other threats relating to direct use are more effectively managed and of less overall risk to the Reef. | **High** | **High, Increased** | **Increasing** |

|  |  |
| --- | --- |
| **Risk** | |
| **Low risk** | Given current management arrangements, any threats considered likely or certain to occur are predicted to have no more than insignificant consequences for the ecosystem. There may be minor or moderate consequences for the Region’s ecosystem for other less likely threats. |
| **Medium risk** | Given current management arrangements, few of the threats considered likely or certain to occur are predicted to have moderate consequences for the Region's ecosystem and none will have catastrophic consequences. Some unlikely threats may have major consequences for the Region's ecosystem. |
| **High risk** | Given current management arrangements, many of the likely or almost certain threats are predicted to have moderate or major consequences for the Region's ecosystem. |
| **Very high risk** | Given current management arrangements, there are likely or almost certain threats that are predicted to have catastrophic consequences on the Region’s ecosystem. |
| **Trend** | |
| Trend since 2009: Increased, Stable, Decreased, No consistent trend  Future trend: Increasing, Stable, Decreasing, No consistent trend | |
| **Confidence in impact and trend** | |
| **Adequate** | Adequate high-quality evidence and high level of consensus |
| **Limited** | Limited evidence or limited consensus |
| **Inferred** | Inferred, very limited evidence |

### Risks to heritage values

**Outlook Report 2009:** *Not assessed*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Assessment component** | **Assessment summary** | **Risk 2009** | **Risk 2014** | **Future trend** | **Confidence** | |
| **Grade** | **Trend** |
| **Climate change** | The threats to the ecosystem associated with climate change flow on to present a serious risk to heritage values, particularly the property’s Outstanding Universal Value. Some shallow-water Indigenous and historic heritage sites are also at risk. | Not assessed | Very high | Increasing | Limited | Limited |
| **Coastal development** | Legacy and contemporary changes in terrestrial habitats as a result of coastal development will continue to affect the Outstanding Universal Value in forthcoming decades and the integrity of the world heritage property. Natural scenic values may also be further diminished, along with Indigenous heritage values. | Not assessed | High | Increasing | Limited | Limited |
| **Land-based run-off** | The widespread effects of pollutants (including marine debris) in land-based run-off will continue to diminish many attributes of Outstanding Universal Value, especially in inshore areas. Resulting declines in ecosystem values will affect related Indigenous heritage values and the overall aesthetic value of wide areas of the Region. | Not assessed | High | Decreasing | Limited | Limited |
| **Direct use** | The risks that direct use presents to the ecosystem are reflected in its risk to heritage values. In addition, if heritage values are not properly identified and considered, there is a risk that activities could damage (potentially irreversibly) heritage sites, reduce natural beauty, and affect the ability of Traditional Owners to undertake cultural practices. Of particular concern are effects on Indigenous heritage values from incompatible uses. | Not assessed | Medium | Increasing | Limited | Limited |
| **Overall risk to heritage values** | The close connections between the Region’s ecosystem and many of its heritage values mean that the projected risk of almost all threats is the same in both assessments. As a result, the most serious risks to the Region’s heritage values are similarly climate change, land-based run-off, coastal development and some aspects of direct use. | **Not assessed** | **High** | **Increasing** |

|  |  |
| --- | --- |
| **Risk** | |
| **Low risk** | Given current management arrangements, any threats considered likely or certain to occur are predicted to have no more than insignificant consequences for the Region’s heritage values. There may be minor or moderate consequences for heritage values for other less likely threats. |
| **Medium risk** | Given current management arrangements, few of the threats considered likely or certain to occur are predicted to have moderate consequences for the Region's heritage values and none will have catastrophic consequences. Some unlikely threats may have major consequences for the Region's heritage values. |
| **High risk** | Given current management arrangements, many of the likely or almost certain threats are predicted to have moderate or major consequences for the Region's heritage values. |
| **Very high risk** | Given current management arrangements, there are likely or almost certain threats that are predicted to have catastrophic consequences on the Region’s heritage values. |
| **Trend** | |
| Trend since 2009: New assessment for this report; no trend provided  Future trend: Increasing, Stable, Decreasing, No consistent trend | |
| **Confidence in impact and trend** | |
| **Adequate** | Adequate high-quality evidence and high level of consensus |
| **Limited** | Limited evidence or limited consensus |
| **Inferred** | Inferred, very limited evidence |

### Overall summary of risks to the Region’s values

Based on current management, the Great Barrier Reef Region’s ecosystem and heritage values face a range of increasing risks into the future. The close connections between ecosystem components and heritage values mean the projected risk for many impacts is equivalent for both sets of values. The identified threats to the Region’s values arise from a number of sources and are highly variable in both scale and timeframe. A lack of understanding of the extent and location of many heritage values (for example wrecks and archaeological sites) means that the risks to them may be underestimated.

Views expressed by community members about the greatest risks to the Region are similar to the outcomes of the structured risk assessment, with climate change, land-based run-off, shipping, port development, fishing, marine debris and pollution common responses. This represents an increase in community concern about some threats since Outlook Report 2009 (for example marine debris, shipping and port development).

The greatest long-term threats facing the Great Barrier Reef ecosystem are from climate change. For all the Region’s values, threats associated with rising levels of greenhouse gases in the atmosphere such as ocean acidification, increased sea temperatures and rising sea level are likely to become more severe into the future. Therefore, these threats pose an increasing risk to the Region’s values. Their impact will be compounded by each other and by other existing regional and local threats.

Generally, increases in assessed risk since the Outlook Report 2009 have resulted from an increased understanding of the threat, its distribution and the likely severity of its consequences. Only the risk of pesticides from land-based runoff has decreased based on new information, from very high to high.

Management arrangements are reducing some lower risk threats; examples include the continued strong management of direct uses such as commercial marine tourism and improvements in the management of shipping activities in the Region. The planning, inputs and processes associated with managing land-based run-off have improved and over time risk is expected to decrease somewhat as a result.

Other activities, in particular coastal development and the remaining impacts of fishing, are still assessed as high risk and desired management outcomes are not being achieved.

The most serious threats are from climate change, land-based run-off, coastal development and some aspects of direct use such as illegal fishing and poaching and the incidental take of species of conservation concern. These threats have the potential to work in combination to weaken the resilience of the Great Barrier Reef ecosystem and therefore its ability to recover from serious disturbances (such as major coral bleaching events) that will become more frequent in the future. An increased understanding of the cumulative effects of threats has highlighted the need for a management approach that takes into account all threats affecting an area and for a combination of Reef-wide, regional and local solutions.

While climate change will affect all parts of the Great Barrier Reef, the compounding effects of other threats means that inshore environments next to developed areas are most at risk.

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