

Findings from an Independent Evaluation of the Queensland Estuarine Crocodile Management Program

Office of the **Queensland Chief Scientist**



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Executive summary

The Department of Environment and Science (the Department) has a long-established program for the management of estuarine crocodiles in Queensland. This program is currently delivered in accordance with the Queensland Crocodile Management Plan, which is available on the Department's website. In 2020, the Department finalised a three-year scientific monitoring program to assess estuarine crocodile populations in Queensland and trends across the species' range. The Queensland Estuarine Crocodile Monitoring Program 2016-2019 Key Findings Report, which is also available on the Department's website, summarises the results of the monitoring program.

In May 2021, the Department asked Queensland Chief Scientist Professor Hugh Possingham to chair a multi-disciplinary, independent expert committee to evaluate the effectiveness of the Department's crocodile management, science, and community education programs, based on consideration of the results of the monitoring program. The voluntary Crocodile Management Independent Expert Evaluation Committee (the Committee) conducted a thorough evaluation between May and September 2021. The evaluation covered the three components of the Department's crocodile management program, which are described in the Queensland Crocodile Management Plan:

- 1) Responding to crocodile sighting reports and removing problem animals.
- 2) Enhancing the *Be Crocwise* community safety education and engagement.
- 3) Undertaking research and monitoring to ensure the department's crocodile management program is informed by the most up-to-date scientific data and findings.

The Committee was very impressed by the professionalism and dedication of the Departmental staff who are involved in the implementation of the Department's Queensland Crocodile Management Plan. The Department's approach to crocodile management in Queensland is pragmatic, robust and fit for purpose. The Department should be very proud of the way the 2016-2019 crocodile monitoring program was conducted, the subsequent preparation of the excellent Estuarine Crocodile Population Monitoring in Queensland (1979-2019) Technical Report, and of the analytical work that followed. These achievements, along with the Department's innovative and practical scientific research program, are world-class. One Committee member noted significant improvements since an earlier review of the Department's crocodile management program, and observed that great credit is due the well qualified, dedicated, and close-knit operational team and its enlightened management, and to the Department for providing support.

To further strengthen the Department's approach, the Committee has identified some improvements the Department could make to the Queensland Crocodile Management Plan, and as such has made eight recommendations for the Department to consider. For example, the Committee recommends the Department establish and publicise clear, structured processes regarding amendments to the Queensland Crocodile Management Plan, including a regular evaluation process, as well as an inclusive and documented system allowing any community group or individual to request modifications to, or minor reviews of the plan, especially regarding the boundaries and locations of the six types of crocodile management zones.

The Committee also recommends that in consultation with stakeholders, the Department consider annual removal of a modest number of crocodiles 2.4 metres or more in length on the populated east coast for several years, in addition to the average number of problem crocodiles currently removed. The number of crocodiles taken each year should be based on population modelling. This trial, to constrain population growth and reduce overall numbers locally, is a form of adaptive management that could deliver improved human safety outcomes and new knowledge.

The Committee notes there are many ongoing challenges to implementing the *Be Crocwise* communication program, and that despite this, the Department is taking a responsible and proactive approach to spreading Crocwise messages and keeping Queenslanders safe. The Committee's most important of nine recommendations regarding the *Be Crocwise* program is for the Department to allocate funding to:

- develop a Crocwise strategy;
- conduct an evaluation of the program; and
- establish new and dedicated Crocwise positions.

The Committee has made five recommendations regarding research and monitoring, including that the Department develop and initiate a funded 'cycling' crocodile monitoring program comprising surveys in a subset of chosen areas within 'croc country' (i.e., Queensland waterways north of the Boyne River) every year so that, collectively, every area is counted with a frequency of no less than, for example, once every five years. The Committee found the science behind the Departments' crocodile monitoring program to be highly credible, and the Committee fully support the methods used to conduct the crocodile surveys during the 2016 – 2019 monitoring program. The Committee has recommended a range of practical actions to increase the public's confidence in the science behind the crocodile monitoring program.

1. Evaluation Background

1.1 Context

The Queensland Government must balance two competing responsibilities regarding its management of estuarine crocodiles: supporting the long-term conservation of wild populations of crocodiles within their normal range, and reducing risks to public safety¹. The Department of Environment and Science's (the Department) long-established program for the management of estuarine crocodiles is currently delivered in accordance with the Queensland Government's Queensland Crocodile Management Plan (the Management Plan) (Appendix 1). Refer to section 2 for an overview of the Management Plan.

While long-term evidence suggests that crocodile attacks remain very rare events in Queensland, four attacks by the end of September in the 2021 calendar year² (one fatal and three non-fatal) have heightened community concern around the risks that crocodiles pose for public safety. Additionally, the Department recently completed a three-year (2016 – 2019) survey of estuarine crocodiles in Queensland. Subsequently, the Department undertook a substantial analysis of its results, combined with all valid data available from monitoring programs dating back to 1979, as detailed in the Estuarine Crocodile Population Monitoring in Queensland 1979 – 2019 Technical Report (Technical Report). Some of the conclusions from the most recent survey and the analysis of long-term data are summarised in the [Queensland Estuarine Crocodile Monitoring Program 2016-2019 Key Findings Report](#) (Appendix 2), published in July 2021, including the size of Queensland's crocodile population and regional population trends.

These events, and an updated knowledge base, provide an opportunity to evaluate the effectiveness of the Department’s crocodile management, science and community education programs and how they might be improved. The Crocodile Management Independent Expert Evaluation Committee (the Committee) was established to conduct the evaluation. The Terms of Reference for the Committee state that the evaluation would consider the effectiveness of the three core elements of the program:

1. responding to crocodile sighting reports and removing problem animals (actions largely mandated in the Management Plan);
2. enhancing community Crocwise safety education and engagement (via the *Be Crocwise* program); and
3. undertaking applied research (including population monitoring) to ensure the crocodile management program is informed by the most up-to-date scientific data and findings.

The Committee was not asked to provide advice on the management of specific crocodiles or specific locations.

1.2 Evaluation process

1.2.1 Crocodile Management Independent Expert Evaluation Committee

The Committee was convened in May 2021 to investigate several key questions regarding the Department’s approach to crocodile management, which included:

- Is the current management approach effective and adequate for ensuring public safety?
- How effective are the current management zone arrangements within the Management Plan, and is there scope for improvements to be made to these arrangements, particularly considering the results from the Estuarine Crocodile Monitoring Program?
- Does the current *Be Crocwise* community education program require enhancement?
- Overall, what is working well and what is not?

The Committee included members with expertise in human and wildlife behaviour, crocodile ecology, social science, and Indigenous knowledge (Table 1).

Table 1: Committee members, their affiliation(s) and relevant expertise

Name	Affiliation and area of expertise
Professor Hugh Possingham (Chair)	Queensland Chief Scientist and University of Queensland; population modelling, decision science and conservation
Emeritus Professor Gordon Grigg	University of Queensland; crocodile biology
Mr Regan Hart	First Nations environmental knowledge and environmental management
Professor Michael Bode	Queensland University of Technology; quantitative environmental decision making
Associate Professor Kyra Hamilton	Griffith University; health psychology and behavioural medicine
Dr Sally Driml	University of Queensland; ecotourism and natural areas management
Dr Duan Biggs	Griffith University; behaviour/education for human/wildlife interaction

1.2.2 Evaluation process

The independent evaluation process was chaired by the Queensland Chief Scientist, Professor Hugh Possingham, and was supported by the Office of the Queensland Chief Scientist. Following the establishment of the Committee, six meetings were held which facilitated discussions, presentations, site visits, and information sharing and analysis. In addition, all Committee members were invited to attend the 2021 Crocodile Roundtable meeting in Cairns on 29 July 2021. Refer to Appendix 3 for a list of Crocodile Roundtable members. Throughout the evaluation, the Committee was supported by Acting Program Coordinator Jane Graham who helped undertake research, prepared meeting papers and presentation materials, engaged with wildlife officers and rangers, coordinated preparation of the draft and final report, and acted as an impartial conduit between the Department and the Office of the Queensland Chief Scientist.

Throughout the evaluation process, Committee members' deliberations and consultations with stakeholders were hampered by several issues, including:

- the rescheduling of several key meetings at short notice due to factors outside of the Department's control, occasionally with no explanation provided to the Committee;
- the significantly delayed release of the [Queensland Estuarine Crocodile Monitoring Program 2016-2019 Key Findings Report](#) (Key Findings Report) on 29 July 2021; and
- the pending public release of the Estuarine Crocodile Population Monitoring in Queensland (1979 – 2019) Technical Report (Technical Report); e.g., many of the questions addressed to the Department at the 2021 Crocodile Roundtable were granular, focussing on specific rivers and crocodiles in those areas. If the Technical Report had been released prior to the meeting, those questions would not have been asked, enabling more time for higher-level discussions.

As neither the Technical Report nor the Key Findings Report were available to Crocodile Roundtable members prior to or during the 29 July 2021 meeting, they were offered the opportunity to speak one-on-one with the Chair or another Committee member, which resulted in five online meetings being held from 11-17 August 2021 (Appendix 4). This feedback was considered by all Committee members during their preparation of the insights, findings and 22 recommendations included in this report.

During the later stages of the evaluation, the Committee Chair received two requests to consider issues not covered by the Committee's Terms of Reference. The first issue was in relation to making waterways in the vicinity of Tully Heads an Active Removal Zone under the Management Plan, and the second was to consider the adequacy of arrangements during surf lifesaving carnivals. These issues were deemed out of scope of the evaluation by the Committee Chair and were not considered further by the Committee.

1.2.3 Key dates

- 25 May 2021 - Initial Evaluation Committee meeting (Brisbane).
- 4 June 2021 - Meeting with the Dawul Wuru Aboriginal Corporation, presentations by the Northern Wildlife Operations team to the Committee and site visits (Cairns).
- 21 June - Evaluation Committee meeting (online).
- 5 July 2021 - Evaluation Committee meeting (online).
- 22 July 2021 - Evaluation Committee meeting (online).
- 29 July 2021 - Crocodile Roundtable meeting (Cairns).
- 30 July - Public release of the Key Findings Report.
- 9 August 2021 - Evaluation Committee meeting (online).
- 11 August 2021 - 17 August 2021 - Individual/small group meetings between Committee member/s and Crocodile Round Table members.
- Pending - Public release of the Estuarine Crocodile Population Monitoring in Queensland (1979-2019) Technical Report.

1.2.4 Acknowledgements

The Committee acknowledges the invaluable input from many individuals and organisations during the evaluation process. The Wildlife and Threatened Species Operations team within the Queensland Parks and Wildlife Service and Partnerships division of the Department was incredibly valuable in understanding current actions, people and crocodile behaviour and the associated management challenges. The Committee appreciates the insights shared by members of the Dawul Wuru Aboriginal Corporation during the 4 June 2021 meeting, and the information shared by members of the Crocodile Roundtable during and after the 29 July 2021 meeting.

The Committee extends a special thanks to the following Departmental personnel from the Wildlife and Threatened Species Operations branch for sharing their insights, knowledge, and experience, throughout the Committee's evaluation process:

- Ms Kirstin Kenyon, Executive Director and Mr Lindsay Delzoppo, Director.
- Managers Mr Michael Joyce, Mr Frank Mills and Mr Andrew Mullens.
- Dr Matthew Brien, Program Coordinator and Dr Laurence Taplin, Scientific Advisor.
- Senior Wildlife Officers Mr Paul Beri, Ms Dayna Adams, Mr Simon Booth, Ms Jane Burns, Mr Steve Coulson, Mr Tony Frisby and Ms Dinouk Perera.
- Wildlife Officers Miss Corinna Browne and Mx Ren Bone.
- Mr Stephen Mastromonaco, Project Officer.

2. Evaluation input data and the Committees' insights and findings

The Committee was provided with a large amount of qualitative and quantitative data during the evaluation period, including, but not limited to, information regarding:

- The Queensland Crocodile Management Plan (Section 2.1 and Appendix 1).
- The 'Be Crocwise' program (Section 2.2).
- The estuarine crocodile monitoring program and applied research (Section 2.3).
- Stakeholder feedback on the Department's crocodile management program (Appendix 4).
- Media (including social media) articles (Appendix 5).

Refer to Appendix 6 for the complete list of documents provided to the Committee.

The Committee's recommendations, based on their insights and findings regarding the evaluation input data as detailed in Section 2, are available in Section 3 of this report.

2.1 Queensland Crocodile Management Plan

2.1.1 Overview of Queensland Crocodile Management Plan

The Queensland Crocodile Management Plan, published in 2017, provides the overarching framework for the state-wide management of public safety risks associated with estuarine crocodiles. Under the Management Plan, the Queensland Government's approach to the management of estuarine crocodiles is based on crocodile management zones. Different parts of the state are located within one of six crocodile management zones, labelled A-F. A zone is determined by the overall risk to public safety. For example, zone B is an 'active removal zone' in which the risk of human-crocodile interaction is considered as high. The management response in this zone is to patrol and remove any crocodiles detected, with the objective of significantly reducing the number of crocodiles near large urban areas, with a particular focus on large crocodiles. A large crocodile is defined as one being 2 metres or more in length¹. Development of the Management Plan included extensive stakeholder input, and the Management Plan includes provision for the Chief Executive to make amendments to crocodile zone maps to enable for local changes to the zone types or extent.

When the Management Plan was developed in 2017, the Department did not have sufficient crocodile population data to apply a scientifically informed approach, as the 2016 – 2019 monitoring program was still underway at that time. The Department's current crocodile management program was originally developed to focus management efforts in and around urban centres along the populated east coast where the majority of historical human-crocodile conflict occurred. It was further revised and updated in 2018 based on stakeholder feedback from local governments.

Risk minimisation strategies

Sometimes crocodiles learn habits and behaviours that put them in closer proximity to humans. For example, if humans leave fish scraps at boat ramps, crocodiles in the area are likely to learn very quickly that if they spend time around boat ramps, they are highly likely to find an easily accessible food source there. In addition to the risk posed by encountering crocodiles in their habitat by chance (i.e., a human and crocodile being in the same place at the same time due to a human swimming in croc country), a crocodile displaying dangerous behaviour can pose a significant risk to public safety as once a crocodile has learned a particular behaviour, the same behaviour is likely to be repeated, and therefore the crocodile presents a much higher threat or potential threat to human safety and wellbeing than it did before it learnt the behaviour.

However, the risk of crocodile attack can be minimised. In Queensland the three key strategies to significantly minimise the risks posed by crocodiles, as explained in the Management Plan, are:

1. The selective and targeted removal, by the Department (and other authorised entities), of crocodiles assessed being 'problem crocodiles', as defined below, that pose the greatest risk to public safety.
2. Installation of recent crocodile sighting warning signs by the Department.
3. Community members taking personal responsibility for their safety, including learning crocwise behaviour (refer to section 2.2.1 of this report for information on the *Be Crocwise* program); the Department puts significant effort into the *Be Crocwise* program.

Removal of problem crocodiles

The Nature Conservation (Estuarine Crocodile) Conservation Plan 2018³ (Conservation Plan) outlines the circumstances under which a crocodile may be considered a problem crocodile and therefore targeted for removal from the wild. Removed crocodiles are generally re-homed in zoos or farms or are humanely euthanised. The Department only undertakes euthanasia of problem crocodiles in limited circumstances, typically in very remote locations (e.g., Cape York Peninsula) where transporting a crocodile to a zoo or farm would result in significant animal welfare concerns due to physiological stress, or where logistical constraints render euthanasia the only safe method of removal from the wild.

The process for determining that a crocodile is a problem crocodile is set out in Section 5 of the Conservation Plan³ and summarised on page eight of the Management Plan (Appendix 1). These circumstances include where:

- A. the crocodile has attacked, is about to attack, or is behaving aggressively towards, a person
- B. the nature of the crocodile's location or behaviour makes the crocodile a threat, or a potential threat, to the safety or wellbeing of humans
- C. a crocodile has passed over, through or under a crocodile prevention barrier on land, on which aquaculture fisheries resources, stock, or a working dog normally lives and is likely to become, a danger to the resources, stock or dog.

Over time, crocodile farms and zoos have become less willing, or have experienced reduced capacity, to accept captured problem crocodiles from the Department. Currently there are three crocodile farms across central and northern Queensland accepting crocodiles for rehoming for educational purposes. A small number of other farms and zoos only take crocodiles from the Department on a sporadic basis, and often they will only take icon crocodiles. An icon crocodile is a problem crocodile that is either four metres or more in length, or has unusual characteristics that distinguish it from other estuarine crocodiles¹.

QWildlife Crocodile sightings reporting

The Department operates a public *Crocwatch* reporting service, whereby members of the public are encouraged to report crocodile sightings using a 1300 telephone number, or through the Department's QWildlife App and web-based platform. The Department investigates all crocodile sighting reports received. The platform has a [publicly facing page](#) which allows anyone to check reported sightings from the previous 30 days.

Funding

The Committee was advised that during the 2021-22 budget process the Queensland Government gave a commitment to provide ongoing funding of \$3 million per year for estuarine crocodile management. The Committee was told that this is the first time such funding had been committed on an ongoing basis, and that previous funding allocations had been for periods of two to four years. This funding will enable the Department to employ and retain 18 specialist crocodile management wildlife officers in regional Queensland, from

Rockhampton to Cairns, to respond to crocodile sightings and manage problem crocodiles, conduct community Crocwise education, and undertake applied research.

2.1.2 Committees' insights and findings regarding the Queensland Crocodile Management Program

Review of the Management Plan

The Technical Report does not indicate substantial recent changes in crocodile abundance and hence an immediate review of the Management Plan is not required. As stated in the Technical Report, the abundance of crocodiles in Queensland is increasing very slowly (two percent per year on average across croc country) and the spatial extent of estuarine crocodiles in Queensland has not significantly increased⁴. The Committee fully supports the methodology used to carry out the 2016-2019 crocodile surveys, as explained in the Technical Report and to the Committee through face-to-face presentations by the authors of the Technical Report. The Committee agrees that the findings as set out in the Technical Report, and summarised in the Key Findings Report, are highly credible.

However, the Committee also agrees there are several areas for improvement in relation to the Management Plan. The current risk management strategy was designed to reduce the number of attacks across the Queensland population. However, the Management Plan does not clearly explain the difference in the risk of attack to the human population in a certain crocodile management zone vs the risk to an individual in that same zone. For example, an individual living in a community with a low human population may statistically be at a higher risk of crocodile attack than an individual living in a more populated area, even though, under the Management Plan, the former may be in a 'lower' risk zone.

The Committee also notes:

1. There is no review process included in the Management Plan, for either the locations and boundaries of management zones included in the plan, or for the Management Plan itself.
2. There is no documented system for stakeholders to suggest or request changes to Queensland's crocodile management zones.

Crocodile attack predictions

Over time, if the reach and effectiveness of the *Be Crocwise* education campaign is not enhanced, crocodile attacks are likely to increase simply because, with the increase in human populations, the number of people in dangerous places is highly likely to increase, even if crocodile numbers stabilise. The rates of crocodile attack will never fall to zero while there are places where people and crocodiles co-inhabit. Queensland residents and visitors need to learn, understand, and remember that the only place that people can swim in croc country and remain completely safe from the risk of attack by a crocodile is a swimming pool, regardless of the time of year.

Strategic, scientifically informed crocodile removal

Up until now, the number of estuarine crocodiles removed each year in Queensland has been dictated largely by the number of crocodiles declared to be 'problem crocodiles' (either following a sighting or an attack) and targeted for removal. Modelling based on the long-term survey data provided in the Technical Report now offers an opportunity for the Department to consider scientifically informed crocodile management options. For example, if there is a desire to contain and perhaps reduce the small but presumably continuing increase in the crocodile population within the Queensland populated east coast, in order to reduce the risk of human-crocodile conflict or rate of fatal attacks, modelling can be used to identify an annual offtake target in terms of both the number and size range of animals to be removed.

The removal of approximately 50 problem crocodiles (averaging over two metres in length) per year along the populated east coast over the past ten years, as part of the Department's crocodile management program, has quite likely been responsible for a reduction in the average size of crocodiles in this region. Given that crocodiles of 2.0 metres or more in length are known to pose a greater threat to humans, this size reduction is likely to have reduced the overall threat of crocodiles to public safety. The analysis in the Technical Report provides an opportunity for the Department to move from a largely reactive program to strategic, scientifically informed active management. Refer to Section 2.3.2 for the Committee's detailed insights regarding scientifically informed, adaptive crocodile management.

Crocodile re-homing needs

Over the next ten years, if current removal rates are maintained, the Committee notes that it is likely approximately 500 crocodiles will need to be removed from the wild and re-homed. If and when crocodile farms and zoos are no longer willing to accept captured problem crocodiles from the Department, the Department will need to euthanise higher numbers of crocodiles upon capture or consider legislative changes to allow zoos and farms to use re-homed crocodiles for a wider range of purposes than is currently allowed under the Wildlife Trade Management Plan - Queensland Crocodile Farming 1 January 2018 - 31 December 2022⁵. Another option may be to provide financial compensation and/or in-kind support to zoos and farms that take crocodiles from the Department.

Egg harvesting

Consideration of egg harvesting is not within the Terms of Reference for the Committee. However, the view that it can and should be used to control crocodile numbers is still held by some members of the community, as the Committee heard during meetings with Crocodile Roundtable members (Appendix 4).

The Nature Conservation (Estuarine Crocodile) Conservation Plan 2018 includes provisions to authorise an individual or corporation to harvest estuarine crocodile eggs under a commercial wildlife harvesting licence, subject to certain conditions being met³. However, it is unlikely to be commercially viable at any substantial scale in Queensland because of the distribution and relatively low density of nests, the long distances involved, and the costs associated with locating nests, egg collection and transport. One exception is that crocodile egg harvesting continues within the Aboriginal Shire of Pormpuraaw, on Cape York Peninsula, but the situation there is unique because of its location on rivers where eggs can be collected relatively easily and comparatively inexpensively, and the permit holder's access to a crocodile farm nearby.

Apart from these constraining practical considerations, work in the Northern Territory has shown that a significant reduction in crocodile numbers cannot be achieved by a commercial harvest of their eggs⁶. Egg collection in the Northern Territory is focussed where nests are clustered in large wetland areas, and harvesting has been practiced commercially for many years, but a recent study shows that egg harvesting would not be a practical approach to reducing crocodile numbers because it has such a small effect on the population⁶.

Culling

Some members of the community advocate large-scale crocodile culling to reduce the risk of crocodile attacks on humans. The Committee suspects this view is driven by positive memories of the freedom older Northern Queensland residents had in their youth, of being able to swim practically anywhere without any concern about crocodile attacks. Those 1970s and 1980s freedoms were not, however, the 'crocodile normal' situation for North Queensland but the result of approximately thirty years of intense commercial hunting after World War 2 and before protection in 1976. Many thousands of medium-to-large crocodiles were shot during that time, and the population was reduced to the extent that harvesting wild crocodiles for their skins was much less commercially viable (in those days, wild-caught

skins still had significant commercial value, before better-quality, less-marked skins were produced by closed-cycle crocodile farming).

Culling crocodiles down to 1970s-1980s levels again would be unacceptable to much of the community (both domestic and international) and also to the tourism industry which profits from tourists being able to observe crocodiles in the wild. Such extensive culling would also be prohibitively expensive and could give the community a false sense of security. There were far fewer people, distributed over a smaller geographic area, in North Queensland in the 1970s and 1980s. Even if crocodile numbers were reduced to the extent that people could feel safe in and around waterways, as in the 'old' days, culling would need to be maintained on an ongoing basis. Otherwise, within another thirty or so years, their numbers would again be approaching the 'crocodile normal' situation for Northern Queensland (i.e., close to current numbers).

Wild harvesting

Commercial harvesting of wild crocodiles for their skins was suggested at the 2021 Crocodile Roundtable meeting and during Committee interviews with stakeholders as a mechanism to reduce risk by making crocodiles less numerous in Queensland. Wild harvesting as a population control option was also mentioned in recent media. However, harvesting wild skins is no longer commercially viable. The imperfections that crocodiles living in the wild accrue naturally on their skins (for example, cuts and bite marks) compromise the commercial value of the skin to the point where they have no value, due to strict international skin grading standards, particularly in comparison to the skins harvested from farmed crocodiles. Any attempt to use commercial wild harvesting of crocodiles to reduce the risk of crocodile attacks would be ineffective.

Synergies with management of other species

The Committee notes there are some common principles around managing public perception and human behaviour change that apply to various native wildlife species present in Queensland such as Wongari, magpies, and cassowaries, as well as crocodiles. These synergies mean there are opportunities to manage these behaviour change programs in a more efficient and coordinated way. The Department could establish a wildlife management stakeholder and expert committee, which could:

- include mechanisms for the involvement of diverse stakeholder groups;
- provide structured opportunities for stakeholders and experts to provide input into decision making processes regarding crocodile management in Queensland;
- establish a process to determine and communicate the best available evidence and science to inform decision making;
- develop a mechanism and process facilitated discussion in situations which become highly polarised (e.g., where there is conflict between stakeholders that have strongly opposing positions on lethal management);
- provide an avenue to respond to incorrect media information, including that circulating on social media; and
- be used to consider options for the management of stakeholder conflict, public safety issues, and concerns related to other Queensland species such as magpies, cassowaries, Wongari, etc.

2.2 The Be Crocwise community education program

2.2.1 Overview of the Be Crocwise program

The *Be Crocwise* program is an important public safety component of the Queensland Government's strategy for managing the risk of crocodile attacks. It is delivered by the Department's Wildlife and Threatened Species Operations Branch of the Queensland Parks and Wildlife Service and Partnerships division. *Be Crocwise* aims to equip locals and visitors with knowledge to help them reduce their risk of crocodile attack, foster self-responsibility, and change the way people behave when entering crocodile habitat in croc country. The Management Plan (Appendix 1) contains key Crocwise information and appropriate Crocwise behaviours for each crocodile management zone.

2.2.2 Committee's insights and findings regarding the Be Crocwise program

From the Committee's perspective, Queensland Parks and Wildlife Service and Partnerships is taking a responsible and proactive approach to direct and indirect communication to spread Crocwise messages. The Committee agrees that public education is an important component of the Department's crocodile management program. Crocwise messages are promoted by all wildlife officers across Northern and Southern Wildlife Operations and by broader Queensland Parks and Wildlife Service and Partnerships staff on protected areas and other land tenures, which is commendable.

The Committee notes there are many ongoing challenges to implementing the *Be Crocwise* program, one of which is influencing the behaviour of particular demographic groups. For example, out of the 47 people who were attacked by a crocodile in Queensland between 1975 and August 2021, 28 (59%) were local residents². The 28 local residents were all male, and 78% of all crocodile attack victims in Queensland between 1975 and August 2021 were also male².

Another challenge for the *Be Crocwise* program is the existence of publicly available, non-government advice regarding crocodile safety, some of which does not align with the Queensland Government's Crocwise messaging. The Committee agrees that some of these messages, particularly those from private tourism operators, are highly likely to lead to confusion about the risks of undertaking aquatic activities in croc country. For example, a popular island resort's website states 'you can swim, snorkel and dive in safety off our iconic coral beaches' and does not provide any advice regarding the possible presence of crocodiles, even though the island is in croc country. There are no specific Crocwise strategies focussed on tourists, including the increasing number of people travelling to more remote areas (without tour operators). However, anecdotal evidence from Wildlife Officers dealing with the public suggest that historically tourists tend to be more sensible about reading and obeying signs than locals.

Other challenges for the *Be Crocwise* program include:

- Maintaining awareness, interest and commitment by locals and key stakeholder groups and preventing complacency.
- Correcting 'urban myths' i.e., stories of crocodiles in areas where there have been no reported or recent sightings.
- Maintaining collaborations with key groups to ensure appropriate and culturally specific messaging.
- Utilising experts in behaviour change to inform approaches.
- Difficulty in engaging some parts of the tourism industry and misinformation contained in some tourism literature.
- There will be increasing remote area tourism within a couple of years, which will be exacerbated with the planned sealing of the Peninsula Development Road in Cape York Peninsula.

- Theft of Crocwise signs.
- Demonstrating that Crocwise communication tools and strategies influence the behaviour of individuals in croc country, or on the number of attacks.
- Demonstrating that the current strategy of narrow-casting tailored communication tools to different communities is effective.
- Establishing, implementing, and maintaining an effective evaluation strategy for Crocwise.
- Allocating dedicated funding, resources, and personnel to Crocwise.
- Media outlets (including social media) distributing messages that are contradictory to Crocwise messages.

Regarding negative and opinionated media (including social media) as described in Appendix 5, the Committee agrees that it can be very challenging to predict how information provided to the public will be interpreted and used. Building and maintaining positive working relationships with a range of stakeholders, and proactive engagement via social media channels is extremely important. The Crocodile Roundtable stakeholder committee established for the program is an important mechanism to facilitate this. Providing regular communication products to local government and local politicians, libraries etc., with short, simple and clear Frequently Asked Questions factsheets is vital.

Multiple previous reviews of the *Be Crocwise* program, over decades, have recommended that the program be subject to better monitoring and evaluation of its effectiveness⁷. This includes pre-evaluation of communication tools, and impact-evaluation programs for measuring behaviour change in croc country. Nonetheless, these elements are currently not coordinated, as evidenced by the most recent Crocwise communication plan. Additionally, there is no clear social science research program, working with behaviour change experts, for testing messaging of behavioural campaigns and any changes proposed. The Department has also not partnered with universities to progress a research agenda in this context of behaviour change messaging and campaigns.

An understanding of changes in individuals' perceptions towards crocodiles, tolerance of crocodiles, behaviours in croc country and how these influence crocodile attack numbers is key to measuring the success of the *Be Crocwise* program. There is currently no social science expertise in the team to undertake such work. Much of the current approach to Crocwise messaging is based on targeting the personas identified in the Public Service Commission report on human-crocodile interactions, which the Department commissioned to get advice in this area⁸.

While current efforts are commended, they are hampered by three key issues. First, a lack of dedicated resources and personnel to the Crocwise program; second, the lack of a clear, theory-based strategy for Crocwise, and third, the lack of evaluation of program effectiveness that builds on the theories of change. The Crocwise team is aware of these issues, and the Committee recognises most of this work is beyond the capacity of the current small team.

2.3 Monitoring and research

2.3.1 Overview of the Department's monitoring program

From 2016 to 2019, the Department conducted a comprehensive monitoring program of the estuarine crocodile population, involving multiple surveys across its range in Queensland. This was the first comprehensive state-wide crocodile monitoring undertaken since 1989. During 2020, the Department compiled and analysed data collected through this program and compared these to historic data to assess how the population had changed in size, distribution, density, and size class structure over time, using results collected from as far back as 1979. The most comprehensive surveys were those carried out in the mid-1980s by Dr Laurence Taplin. The department worked with Dr Taplin to develop the design of the 2016-2019 monitoring program. This consistency in survey methods, particularly between the two most comprehensive surveys, enables the Department to have a high level of confidence in the reported population trends for most rivers and in the overall trend over the last 33 or so years. These data and analyses are fully described in the Estuarine Crocodile Population Monitoring in Queensland (1979-2019) Technical Report, which, as of 30 September 2021, has not yet been publicly released.

The Committee received a detailed briefing from the team which designed and conducted the monitoring program and wrote the Technical Report, and had the opportunity to ask questions and discuss issues with the team. The Committee also had the opportunity to read the Technical Report.

Facts from Technical Report as summarised in the Key Findings Report⁹

- The size of the estuarine crocodile population in Queensland is currently estimated at 20,000–30,000 non-hatchlings.
- Densities differ greatly within Queensland's croc country; the number and density of crocodiles are highest in northern Cape York Peninsula (3.0 non-hatchling crocodiles per km of stream) and decline southward, with 1.2 per km in the Gulf of Carpentaria and the Cairns region, down to 0.2 per km in the Fitzroy River, Rockhampton. One outlier in the data is the Proserpine River which has a density of 5.5 crocodiles per km, for reasons that are yet to be fully understood.
- There has been an increase in the crocodile population over time (about two percent per year on average across croc country), but there is no evidence of a 'large increase' now or into the future. The removal of more than 450 breeding-sized males and females since 2004 has reduced that rate of increase where the human population is highest, and the number of large crocodiles there may have stabilised, if not declined.
- Estimated doubling times for crocodile numbers in Queensland range from 36 years on Cape York Peninsula, along the Gulf of Carpentaria and in the Cairns region, to up to 100 years in the Fitzroy River, Rockhampton.
- The spatial extent of crocodiles in Queensland has not changed significantly over time, and there is no evidence of a southward expansion of their range.

Further details are available in the Key Findings Report (Appendix 2).

2.3.2 Overview of current research initiatives

The Department has been undertaking applied research, utilising innovative technology to improve management practices to further reduce the risks to public safety. These are described below.

Detect, alert and deter

The Department is currently researching and developing technology that can automatically detect, alert, and deter/attract crocodiles using multi-beam sonar technology and deep learning recognition software. This technology may provide a potentially valuable management tool for detecting and managing saltwater crocodiles in areas frequented by people where there is a high chance of a negative interactions (e.g., beaches, boat ramps, upper freshwater areas) in real time.

The Department has successfully completed and published the first phase of the project as a scientific paper¹⁰. This paper details the successful use of digital video surveillance systems (above water) and multi-beam sonar (underwater) to detect and monitor saltwater crocodiles in a semi-natural freshwater environment.

Population relatedness and connectivity, and movement patterns

The Department is collaborating with CSIRO along with the Northern Territory and Western Australia to trial new techniques in DNA analysis (Close-Kin Mark-Recapture) to advance the Department's understanding of crocodile dispersal and movement patterns in Queensland (and between the Northern Territory and Papua New Guinea). A better understanding of the nature of source-sink populations in Queensland will directly assist management. For example, despite active removal of all crocodiles in Cairns, crocodiles continue to repopulate the area. Knowing where they are coming from would enable the Department to consider the 'source' areas as targets for proactive management.

Capture techniques

Capturing crocodiles is time-consuming and expensive. Over the last eight years the Department has expanded its range of capture techniques to include all known techniques from around the world (e.g., Africa, USA, Indonesia, South America), while also exploring innovative methods. In Queensland, the Department currently uses small drones (i.e., drones less than 2 kg in weight) to locate and capture problem crocodiles.

Proserpine River

As noted in the Key Findings Report (Appendix 1) the Proserpine River has the highest density of crocodiles in Queensland and is less than 30km away from the Whitsundays area. Crocodile sightings in the region have been increasing in recent years and there is concern regarding potential future human-crocodile conflicts. In response, the Department is currently looking at the movement patterns (via satellite tracking and DNA analysis) of crocodiles in coastal areas within and adjacent to the Proserpine River to determine how they are using ocean currents and tides in this area, and whether there are any barriers preventing them travelling from the Proserpine River to the Whitsundays.

2.3.3 Committee's insights and findings regarding monitoring and research

The Committee agrees the monitoring program was conducted in a suitable and thorough manner, and the Committee has confidence in the detailed results presented in the Technical Report and summarised in the Key Findings Report.

Public confidence in the Department's crocodile monitoring program and its results

Releasing the Estuarine Crocodile Population Monitoring in Queensland (1979-2019) - Technical Report is important, as emphasised by the requests for local data made by local government Mayors at the 2021 Crocodile Roundtable, and by the recent media articles and interviews seeking to undermine the credibility of the 2016 – 2019 monitoring program's results. There is a need to gain and maintain the public's confidence in the results from the surveys and their analysis. These analyses are particularly important because they summarise population trends over a long period of time.

Suggestions about how to improve public confidence in the survey results and subsequent analysis include:

- 1) production of a well-illustrated and technically informative description on the Department's website;
- 2) a short, engaging video depicting boat and helicopter surveys with explanatory voice-over commentaries; and
- 3) inviting 'influential sceptics' from the community on boat and helicopter surveys so they can see how professionally the surveys are conducted and to emphasise that what is being done is world best practice.

In addition, proactive engagement with social media networks is important to detect 'early warning signs' of misinterpretation and misleading information being shared.

Research and monitoring vs the Department's crocodile management priorities

The Department is undertaking a range of research programs, and is collaborating well with external researchers and industry. However, the connection between identified management priorities and chosen projects is not always well communicated. For example, it is not clear why the projects listed in section 2.3.2 are being pursued when major crocodile research questions (e.g., population trajectories) remained unanswered for decades. The Committee also notes that it is not clear why Close-Kin Mark-Recapture projects have seemingly been prioritised over monitoring and evaluating the effectiveness of the *Be Crocwise* program. The Committee is not claiming these research activities should not be pursued, rather that the rationale for prioritising one project or initiative over others should be articulated.

A key point of contention is the availability of safe places to swim in croc country. An alert and detection system like the one being trialled by the Northern Wildlife Operations team, as used for sharks in some areas of Australia, has the potential to reduce human-crocodile interactions if implemented well.

Using data to predict human-crocodile interaction rates

For several decades, a lack of monitoring left the Department unaware of changes to the Queensland crocodile population. This lack of information limited the state's ability to respond to changes in the risk of crocodile-human interactions along the populated Queensland coastline. The most recent Queensland crocodile monitoring program offers insights into likely future crocodile populations along the Queensland coastline. Coupled with observed and projected changes in population densities and human behaviour (e.g., boat ramp usage, tourism numbers), this data should allow the Department to anticipate future rates of crocodile-human interactions at key locations, and to respond pre-emptively if needed.

Future crocodile surveys

The size of the area needing to be surveyed and the extent to which surveys are constrained by season and local tidal cycles, along with other constraints, means that a comprehensive survey of croc country in its entirety cannot be undertaken each year. Given the relatively slow growth rates of individual crocodiles and crocodile populations, such frequent sampling is probably not necessary. Some areas of croc country may need more frequent attention than others. Survey work is very specialised and relies on the availability of a well-trained and committed team. The survey program could be designed so that the Department surveys an identified study area each year, so that each part of croc country is surveyed at an appropriate interval (for example, once every five years). This will facilitate integration of surveys into the work schedule, maintain adequate monitoring throughout croc country and ensure maintenance of survey skillsets within the Department.

Removal of additional crocodiles, informed by population modelling arising from analyses of 1979-2019 survey results

To date, the number of crocodiles defined as problem crocodiles has determined the number of animals removed each year (typically now 40-50). Significantly, the Technical Report showed that even with more than 450 breeding females and adult/subadult males removed between Ingham and Cooktown in the last 15 years, there was still measurable increase in numbers of small crocodiles within the populated east coast⁴.

As briefly mentioned in section 2.1.2, because of new information the Department now has the opportunity to consider a strategic, scientifically informed, adaptive crocodile management approach. A deliberate reduction in the number of crocodiles within the populated east coast is something the Department could now consider as an option to constrain the rate of natural population increase and lower the risk of human-crocodile interactions. Modelling based on the long-term survey data detailed in the Technical Report suggests that if the Department maintains the current removal rate of 40 crocodiles a year on average from the populated east coast, the crocodile population there may continue to increase slowly. The modelling also suggests that the removal of an additional 50 animals (breeding-sized females and sub-adult males and breeders) from this area each year could reduce the population density by approximately 20% over ten years, if the latest Northern Territory modelling holds for the Queensland population. The slow predicted change in crocodile population density is due to the longevity of crocodiles, their slow maturity and the presence of young and sub-adults already in the population.

If the Department undertook scientifically informed removal of additional crocodiles within the Queensland populated east coast on a trial basis and conducted surveys after at least five and ten years, this would enable comparison between the measured population change and that predicted by the modelling. This would provide an informative test of the population modelling in the spirit of adaptive management. Removing an additional 50 animals, for example (breeding females and subadult and breeding males) each year from the populated east coast (on top of the 40 that are removed on average each year under current Management Plan arrangements) would not put the Queensland crocodile population at risk in any way; there is abundant information from Queensland and the Northern Territory to show that crocodile populations are highly resilient to even a high offtake. Prior to implementation by the Department, any such additional crocodile removal approach would require consultation with all relevant stakeholders, including First Nations people, national park, marine park and World Heritage Area managers, local councils, conservation interests and other interested stakeholders. Subsequently, there would need to be consultation with stakeholders relevant to local operational areas.

3. Committee Recommendations

The Committee notes that evaluations such as the one conducted by this Committee are a key part of strengthening the Queensland Government's program and policy-making processes and aligning them with the latest scientific evidence and broader societal concerns. Based on their insights and findings, the Committee has made 22 recommendations which they believe will further strengthen and improve the Department's crocodile management program. The six recommendations the Committee agrees are the most important appear below in emboldened text and are labelled as Priority A – F for reference purposes. These six actions are of equal importance - i.e., the Committee does not believe A to be more important than B, for example.

3.1 Committee recommendations regarding the Management Plan

The Committee recommends the Department:

3.1.1 Management Plan document

- 1. (Priority A) Establishes and publicises clear, structured processes regarding Management Plan amendments, including:**
 - **a regular evaluation process, which could include a major review of the Management Plan every five years commencing from 2022, for example; and**
 - **an inclusive and documented system allowing any community group or individual to request modifications to/minor reviews of the Management Plan, including modification and refinement of Crocodile Management Zones.**
2. Considers (during the next major review of the Management Plan), turning the Management Plan into a communications document, and considers taking a more quantitative approach to the included risk assessment process. For example:
 - Zones could be re-named to increase public understanding of the intent of each zone. For example, 'Active/Total Removal Zone' may have more meaning to the public than 'Zone A.'
 - More information should be included regarding what happens to crocodiles that are removed.
 - The objectives of the Management Plan could be explained clearly within the document.
3. Considers providing clearer information on risk profiles for each Crocodile Management Zone and providing more information explaining how each of the zones was determined. Information on the key factors used to determine the level of risk to public safety should be estimated quantitatively (e.g., not just as "higher" or "lower"), and the way in which these factors are integrated to determine a zone should be explicitly stated.

3.1.2 Crocodile management

4. Clearly communicates that egg harvesting, wild crocodile harvesting for their skins, and widespread culling are not practical approaches to reducing the risk of crocodile attack.
5. Proactively considers future options for rehoming problem crocodiles before zoos and farms across Queensland reach capacity.
6. **(Priority B) In consultation with stakeholders, considers annual removal of a modest number of crocodiles 2.4 metres or more in length on the populated east coast for several years, in addition to the average number of problem crocodiles removed under current Management Plan arrangements, with appropriate frequency of monitoring. The number taken each year should be based on population modelling. This trial, to constrain population growth and**

reduce overall numbers locally, is a form of adaptive management that could deliver improved crocodile management outcomes and new knowledge.

3.1.3 Collaboration

7. Considers ways to increase the role of Land and Sea Rangers in on-ground crocodile management.
8. **(Priority C) Establishes a Wildlife Management Stakeholder and Expert Committee for ongoing deliberation regarding the management of wildlife.**

3.2 Committee recommendations regarding the Be Crocwise Program

The Committee recommends the Department:

3.2.1 Information needs

9. Pending funding availability, as discussed in section 3.2.3, conducts research into the opinions and attitudes, as well as behaviours, of people that live in and visit croc country (including indigenous communities), and conducts research on people who live well outside croc country (e.g., Brisbane residents). This research could be similar to research conducted by Ipsos in relation to attitudes and behaviours towards Wongari (dingos) on K'gari in 2021-22; to enhance the Department's ability to target messaging towards key audiences pending resource allocation.
10. Gathers further evidence regarding human behaviour at popular boat ramps in croc country and what behaviour change approaches could be enhanced accordingly.

3.2.2 Collaboration

11. Explores additional opportunities to work with First Nations people to access their cultural knowledge about living with crocodiles, and to include culturally relevant interesting facts on interpretive signs to make them more engaging.
12. Broadens Crocodile Roundtable membership to include relevant local and state government representatives from central Queensland areas.
13. Provides an annual facts sheet to all Crocodile Roundtable members, local libraries, local councillors and members of parliament to educate them about latest crocodile management actions.
14. Continues to work in partnership with key stakeholders who publicly display crocodiles at wildlife parks and zoos to design and deliver consistent *Be Crocwise* program messaging.
15. Consults with tourism sector stakeholders (e.g., accommodation providers and tourism operators) to find out what educational tools and resources they need to support the *Be Crocwise* program.
16. Collaborates with Australian research institutions, especially those with strong behaviour change management expertise, to evaluate existing programs and devise new messaging.

3.2.3 Funding

17. **(Priority D) Allocates:**
 - **one-off funding to design a comprehensive Crocwise strategy that incorporates learnings by work undertaken with Wongari, First Nations people, and the theories of behaviour change;**
 - **ongoing and increased funding to implement and evaluate the effectiveness of the Crocwise program; and**
 - **new, fully-funded, dedicated positions to manage and coordinate the Be Crocwise program and to undertake analysis of effectiveness of Be Crocwise.**

3.3 Committee recommendations regarding research and monitoring

The Committee recommends the Department:

3.3.1 Communication with the public regarding research and monitoring results

18. (Priority E) Increases the public's confidence in the science behind the crocodile monitoring program by:

- immediately releasing the **Estuarine Crocodile Population Monitoring in Queensland (1979-2019) - Technical Report** to the public;
- providing a short, plain English document to the public explaining the methodology used throughout the Department's crocodile monitoring program and the validity of the results;
- considering producing a short video (with explanatory commentary) for the public featuring Wildlife and Threatened Species Operations staff conducting monitoring surveys; and
- considering inviting several selected influential sceptics (e.g., media and social media commentators) to observe the process, and the professionalism, of Wildlife and Threatened Species Operations staff undertaking field operations.

3.3.2 Crocodile monitoring program and data use

19. **(Priority F) Develops and initiates a funded 'cycling' crocodile monitoring program comprising surveys in a subset of chosen areas within croc country every year so that, collectively, every area is counted with a frequency of no less than once every five years (or as determined).**
20. Uses projections of crocodile and human populations and behaviour to predict and anticipate future changes in patterns of human-crocodile interactions and crocodile attacks.

3.3.3 Project governance and prioritisation

21. Develops a more transparent process to document the way in which data collection and research are driving continuous improvement relating to crocodile management priorities. For example:
 - The Department could document the relative benefits of Close-Kin Mark Recapture projects vs monitoring and evaluating the effectiveness of the Crocwise program.
 - The Department could explain why investigating and trialling crocodile detection and alert technology is its highest priority regarding crocodile management applied research.
22. Ensures research projects align with the objectives of the Management Plan by:
 - clearly justifying the need for research and monitoring projects;
 - prioritising research and monitoring projects; and
 - seeking the opinion of a wildlife management stakeholder committee (refer to recommendation eight) regarding the research and monitoring program. This committee would investigate, for example, how the research findings would be used to improve current management practices.

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List of Appendices

1. Queensland Crocodile Management Plan.
2. Queensland Estuarine Crocodile Monitoring Program 2016–2019 Key Findings Report.
3. Crocodile Roundtable membership list.
4. Stakeholder feedback.
5. Media summary.
6. List of documents provided to Committee members.

Appendix 1—Queensland Crocodile Management Plan



Queensland Crocodile Management Plan

Prepared by: Conservation and Biodiversity Policy Unit, Department of Environment and Heritage Protection

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Foreword



One of the things Queenslanders, and visitors to our wonderful State, appreciate is our wildlife. Crocodiles are amazing wild animals to see, but they also pose a danger to humans. The estuarine crocodile is found in waterways of northern Queensland from Gladstone to Cape York Peninsula, and throughout the Gulf of Carpentaria and Torres Strait.

Until 1974, estuarine crocodiles in Queensland were hunted to the brink of extinction for their prized skins. The estuarine crocodile is now listed as a vulnerable species in Queensland, with strong efforts made over the past 40 years to conserve this prehistoric creature.

Crocodiles may be present in or near almost any water body north of Gladstone, all the way to the Northern Territory border. While crocodile conservation is important, understandably the community is concerned about the risk of crocodile attack.

This plan sets out a comprehensive and coordinated framework for managing the risks crocodiles pose to people, while continuing to ensure that crocodiles can maintain healthy populations in their natural habitat.

The plan responds to the public's support for a balanced approach between crocodile conservation and public safety by setting out how the Queensland Government will manage crocodiles, including removal in certain circumstances, in accordance with the level of risk posed across different areas of the state. The plan also highlights the key safety messages that everyone needs to keep in mind when in croc country.

I am confident that by undertaking management in accordance with this Queensland Crocodile Management Plan, and by making people aware of key safety messages, we can reduce the risk of crocodile attack while ensuring the ongoing conservation of crocodiles in the wild.

Dr Steven Miles

Minister for Environment and Heritage Protection and
Minister for National Parks and the Great Barrier Reef

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Part A—Introduction and overview

Purpose

The Queensland Crocodile Management Plan (the QCMP) has been prepared by the Department of Environment and Heritage Protection (the department) as the overarching framework for the statewide management of public safety risks associated with crocodiles.

The purpose of the QCMP is to outline:

- a consistent approach to crocodile management for Queensland
- the risks posed by crocodiles in Queensland in each of the *crocodile management zones*
- how the Queensland Government responds to and manages crocodiles in each *crocodile management zone*
- the knowledge and behaviours that can help minimise risks of crocodile attacks in each *crocodile management zone*.

Estuarine crocodiles (Crocodylus porosus) are a protected species in Queensland, listed as a vulnerable species under the *Nature Conservation Act 1992 (Qld)*. They are also protected nationally under Commonwealth legislation and internationally under the Convention on the International Trade of Endangered Species (CITES). These arrangements effect how crocodiles are managed, farmed and traded.

The QCMP supports the *Nature Conservation (Estuarine Crocodile) Conservation Plan 2018 (Qld) (the conservation plan)*, which is made under the Nature Conservation Act. Together these documents describe the strategic management framework to reduce risks to public safety and protect crocodiles in the wild.

The necessary scientific evidence to support these management arrangements is being provided by the department through a comprehensive multi-year survey of crocodile populations in rivers and estuaries from Cape York to Gladstone. This work is based on advice from some of the world's leading crocodile scientists and will help guide best practice crocodile management into the future. This program began in 2017.

As *estuarine crocodiles* pose a significantly higher risk to humans than freshwater crocodiles (*Crocodylus johnstoni*), the QCMP is largely focused on the management of public safety risks associated with *estuarine crocodiles*.

Crocodile habitat and behaviour

Estuarine crocodiles range from India to northern Australia, and across to Vanuatu and the Solomon Islands. In Queensland they are known to occur throughout the Gulf of Carpentaria, Cape York Peninsula, Torres Strait, and along the east coast of Queensland. Crocodiles are regularly present as far south as the Boyne River near Gladstone, and occasionally as far south as the Mary River.

Crocodiles most commonly live in the tidal reaches of rivers and associated inlets and wetlands. However, they also occur along beaches and offshore islands in the Great Barrier Reef and Torres Strait, and in freshwater lagoons, rivers, and swamps up to hundreds of kilometres inland from the coast.

As a result there is a possibility that a crocodiles may be present in or near almost any water body north from near Gladstone, all the way to the Northern Territory border.

Juvenile *estuarine crocodiles* feed on small insects, crabs, prawns and shrimps. As they grow, so does their range of potential food items. At sizes of around 2m they begin to take an increasing amount of vertebrates such as fish, frogs, birds, and rats.

An adult crocodile's prey may include sea turtles, goannas, wallabies, cats, pigs, dogs, kangaroos, cattle, horses, buffalo, other crocodiles, and very occasionally, people.

Full-grown adult estuarine crocodiles will feed on any animal they can overpower.

To capture prey, *estuarine crocodiles* typically wait in ambush at the water's edge and lunge or snap sideways at animals which come to feed or drink. Their well-developed sense of smell will also lead them some distance in search of prey.



Crocodiles will often drag unsuspecting prey from the water's edge to deeper water. © Queensland Government.

In comparison, freshwater crocodiles rarely grow more than 2.5m long and their diet consists of small animals (including insects, fish, frogs, lizards, turtles, bats, birds). Because of this they pose a lower risk to humans than *estuarine crocodiles*.

Risks associated with crocodiles in Queensland

Crocodiles are opportunistic feeders that can feed on any sized animal they can overpower. They can also be highly territorial, particularly during breeding seasons, and will attack anything in their habitat that they perceive is a threat.

As a result, crocodiles can and do attack humans. Queensland Government records indicate that between 1985—2016, 17 non-fatal attacks and eight fatal attacks by estuarine crocodiles have occurred in the wild. While the likelihood of being attacked by a crocodile is relatively low when compared to many other risks (e.g. the risk of drowning) the consequence for an individual who is attacked can be very severe.

Furthermore, since the cessation of crocodile hunting in the 1970's, and the continuing growth of the human population in North Queensland, there is an ever increasing likelihood of contact between people and crocodiles.

It is imperative that each person takes accountability for staying safe in croc country. A common misconception is that it's safe to swim if no crocodiles have been sighted recently in an area and if someone is 'on lookout' for crocodiles.

Statistics show that most attacks are made by crocodiles that were not reported or seen in an area until the moment of attack.

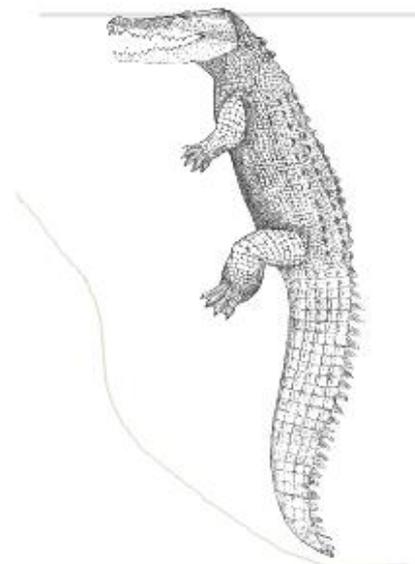
Appendix A includes stories about circumstances that are often associated with fatal and near fatal attacks.

Like many risks in our environment, the risk of crocodile attack can be minimised. In Queensland the three key strategies to significantly minimise the risks posed by crocodiles are:

1. installation of warning signs by the Queensland Government
2. community members taking personal responsibility for their safety, including being Crocwise
3. the selective and targeted removal, by the Queensland Government (and other authorised entities), of crocodiles that pose the greatest risks to public safety.

Crocodile management in Queensland

Crocodiles can lay in wait for many hours with the bulk of their body hidden underwater, sometimes with nothing visible above the water but their eyes and nostrils. Image by Tom Mumbray © Queensland Government.



Crocodile removal

The Nature Conservation (Estuarine Crocodile) Conservation Plan 2018 outlines the limited circumstances under which a crocodile may be considered a problem crocodile and therefore targeted for removal from the wild.

The process for determining that a crocodile is a problem crocodile is outlined in appendix C.

These circumstances include where:

- A. the crocodile has attacked, is about to attack, or is behaving aggressively towards, a person
- B. the nature of the crocodile's location or behaviour makes the crocodile a threat, or a potential threat, to the safety or wellbeing of humans
- C. a crocodile has passed over, through or under a crocodile prevention barrier on land, on which aquaculture fisheries resources, stock, or a working dog normally lives and is likely to become, a danger to the resources, stock or dog.

Circumstances A and B above relate to public safety, and this QCMP provides detailed guidance on when the Chief Executive may consider a crocodile as a *problem crocodile* under these circumstances.

Circumstance C relates to *problem crocodiles* in specific grazing and agricultural settings, to which the department routinely responds, and crocodiles are targeted where the relevant circumstances occur.

Dangerous crocodile behaviour

While all crocodiles can be dangerous, some crocodiles display particular dangerous behaviours around or towards humans. A *crocodile displaying dangerous behaviour* can pose a significant risk to public safety as once a crocodile has learned a dangerous behaviour, the behaviour is likely to be repeated, and this represents a much higher threat or potential threat to human's safety and wellbeing.

A crocodile repeatedly sighted at a boat ramp or making its way into a water feature on a golf course is likely to be regarded as displaying dangerous behaviour.

While each management zone provides different criteria for determining whether a crocodile is a *problem crocodile*, throughout the state crocodiles are targeted for removal where they display certain dangerous behaviours around or towards humans.

For the purposes of management, a crocodile may be considered as a *crocodile displaying dangerous behaviour* when it has attacked, is about to attack, or is behaving aggressively towards, a person; or its location or behaviour, is a threat, or a potential threat, to the safety or wellbeing of humans.

Importantly any crocodile that develops an association between humans and food availability is likely to be considered a *crocodile displaying dangerous behaviour*. Any crocodile displaying certain territorial behaviours are also likely to be considered a *crocodile displaying dangerous behaviour*.



Crocodile removal can be difficult and dangerous, and there are only limited circumstances where it is useful.
© Gordon Grigg.

To remove all doubt, a *crocodile displaying dangerous behaviour* is a crocodile that satisfies the criteria of a *problem crocodile* under section 6(3)a of the *conservation plan*.



As crocodiles grow larger they become more able to injure or kill people. © Queensland Government.

Large crocodiles

For the purposes of management, a crocodile that is larger than 2m in length may be considered a *large crocodile*.

While most crocodiles are highly territorial and can attack humans, *large crocodiles* are more capable of injuring or killing people. The vast majority of attacks are carried out by crocodiles larger than 2m.¹

This criterion is used in the targeted management zone and the targeted beach management zone to determine if a crocodile is a *problem crocodile* (some crocodiles less than 2m in length are also targeted for removal in this zone if they display dangerous behaviour).

Size is also used as one of a number of criteria in other zones to determine if a crocodile poses a threat, or a potential threat, to the safety or wellbeing of humans.

Crocodile management zones

The Queensland Government's approach to the management of crocodiles is based on *crocodile management zones*. Different parts of the state are located within different management zones. The particular zone is determined by the overall risk to public safety that is present there.

¹ Caldicott, Croser, Manolis, Webb, & Britton (2005) Crocodile attack in Australia: an analysis of its incidence and review of the pathology and management of crocodylian attacks in general. *Wilderness Environ Med.* 2005;16: 143–159).

As shown in Appendix B, factors used in evaluating the risks to public safety in different parts of the state include

- A. the size of the human population in an area
- B. the size of the crocodile population in an area
- C. whether crocodiles are resident or transitory in an area
- D. the viability of various management options in an area.

The criteria for determining that a crocodile is a *problem crocodile* are slightly different in each zone taking into consideration the differing risk factors.

Boundaries for the *crocodile management zones* are determined by the Chief Executive, in consultation with stakeholders, with the aim of minimising risks to public safety and ensuring the conservation of crocodiles in the wild.

Each area of Queensland is zoned as one of the following *crocodile management zones*:

- a ‘barrier and removal zone’
- an ‘active removal zone’
- a ‘targeted management zone’
- a ‘targeted beach management zone’
- a ‘general management zone’ or
- an ‘atypical habitat zone’.

The area included in each crocodile management zone is shown on the crocodile management zone maps which can be found on the [department’s website](#). Links to each crocodile management zone map are provided in Part B of this document.

Zone rationale

A ‘barrier and removal zone’ is suited to areas where there are physical barriers that are generally effective in preventing crocodiles from entering the area.

An ‘active removal zone’ is suited to areas of rivers, creeks and wetlands where crocodiles are frequently in close proximity to large urban populations.

A ‘targeted management zone’ is suited to areas that are frequented by large numbers of people due to being near an urban centre or popular swimming areas and are also frequented by crocodiles.

A ‘targeted beach management zone’ is suited to areas where crocodiles are often seen passing through but are not core habitat, such as beaches.

A ‘general management zone’ is suited to areas that are typical habitat for crocodiles but are not near a large urban centre, as well as other areas with varied crocodile numbers that are not otherwise zoned.

An ‘atypical habitat zone’ is suited to areas that are not typical habitat for crocodiles e.g. beyond their typical extent.

Making and amending a crocodile management zone map

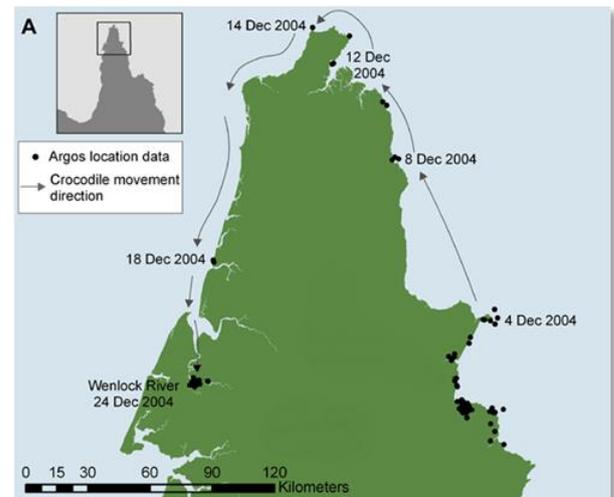
Crocodile management zones are defined by the *crocodile management zone maps* which are made by the Chief Executive, and may be amended by the Chief Executive from time to time.

In making decisions about amending a map, the Chief Executive may consider:

- matters relevant to the conservation of crocodiles
- matters relevant to overall public safety
- the zone rationale (see section - Zone rationale)
- any other matter the chief executive considers appropriate.

Being Crocwise in Queensland

The government is committed to reducing the risks posed from crocodiles through the sensible management and removal of crocodiles in each management zone.



*Crocodile tracking data has shown that crocodiles can and do travel vast distances. For example, this image shows a crocodile in Cape York moving hundreds of kilometres in just a few weeks. Image adapted from Read MA, Grigg GC, Irwin SR, Shanahan D, Franklin CE (2007) Satellite Tracking Reveals Long Distance Coastal Travel and Homing by Translocated Estuarine Crocodiles, *Crocodylus porosus*. PLoS ONE 2(9): e949. Article published under the Creative Commons Attribution (CC BY) license <http://journals.plos.org/plosone/s/licenses-and-copyright>*

Regardless of the number of crocodiles that are removed the best way to avoid a crocodile attack is for people to be aware of the risks posed by crocodiles, and for individuals to stay safe when they are in and around waterways that may be inhabited by crocodiles.

Maintaining awareness and exercising key behaviours when in and near the water is called 'being Crocwise'.

To be Crocwise a person should:

- Understand that management of crocodiles never completely removes the risk that a crocodile may be present.
- Know that crocodiles are ambush predators and evidence of their presence may not be obvious.
- Pay attention to any warning signs at the locations you visit.
- Be aware that crocodiles can attack people in boats and the smaller the boat the greater the risk.
- Pay attention to zone specific Crocwise messages (see Part B of this QCMP).
- Whenever you see a crocodile, report it to CrocWatch by calling 1300 130 372.
- Avoid incidental or deliberate feeding, e.g. leaving food scraps near the water, or disposing of bait at boat ramps.

A key part of being Crocwise is to always be aware when you are in croc country.

A number of videos are available about being Crocwise, including for launching a boat, camping and fishing. These can be found on the department's YouTube channel:

<https://www.youtube.com/user/QldEHP>

And at the following departmental webpage:

https://www.ehp.qld.gov.au/wildlife/livingwith/crocodiles/crocodiles__be_croc_wise.html

The department runs a comprehensive Crocwise community education and awareness program to minimise the risks posed to people and provide information on crocodile biology and behaviour. The program encourages individuals to adopt an overall awareness that they are in 'croc country', to underpin a set of safety behaviours.

Crocwise uses a broad range of communication tools to deliver safety messages to target audiences including both locals and tourists

2–2.5 metre crocodile difficult
to see in murky water

Part B—Crocodile Management Zones

Barrier and removal zone (zone A)

Zone map

Note: This QCMP should be read in conjunction with the *crocodile management zone* maps available on the department's website:

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/crocodile_plan.html#crocodile_management_zones



Effective barriers to crocodiles exist only in limited places in croc country. For example, Aplins Weir. Photo © Thuringowacityrep.

Risks posed by crocodiles

In this zone, the risk of human–crocodile interaction is generally low. This is due to the low likelihood of crocodiles being present because there is a physical barrier that largely prevents crocodiles from entering the area, combined with the management response of removing all crocodiles that are reported in the area.

Management response

The management objective for this zone is to make the area free of crocodiles so people can be in or near the water with a very low likelihood of crocodile attack.

Management involves using physical barriers (generally existing barriers such as weirs) to prevent crocodiles entering the area and targeting for immediate removal any crocodiles reported to have passed the barrier.

There are limited areas where physical barriers capable of preventing crocodile access exist.

While crocodiles are generally unlikely to be present in this zone, people should be aware that safety cannot be guaranteed given crocodiles are wild animals that can be difficult to detect in water bodies. To reduce the likelihood of a crocodile attack, people living in or visiting areas in this zone need to practise Crocwise behaviour and follow any warning signs.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

- Understand that even when barriers are used in conjunction with crocodile removal, the area may not be free of crocodiles given the site is within crocodile habitat and crocodiles are highly mobile.
- If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.
- Obey any warning signs and practise Crocwise behaviours if a crocodile has been sighted in the area.

Active removal zone (zone B)

Zone map

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/s/crocodile_plan.html#crocodile_management_zones

Risks posed by crocodiles

In this zone, the risk of human–crocodile interaction is high. This is due to the significant number of people living in the area and the high likelihood of crocodiles entering the area from surrounding crocodile habitat. The management responses of patrolling to detect crocodiles and removing them when found in the area mitigates the risk of crocodile attack to an extent.

Management response

The management objective for this zone is to significantly reduce the number of crocodiles in close proximity to large urban areas, with a particular focus on *large crocodiles*.



Waterfront home in croc country © Great Barrier Reef Marine Park Authority (GBRMPA).

The management approach changes from time to time, but generally involves a combination of the use of permanent, regularly monitored traps in some creeks, and patrolling to detect and target crocodiles for removal. Crocodiles are also targeted for removal if a sighting is received from the public. In this zone crocodiles are targeted for removal regardless of size or behaviour.

Although management of this zone should help reduce the total number of crocodiles (particularly *large crocodiles*), it is not possible to make this zone completely free of crocodiles or to entirely remove the risk of a crocodile attack.

Crocodiles are wild animals that can be difficult to detect and capture, and can swim long distances. At any given time, there may be undetected crocodiles already within the zone, known crocodiles yet to be removed, or new crocodiles entering the zone.

Even when a crocodile has been removed, it leaves a vacated territory for another crocodile to fill.

People living in or visiting areas in this zone need to practise Crocwise behaviour to reduce the likelihood of a crocodile attack.



Crocodile removal in action. © Queensland Government.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

- Understand that while regular removal of crocodiles in this zone is the responsible action to take to reduce the immediate risk of a negative interaction with a person, it will not eliminate the overall risk that crocodiles pose to humans in the area.
- Understand that removal of crocodiles often creates vacant territory that is quickly filled by the next most dominant animal and that crocodiles are still likely to be present in the zone, so it is important to comply with Crocwise safety messaging, including warning signs.
- Know how to look for signs of a crocodile before going near the water (for example, slide marks), and check each time you are near or in the water.
- If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.

Targeted management zone (zone C)

Zone map

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/crocodile_plan.html#crocodile_management_zones

Risks posed by crocodiles

In this zone, the risk of human–crocodile interaction is moderate to high. This is due to the moderate to high likelihood of crocodile presence in close proximity to urban populations or large towns. It should be noted that *large crocodiles* are often likely to be living in this zone. A number of popular swimming holes in crocodile habitat areas are included in this zone.

Management response

The management objective for this zone is to reduce the likelihood of a crocodile attack. Management involves targeting for removal of all *large crocodiles* and any *crocodile displaying dangerous behaviour* (following a problem crocodile determination).

It is not possible, nor the intent of management, to make this zone free of crocodiles. Crocodiles will be present and the chance of attack from a crocodile remains.

The removal of a *large crocodile* or *crocodile displaying dangerous behaviour* may reduce the likelihood of a crocodile attack but also makes space for another crocodile to fill. People living in or visiting areas in this zone need to practise Crocwise behaviour and assume that crocodiles may be present to reduce the likelihood of a crocodile attack.



Crocodiles may or may not leave tracks and slide marks on a creek bank. A lack of slide marks does not mean that the water is safe. © Queensland Government.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

- Understand that while the removal of a *large crocodile* or a *crocodile displaying dangerous behaviour* in this zone is the responsible action to take to reduce the immediate risk of a negative interaction with a crocodile, it is unlikely to eliminate the overall risk that crocodiles pose to humans in the area.
- Always adhere to safety messages, which may be targeted at typical activities undertaken in the area (e.g. launching a boat, swimming).
- Remember that the removal of crocodiles often creates vacant territory that is quickly filled by the next most dominant animal.
- Even when crocodiles are removed, other crocodiles are still likely to be present within the zone, so it is important to comply with Crocwise safety messages, including warning signs.
- Know how to look for signs of a crocodile before going near the water (for example, slide marks near the water).
- If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.



If a crocodile is targeted for removal, traps are one method that may be used. © Queensland Government.

Targeted beach management zone (zone D)

Zone map

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/s/crocodile_plan.html#crocodile_management_zones

Risks posed by crocodiles

In this zone, the risk of human—crocodile interaction is moderate. This is due to the moderate to high likelihood of crocodile presence (generally only for short periods while they are passing through), combined with frequent use by people. People should note that crocodiles are often likely to be passing through this zone. A number of beaches and some urban waterways are included in this zone.



Removal of crocodiles in open coastal waters is extremely difficult, and often ineffective at minimising the risk of an attack © Queensland Government.

Management response

The management objective for this zone is to reduce the likelihood of a crocodile attack. Management involves targeting for removal of all *large crocodiles* and any *crocodile displaying dangerous behaviour* (following a problem crocodile determination).

It is generally very difficult to catch crocodiles in beach areas or nearby open water as they rarely remain near beaches for long

Temporary warning signs are also placed on beaches following any sightings to alert people that a crocodile may be in the area.

Although removing crocodiles reduces the likelihood of an attack, crocodiles regularly move through open waters. This means that this zone may still have undetected crocodiles in it or crocodiles that have been sighted but not yet removed.

People living in or visiting areas in this zone need to practise Crocwise behaviour to reduce the likelihood of a crocodile attack. This includes following Surf Life

Saving Queensland's directions and respecting all beach closures.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

- Know that crocodiles often move through this zone to reach neighbouring estuaries and may be present at or near the water's edge (however, they typically move out of the area relatively quickly).
- Know that capture and removal is often not a practical option in open water, and is often unnecessary as crocodiles generally move on quickly of their own will.
- Understand that while removing *large crocodiles* and *crocodiles displaying dangerous behaviour* in this zone is the responsible action to take to reduce the immediate risk of a negative interaction with a crocodile, it will not eliminate the overall risk that crocodiles pose to humans in the area.
- Always adhere to safety messages, which may be targeted at typical activities undertaken in the area (e.g. walking a dog along the shoreline, swimming). If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.

General management zone (zone E)

Zone map

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/s/crocodile_plan.html#crocodile_management_zones

This zone extends offshore from the mainland, and islands to the extent of Queensland Waters (a distance of 3 Nautical Miles, or 5.6 km).

Risks posed by crocodiles

In this zone, the risk of human–crocodile interaction is variable. This is due to the range of habitats and varying numbers of people found within this zone. *Large crocodiles* or *crocodiles displaying dangerous behaviour* may be living within this zone.



Crocodile nests can sometimes be large mounds but can also be much less conspicuous. © Queensland Government

Management response

The management objective for this zone is to reduce the likelihood of a crocodile attack. Management involves community education regarding Crocwise behaviours, and removing *crocodiles displaying dangerous behaviour* (following a problem crocodile determination). *Large crocodiles* are generally not removed, however size is a factor in determining the risk an individual crocodile may pose.

While the removal of *crocodiles displaying dangerous behaviour* from this zone reduces the likelihood of attacks from individual crocodiles, the chance of a crocodile attack remains, particularly in areas of high quality crocodile habitat. People living in or visiting areas in this zone need to practise Crocwise behaviour to reduce the likelihood of a crocodile attack.

Under Part 2 of the *conservation plan*, the Chief Executive may grant a Crocodile Management Authority to an approved person or a prescribed officer so that they can catch and remove a *problem crocodile* rapidly, which may be appropriate in some remote communities. However the determination that

a crocodile is a *problem crocodile* must first be made by the Chief Executive of the department.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

- Know that crocodiles are often highly likely to be present, difficult to detect, highly mobile, and are skilful stealth hunters.
- Understand that while removal of crocodiles displaying dangerous behaviour in this zone is the responsible action to take to reduce the immediate risk of a negative interaction with a crocodile, it will not eliminate the overall risk that crocodiles pose to humans in the area.
- Know that removal often creates vacant territory that is quickly filled by the next most dominant animal.
- Always adhere to safety messages, which may be targeted at typical activities undertaken in the area (e.g. launching a boat, swimming). If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.



Crocodiles will often drag unsuspecting prey from the water's edge to deeper water. © Queensland Government

Atypical habitat zone (zone F)

Zone map

http://www.ehp.qld.gov.au/wildlife/livingwith/crocodile/crocodile_plan.html#crocodile_management_zones

Risks posed by crocodiles

In this zone, the risk of human–crocodile interaction is low. This is due to the low likelihood of crocodile presence beyond their typical range limit, combined with the management response of targeting for removal all crocodiles found in the area.

Management response

The management objective for this zone is to keep the area free of crocodiles. Management involves targeting all crocodiles for removal once their presence has been confirmed.

It is generally unlikely, but still possible, that crocodiles may be present within this zone. However recent cases of crocodiles in this zone indicate that removal can take considerable time. To minimise the risks to public safety during this period, local education and community engagement will be used.

- Obey any warning signs if a crocodile has been sighted in the area and practise Crocwise behaviours.



Waterways south of the Boyne River are not typical habitat for crocodiles.

Crocwise knowledge and behaviours

Key Crocwise knowledge and behaviours in this zone are:

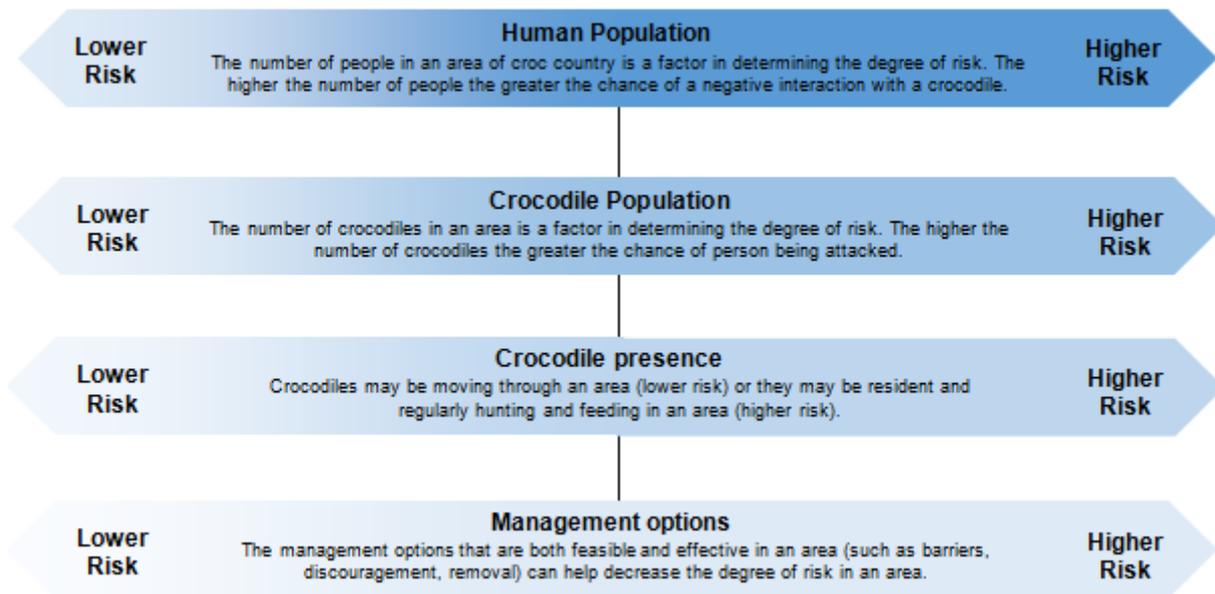
- Understand that although the area is not croc country, it is possible for crocodiles to be present in this zone due to their high mobility and the typical animal behaviour of regularly ‘testing the boundaries’ of their territory to find new territory.
- If a crocodile is present in the area, report it to CrocWatch by calling 1300 130 372.

Definitions	
Problem crocodile determination	The process by which crocodile sightings/reports are assessed by the chief executive of the agency administering the NC Act to determine if the crocodile should be declared a problem crocodile (process is outlined in Appendix C). While this determination is being made sightings are publicly reported as "sighting under investigation".
Conservation Plan	The Nature Conservation (Estuarine Crocodile) Conservation Plan 2018.
Croc country	The coastal areas from the Boyne River near Gladstone to the northern tip of Queensland and west to the Northern Territory border. It can stretch some hundreds of kilometres inland from the coast, while also encompassing many coastal islands.
Crocodile	An animal of the species <i>Crocodylus porosus</i> or <i>Crocodylus johnstoni</i> .
Crocodile management zones	Areas defined by maps referred to in the 'Crocodile management zone' section of this QCMP.
Crocodile displaying dangerous behaviour	A crocodile that has attacked, is about to attack, or is behaving aggressively towards, a person; or a crocodile the chief executive of the agency administering the NC Act reasonably believes, due to its location or behaviour, is a threat, or a potential threat, to the safety or wellbeing of humans.
Estuarine crocodile	An animal of the species <i>Crocodylus porosus</i> .
Large crocodile	A crocodile that is two metres or greater in length.
NC Act	The <i>Nature Conservation Act 1992</i>
Problem crocodile	A crocodile that the chief executive of the agency administering the NC Act determines satisfies the definition in section 6 of the Nature Conservation (Estuarine Crocodile) Conservation Plan 2018, as further detailed in the 'Crocodile removal' section of this QCMP, and in accordance with the problem crocodile determination procedure (Appendix C)
QCMP	The Queensland Crocodile Management Plan.

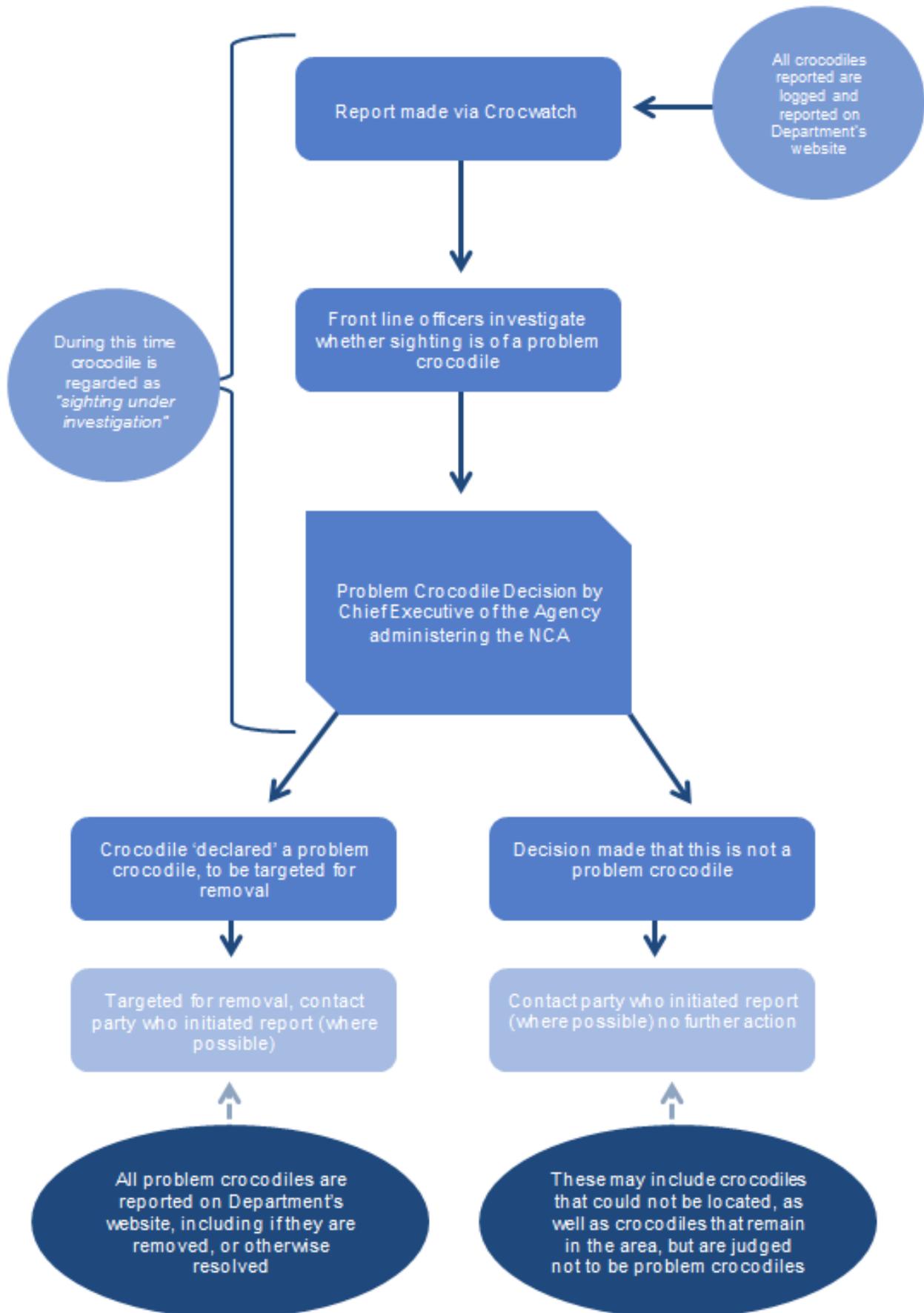
Appendix A – Risk stories	
The follower	<p>They were visiting from the south and had come to croc country for the first time. They knew there were crocodiles living here and that they could kill you. They had read the safety information and the warning signs. In fact they saw that there were the same warning signs everywhere. The locals didn't seem to pay them much attention and in some places did things that seemed dangerous, they swam and went fishing in knee deep water, and they walked their dogs along the water's edge. The locals said there had never been a crocodile attack there and the big crocodiles were further downstream. The last crocodile seen there was trapped and taken away. Maybe it wasn't dangerous after all. Other people were doing whatever they wanted. So they decided they would go in—but only for a few minutes and only up to their knees.</p>
The regular	<p>They had gone there every weekend for years to camp and fish. Crocodiles were rarely seen there and there had certainly never been any attacks. Now in their retirement, with less available income, these fishing trips had also become a practical way of cutting their food bill. They tried to scrimp on other things to save money, including their fishing gear. They started trying to retrieve their snagged lures whenever they could. Each time they got a snag, they would cut the line and tie it to a tree. At low tide one of them would go out (only to knee depth) and try getting a better angle for pulling the lure free while the other kept watch. They saved 10 lures in the first four weeks. The next weekend they arrived on an incoming tide and by the time they were ready to leave the tide was almost full. They had snagged three lures each. They thought it would be safe so one of them went in, pulling on the line as they went sending vibrations through the water.</p>
The dare	<p>All the other girls had jumped off the bridge except her. Even her best friend <u>and</u> the boy she was trying to impress said she was scared, but she didn't want to jump off the bridge. She knew there was big crocodile called 'the Baron' living somewhere nearby and she'd heard that some locals even fed it chickens from the bridge. She wore the jibes for as long as she could. People had been jumping in all day and there was no sign of any crocodiles. No one had ever been attacked there. So, she went to the edge of the bridge, took a deep breath and jumped.</p>
The expert	<p>He knew a lot about crocodiles and would tell everyone about them, how they live, how they behave, how big they grow, how dangerous they are. From what he read, crocodiles were predictable in the way they hunted, where they could be found and when they were active. They were just primitive reptiles with very small brains that relied largely on their instincts and their senses to survive. If you understand all this you can safely predict where they will be. He would be safe if he went to the right spots that he knew about.</p> <p>But crocodiles <u>are</u> highly mobile and, like any animal, test out new areas to live. Predictability is a popular perception that is applied to 'lower animals' like reptiles—and particularly ones that coexisted with dinosaurs. If instead they were portrayed as an enduring alpha predator that has thrived in ecosystems for millions of years then any expert would have second thoughts before diving in.</p>
The gambler	<p>She knew the odds. There was less than one fatality a year (there was a greater risk of being hit on the head by a falling coconut). She ran her life very carefully and sensibly. On her trip to north Queensland she went swimming every day in the same spot for five days with no sign of a crocodile. For the last two days she had been watched by a couple on holidays who had been more cautious. She smiled at them as she came out of the water. They looked at each other. The next day they planned to go swimming.</p> <p>Over the past five days a crocodile had been calculating the odds too. A pattern had been forming, an animal was entering the water in the same place every day and it was likely that this would happen tomorrow too. The crocodile would get a little closer and wait.</p>

Appendix B – Risk determination tools

Key factors in determining risks to public safety.



Appendix C – Problem crocodile determination procedure



Appendix 2—Queensland Estuarine Crocodile Monitoring Program 2016–2019 Key Findings Report



Queensland Estuarine
Crocodile Monitoring Program
2016–2019
Key Findings Report

#32064



Queensland
Government



Introduction

In Queensland, the estuarine crocodile (*Crocodylus porosus*) occurs in a coastal strip from Gladstone northwards along the east coast, throughout the Cape York Peninsula, and across the Gulf of Carpentaria to the Northern Territory border. Estuarine crocodiles are not uncommon on offshore islands of the Great Barrier Reef and Torres Strait. Queensland has some of the most diverse crocodile habitat in Australia.

In the previous century, unregulated hunting of estuarine crocodiles for their skins led to a decline in the population and effective commercial extinction of the species, resulting in full legal protection by 1974. The crocodile population in Queensland has since increased, but the species is still listed as Vulnerable under state conservation laws. Current threats to Queensland's population arise from illegal killing, incidental mortality, destruction of nesting habitat by feral pigs, and land development.

Since 1975, there have been 46 estuarine crocodile attacks on humans in Queensland, 16 of which have been fatal. The average of 0.3 fatalities per year is much lower than deaths from sharks – 1.1 deaths per year (West, 2011). Most of these attacks occurred along the coast between Townsville and the Daintree River, and as in the Northern Territory, the majority impact local, adult males (Brien et al. 2017). Each fatality is a tragedy and makes balancing the responsibilities of conservation and public safety more challenging.

From 2016 to 2019, the Department of Environment and Science conducted a comprehensive monitoring program of the estuarine crocodile population across its range in Queensland. During 2020, the department compiled and analysed data collected through this program and compared these to historic data to assess how the population had changed in size, distribution, density, and size class structure over time—using results collected from as far back as 1979.



Summary of key findings

The size of the estuarine crocodile population in Queensland is currently estimated at 20,000–30,000 non-hatchlings, with an average of 1.7 crocodiles and 36kg of crocodile biomass¹ per kilometre of river surveyed.

For comparison, the population of estuarine crocodiles in the Northern Territory is three to four times larger (100,000), three times more abundant (5.3/km) and has a ten times higher biomass per kilometre (388kg/km) than in Queensland (Fukuda et al. 2011, 2020).

The population started from a very low base and recovery has been relatively slow and highly variable across the state.

The spatial distribution of crocodiles in Queensland has not changed over time, and there is no evidence of a southward expansion of their range.

The number and density of crocodiles are highest in northern Cape York Peninsula (3.0/km) and decline southward, with 1.2/km in the Gulf of Carpentaria and the Cairns region, down to 0.2/km in the Fitzroy River, Rockhampton.

That section of coastline from Cooktown to Rockhampton accounts for around 20% of the Queensland crocodile population.

The crocodile population in Queensland is highly unlikely to reach the size or density of the Northern Territory due to the lack of suitable habitat.

While the crocodile population has continued to increase relatively slowly along the east coast between Cooktown and Ayr, the average size of crocodiles has reduced in this area. This is likely to be a consequence of the regular removal of ‘problem crocodiles’ under the Queensland Government’s crocodile management program.

Queensland has seen the recovery of a threatened species that is a large predator, while at the same time seeing a reduction in the risk to public safety.

¹ Biomass refers to the mass of crocodiles in a particular section of waterway as opposed to the number (density) of individuals

Methods



Figure 1. State-wide survey effort showing areas covered in 2016-2019 by: boat-based spotlight surveys (56), including 42 rivers and covering 2200km; and helicopter surveys (14), including 27 rivers covering 2500km.

In 2016, the Department of Environment and Science embarked on a comprehensive crocodile monitoring program involving systematic spotlight and helicopter surveys in carefully selected, previously surveyed areas of river systems throughout the state.

During the 2016-2019 program a total of 56 boat surveys were conducted in 42 rivers covering 2,200 km, and a total of 14 helicopter surveys were conducted in 27 rivers covering 2,500 km (**Figure 1**). This included rivers as far south as Maryborough on the east coast, through to Cape York Peninsula and the Gulf of Carpentaria.

The survey teams consisted of highly skilled departmental officers who were selected through a rigorous competency-based testing process and received intensive training from highly experienced crocodile biologists, who also provided ongoing support and quality control for the program.

This was the most comprehensive crocodile population monitoring program to be carried out in Queensland for more than a decade, with previous state-wide surveys occurring in 1979, 1984-89, and 1994-2003. The results of these historical surveys were compared and analysed with those of the current program.

The design of the program and subsequent analyses were peer reviewed and endorsed by members of the International Union for the Conservation of Nature (IUCN) Crocodile Specialist Group, which includes the world's leading experts on crocodilian biology and monitoring.

Overall population trends (numbers, density, biomass, and trajectory)

The size of the estuarine crocodile population in Queensland is currently estimated at 20,000 – 30,000 non-hatchling² crocodiles, with an average of 1.7 crocodiles and 36 kg of crocodile biomass³ per kilometre of river surveyed.

There has been an increase in the crocodile population over time. However, there is no evidence of a ‘large increase’ now or into the future. Estimated doubling times⁴ for crocodile numbers in Queensland range from 36 years on Cape York Peninsula, along the Gulf of Carpentaria and in the Cairns region, to up to 100 years in the Fitzroy River, Rockhampton.

The population started from a very low base due to previous hunting, and recovery has been relatively slow and highly variable across the state. For example, while numbers in some rivers appear to have stabilised as early as the 1980s (e.g. Wenlock River, north-western Cape York), some others continue to increase (e.g. Norman River, Gulf of Carpentaria).

The contemporary population of estuarine crocodiles in the Northern Territory is approximately 3-4 times larger (100,000), 3 times more abundant (5.3/km), and 10 times higher in biomass/km (388kg/km) than in Queensland. The population in Queensland is highly unlikely to reach the size or density of the Northern Territory due to the lack of suitable crocodile habitat across the state.

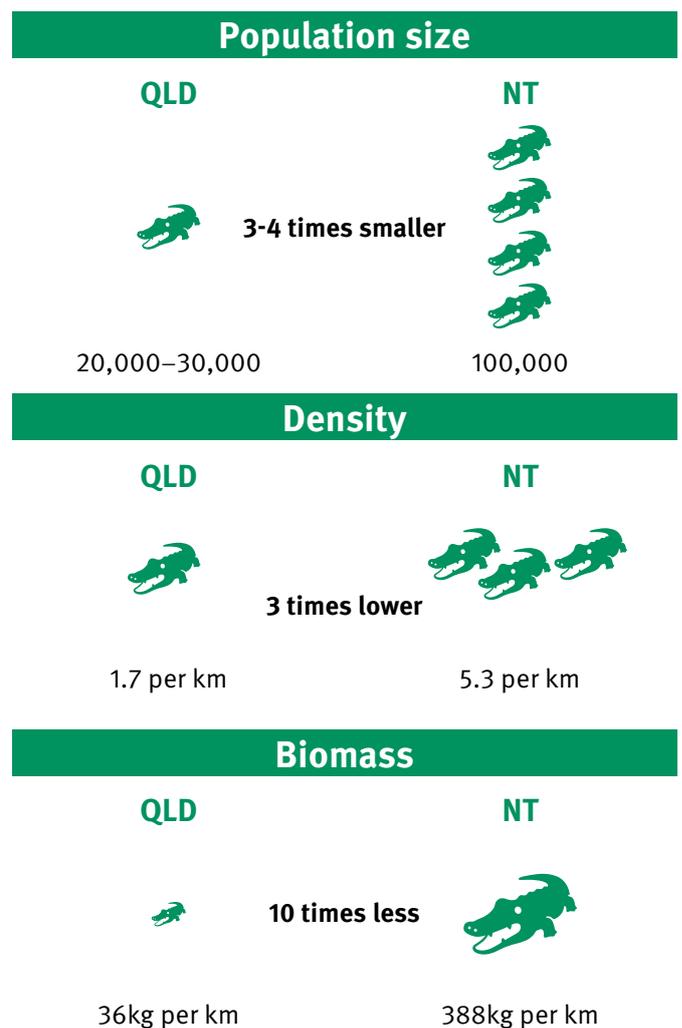


Figure 2. The contemporary population of estuarine crocodiles in the Northern Territory is 3-4 times larger (100,000), 3 times more abundant (5/km), and 10 times heavier/km (388kg) than in Queensland.

2 Only non-hatchling crocodiles >60cm in length are included in density estimates, as crocodiles smaller than this have very low survivorship
 3 Biomass refers to the mass of crocodiles in a particular section of waterway as opposed to the number of individuals per kilometre of waterway (density)
 4 The estimated time in years required for a doubling of the local population density

Results from the populated east coast management area (Cooktown to Ayr)

Management of estuarine crocodiles in Queensland is the responsibility of the Queensland Department of Environment and Science under the *Nature Conservation Act 1992* and Nature Conservation (Estuarine Crocodile) Conservation Plan 2018. The Queensland Crocodile Management Plan provides the current framework for the state-wide management of public safety risks associated with crocodiles. Under the management program, crocodiles that pose a threat to public safety are targeted for removal from the wild by the department or its contractors.

While the crocodile population continues to increase relatively slowly along the populated east coast between Cooktown and Ayr, the average size of crocodiles in this region has been reduced, which is likely to be a consequence of the Queensland Government's crocodile management program, with ~460 crocodiles (>2m; average: 2.3m) having been removed between 2004-2019.

While the absolute rate of non-fatal attacks (0.9 per year) in Queensland has increased over time, there has been no increase in the rate of fatal attacks (0.3 per year; Brien et al. 2017). The removal of larger crocodiles (~4m), capable of causing fatalities, from in and around populated areas on the east coast has likely contributed to this lack of increase in fatalities.

Distribution and range in Queensland

The spatial distribution of estuarine crocodiles in Queensland has not changed since the 1980s and there is no evidence of a southern expansion of their range. The crocodile population in Queensland is primarily riverine, with over 90% of the population existing below 20m elevation above sea level.

The number and density of crocodiles are highest in northern Cape York Peninsula (3.0/km) and decline southward, with 1.2/km in the Gulf of Carpentaria and Cairns regions, down to 0.2/km in the Fitzroy River, Rockhampton (Figure 4). This southerly reduction is a likely consequence of lower temperatures and less suitable habitat.

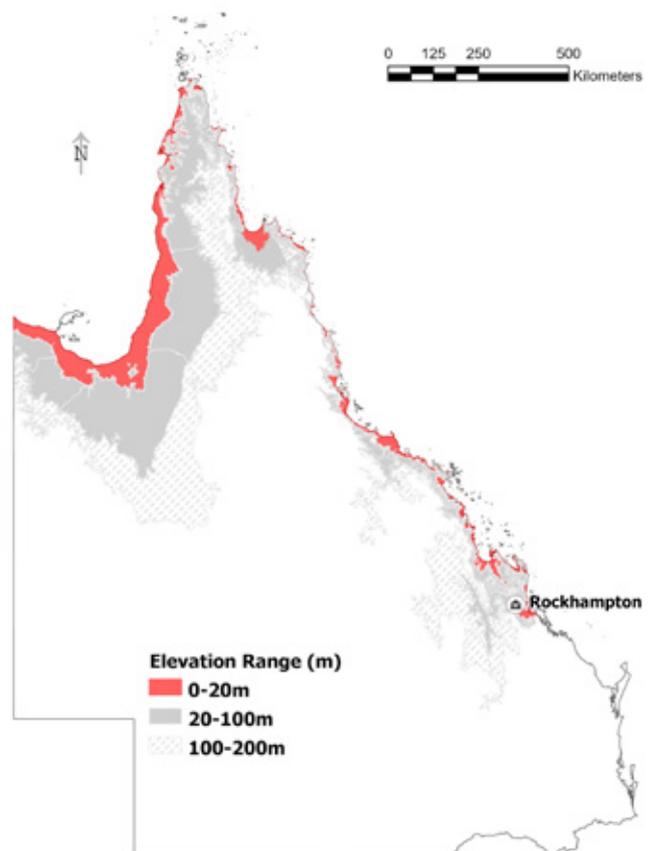


Figure 3. The majority (>90%) of the estuarine crocodile population in Queensland exists below 20m elevation above sea level, with a further ~9% at 20-100m elevation and ~1% at 100-200m elevation.

Regional variations

- North-western Cape York Peninsula is the most important source of nesting and recruitment in Queensland and contains almost 40% of the state's estuarine crocodile population.
- The Proserpine River, in the Whitsundays region, has the highest density of crocodiles (5.5/km) in Queensland, for reasons that are yet to be fully understood.

No crocodiles were detected in waterways south of the Fitzroy River, Rockhampton, during the monitoring program. While crocodiles are known to occur in waterways south of the Fitzroy River, they occur as individual animals rather than established populations and are best considered vagrants or non-breeding residents.

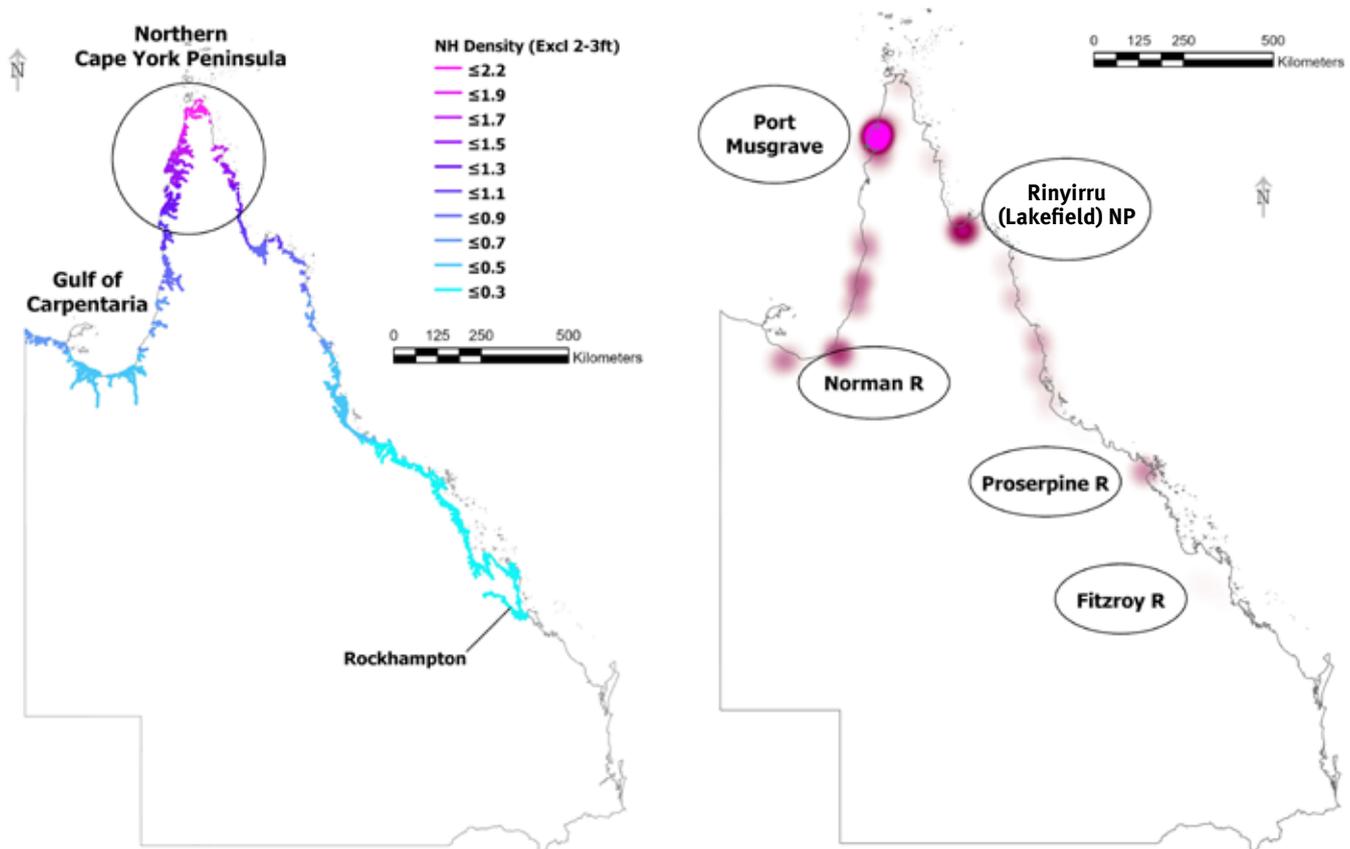


Figure 4. a) Crocodile densities are highest in northern Cape York Peninsula and decline southward; b) The far north-west of CYP contains 40% of the population, while Rinyirru (Lakefield) National Park and the Norman River are also key areas for nesting and recruitment. The Proserpine River has the highest density of any river in Queensland – 5.5/km, while the Fitzroy River represents the southern-most breeding population.

Where to from here?

Human-crocodile conflict will continue into the future. However, the modest growth rate of the crocodile population and the low to very low density of crocodiles across much of their range should allow for continuing effective management into the future. Key to this is the adoption and promotion of Crocwise behaviour.

The Department of Environment and Science will continue to actively monitor crocodiles into the future. It forms a key knowledge source to inform actions that improve both conservation and public safety outcomes. Rigorous and comprehensive monitoring allows future management models to become more responsive to population trends. This includes taking a proactive approach by identifying key areas for future management efforts and critical research.

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Appendix 3—Crocodile Roundtable Membership List

Name	Position	Organisation
Ms Cynthia Lui MP	Member of Parliament	Member for Cook
Mr Michael Healy MP	Member of Parliament	Assistant Minister for Tourism Industry Development and Member for Cairns
The Honourable Craig Crawford MP	Member of Parliament	Minister for Seniors and Disability Services and Minister for Aboriginal and Torres Strait Islander Partnerships and Member for Barron River
Cr Brett Olds	Councillor	Cairns Regional Council
Ms Leah Nugent	Council lands officer	Cairns Regional Council
Ms Tara Bennett	Chief Executive Officer	Tourism Port Douglas Daintree
Cr Jeff Baines	Councillor	Cassowary Coast Regional Council
Cr Michael Kerr	Mayor	Douglas Shire Council
Mr Damon Sydes	Manager, Parks, Open Space and Environment Technical Services	Cassowary Coast Regional Council
Cr Lisa Scomazzon	Deputy Mayor	Douglas Shire Council
Cr Lenore Wyatt	Councillor	Mareeba Shire Council
Cr Peter Scott	Councillor	Cook Shire Council
Cr Ramon Jayo	Mayor	Hinchinbrook Shire Council
Mr Brett Spencer	Manager	Cairns Regional Council
Mr Greg Bruce	Executive Manager, Integrated Sustainability Services	Townsville City Council
Cr Brett Moller	Councillor	Cairns Regional Council
Cr Jenny Hill	Mayor	Townsville City Council
Cr Angela Toppin	Mayor	Mareeba Shire Council
Cr Mark Nolan	Mayor	Cassowary Coast Regional Council
Mrs Angela Freeman	Director, Sales and Marketing	Hartley's Crocodile Adventures
Mr Daniel Hammersley	Representative	Recreational Fishing Representative
Mr David White	Tourism Business Owner	Solar Whisper
Ms Lyndal Singleton	Director	Dawul Wuru Aboriginal Corporation
Cr Bradley Creek	Mayor	Wujal Wujal Aboriginal Shire Council
Cr Ross Andrews	Mayor	Yarrabah Aboriginal Shire Council
Ms Lucy Graham	Director	Cairns and Far North Environment Centre
Mr Denis Walls	President	Cairns and Far North Environment Centre

Name	Position	Organisation
Mr Matt Plummer	Manager	Cairns Crocodile Farm
Mr Peter Todd	Representative	Recreational Fishing representative
Mr Mark Olsen	Chief Executive Officer	Tourism Tropical North Queensland
Ms Jennifer Rees	Regional Manager	Surf Life Saving Queensland
Ms Kaitlyn Akers	General Manager, Club Services	Surf Life Saving Queensland
Mr Bill Ferguson	Government Relations Manager	Australia Zoo
Ms Kelsey Engle	Representative	Australia Zoo
Mr Andrew Buckley	Assistant Director-General	Department of Environment and Science
Ms Kirstin Kenyon	Executive Director, Wildlife and Threatened Species Operations	Department of Environment and Science
Mr Lindsay Delzoppo	Director, Northern Wildlife Operations	Department of Environment and Science
Mr Michael Joyce	Regional Manager, Northern Wildlife Operations	Department of Environment and Science
Dr Matt Brien	Program Coordinator, Northern Wildlife Operation	Department of Environment and Science
Dr Laurence Taplin	Crocodile Expert	Advisor to Department of Environment and Science on the crocodile monitoring program

Appendix 4—Stakeholder feedback on the crocodile management program

The Department of Environment and Science (the Department) commenced a targeted stakeholder consultation process regarding its management of estuarine crocodiles on Thursday 29 July 2021 at the Crocodile Roundtable meeting in Cairns. The Crocodile Roundtable provides stakeholders with an opportunity to work closely with the Department during development and application of Crocwise messages to target specific stakeholders' needs. At the 29 July 2021 Crocodile Roundtable meeting, Northern Wildlife Operations staff from the Department presented an overview of the results of the Department's 2016-2019 estuarine crocodile monitoring program. Attendees had the opportunity to ask the scientists who coordinated the monitoring programs questions. However, attendees did not have the opportunity to consider the monitoring program's results prior to the meeting, as the Queensland Estuarine Crocodile Monitoring Program 2016-2019 Key Findings Report had not been publicly released.

Crocodile Roundtable and The Crocodile Management Independent Expert Evaluation Committee (Committee) members who were not able to attend the 29 July 2021 meeting could view the recording of the entire meeting.

Crocodile Roundtable meeting feedback

During the 29 July 2021 Crocodile Roundtable meeting, many Crocodile Roundtable members made very positive comments regarding the Queensland Parks and Wildlife Service and Partnerships progress since 2016 regarding crocodile management and communication. Many local council representatives requested crocodile population data specific to their area, along with relevant communication material (written in simple, plain English) to share with their constituents via social media and other channels.

A Cairns Regional Council representative advised the public wants more proactive monitoring and removal. Crocodile Roundtable members also expressed interest in crocodile detection devices that would tell swimmers to get out of the water if a crocodile was detected.

The QWildlife App was discussed, with members advising they would like to see increased promotion and use of the App. The need for security cameras at boat ramps was also discussed, because the Department's Wildlife Officers have witnessed people deliberately or inadvertently feeding crocodiles at boat ramps. Penalty Infringement Notices have been issued in some cases. Some Crocodile Roundtable members believe this deliberate feeding is intended to turn them into a problem crocodile so that they are targeted for removal by the Department, however there is no evidence of this.

Some tourism industry representatives present at the meeting expressed concern over the increasing number of tourists who want to swim in natural water bodies in croc country, and the subsequent desire for safe areas to swim around the Northern Beaches, at Lake Placid, and in Douglas Shire. Tourism industry representatives also raised concerns regarding increasing tourism numbers around Cooktown and the Cape York Peninsula.

During the networking lunch immediately after the Crocodile Roundtable meeting, Professor Possingham spoke with a representative from Australia Zoo, who advised the zoo does not believe in sustainable use of wildlife and would oppose egg harvesting (as has been undertaken in the Northern Territory since the 1980s, for example).

At the conclusion of the meeting, Professor Possingham invited all Crocodile Roundtable members to contact him directly if they'd like to discuss the Department's estuarine crocodile management program further. Consequently, between 11 August and 17 August 2021, Professor Possingham and other Committee members held individual meetings with five Crocodile Roundtable members.

Feedback received during individual meetings

On 11 August 2021, Councilor Brett Olds from Cairns Regional Council advised:

- signs erected by local councils at popular swimming spots such as Kewarra Beach are sending mixed messages to the public (as the signs say not to go within five meters of the ocean, but there is a Surf Lifesaving patrol hut and a stinger net present, literally directly behind the one of the signs). Signs need to be located in the most appropriate places to reduce the potential for mixed messages to be sent;
- his constituents are not really concerned about the crocodile numbers (as it doesn't matter if there's only one crocodile present, or 100), they just want crocodiles to be removed more quickly, and not just when they are reported to the Department of Environment and Science. They would like more proactive patrolling near local beaches and swimming holes;
- he is happy with the current crocodile management zones (but if there was a way to make popular locations like Lake Placid safe for swimming again, that would be a huge win in Brett's opinion);
- he would like wildlife officers to be assigned on a full-time basis to patrol popular swimming areas; and
- floating pontoons at boat ramps make launching and docking boats much safer.

On 11 August 2021, Councilor Lenore Wyatt from Mareeba Shire Council advised:

- Zone F are locations where saltwater crocodiles were not known historically and there is a very large Zone F around Mareeba;
- the length of time it can take for wildlife officers to remove crocodiles in Zone F is of great concern to her constituents;
- the presence of crocodiles in Two Mile Creek is a lifestyle and workplace health and safety issue for many of her constituents, and the community would like them removed; and
- she would like Zone F to be extended to include parts of the Barron River and Lake Mitchell.

On 13 August 2021, Angela and Peter Freeman, Hartley's Crocodile Adventures (Hartley's), advised:

- Hartley's plays an important role in educating the community; people on their way to Cape York, the Daintree and Cape Tribulation often stop at Hartley's and get information and advice on how to stay safe in croc country;
- First Nations people do not feel the Department engages with them enough and First Nations people are very concerned about crocodile management in croc country;
- different Traditional Owner groups have different relationships with crocodiles;
- Hartley's are very concerned about what will happen to crocodiles that are removed once they and the Cairns Crocodile Farm are at capacity. Other crocodile farms in the region have already reached capacity, and the State Government does not provide Queensland crocodile farms with any funding support.
- Hartley's could house a few more crocodiles if financial assistance and in-kind support was provided (the Department has equipment Hartley's would like to use from time to time);
- Hartley's welcomes DES staff using their facilities and crocodiles for research purposes;
- Hartley's tells people that the chance of them being attacked by a crocodile in Winter is very low, and that visitors always need to be situationally aware and assess risks;
- Hartley's strongly supports more research into crocodile detection, warning and deterrence devices and believes other crocodile-related research is also lacking;
- Hartley's recommend the Department meets with the Department of Agriculture and Fisheries' shark management group twice a year to discuss areas for collaboration, as Angela has observed a lot of duplicated effort between the two departments, particularly around conflict wildlife research; and

- any renaming of crocodile management zones would need to be undertaken in a manner that considers the views of tourism industry stakeholders. Attaching place names to the zones could be inflammatory or detrimental e.g., Mission Beach, Palm Cove, etc.

On 16 August, Peter Todd, recreational fishing representative and Cairns local for the last 73 years, stated that in his opinion:

- Wonga Beach (approximately 115km North North-West of Cairns) is being overrun by crocodiles and large numbers of dogs are being attacked by crocodiles;
- his lifestyle, and the lifestyle of the whole community, is being significantly affected by the presence of crocodiles in areas they didn't inhabit when he was a child;
- most Cairns locals feel the same way he does;
- the crocodiles are calling the shots, and crocodile management in North Queensland is not keeping pace with crocodile numbers; and
- if the same situation was occurring on the Gold Coast, South-East Queensland, politicians and other decision-makers would take it much more seriously.

Peter also mentioned he has friends in the Cairns area whose cattle have been taken by crocodiles. Peter advised that he supports Councillor Brett Olds' opinion that all of Cairns should be an active removal zone. Peter supports crocodile egg harvesting. Peter also spoke about Tilapia, a restricted noxious fish under the *Biosecurity Act 2014*, which he believes are providing a food source for crocodiles and contributing to their increasing numbers. Peter mentioned that in the past, locals would fish for Tilapia, therefore keeping their numbers down, in his opinion. However, now it is illegal to keep, feed, give away, sell, or release Tilapia into the environment without a permit. If Tilapia are caught, they must be humanely killed and disposed of by burying them above the high-water mark or disposing of them in a nearby bin.

On 17 August 2021, Tara Bennett, Chief Executive Officer, Tourism Port Douglas Daintree (TPDD), advised:

- TPDD would like more opportunities to collaborate with DES regarding on-ground crocodile management;
- TPDD would like Land and Sea Rangers to receive additional training so they can play a more important and hands-on role in the crocodile removal program;
- the tourism industry would like to know what crocodile management actions are available going forward and how this is going to be resourced;
- there is a range of views across the Queensland tourism industry, and some operators (particularly accommodation providers near the beach in croc country) want all crocodiles to be removed;
- TPDD understands and supports the science behind the crocodile management program and is happy with the current management zones;
- it's hard to get the right information to visitors, especially when they use a range of information sources which may or may not be factual. For example, Facebook groups are being used more and more as an information source; and
- it's going to be a challenge to get Crocwise messaging to the increasing number of free and independent travellers (i.e., tourists that are not part of an organised tour group) visiting remote areas like the Cape York Peninsula.

Tara recommended:

- the Department talks to beachside resorts in Port Douglas to find out what tools and resources would help them communicate Crocwise messages to visitors and train frontline staff;
- the Department talks to recreational users e.g., kite surfers to inform development of Crocwise messaging and communication strategies;
- it would be beneficial to communicate the science behind the crocodile management program in a simple way; and
- the Department could include fun and interesting facts on interpretive signs.

Appendix 5—Media summary

The Crocodile Management Independent Expert Evaluation Committee monitored media and social media reports that followed the release of the Queensland Estuarine Crocodile Monitoring Program 2016-2019 Key Findings Report (Key Findings Report) and the non-fatal crocodile attack 6 August 2021, and gained insight into the wide range of views expressed by members of the public and other commentators.

On release of the Key Findings Report, there were several media articles supporting the science behind the 2016-2019 crocodile monitoring program and its findings, including by tour operators and scientists. However, there were also views expressed in the media by some local politicians casting doubts on the findings and calling for a change in crocodile management.

While some reports of the crocodile attack presented one of the victims as a hero for having fought off the crocodile and rescued his mate, there were also comments, particularly by local residents and the Mayor of Lockhart River Community Council, that it is croc country and people should not be swimming there. Following a Department of Environment and Science press release stating the crocodile had been humanely euthanised, there were strong comments on social media opposing the euthanasia of the crocodile because, in the writers' opinions, it had the right to be there and the victims had acted irresponsibly. Other social media commentators supported the euthanasia, given the circumstances.

Appendix 6—List of documents provided to the Committee

Internal reports and other documents

- Department of Environment and Heritage Protection, “Crocwise survey results.xlsx,” 2016.
- Department of Environment and Heritage Protection, Crocwise communication plan.pdf, 2017.
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- Public Service Commission, “Human-crocodile interaction persona research.pdf,” 2018.
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- Queensland Government, "*Nature Conservation Estuarine Crocodile Conservation Plan 2018.pdf*," 2020.
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- Department of Environment and Heritage Protection, "*2017 Queensland Crocodile Management Plan.pdf*", 2017.
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 - "*Cairns map.pdf*"
 - "*Cassowary map.pdf*"
 - "*Douglas map.pdf*"
 - "*Gladstone map.pdf*"
 - "*Hinchinbrook map.pdf*"
 - "*Mackay map.pdf*"
 - "*Mareeba map.pdf*"
 - "*Overview map.pdf*"
 - "*Rockhampton map.pdf*"
 - "*Townsville map.pdf*".
- Department of Environment and Heritage Protection, "*Wildlife Trade Management Plan – Queensland Crocodile Farming 1 January 2018 - 31 December 2022*", 2017.
- Department of Environment and Heritage Protection, "*Guideline - Allocation of crocodiles of concern to farms and zoos.pdf*", 2013.
- Department of Environment and Heritage Protection, "*Operational Policy - Crocodile sighting and incident response.pdf*", 2013.
- Department of Environment and Science, "*Operational Policy - Responding to a crocodile attack resulting in a human fatality.pdf*", 2020.
- Department of Environment and Science, "*Operational Policy - Revoke a Problem Crocodile Decision.pdf*", 2021.
- Department of Environment and Science, "*20170613 Crocodile Monitoring Operational Plan.pdf*", 2017.
- Department of Environment and Science, "*Standard Operating Procedure Reporting of Deceased Crocodiles.pdf*", 2018.
- Department of Environment and Science, "*Standard Operating Procedure - Crocodile Permanent Warning Sign allocation to external agencies.pdf*," 2017.
- Department of Environment and Science, "*Standard Operating Procedure - QWildlife Managing Priorities and Declarations in QWildlife.pdf*," 2020.
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- Department of Environment and Science, “Crocodile commercial activity compliance plan.pdf”, 2018.
- Department of Environment and Science, “Crocodile Management Training Package.pdf”, 2020.

Journal articles and published reports

- Brien et al., “The suitability of digital video surveillance and multi beam sonar.pdf”, 2020.
- Brien et al., “Suitability of Digital Video Surveillance and multi-beam sonar to monitor crocs.pdf”, 2021.
- Brien et al., “Patterns of human crocodile conflict in Qld a review of historical estuarine croc management.pdf”, 2017.
- Brien et al., “A Novel Method of Using a Drone Capture Saltwater Crocodiles.pdf”, 2020.
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- Department of Environment and Science, “Crocodile Roundtable presentation.pptx”, 2021.
- Department of Environment and Science, “Crocodile management overview presentation.pptx”, 2021.
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- Department of Environment and Science, “Crocodile Management page.pdf”, 2021.
- Department of Environment and Science, “Crocodile sightings page.pdf”, 2021.
- Department of Environment and Science, “Working with communities page.pdf”, 2021.
- Department of Environment and Science, “Crocodile egg harvesting page.pdf”, 2021.
- Department of Environment and Science, “Crocwise home page.pdf”, 2021.
- Department of Environment and Science, “Estuarine Crocodile page.pdf”, 2021.

- Department of Environment and Science, “FAQs page.pdf”, 2021.
- Department of Environment and Science, “Colouring in page.pdf”, 2017.
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