



Northern
Territory
Government

DEPARTMENT OF LAND RESOURCE MANAGEMENT

Wildlife Trade Management Plan for the Saltwater Crocodile (*Crocodylus porosus*) in the Northern Territory of Australia, 2016-2020



Photo: Parks and Wildlife

Wildlife Trade Management Plan for the Saltwater Crocodile (*Crocodylus porosus*) in the Northern Territory of Australia, 2016-2020

Department of Land Resource Management
PO Box 496
Palmerston NT 0831

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This is a Wildlife Trade Management Plan prepared under the *Environment Protection and Biodiversity Conservation Act 2000*.

Plan Approval

The Wildlife Trade Management Plan for the Saltwater Crocodile (*Crocodylus porosus*) in the Northern Territory of Australia, 2016-2020.

Approved by the Australian Minister for the Environment as an approved Wildlife Trade Management Plan under subsection 303FO of the *Environment Protection and Biodiversity Conservation Act 2000* on dd-mmm-yyyy.

Approval of this program is valid until 31 December 2020.

The accompanying *Management Program for the Saltwater Crocodile (Crocodylus porosus) in the Northern Territory of Australia, 2016* was approved by the Administrator for the Northern Territory as an approved management program under section 34(2) of the *Territory Parks and Wildlife Conservation Act* on dd-mmm-yyyy.

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Definitions and Acronyms

Adult

Animals greater than 1.8 metres total length are classed as adults. This is a defined size class for the purpose of this Management Plan and does not equate to sexual maturity.

ALR(NT) Act

Aboriginal Land Rights (Northern Territory) Act, Commonwealth legislation.

CITES

Convention on International Trade in Endangered Species of Wild Fauna and Flora

Crocodile Products and By-products

Includes all parts from a crocodile except for skins as defined below.

Crocodile Skins

Includes raw or tanned belly skins (cut along the back), horn-back (cut along the belly) and whole skins.

DLRM

Department of Land Resource Management, Northern Territory Government.

DoE

Department of the Environment, Australian Government.

DPIF

Department of Primary Industry and Fisheries, Northern Territory Government.

Egg Harvest

The physical removal of an egg from its natural location in the wild and transportation to another location.

Eggs

Unless otherwise stipulated includes all eggs regardless of whether fertile or infertile, or with a live or dead embryo.

Eggs - dead

Eggs that are infertile or contain a dead embryo.

Eggs - live

Eggs that contain a live embryo.

Eggs - viable

Eggs that produce a normal hatchling surviving for at least one day outside the egg.

EPBC Act

Environment Protection and Biodiversity Conservation Act, Commonwealth legislation.

Harvest Ceiling

Under this Management Plan, the annual maximum number of individuals that can be harvested in each of the defined life stages.

Hatchling

Animals classed as hatchlings are born during the preceding nesting season and are typically less than 0.6 metres total length.

Juvenile

Animals classed as juveniles are between 0.6 and 1.8 metres total length.

Live Harvest

The physical removal of a hatchling, juvenile or adult animal from its natural location in the wild and transport to another location, excluding the relocation of an animal from one location in the wild to another location in the wild.

Management Program

The Management Program for the Saltwater Crocodile (Crocodylus porosus) in the Northern Territory of Australia, 2016.

Non-hatchling

Animals classed as non-hatchling are greater than 0.6 metres total length (ie. juvenile and adult animals).

PWCNT

Parks and Wildlife Commission of the Northern Territory, Northern Territory Government.

Ranching

As used in the context of CITES, the rearing in a controlled environment of animals taken from the wild.

Regional Catchment

Catchments as defined in Australian Surface Water Management Areas (2000), that are grouped for monitoring of the crocodile harvest in the Northern Territory.

Total Length

Animal length measured from the tip of the snout to the end of the tail.

TPWC Act

Territory Parks and Wildlife Conservation Act, Northern Territory legislation.

WTMP

Wildlife Trade Management Plan for the Saltwater Crocodile (Crocodylus porosus) in the Northern Territory of Australia, 2016-2020.

1. Introduction

Saltwater Crocodile (*Crocodylus porosus*) is the largest of the extant crocodylian species, with a wide distribution throughout the Indo-Pacific region (Webb *et al.* 2010). They are top-order predators, including of humans, and co-existence with crocodiles present challenges for the Northern Territory community. Crocodiles also provide significant economic opportunities, are a valuable resource to both Indigenous and non-Indigenous people in northern Australia, and an icon for tourism within the Top End of the Territory.

During the 20th century, habitat loss and hunting for commercial trade depleted many populations of the saltwater crocodile throughout its range (Webb & Manolis 1989, Webb *et al.* 2010). In the Northern Territory, where the greatest proportion of saltwater crocodile numbers occur (Fukuda *et al.* 2007, 2011 & submitted), a lucrative and uncontrolled trade in saltwater crocodile skins between 1945 and 1971 led to intensive hunting that depleted the wild populations to the point of extinction. Consequently, the species became protected in 1971 in the Northern Territory (Webb *et al.* 1984).

In the early 1980s, following a series of fatal and non-fatal attacks and an increase in other negative interactions with people, there were calls for an end to the ongoing recovery of the crocodile population and widespread culling was actively promoted. At this time the population had increased from an estimated minimum of 5,000 to around 30,000 (Webb *et al.* 1984).

To ensure that the conservation program aimed at rebuilding the wild population back to carrying capacity was maintained, the Northern Territory Government implemented an “incentive-driven conservation” strategy. This strategy promoted crocodile conservation by informing the public of the environmental and economic benefits of crocodile conservation. Positive incentives were created through commercial activity (tourism, crocodile farming and ranching) and negative impacts addressed by an active ‘Problem Crocodile’ control program.

Ranching of eggs (the commercial collection of eggs from the wild and raising into hatchlings) was considered to be the safest strategy for sustainable use, as the egg stage is an abundant but naturally vulnerable part of the life cycle. This resulted in nesting habitat on private lands becoming a commercial asset worth protecting.

In 1985 Australia was successful in having its population of Saltwater Crocodiles transferred from Appendix I to Appendix II of the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) specifically for ranching, so that farms could export the skins produced from the harvested eggs they bought from landowners. In 1987, the first Northern Territory Crocodile Management Program was approved as a Wildlife Trade Management Plan by the Commonwealth and skins derived from the ranching program began to be exported. In 1994, Australia obtained an unrestricted Appendix II CITES listing to allow landowners with crocodiles, but no nesting habitat, to also receive commercial benefits from crocodiles through a wild harvest.

The Northern Territory Government has fostered the crocodile farming industry and in recent years the Territory crocodile industry has significantly invested in farm infrastructure to increase their capacity. The industry has grown in conjunction with the crocodile population,

to the point where the Northern Territory leads the world in the production of high quality saltwater crocodile skins.

The incentive-driven wildlife program has been a major conservation success, with saltwater crocodiles no longer a threatened species in the NT. Saltwater Crocodile populations have recovered to such an extent that abundance is approaching pre-hunting levels and near natural carrying capacity (Fukuda *et al.* 2011, submitted).

Saltwater Crocodiles are recognised as a valuable commercial resource, generating wealth and employment which promotes their conservation. The Wildlife Trade Management Plan no longer has as its core aim the recovery of the saltwater crocodile population, but rather the continued growth of a prosperous, sustainable crocodile farming industry as the key driver for saltwater crocodile conservation. The tourism value of crocodiles both in the wild and in captivity also generates significant economic activity. Economic benefits from crocodile harvest and tourism value flow to landowners and particularly indigenous communities, encouraging the protection and management of wetland habitats.

Through this Wildlife Trade Management Plan, the *Management Program for the Saltwater Crocodile (Crocodylus porosus) in the Northern Territory of Australia, 2016* and the *Northern Territory Crocodile Farming Industry Strategic Plan 2016-21*, the Northern Territory Government will continue to support industry to maximise the investment, commercial activity and employment generated through crocodiles. The farming industry's vision is for the Northern Territory to grow as a world leader in the reliable production of the highest quality Saltwater Crocodile skins, and for the industry to grow its role as a significant contributor to the economic and social prosperity of the NT.

This Wildlife Trade Management Plan addresses the balance that is required between sustainable harvest, industry growth and maximizing economic benefits to landowners. It focuses on mechanisms to support the crocodile industry, enhance landholder benefit and participation, establish safe harvest limits and monitor sustainability of use.

1.1 Aim

The aim of the Wildlife Trade Management Plan is to manage the Saltwater Crocodile for the benefit of Territorians while ensuring the long-term conservation of the species and its habitats in the Northern Territory.

In achieving this aim two general principles are applied:

1. Management and regulatory decisions should be evidence-based, supported by high-quality scientific data and robust monitoring;
2. The treatment of saltwater crocodiles must be humane and in accordance with the requirements of Animal Welfare legislation, and adhere to [The Code of Practice on the Humane Treatment of Wild and Farmed Australian Crocodiles](#).

1.2 Species

The Saltwater Crocodile (*Crocodylus porosus* Schneider) is one of two species of crocodile found in Australia, the other being the smaller Freshwater Crocodile (*Crocodylus johnstoni*). Subspecies or races for Saltwater Crocodile within Australia have not been described. Further details on the conservation status, distribution, biology, ecology, population and habitat of the Saltwater Crocodile are provided in Appendix 1.

1.3 Responsible authority

The Northern Territory Government, through the Department of Land Resource Management (DLRM) and the Parks and Wildlife Commission of the Northern Territory (PWCNT), manages wildlife in the Northern Territory pursuant to the *Territory Parks and Wildlife Conservation Act (TPWC Act)*. The management and regulation of all aspects of harvest from the wild and use of protected wildlife in the Northern Territory is administered under this legislation. The Department of Primary Industry and Fisheries (DPIF) has some regulatory responsibilities for wild and farmed crocodiles arising from the *Animal Welfare Act*, *Livestock Act* and *Meat Industries Act*. These responsibilities are outlined in Appendix 2.

1.4 Legislative, national and international obligations

1.4.1 Northern Territory

Territory Parks and Wildlife Conservation Act (TPWC Act)

The Saltwater Crocodile is classified as protected wildlife throughout the Northern Territory under the [TPWC Act](#) (section 43). The Act prohibits the taking or interfering with, the keeping of, or the import or export of protected wildlife in the Northern Territory without authority. Authority is a permit issued by the Director of the Parks and Wildlife Commission or their delegate under Section 56 of the Act.

The taking of protected wildlife by Aboriginal people for traditional purposes, including food, is provided for under Section 122 of the *TPWC Act*. Aboriginal people are not bound by hunting regulations or seasons when taking animals for food or other traditional purposes.

Animal Welfare Act

Crocodiles are “animals” under the [Animal Welfare Act](#). The objectives of this Act are to ensure that animals are treated humanely, to prevent cruelty to animals and to promote community awareness about the welfare of animals. Persons owning, managing or handling crocodiles have a responsibility of “duty of care” and must not commit an act of cruelty to the animal.

Code of Practice on the Humane Treatment of Wild and Farmed Australian Crocodiles

Animal welfare standards for crocodiles are detailed in this [Code](#). All crocodiles must be managed in accordance with this Code.

Environmental Assessment Act

New developments for the farming, processing and display of crocodiles that may have a significant environmental impact will need to meet the requirements of the [Environmental Assessment Act](#).

Meat Industries Act

Farmed crocodiles may be slaughtered in abattoirs licensed for the slaughter of crocodiles for human consumption. The [Meat Industries Act](#) provides for the safety and suitability of food for human consumption. The Saltwater Crocodile was declared (G24) as a game animal under the *Meat Industries Act* on 10 June 2004, which enables crocodiles killed in the wild to be slaughtered. This is strictly monitored and requires approval of the Northern Territory’s Chief Inspector (Meat).

Livestock Act

Farmed crocodiles are treated as livestock under the [Livestock Act](#) which provides for disease surveillance, disease control, identifying and tracing animals and regulating movement of animals and animal products for the purpose of disease control.

1.4.2 Commonwealth Government

Environment Protection and Biodiversity Conservation Act 1999

The [Environment Protection and Biodiversity Conservation Act](#) regulates import to and export from Australia of all Australian native animals, or their parts. Part 13A of the *EPBC Act* regulates import and export of crocodiles and crocodile products, and fulfils Australia’s legislative requirements as a signatory party to CITES (see 1.4.3). Section 303CH lists specific conditions that must be met for the export or import of CITES specimens. For export of CITES Appendix II species, the specimen must be sourced from an appropriate captive breeding or artificial propagation program, an approved wildlife trade operation, or an approved Wildlife Trade Management Plan. Commercial export permits for crocodiles are issued under Section 303CG.

The Saltwater Crocodile is also a listed marine species under section 248 of the *EPBC Act* and a listed migratory species under s209 of the Act and this species may be considered as a Matter of National Environmental Significance under the Act.

This Wildlife Trade Management Plan for the Saltwater Crocodile (*Crocodylus porosus*) in the Northern Territory of Australia, 2016-2020 complies with the requirements for an approved Commonwealth Wildlife Trade Management Plan under Section 303FO of the *EPBC Act*.

Aboriginal Land Rights (Northern Territory) Act

The [Aboriginal Land Rights \(NT\) Act](#) establishes the Land Councils in the Northern Territory. One function of the Land Councils is that they confirm the correct landholders (traditional owners) have given their permission for any commercial wildlife harvest before *TPWC Act* permits can be issued. This Act also provides for Section 19 Land Use Agreements which should be in place for commercial crocodile harvesting from Aboriginal land. These agreements provide the conditions of access to land for the purpose of harvesting and there should be consistency between *ALR(NT) Act* Land Use Agreements and *TPWC Act* permits.

1.4.3 International

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

All crocodylians (including alligators, caimans and true crocodiles) are listed on the Appendices of the CITES convention, to which Australia is signatory. Those species most threatened in the wild by trade are listed on Appendix I and all remaining species are listed on Appendix II. In most countries *C. porosus* is listed on Appendix I but the Australian, Indonesian and Papua New Guinean populations are included in Appendix II, which allows international trade subject to the provisions of CITES. The Appendix II listing places controls on international trade in crocodiles and crocodile products through export permits. A CITES export permit is required for all commercial exports and can only be issued if it has been determined that the export will not be detrimental to the survival of the species and that the specimen was legally obtained.

Convention on Wetlands of International Importance (Ramsar Convention)

Australia is a signatory to the Ramsar Convention. There are plans of management for all three of the Ramsar-listed areas of the Northern Territory (Stages One and Two of Kakadu National Park and Garig Gunak Barlu National Park) which seek to protect wetlands and their dependent fauna, including Saltwater Crocodile.

2. Background information

2.1 Socio-economic significance

In the Northern Territory, crocodiles are an iconic species that attract considerable publicity and a wide range of community views and opinions regarding their abundance, distribution and cultural and economic importance.

2.1.1 Cultural values

The importance of crocodiles in Aboriginal culture is reflected in a complex system of totems and ceremonies which is still evident among most coastal Aboriginal communities in northern Australia (Lanhupuy 1987). Aboriginal communities also regard saltwater crocodiles as dangerous animals. The non-Indigenous community has a diversity of views on saltwater crocodiles from being reviled as dangerous pests to being admired and recognised as a significant component of the environment. Crocodiles are an important natural resource for many sectors including Aboriginal communities, the tourist industry and the crocodile farming industry.

2.1.2 Economic values

The harvesting of crocodiles, primarily for their skins but also for their flesh and body parts, supports a significant industry in the Northern Territory. The NT crocodile farming industry was worth approximately \$25 million annually in 2014-2015 and has the potential to double in value over the life of this Wildlife Trade Management Plan (*Northern Territory Crocodile Farming Industry Strategic Plan, 2016-2021*).

The NT crocodile farming industry is the world leader in the production of high quality Saltwater Crocodile skins. Australia accounts for approximately 60% of the reported global trade in Saltwater Crocodile skins, with about two-thirds of this (~21,000 skins in 2011) grown and exported from the NT.

The mainstay of the crocodile farming industry is the annual harvest of eggs from the wild under a ranching program. This harvest has operated annually since the first small trial harvest in the 1983/84 nesting season. The annual harvest of up to 70,000 live eggs (in the previous management program a live egg was defined as an egg placed in an incubator) provides a significant employment and commercial opportunity to landholders, in particular remote indigenous communities. During this plan (2016-2020) the wild harvest of eggs will continue to be the primary form of harvest.

Commercial live harvest (hatchlings, juveniles and adults) has been permitted since 1994 when all restrictions and conditions on the CITES listing of the Australian population of Saltwater Crocodile were removed. The commercial live harvest has always been small, substantially less than the annual ceiling of 500 adults in the previous program and almost zero for hatchlings and juveniles (Saalfeld & Fukuda 2014).

Crocodiles contribute significantly to visitor experiences of the Top End and viewing crocodiles is an important expectation or even a “must” for most Top End visitors. In visitor surveys, Tremblay (2003) reported that seeing crocodiles dominates the best experiences in

wildlife-viewing. While tourists generally prefer to see crocodiles in the wild and this is an increasingly sought after experience, attractions featuring captive crocodiles are also rated highly and are popular destinations. The Top End offers a wide range of experiences from observing in the wild, modified behaviour in the wild, research/educational displays and captive encounters. The economic value of saltwater crocodiles to tourism is estimated to be on the order of tens of millions of dollars annually but no firm value has been ascribed due to the difficulty in estimating the indirect component.

2.2 Population estimates and trends

The Northern Territory population of wild, non-hatchling saltwater crocodiles was estimated in 2012 as 90,000 to 100,000 individuals (Fukuda *et al.* submitted). The current monitoring data provides a measure of the population trend in the sampled rivers and by extrapolation an estimate of the trend for the total population. The wild population is approaching pre-hunting levels and is thought to be near carrying capacity (Fukuda *et al.* 2011, submitted). Details of the long-term population trends are shown in Appendix 3. These metrics do not provide a measure of the total number in the population nor is such an absolute measure required for management purposes.

2.3 Saltwater crocodile habitat

Saltwater Crocodiles may potentially occupy almost any water body throughout their distribution in the NT (see Appendix 1, Saalfeld *et al.* 2014). Suitable nesting habitat is limited to freshwater wetlands within this distribution (Fukuda *et al.* 2007, Fukuda & Cuff 2013). Fukuda & Cuff (2013) estimate the area of high quality saltwater crocodile habitat in the Northern Territory at 41,154 km². This is approximately 11% of the total area of extent (378,000 km²) of saltwater crocodiles in the Northern Territory (see Appendix 1).

Approximately 70% of saltwater crocodile habitat is Aboriginal land and approximately 10% (4,680 km²) of high quality habitat falls within formal protected areas (Fukuda & Cuff 2013, Saalfeld *et al.* 2014). No harvesting is permitted in Kakadu National Park so it is of particular significance as a protected area for crocodiles, containing 58% of NT crocodile habitat within protected areas (Saalfeld *et al.* 2014).

2.4 Problem saltwater crocodiles

Saltwater Crocodiles can pose an extreme risk to human safety (Fukuda *et al.* 2014 & 2015) and can also be a significant risk to livestock and domestic animals.

“Problem crocodiles” are defined as those individuals where one or more of the following applies:

- The crocodile has attacked or is about to attack a person or persons;
- The crocodile is behaving aggressively towards a person or persons;
- The location of the crocodile makes it a threat or potential threat to human safety or wellbeing; or
- The activity of the crocodile is affecting the productivity of industry or commercial enterprises.

The Wildlife Trade Management Plan allows for problem crocodiles to be removed from the wild (harvested). Because crocodiles released back to the wild tend to return quite rapidly to sites of capture (Walsh & Whitehead 1993) and transport and handling is stressful and costly, problem crocodiles are not relocated.

Recent reviews (Fukuda *et al.* 2014 & 2015) of saltwater crocodile attacks and problem crocodile management indicate that intensive localised removal of crocodiles can reduce the risk of crocodile attack, but targeted removal of large individuals does not substantially decrease risk.

2.5 History of use

Crocodile meat and eggs are thought to have been used as a food source by Aboriginal people for at least 40,000 years (McBryde 1979, Flood 1983). The subsistence use of crocodiles by Aboriginal people has declined and is considered now to be negligible (Altman 1987; A Griffiths (DLRM), G Wightman (DLRM) and J Altman (ANU), pers. comm.).

Saltwater Crocodiles were commercially hunted in the Northern Territory before they were protected in 1971. Experimental egg harvests commenced in 1983 for *C. porosus* and ranching operations with CITES approval commenced in 1987. Initial management programs for crocodiles (*C. porosus* and *C. johnstoni*) in the Northern Territory included harvest of eggs, hatchlings, juveniles and adults from the wild to rear in captivity for production. The 1998 Management Program (PWCNT 1998) also allowed non-hatchlings to enter trade directly after harvesting, without the need to spend time in a farm. However, the poor quality of skins from wild animals means this source is rarely used. The harvest of eggs is a critical component of the Northern Territory crocodile farming industry. Since farming started in the early 1980s, the total number of eggs collected has increased from 298 in 1982/83 to 51,000 in 2013/14.

2.6 Threats and impacts

Groombridge (1987) and Jenkins (1987) have detailed potential threats to crocodile populations worldwide and, as with all crocodylian species, most threats (direct and indirect) impacting *C. porosus* are anthropogenic in origin. Existing patterns of land tenure and use in the Northern Territory (mostly pastoral, conservation and Indigenous lands) are generally consistent with retaining large wetland areas and their dependent crocodile populations. Within the life of this Plan there are no likely foreseeable threats to the conservation status of *C. porosus* in the Northern Territory and all available data indicate that the species will continue to be abundant. Detailed consideration of specific threats is included in Appendix 1.

3 Management practices

The Northern Territory's crocodile farming industry is based on the harvest of eggs and live animals from the wild to supply crocodile farms and other crocodile processors. The ranching component of the industry is supplemented by captive breeding on some farms, but captive breeding has substantially less input to production than ranching. Wild harvest is likely to remain the cornerstone of the NT crocodile farming industry into the future (*Northern Territory Crocodile Farming Industry Strategic Plan 2016-21*).

To achieve the aims of this Wildlife Trade Management Plan, NT Government agencies in conjunction with the crocodile industry and land managers will implement a range of management practices to regulate the harvest, farming and trade of Saltwater Crocodiles in accordance with the *TPWC Act* and the *EPBC Act*.

The actions and performance measures for the life of this Plan are tabulated in section 3.6.

3.1 Commercial harvest from the wild

3.1.1 Harvest Ceiling

Commercial harvest of saltwater crocodiles has two components: the egg harvest and the harvest of live animals (hatchling, juvenile and adult animals) from the wild. Both harvest components must, in isolation and combination, be sustainable.

The harvest ceilings for eggs and live animals in previous management programs were based on an adaptive management approach through implementation of a conservative harvest, monitoring of the impact of that harvest and subsequent adjustment of the harvest. The harvest ceilings were above what was anticipated to be collected and below what was considered sustainable.

To ensure sustainability whilst optimising the level of both eggs and live animals available to industry for wild harvest this Wildlife Trade Management Plan imposes harvest ceilings derived from population modelling based on historical population and harvest data. Fukuda *et al.* (submitted) modelled the impact of different harvest regimes on the Saltwater Crocodile population in the NT. Their model predicted the 2011 population abundance as about 94,000 non-hatchling crocodiles and was consistent with empirical data. Harvest simulations for a 30 year period (2012-2041) indicated that the current population can sustain an annual harvest of up to 120,000 eggs and 1,200 non-hatchling crocodiles.

The egg harvest ceiling in this Plan represents less than 50% of the total number of eggs laid each year and, because a very low percentage of eggs would normally survive to later age classes in the wild (Webb & Manolis 1993), the egg harvest mostly represents a displaced mortality rather than additional mortality. The live harvest ceiling in this Plan represents less than two percent of the estimated Northern Territory saltwater crocodile population.

The total maximum number of *C. porosus* that can be harvested annually within the Northern Territory during this Plan is shown in Table 1. The full harvest ceiling may not be allocated

in any year where there is insufficient demand from industry. The live harvest ceiling includes animals taken for commercial use and for non-commercial reasons (such as problem crocodiles).

Table 1: Annual harvest ceiling for eggs and live animals from the wild. Numbers are set for the calendar year for live harvest and nesting season for egg harvest. The egg harvest ceiling is based on viable eggs.

| | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 |
|---------------------|---------|---------|---------|---------|---------|
| Viable Eggs | 90,000 | 90,000 | 90,000 | 90,000 | 90,000 |
| | 2016 | 2017 | 2018 | 2019 | 2020 |
| Live Harvest | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |

Egg Harvest

Fukuda *et al.* (submitted) reported that harvest models show the population can support an annual harvest of 120,000 eggs (in conjunction with a live harvest of 1,200 animals) with no detriment to population abundance over a 30 year period. Based on reported harvest, incubation and farm data (DLRM and PWCNT, unpublished data) a harvest of 120,000 eggs would equate to 100,000 live eggs (the harvest unit used in previous management programs) or 90,000 viable eggs. In this Plan, the harvest ceiling and egg allocation for harvesters will be based on viable eggs (see definitions).

The shift to viable eggs as the harvest unit is based on input from both industry and regulators about appropriate measures to streamline harvest and farming compliance processes. Viable eggs (ie.an egg which hatches to produce an animal usable for skin production) is the basic measure of input into the farm industry and as such has considerable investment by the industry in record keeping. Coupling harvest ceiling and allocation to this measure will streamline compliance monitoring and reporting for both industry and regulators. It also encourages industry to optimise efficiency as the high cost of egg collection means it is undesirable to collect excessive numbers of eggs that do not enter production.

The egg harvest ceiling is set at 90,000 viable eggs for each annual nesting season during the life of this program. This allows for a 40% increase from the previous program in the potential harvest during the next five years without militating in which year increase in harvest should occur. Ongoing monitoring of both harvest and population levels will ensure that the permitted level of egg harvesting remains sustainable. Currently, all of the monitored rivers except those in Kakadu National Park are harvested. All monitored rivers have shown an increase in both abundance and biomass (Appendix 3), consistent with the continued increase in the overall population in the Northern Territory (Appendix 1) and supporting the sustainability of an increase in the permitted egg harvest.

Should industry growth over the period of this Wildlife Trade Management Plan approach the egg harvest ceiling, monitoring data and population and harvest modelling will be utilised to

determine if further increases in the harvest ceiling are sustainable. Approval for an increase in the harvest ceiling may then be sought by the Director of the Parks and Wildlife Commission from the Australian Government.

Live Harvest

The increased focus of industry on harvesting eggs has been mirrored by a decreasing take of non-hatchlings. Saalfeld & Fukuda (2014) report total live harvest of fewer than 600 crocodiles annually over the last five years, with live harvest including all animals (hatchling, juvenile or adult) taken from the wild, either for commercial use or as problem animals.

Harvest models developed by Fukuda *et al.* (submitted) show that the population can support an annual harvest of 1,200 non-hatchling crocodiles (in conjunction with an egg harvest of 120,000 eggs) with no detriment to population abundance over a 30 year period. A harvest of 1,500 non-hatchling crocodiles and 120,000 eggs over the same period would produce a very slight decline (< 5%) over the same 30 year period.

The annual live harvest ceiling under the WTMP has been set at 1,200 crocodiles (hatchling, juvenile or adult) during the life of this Plan. This will allow for a potential 100% increase in the non-hatchling harvest over the next five years. Should the live harvest ceiling be reached during the life of this Wildlife Trade Management Plan, monitoring data and population and harvest modelling will be utilised to determine if further increases in the harvest ceiling are sustainable. Any increase in the harvest ceiling would require the approval of a new Wildlife Trade Management Plan under the *EPBC Act*.

The Northern Territory Government may seek to maintain the presence of a visible crocodile population and large (generally ≥ 4.5 m), iconic individuals through the prescription of zones where harvesting of live crocodiles is prohibited or restricted, although problem crocodiles can be removed wherever there is a public safety or livestock concern. In general, harvesting of live crocodiles will normally not be permitted:

- 1) in waterways where the watercourse forms the boundary between two or more properties, without the agreement of all property holders.
- 2) in mainstream channel of rivers that are heavily used by the tourism and fishing industry, such as the East Alligator River, the Mary River downstream of the Arnhem Highway, the Adelaide River downstream of the Marrakai Crossing and the Daly River downstream of Ooloo Crossing. Where low level harvest is permitted it will be tightly regulated to ensure that tourism interests are not damaged.
- 3) from sites where crocodiles are particularly significant to local Indigenous people.

3.1.2 Harvest review

Maximum harvest ceilings have been set for the period of the Wildlife Trade Management Plan and have sufficient scope for projected industry growth over the next five years (*Northern Territory Crocodile Farming Industry Strategic Plan 2015*). Both harvest levels and population trends will be monitored during the life of the program. Should monitoring detect catastrophic decline or a clear trend of population decline, then the need for harvest restrictions will be assessed (see section 3.1.5). The population trend must be distinguishable from natural fluctuation due to environmental conditions such as rainfall and

the seasonal availability and quality of breeding habitat (Fukuda *et al.* 2007, 2011 & submitted).

3.1.3 Permits and compliance

Crocodylus porosus is a protected species in the Northern Territory. The take (harvest) of or interference with any saltwater crocodiles from the wild; the keeping of and/or trading in saltwater crocodiles; and the import or export of saltwater crocodiles require a permit issued under Section 56 of the TPWC Act.

Commercial use of saltwater crocodiles under this program will be regulated by permit. The PWCNT web site provides details of the types and conditions of permits relating to wildlife (<http://parksandwildlife.nt.gov.au/permits>). As described in section 1.4.1 other NT legislation may apply to certain aspects of crocodile farming.

Permit to Take Protected Wildlife

Harvest of saltwater crocodiles (animals or eggs, live or dead) requires a Permit to Take Protected Wildlife from the Northern Territory Government, or a permit from the Australian Government if it occurs on Commonwealth land such as Kakadu National Park.

Permit applications must include details on the purpose, method, extent and location of the proposed harvest. All permits for harvesting will require the written consent of the landholder. Permits are valid for one to five years, and subject to terms and conditions including identification of who may carry out activities authorised by the permit; how, when and where those activities may be undertaken; the maximum quantity of Protected Wildlife that may be taken; and the requirement to provide returns for activities authorised by the permit. The return should include details on the number of animals (including eggs) taken, skin tag numbers if relevant, the size and sex of each crocodile that was taken, and a GPS location of the harvest site. In the case of egg collections, returns must be lodged by 31st July and the return must provide detail of all eggs including the date and GPS location of harvested nests and the number of viable eggs produced. Annual returns need to be submitted each year for a multi-year permit.

The Northern Territory Government may vary or cancel a permit if information becomes available that indicates conservation management measures may be required to protect a *Crocodylus porosus* (sub)population.

Permit to Keep Protected Wildlife

A Permit to Keep Protected Wildlife from the Northern Territory Government is required to keep or trade *C. porosus* or its parts. Permits are valid for one or more years and subject to terms and conditions including identification of who is authorised to keep and/or trade saltwater crocodiles under the permit; where and the quantity of Protected Wildlife that may be kept; and the requirement to provide returns.

Permits to export and import

A permit issued under the *TPWC Act* is required to export (including re-export) wild caught, commercially farmed and captive-bred *C. porosus* or its parts from the Northern Territory to other Australian States and Territories.

The overseas export of live crocodiles and commercial shipments of crocodile skins, products or by-products from Australia requires a CITES permit from the Australian Government Department of the Environment. PWCNT provides CITES skin tags on behalf of the Australian Government for commercial shipments of skins from crocodile farms. Other international exports require an export permit from PWCNT prior to the Australian Government issuing a CITES permit.

Under CITES provisions and *EPBC Act* regulations, up to four crocodile products can leave Australia within a passenger's personal luggage without a CITES permit if they are personally owned, non-commercial and legally acquired.

An import permit issued by the Department of the Environment is required for the commercial shipment of crocodile products or their parts into the Northern Territory from overseas. A Northern Territory import (including re-import) permit, issued under the *TPWC Act* is required for all shipments of crocodiles or their parts entering the Northern Territory. Imports from other Australian jurisdictions must also be accompanied by an export permit from that jurisdiction. All import permits are issued by PWCNT and are valid for one month.

Crocodile farm permits

Crocodile farms require a Permit to Keep Protected Wildlife to authorise the keep and trade of saltwater crocodiles and Permit(s) to Import and Export Protected Wildlife to import or export saltwater crocodiles from the Northern Territory. A Crocodile Farm Enterprise Permit combines all three permits in a single permit document. The Enterprise permit is valid for a period of 10 years and authorises the permit holder (crocodile farm) to keep, trade, import and export saltwater crocodiles subject to terms and conditions of the permit.

Farm records are administered by PWCNT. The holder of the Crocodile Farm Enterprise Permit is required to provide an annual permit return to PWCNT detailing stock gains/losses, transfers, sales, mortality, and skin and meat processing figures. This information is used to compare farm holdings with wild harvest permit returns and ensure compliance with wild harvest permits. The annual permit return is also provided to both DLRM and DPIF.

The Enterprise permit authorises the permit holder to import or export saltwater crocodiles without the need to apply for individual permits for each shipment. It is a condition of the Enterprise permit that the permit holder provides prior notice to PWCNT of any shipment. The shipment is then authorised unless the permit holder is advised otherwise by either PWCNT or DLRM.

Individuals or companies trading products derived from Saltwater Crocodiles taken under this Wildlife Trade Management Plan are required to hold either a Permit to Keep Protected Wildlife or a Crocodile Farm Enterprise Permit. It is a condition of permit that the permit holder maintains detailed records, and to mark certain products with a product label in accordance with the PWCNT product label guidelines. PWCNT issues product labels on a cost recovery basis or producers can print the required information on their own labelling and packaging. The minimum requirement for an approved product label is that the label:

- states that this is a crocodile product produced in accordance with an approved management program;

- shows the permit holder name and permit number of the Enterprise Permit or Permit to Keep that the product was produced under; and
- shows the date that the product label was affixed to the product.

These labels provide the means to identify products as originating from a legitimate source.

Shipment Inspections

A Department of Agriculture health declaration and Department of the Environment inspection of any skins and hides is required for international shipment.

Skins

Each whole skin, whole belly skin, whole horn-back skin or trophy skin entering trade or being exported will be marked with a non-reusable orange plastic skin tag issued by the Australian Government in compliance with the provisions of CITES Resolution Conf. 11.12. (<http://www.cites.org/eng/res/11/11-12.shtml>). Excised back-straps are packaged into a carton and the skin tag is attached to the carton. The permit issued for back-straps states that the tag is attached to the box and records the total number of back-straps in the carton.

Each farm completes a Specimen Export Record (SER) which states the skin tags have been attached to either whole skins or cartons of back-straps and returns it to the Australian Government Department of the Environment. Each skin tag is uniquely numbered and the number serves as an identification number for all subsequent record keeping related to the skin of that particular animal. PWCNT is responsible for issuing skin tags on a cost-recovery basis, and skin tags are issued annually.

Flesh

Flesh is packed in cartons that are marked to show that the enclosed product is a farmed product. Producers can use pre-labelled cartons which state that the contents are perishable and need to be kept frozen or kept cold. Alternatively flesh can be sealed in standard cartons using specially marked green tape printed with “contents are perishable and needs to be kept frozen or kept cold”. This labelling requirement applies to both domestic and international shipments.

By-products

Product labels are required for derived parts from animals under 2.3 metres in length. This includes whole dead animal, stuffed heads, skulls, whole skins, belly skins, horn-back skins and back-straps. A Permit to Keep is required for parts derived from animals over 2.3 metres in length. Skins which have a CITES skin tag affixed do not require either Permit to Keep or product label. Products to which a product label has been affixed do not require either a Permit to Keep or an import/export permit for movement into/out of the Northern Territory as the product label is the authority to keep and import/export.

Manufactured items

Product labels are not required for a range of finished manufactured products. Items included are: bags, belts, wallets, back scratchers, hat bands, necklaces, bracelets, key fobs, drink coasters, book covers and trimming. While labels are not required for these items they can be affixed at the permit holder’s discretion. Manufactured items which do not

require a product label will not require an import/export permit for movement into/out of the Northern Territory as the Northern Territory Government will exempt these items from the provisions of the *TPWC Act*.

The Crocodile Farm Enterprise Permit has been introduced to streamline the permit process and reduce the regulatory burden associated with multiple, duplicate permit conditions across the different permits. Amendment of the *TPWC Act* to allow for the commercial licencing of crocodile farms will be investigated and, if practicable, implemented during the life of this management program.

Compliance

Failure to lodge a permit return or the inclusion of insufficient or incorrect information in the permit return may result in the issue of a warning letter, caution notice or infringement notice, and could also result in cancellation of the current permit, refusal to issue any further permits, or prosecution.

The Northern Territory Government will implement the following actions to help ensure compliance:

- random checks on eggs and farm stock to ensure compliance with permit conditions and reporting;
- remote surveillance of random crocodile nests in known locations;
- data collected on eggs and hatchlings will be linked and compared to ensure the smooth transition between different Northern Territory Departmental auditing systems;
- collaborate with other jurisdictions and agencies (Kakadu National Park, Queensland, Western Australia, Australian Governments, tanneries etc) to help eliminate illegal trade of eggs, animals or products interstate; and
- investigate of any reports of potentially illegal incident and take legal action where sufficient evidence is obtained.

The Northern Territory Government has the capacity to develop and introduce permit conditions on an as-needs basis.

3.1.5 Monitoring

Spotlight survey of selected river systems within the Northern Territory (Appendix 3) provide indices of the density and size structure of crocodile populations and are the standard method of monitoring *C. porosus* in the Northern Territory (Messel *et al.* 1981, Stirrat *et al.* 2001, Fukuda *et al.* 2013). The surveys include counts of the 0-2 foot (0-0.6m) size class which is accepted as equating to hatchlings (less than one year old) and so provide a measure of recruitment from the last nesting season. The rivers monitored under this program are highly productive rivers where most crocodile harvesting occurs and for which long-term datasets using comparable techniques are available (Appendix 3).

The crocodile monitoring program uses existing knowledge of the variation in data from a particular river to detect any significant trend in numbers or biomass (Appendix 3). There is inherent variability in both the survey data and the real crocodile population which are independent of harvesting. Survey data from each of the monitored rivers is rigorously analysed to detect any significant population decline.

If survey results in any one year show a population decrease in one or more monitored rivers, those rivers will be resurveyed in each of the following two years (rather than on a biennial basis) to verify the declining trend. Additionally, if declines are detected in multiple rivers, nearby unmonitored rivers that are subject to harvest may also be monitored. If population declines continue for three consecutive years, management intervention will be considered, potentially including reducing or stopping harvest and/or restocking the catchments. Management intervention would be maintained until monitoring suggests that the populations has stabilized or is increasing, allowing harvesting to continue, at which time monitoring would revert to the standard program (Appendix 3).

The monitored rivers are generally highly productive and in the most heavily harvested regional catchments. Because of high environmental variability, survey data subsequently shown to be outliers has occurred in the past. Therefore, the Northern Territory Government will not intervene based on the monitoring results from a single year.

Information on the crocodile harvest (size and sex of non-hatchling crocodiles, numbers of total, live and viable eggs) is obtained through harvest returns submitted by permit holders. Harvest figures will also be considered in combination with environmental conditions that may impact on population size and structure (drought and habitat changes) when assessing the need for management intervention.

3.1.6 Animal Welfare

The *Code of Practice on the Humane Treatment of Wild and Farmed Australian Crocodiles* recommends a number of methods for capture of wild crocodiles, including traps, snares, hooks, nets, harpooning and shooting. Harvest, capture of problem crocodiles and farming of *C. porosus* must be in accordance with the Code of Practice.

The *Code of Practice on the Humane Treatment of Wild and Farmed Australian Crocodiles* is an approved Code of Practice under the Northern Territory's *Animal Welfare Act*. Compliance with the Code of Practice is a condition of permit for all permits issued for the take, keeping and movement of saltwater crocodiles. Non-compliance with the Code of Practice may result in the issue of a warning letter, caution notice or infringement notice, and could also result in cancellation of the current permit, refusal to issue any further permits, or prosecution under the *Territory Parks and Wildlife Conservation (TWPC) Act*.

Any breach of the *Animal Welfare Act* relating to duty of care or cruelty is an offence and may result in the issue of a warning letter, caution notice or infringement notice, or prosecution under the *Animal Welfare Act*.

3.1.7 Reporting

The performance indicators listed in this plan will be assessed annually by Northern Territory Government (DLRM, PWCNT) staff responsible for implementing the Plan. The Northern Territory Government will provide annual reports to the Australian Government by 31 December in each year of operation of the plan. Reporting will include:

- Progress against performance indicators;
- Harvest statistics including:
 - Number of viable saltwater crocodile eggs taken;

- Number of live saltwater crocodiles taken (hatchling, juvenile & adult);
- Sex ratio and average size of live saltwater crocodiles taken (where required); and
- Number of problem crocodiles taken;
- Number of permits issued for commercial live crocodile harvest and problem crocodile removal;
- Crocodile farm stock holdings;
- Number of saltwater crocodile eggs and live animals exported by destination; and
- Industry compliance indicators.

3.2 Landholder benefit

Landholder support for the sustainable harvest and conservation of saltwater crocodiles and their habitat is crucial to the long-term viability and growth of the crocodile farming industry. The *Northern Territory Crocodile Farming Industry Strategic Plan 2015* identifies the economic return that landholders receive as one of the most important component of the egg harvest program, and the driver of the incentive-driven conservation program. Protecting landholder rights to determine who can access their crocodile resource, maximising the benefit that may be derived from the resource and ensuring that negative landholder interactions with saltwater crocodiles do not outweigh benefit derived from crocodiles are all vital.

Regulation of economic return to landholders (Indigenous, pastoral, private and Government) is not included within this Wildlife Trade Management Plan as neither the *TPWC Act* nor *EPBC Act* provide for this. However, the plan can implement sustainable harvest regimes which are most likely to provide appropriate economic return.

Protection of landholder rights and maximizing the benefit they receive is achieved indirectly by ensuring that landholder permission must be obtained before any saltwater crocodile eggs or live animals can be harvested. Under the *TPWC Act*, a Permit to Take Protected Wildlife gives authority to take animals from the wild but does not authorize entry onto the landholder's property (Section 60). To ensure that an applicant for a permit to harvest either crocodile eggs or live animals has the landholder's permission, the applicant must provide a copy of the landholder's written permission for the applicant to access the property and to take the protected wildlife applied for. The written permission is to cover the permit applicant and nominees, the harvest type (egg or live animal), quantity and harvest period. The permit will not be issued until the landholder's written permission is provided to the issuing agency.

On Indigenous lands declared under the ALR(NT) Act, Section 19 of the Act provides for Land Use Agreements which should be in place for commercial crocodile harvesting(eggs and/or live animals). The Land Use Agreement is negotiated between the Indigenous Traditional Owners and the crocodile harvest proponents and facilitated through the appropriate Land Council. Amongst the matters covered by the Land Use Agreement are the conditions of access to land. A harvest permit will not be issued until the issuing agency is advised by the relevant Land Council that a Land Use Agreement has been enacted.

Additional protection of landholder rights is provided through the condition on all saltwater crocodile harvest permits that the permit holder must have written landholder permission

before entering land to carry out any activities under the authority of the permit. This provides protection if landholder permission is withdrawn prior to the expiry of the permit.

The Northern Territory Government considers that stringently regulated safari hunting of saltwater crocodiles can be a legitimate sustainable use, with the potential to provide substantial direct and indirect economic and employment opportunities to landholders and particularly to remote indigenous communities. This economic benefit would also provide further incentive for the careful management and conservation of crocodiles and their habitat in the Territory. However, recognising that Australian Governments have chosen not to approve provisions allowing safari hunting in previous Management Plans, this Wildlife Trade Management Plan does not include safari hunting as a component of the annual live harvest.

3.3 Review of the Wildlife Trade Management Plan

The detail included in this Wildlife Trade Management Plan in relation to management actions, legislation and administrative arrangements is current as at June 2015.

The 2016–2020 plan will be reviewed at the end of 2020 or sooner as required under subsection 303FO of the *EPBC Act*. It is not proposed that the plan will be rewritten should there be changes to management actions, legislation and administrative arrangements during the life of the program unless any such changes are sufficiently significant that the Australian Government determines that a new plan is required.

3.4 Annual actions and performance measures for 2016-2020 Plan

| Milestone | Program Reference | Agency | 2016 | 2017 | 2018 | 2019 | 2020 |
|--|-------------------------------|---|----------|----------|----------|----------|----------|
| Ensure the harvest ceiling is set in accordance with the Plan. | 3.1.2 Harvest review. | DLRM, Wildlife Use | Annually | Annually | Annually | Annually | Annually |
| Investigate and take appropriate action on all suspected local impacts on the population. | 3.1.2 Harvest review. | DLRM, Wildlife Use | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Exempt manufactured items from the provisions of the <i>TPWC Act</i> . | 3.1.4 Permits and compliance. | DLRM, Wildlife Use | Complete | | | | |
| Investigate amendment of the <i>TPWC Act</i> to allow for the commercial licencing of crocodile farms. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use | Commence | | | | |
| Ensure that the annual commercial harvest of Saltwater Crocodiles does not exceed the approved ceiling. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use | Annually | Annually | Annually | Annually | Annually |
| Assess applications and issue permits under the <i>TPWC Act</i> . | 3.1.4 Permits and compliance. | DLRM, Wildlife Use | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Monitor and audit harvest applications, approvals and returns and investigate and resolve any discrepancies. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use PWCNT, Wildlife Ops | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Ensure all permit applications have correct landholder approval. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |

| Milestone | Program Reference | Agency | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|-------------------------------|--|----------|----------|----------|----------|----------|
| Conduct random checks on eggs and farm stock numbers. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use PWCNT, Wildlife Ops | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Ensure compliance with all permit terms and conditions, including lodgement of annual returns, prior notification of import/export shipments, and any other term or condition | 3.1.4 Permits and compliance. | DLRM, Wildlife Use PWCNT, Wildlife Ops | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Address any permit breaches through warning letters, caution notices, infringement notices, permit cancellation or prosecution. | 3.1.4 Permits and compliance. | DLRM, Wildlife Use PWCNT, Wildlife Ops | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Continue the population survey program as described in this Plan. | 3.1.5 Monitoring | DLRM, Wildlife Use | Annually | Annually | Annually | Annually | Annually |
| Analyse and assess the results of the survey program and implement any management recommendations. | 3.1.5 Monitoring | DLRM, Wildlife Use | Annually | Annually | Annually | Annually | Annually |
| Ensure the requirements of the Code of Practice are a condition on all permits and that a copy of the Code is distributed to all new permit holders | 3.1.6 Animal welfare | DLRM, Wildlife Use | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |
| Ensure all successful permit applicants are competent to comply with the relevant animal welfare standards. | 3.1.6 Animal welfare | DLRM, Wildlife Use | Ongoing | Ongoing | Ongoing | Ongoing | Ongoing |

| Milestone | Program Reference | Agency | 2016 | 2017 | 2018 | 2019 | 2020 |
|--|----------------------|----------------------|------------------|------------------|------------------|------------------|------------------|
| Investigate and take appropriate action on any suspected breaches of the <i>Animal Welfare Act</i> . | 3.1.6 Animal welfare | DPIF, Animal Welfare | Ongoing as needs | Ongoing as needs | Ongoing as needs | Ongoing as needs | Ongoing as needs |
| Annually audit the progress of the Plan against each of the performance indicators and adjust management practices as necessary. | 3.1.7 Reporting | DLRM, Wildlife Use | Annually | Annually | Annually | Annually | Annually |
| Submit annual reports to the Australian Government and provide a summary on the Northern Territory Government website. | 3.1.7 Reporting | DLRM, Wildlife Use | December | December | December | December | December |

4. References

To avoid repetition all references in the Appendices have been included here.

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Appendix 1: Background Information - *Crocodylus porosus*

Conservation status

Northern Territory (*Territory Parks and Wildlife Conservation Act*): Protected species listed as least concern.

Australia (*Environment Protection and Biodiversity Conservation (EPBC Act)*): Listed marine and migratory species.

International (*Convention on the International Trade in Endangered Species (CITES)*): Appendix II for the Australian population.

Distribution

Crocodylus porosus are found from Sri Lanka and the east coast of India in the west to the Caroline Islands in the east and from Myanmar and south-east Asia in the north to Australia in the south. *C. porosus* inhabit coastal rivers and swamps, the open sea and island shorelines, and their distribution extends well inland *via* major rivers and floodplain billabongs into freshwater rivers, creeks and swamps.

In Australia, *C. porosus* occur in high densities in the tidal portions of some mangrove-lined rivers; particularly those associated with extensive freshwater wetlands or floodplains. *C. porosus* may therefore occur in any salt or fresh water within their range. Detailed descriptions of *C. porosus* habitats within the Northern Territory are available in Letnic and Connors 2006; Messel *et al.* 1981; Magnusson 1980; Magnusson *et al.* 1978; Magnusson and Taylor 1980; Webb *et al.* 1977 1983; and Usback and James 1993.

Ecology

Cogger (1993) provides a general description of Crocodylia; Grigg and Gans (1993), Cooper-Preston and Jenkins (1993) and Molnar (1993) discuss morphology, physiology, natural history, biogeography and phylogeny. Detailed discussion of many topics concerning crocodile biology may be found in Webb *et al.* (1987).

Considerable research has been conducted into the biology and status of *C. porosus* in northern Australia, particularly in the Northern Territory. Their biology, population dynamics, recovery since protection and management have been the subject of intensive research efforts over the last 30 years, the details of which are contained in a variety of publications (e.g. Bayliss and Messel 1990; Burbridge 1987; Messel *et al.* 1981; Messel and Vorlicek 1985, 1986; Taplin 1987, 1990; Webb *et al.* 1984, 1987; Webb and Manolis 1989, 1993; Fukuda *et al.* 2007, 2011, submitted; Fukuda and Cuff 2013; Fukuda and Saalfeld 2014).

Nesting ecology

Saltwater Crocodiles breed during in the wet season between October and May. Females construct a mound of grasses and reeds that is typically located close to permanent water. Freshwater swamps near tidal rivers and saltmarsh habitats are the most frequently used

nesting habitats (Webb et al. 1984; Webb & Manolis 1989). Mangrove swamps can also be used for nesting. The extent and timing of nesting is related to rainfall and water levels in the late dry season (Webb 1991). Years with high rainfall and cool conditions between August and November are associated with high nesting effort. Conversely, years with poor rainfall and hot conditions between August and November are associated with low nesting effort (Webb 1991).

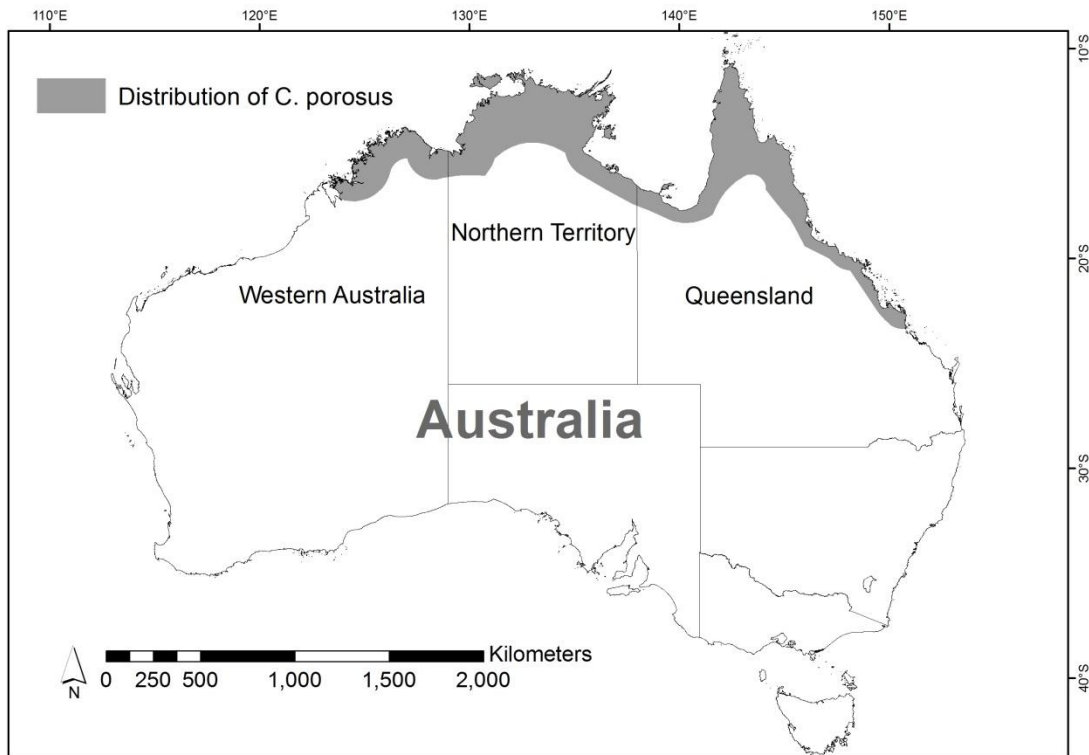


Figure 1: The distribution of *Crocodylus porosus* in Australia (modified from Cogger 1993).

Table 1: Summary of the biological characteristics of *C. porosus* (Source: Webb & Manolis 1993 and citations therein)

| Characteristic | <i>Crocodylus porosus</i> |
|---|----------------------------|
| Size and age at sexual maturity (males) | 3.3 m; 16 yrs |
| Size and age at sexual maturity (females) | 2.3 m; 12 yrs |
| Normal maximum length (males) | 4.6-5.2 m |
| Normal maximum length (females) | 3.1-3.4 m |
| Maximum length (males) | 6-7 m |
| Maximum body weight | 900-1500 kg |
| Nesting Season; months | Wet Season; Nov.-May. |
| Duration of egg laying | 28 weeks |
| Mean clutch size; (range) | 50.0 (2-78) |
| Mean egg weight; (range) | 113.0 g (65-147) |
| Mean hatchling weight | 69.4 g |
| Egg incubation time (days) | 75 (at 33°C)-106 (at 29°C) |
| Nest defence | Common |

The typical clutch size of *C. porosus* is approximately 50 eggs. The size of the clutch is proportional to the size of the individual female. The clutch of first-time breeders is normally around 30 eggs. Large crocodiles also produce larger eggs than smaller crocodiles (Webb & Manolis 1989). Around 6.5% of the eggs laid are infertile (Webb & Manolis 1989). There is a high mortality of *Crocodylus porosus* eggs with flooding being the major cause of deaths as it may kill over 50% of the eggs laid each year (Webb & Manolis 1989).

Survivorship and population dynamics

There is a high mortality rate of crocodiles from egg to maturity. Webb and Manolis 1993 estimated rates of survival for several size classes of *C. porosus* in the wild: approximately 30% of eggs usually hatch; 12% of hatchlings survive to one year; 85% of one year old crocodiles survive to two years; 85% of two year olds survive to three years of age; 85% of three year olds survive to four years of age; 85% of four year olds survive to five years of age. It follows that about 6 crocodiles would survive to five years from 1,000 eggs laid. The actual rates of survival between age five and maturity have never been established. Webb and Manolis (1993) speculated that less than one per cent survive to breed. The survival rate of mature animals is unknown.

In the wild, females normally reach maturity at 2.3 m total length and approximately 12 years of age. Males mature at around 3.3 m and about 16 years of age. The normal maximum size of *C. porosus* is around 4.6 to 5.2 m for males and 3.1 to 3.4 m for females. Individual *C. porosus* may live for more than 70 years (Webb and Manolis 1989).

Population size

The Northern Territory population of Saltwater Crocodiles is estimated at 90,000 to 100,000 non-hatchling individuals in 2012 (Fukuda *et al.* submitted). This is an almost thirty-fold increase from the 1971 population of approximately 3,000 non-hatchling individuals to between 30,000 to 40,000 individuals in 1984 (Webb *et al.* 1984) to between 70,000 to 75,000 individuals in 1994 (Webb *et al.* 1994) to the current estimate of 90,000 to 100,000 individuals.

The population of Saltwater Crocodiles in the Northern Territory continues to increase as demonstrated by the trend in the pooled data from monitored rivers (Figure 2) and individual rivers (Appendix 3). In some rivers rates of increase have recently slowed and may be approaching relatively stable levels (Saalfeld & Fukuda 2014).

The continuing increase in the Saltwater Crocodile population is also demonstrated by:

- The biomass of crocodiles in some rivers continues to increase, including rivers in which increase in numbers is levelling off (Appendix 3). This is consistent with the expectation of the maturing size and age structure of a large, slow-growing species that is recovering from the threshold of extinction in the 1970s.
- The distribution of Saltwater Crocodiles is expanding upstream to recolonise accessible freshwater habitats in the Northern Territory (Letnic and Connors 2006).
- There is an increase in the number of crocodiles that are living in other marginal habitat, such as the coasts and seas (Nichols and Letnic 2008).
- The number of crocodiles removed from the 'Intensively Managed' zone in the Darwin Harbour has increased in recent years, indicating that animals in expanding populations continue to disperse in search of living areas (Saalfeld & Fukuda 2014).

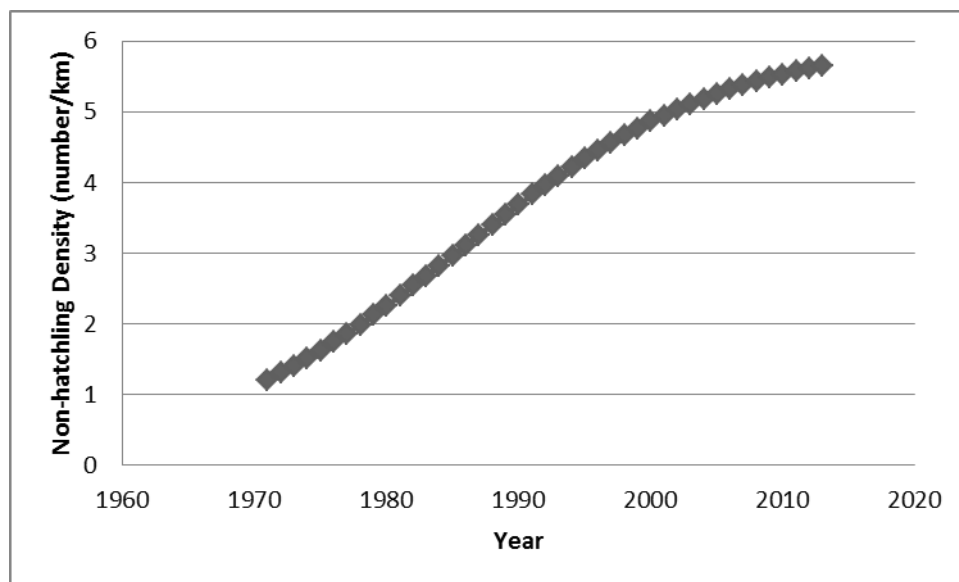


Figure 2: Modelled abundance density of non-hatchling (>0.6 m, including eyes-only) of *C. porosus* calculated from standardised spotlight surveys in 12 (to 2007 then 8) tidal rivers since 1975.

Diet

The diets of *C. porosus* vary with the size of individuals. Hatchlings feed mainly on small crabs, prawns and insects (Webb and Manolis 1989). Crabs and prawns are the major food items in tidal rivers for crocodiles up to 2 m long. With increasing size, crocodiles feed on a greater variety of food items and the diet of crocodiles over 2 m long includes fish, crabs, turtles, birds and mammals. Large prey such as cattle and horses are eaten only by the largest of crocodiles. Large crocodiles will also scavenge.

Population Threats

Natural Predators

The only significant predator of adult crocodiles apart from humans is other crocodiles with larger Saltwater Crocodiles eating small animals of both species. There are predators of young hatchlings such as fish (e.g. barramundi) and birds (e.g. Black-necked Stork) and other species such as Goannas can be predators of eggs. Saltwater Crocodiles are thought to be little affected by Cane Toad (*Rhinella marina*, formerly *Bufo marinus*) poisoning (van Dam *et al.* 2002; Letnic 2008), possibly because the species is continuously distributed from Australia to south-east Asia where other related toad species are also found.

Drought, flood and climate change

Drought can have a significant but not long-lasting impact on *C. porosus* populations unless coupled with other factors. Heavy rainfall and subsequent flooding, particularly associated with cyclones can cause localised egg and juvenile mortality (Webb and Smith 1987).

One of the major effects of climate change is an anticipated rise in sea level with conservative estimates (Hennessy *et al.* 2004, 2007) anticipating an increase in sea level of 50 centimetres by 2100 and a corresponding loss of coastal floodplain systems and wetland habitat. These calculations do not take into account other anticipated and compounding changes such as further saltwater intrusion or changes in hydrology and in weed and feral animal distributions and increased temperature. As temperature determines the sex of hatchlings, long-term temperature changes could also affect the population structure. The predictions of more frequent and intense dry season wildfires and severe storm events may have negative impacts on nesting vegetation, food sources and survivorship rates. However, changes may also create opportunities for crocodiles to expand their distribution. The possible impacts of climate change remain in the realm of prediction and modeling and over a time frame much longer than the life of the Wildlife Trade Management Plan. As such they cannot be mitigated within the program but monitoring should be capable of detecting significant population changes through whatever cause.

Habitat loss and modification

The habitats of *C. porosus* in the Northern Territory are generally not threatened by development although current and proposed clearing in the Daly and Katherine regions may have indirect long-term impacts. There is anecdotal evidence that Saltwater Crocodiles are affected by the invasion of freshwater wetlands by introduced plants such as *Mimosa pigra* including through reducing the availability of nesting habitat. Anecdotal reports indicate that the removal of *Mimosa* is likely to increase Magpie Geese and crocodile nesting. Since the 1970s, disturbance of floodplain habitats by feral buffalo was greatly reduced following

eradication campaigns with a resultant improvement in nesting habitat. There are increasing numbers of buffalo and pig which will cause concern as these negatively impact on nesting vegetation. The increasing value of crocodile eggs is encouraging improved control of *M. pigra*, feral herbivores and fire by landowners to favour crocodile nesting habitat (RMCG 2008).

Entanglement in fishing nets

Entanglement in fishing nets is known to cause crocodile deaths in Australia. Losses of *C. porosus* due to accidental capture and drowning in barramundi fishing nets were documented and assessed in the early 1980s (Webb *et al.* 1984). Since these surveys commercial fishing has been banned within a number of river systems that are important nesting habitats for *C. porosus*, such as the Mary, Roper and Alligator Rivers. Fishermen are not permitted to use wild crocodiles that drown in their nets. Recent internal DPIF reports show that crocodile mortality due to drowning in fishing nets during 2007 and 2008 was less than 30 individuals.

Disease

There appear to be no significant diseases of wild crocodiles that present a major threat to the wild population. Intensive animal husbandry of any species can create conditions which lead to high mortality due to disease and this is true for crocodiles. There were significant hatchling losses in some farms due to a disease outbreak in 2006.

Appendix 2: Farm Management

Farm Biosecurity

Farms are advised to follow the Biosecurity plan available from DPIF. Any signs of unusual illness, disease outbreak or unusual deaths should be reported as soon as possible to DPIF. In the event of an emergency crocodile disease outbreak, the Biosecurity plan would be mandated under the *Livestock Act* for the period of the emergency animal disease response.

Farm Security

Farms are required to have secure fencing, capable of containing crocodiles, as a condition on the Crocodile Farm Enterprise Permit. Fences and enclosures must be maintained to ensure animals cannot escape. PWCNT will check farm security prior to any permit being issued or renewed and as required through information received.

Farm Data

Farms are required to submit an annual return to DPIF and PWCNT as a condition on the Crocodile Farm Enterprise Permit. Return data will be audited for discrepancies and any discrepancies investigated.

Farm Visitation

Farms may be visited by DPIF under the powers of the *Livestock Act* to investigate unusual disease events or under the *Animal Welfare Act* to investigate potential welfare breaches or related matters. Farms may be visited by DLRM AND PWCNT to ensure that farms meet the conditions stated on the Enterprise Permit, investigate wildlife breaches and related matters.

Animal Welfare

Animal welfare on all crocodile farms must comply with the *Animal Welfare Act* and follow the *Code of Practice on the Humane Treatment of Wild and Farmed Australian Crocodiles* as stated in this Management Program. Animal welfare complaints can be investigated by Animal Welfare Officers based on reports received.

Farm Workers OH&S

Workers on all crocodile farms that have duties involving handling crocodiles or being in close contact with crocodiles must meet the relevant Northern Territory OH&S legislation.

Farmer Responsibilities

The responsibilities of farms are detailed in Table 1.

Table 1: Stakeholder Responsibilities in the Saltwater Crocodile Management Program 2016-2020

| Stakeholder | Responsibilities |
|--|--|
| Department of Land Resource Management | <ul style="list-style-type: none"> • Assess applications and issue permits as appropriate. • Undertake annual population monitoring surveys. • Collate annual report to the Australian Government. • Compare wild egg collection data with farm hatchling data each year. • Review the Management program for the Saltwater Crocodile (<i>Crocodylus porosus</i>) in the Northern Territory of Australia. |
| Parks and Wildlife Commission | <ul style="list-style-type: none"> • Remove and dispose of problem crocodiles from agreed intensively managed areas. • Ensure compliance with permit conditions. • Issue CITES skin tags |
| Department of Primary Industries and Fisheries | <ul style="list-style-type: none"> • Implement the Biosecurity plan in the event of an emergency crocodile disease outbreak • Monitor crocodile farm production and provide industry support |
| Northern Territory Crocodile Farming Industry | <ul style="list-style-type: none"> • Comply with all permit conditions. • Submit annual returns to DPIF and PWCNT. • Ensure animal welfare standards are being met in accordance with the <i>Animal Welfare Act</i> and the <i>Code of Practice</i>. • During an emergency disease outbreak comply with the Biosecurity plan. • Ensure worker safety is not comprised by adhering to appropriate Workplace Health and Safety requirements. • Submit applications for permits to import/export crocodile shipments both domestically and overseas to PWCNT , at least two business days before the date needed. • Ensure that a CITES permit has been issued and that CITES permit numbers are available for overseas shipments of crocodile skins and products. |

Appendix 3: Saltwater Crocodile Densities in the Rivers Monitored in the Northern Territory

The Northern Territory spotlight monitoring program covers the following river systems (Figure 1):

Adelaide River – The catchment contains Melacca Swamp where long-term egg harvest monitoring data has been collected by Wildlife Management International since egg harvest commenced in 1983. The catchment has been subject to continuous harvest longer than any other.

Mary River – This is a river with a particularly high density of large crocodiles. The catchment has limited nesting habitat. The catchment has had substantial live harvest compared with other catchments across the Top End.

Daly River – Floodplains in the Daly River are subject to substantial egg and live harvest.

Arnhem Land rivers – Significant harvests of eggs occur in these areas, where there is an ongoing commitment by Aboriginal landholders to a variety of sustainable use projects. It includes the Liverpool, Tomkinson, Cadell, Blyth, and Glyde Rivers.

In addition to data collected from these rivers by the Northern Territory Government, data from the East, South and West Alligator Rivers and the Wildman River (Figure 1), collected by Parks Australia staff provide additional data on the status of populations in Kakadu National Park. The South Alligator and West Alligators River are unique in the data set because they are not subject to any form of harvesting. All other major rivers in the Northern Territory do have some form of harvesting. The data from the South Alligator River can be analysed to interpret whether any major reduction is due to harvesting or some other independent factor (e.g. climate change). Data for the Wildman, West Alligator, South Alligator and East Alligator Rivers collected by Parks Australia North in Kakadu National Park has not been available to DLRM since 2008 and is not presented. Parks Australia North report that crocodile numbers in these rivers are stable or increasing.

Spotlight survey data (Fukuda *et al.* 2013) are used to estimate the relative density of crocodiles on individual rivers (usually tidal mainstream sections) as an index of the total crocodile population in the catchment. The density is calculated in terms of the abundance (sighting) and biomass (kg) of crocodiles per kilometre of a river surveyed. Three candidate regression models (linear, exponential and logistic) are then fitted to approximate the pattern of population growth for each river.

For each river the fit of each model is compared to determine the model that best describes the population growth pattern using model selection parameters of Akaike's information criterion corrected (AICc), difference in AICc (Δ_i), and Akaike weight (w_i). The smaller the AICc a model shows, the more support the model is considered to have. If a model has small Δ_i (<2), it is generally considered highly supported (Burnham and Anderson 2002). The strength of evidence that a model is the best in a set is measured by w_i (%).

The following graphs plot non-hatchling crocodile density for each river with the model lines fitted. Details of the model selection parameters are provided in the table following the graphs.

The sighting density of crocodiles for two of the eight rivers, includes those with intensive harvesting (the Adelaide and Mary Rivers), most strongly support the logistic model (Figure 2, Table 1). This suggests that the populations have been stabilising in recent years and are approaching carrying capacity in these rivers. Five of the six remaining rivers are still increasing either linearly or exponentially due to large variation in natural habitat quality (e.g. availability of nesting sites) that also contributes to the large variation in density between rivers. Sampling error is not taken into account.

The biomass density supports a logistic increase in two of the eight rivers (Figure 3, Table 2). This suggests that the size of individuals has been stabilising in recent years and is approaching carrying capacity in these rivers. Again, the large variation in density between rivers is attributable to varying habitat quality (e.g. the Mary River is known to have an unusually high density with large-sized animals) rather than an impact of harvesting as they show the same trends as the control rivers.

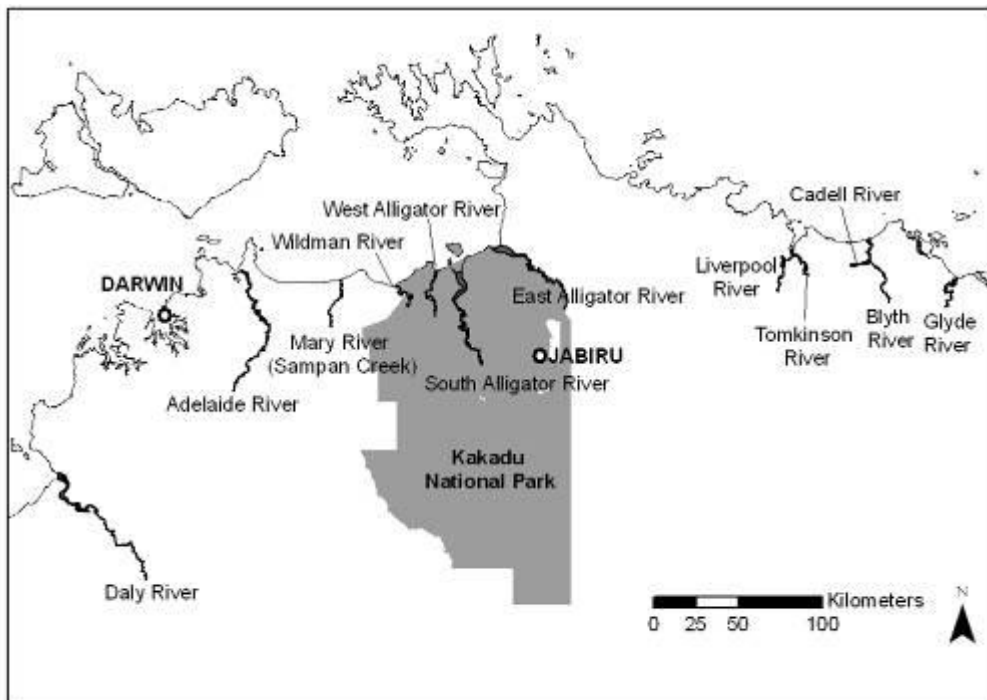
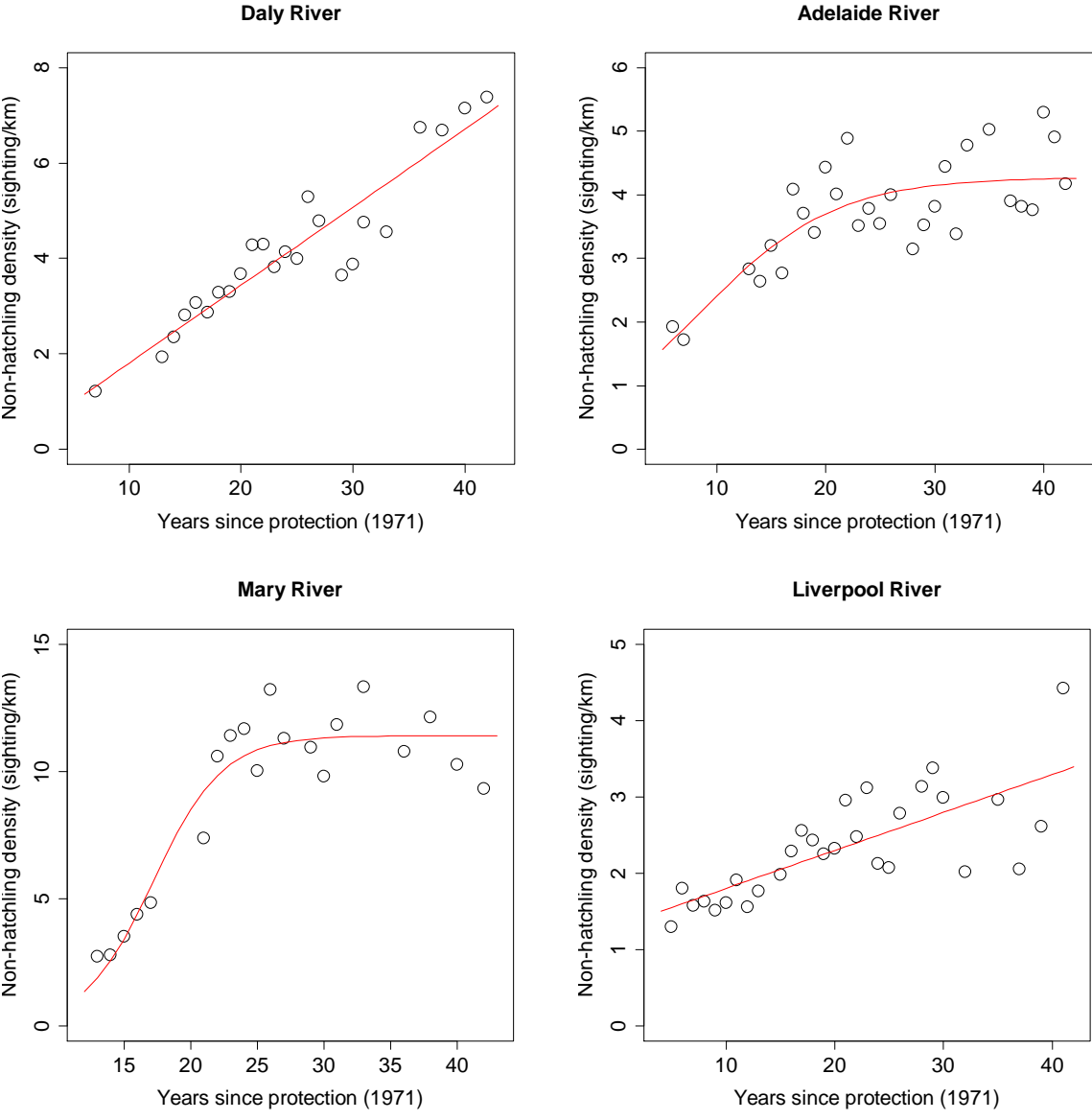
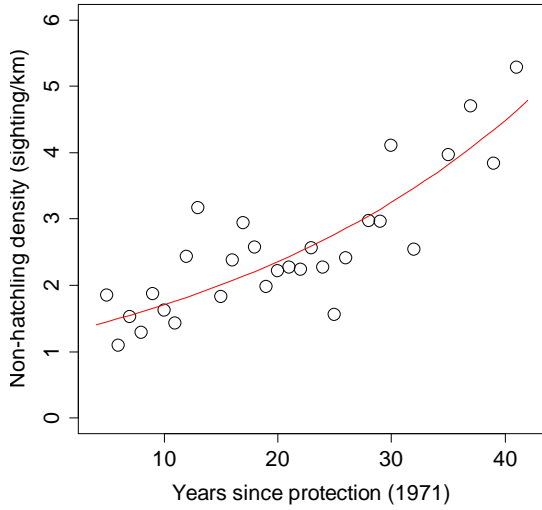


Figure 1: Rivers surveyed to monitor Saltwater Crocodile populations in the NT.

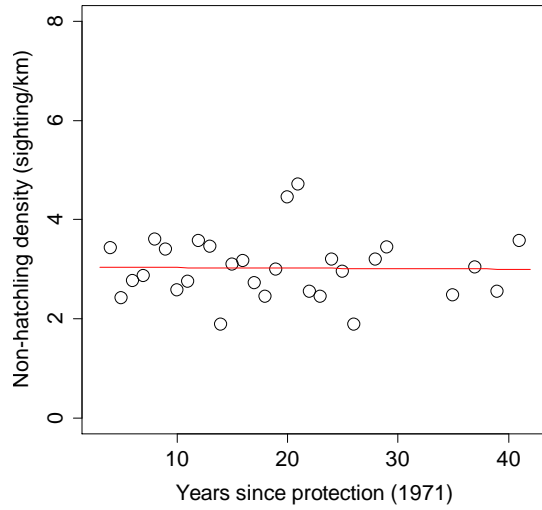
Figure 2: Abundance density (sighting/km) plots with data up to 2013 (Adelaide, Daly & Mary) and 2012 (Arnhem Land).



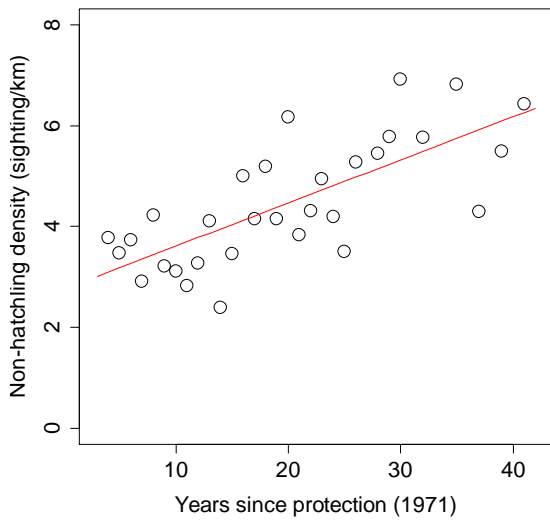
Tomkinson River



Cadell River



Blyth River



Glyde River

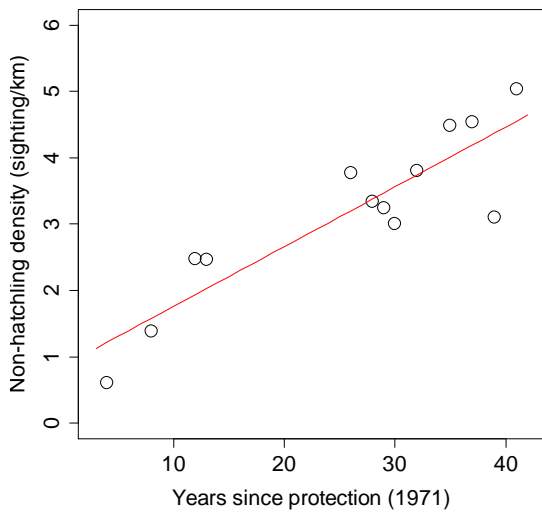
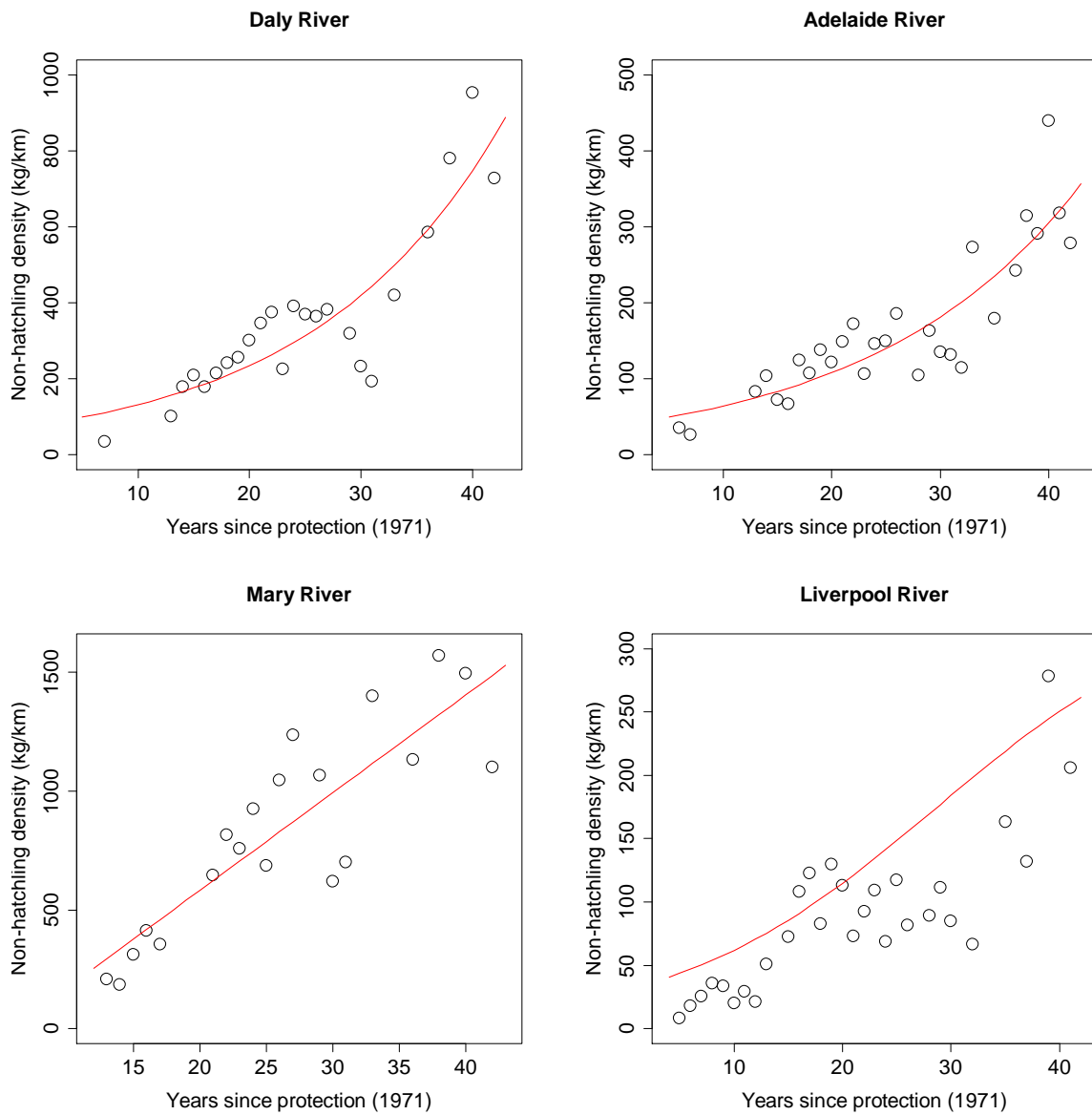


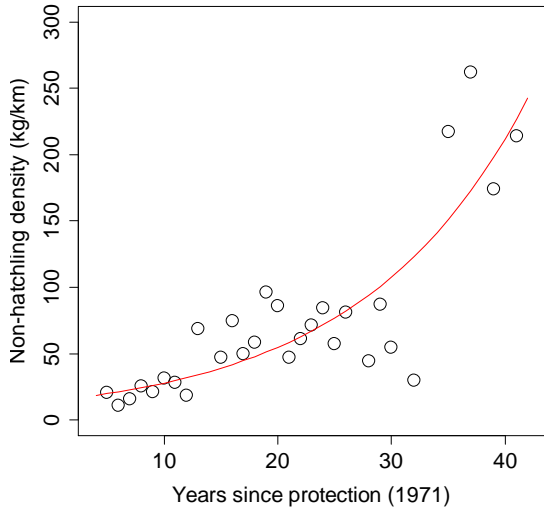
Table 1: Results of model selection fitted to the abundance density data. N = number of years surveyed, -- Not converged.

| River | Year (N) | Model | AICc | Δ_i | w_i |
|---------------------------|----------------|-------------|-------|------------|-------|
| Adelaide River | 1977-2013 (29) | Logistic | 52.72 | 0.00 | 0.84 |
| | | Exponential | 58.48 | 5.77 | 0.05 |
| | | Linear | 56.68 | 3.97 | 0.12 |
| Daly River | 1978-2013 (24) | Logistic | 46.85 | 3.23 | 0.11 |
| | | Exponential | 44.64 | 1.03 | 0.33 |
| | | Linear | 43.61 | 0.00 | 0.56 |
| Mary River (Sampan Creek) | 1984-2013 (20) | Logistic | 69.49 | 0.00 | 1.00 |
| | | Exponential | 99.82 | 30.33 | 0.00 |
| | | Linear | 96.05 | 26.56 | 0.00 |
| Liverpool River | 1976-2012 (29) | Logistic | 42.62 | 1.55 | 0.23 |
| | | Exponential | 42.44 | 1.38 | 0.26 |
| | | Linear | 41.07 | 0.00 | 0.51 |
| Tomkinson River | 1976-2012 (28) | Logistic | -- | -- | -- |
| | | Exponential | 50.43 | 0.00 | 0.91 |
| | | Linear | 55.09 | 4.66 | 0.09 |
| Blyth River | 1975-2012 (31) | Logistic | 81.78 | 2.20 | 0.16 |
| | | Exponential | 80.05 | 0.47 | 0.37 |
| | | Linear | 79.58 | 0.00 | 0.47 |
| Cadell River | 1975-2012 (31) | Logistic | -- | -- | -- |
| | | Exponential | 59.68 | 0.00 | 0.50 |
| | | Linear | 59.68 | 0.00 | 0.50 |
| Glyde River | 1975-2012 (13) | Logistic | 29.72 | 3.66 | 0.11 |
| | | Exponential | 28.53 | 2.47 | 0.20 |
| | | Linear | 26.06 | 0.00 | 0.69 |

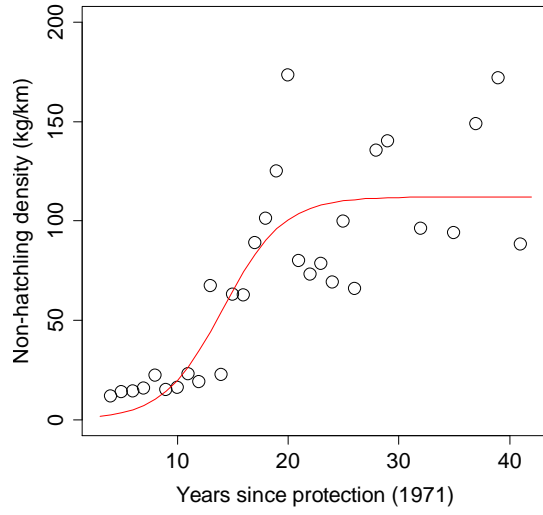
Figure 3: Biomass density (kg/km) plots with data up to 2013 (Adelaide, Daly & Mary) and 2012 (Arnhem Land).



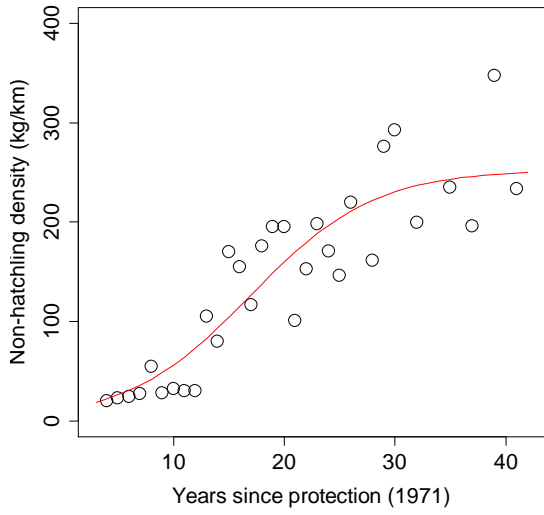
Tomkinson River



Cadell River



Blyth River



Glyde River

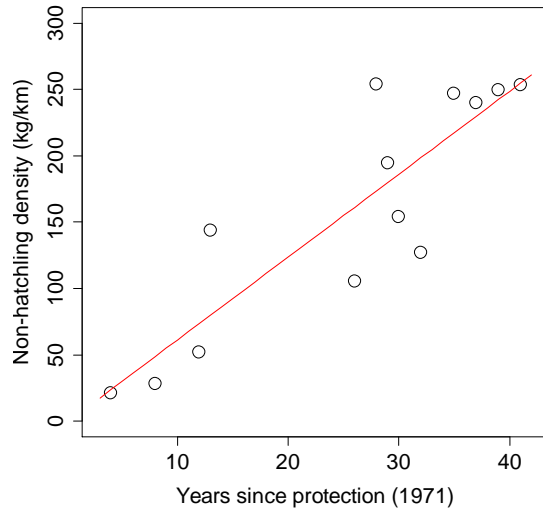


Table 2: Results of model selection fitted to the biomass density data. N = number of years surveyed, -- Not converged.

| River | Year (N) | Model | AICc | Δ_i | w_i |
|---------------------------|----------------|-------------|--------|------------|-------|
| Adelaide River | 1977-2013 (29) | Logistic | -- | -- | -- |
| | | Exponential | 307.25 | 0.00 | 0.95 |
| | | Linear | 313.06 | 5.81 | 0.50 |
| Daly River | 1978-2013 (24) | Logistic | -- | -- | -- |
| | | Exponential | 293.11 | 0.00 | 0.95 |
| | | Linear | 299.20 | 6.09 | 0.50 |
| Mary River (Sampan Creek) | 1984-2013 (20) | Logistic | 276.14 | 1.12 | 0.35 |
| | | Exponential | 280.30 | 5.28 | 0.4 |
| | | Linear | 275.02 | 0.00 | 0.61 |
| Liverpool River | 1976-2012 (28) | Logistic | -- | -- | -- |
| | | Exponential | 290.05 | 0.00 | 0.64 |
| | | Linear | 291.22 | 1.18 | 0.36 |
| Tomkinson River | 1976-2012 (28) | Logistic | -- | -- | -- |
| | | Exponential | 291.51 | 0.00 | 0.99 |
| | | Linear | 299.90 | 8.39 | 0.01 |
| Blyth River | 1975-2012 (30) | Logistic | 323.48 | 0.00 | 0.62 |
| | | Exponential | 336.02 | 12.54 | 0.00 |
| | | Linear | 324.49 | 1.00 | 0.36 |
| Cadell River | 1975-2012 (30) | Logistic | 290.49 | 0.00 | 0.89 |
| | | Exponential | 301.52 | 11.03 | 0.00 |
| | | Linear | 294.83 | 4.34 | 0.11 |
| Glyde River | 1975-2012 (12) | Logistic | 142.65 | 3.99 | 0.08 |
| | | Exponential | 140.14 | 1.48 | 0.30 |
| | | Linear | 138.66 | 0.00 | 0.62 |