

New Guinea Freshwater Crocodile *Crocodylus novaeguineae*

S. Charlie Manolis¹ and Godfrid Solmu²

¹ Wildlife Management International, P.O. Box 530, Karama, NT 0813, Australia (cmanolis@wmi.com.au)

² Jamadel Enterprises Limited, P.O. Box 1434, Vision City, Waigani, NCD, Papua New Guinea (solmu009@gmail.com)

Common Names: New Guinea crocodile, New Guinea freshwater crocodile, buaya air tawar, buaya hitam, freswara pukpuk, blakpela pukpuk, Wahne huala

Range: Papua New Guinea (mainland only), Indonesia (Papua and West Papua Provinces)



Figure 1. Distribution of *Crocodylus novaeguineae* (Solmu and Manolis 2019).

Conservation Overview

CITES: Appendix II

CSG Action Plan:

- Availability of survey data: Adequate
- Need for wild population recovery: Moderate
- Potential for sustainable management: High

2018 IUCN Red List: Least Concern. The species appears to remain abundant throughout much of its extensive habitat (last assessed in May 2018; Solmu and Manolis 2019).

Principal threats: Illegal hunting, habitat alteration

Ecology and Natural History

The New Guinea freshwater crocodile is a medium-sized crocodylian restricted to the island of New Guinea and Pulau Kimaam off the southwestern coast of Papua, Indonesia (Cox *et al.* 2003). Maximum size is around 3 m TL for females and 3.5 m for males (Hall 1991b), although skins taken through the wild harvest in the Sepik River area of Papua New Guinea

suggest larger individuals may occur.

The species prefers freshwater habitats, and is found throughout most of New Guinea's vast system of freshwater rivers, swamps, overgrown channels and marshes. In some areas it is sympatric with the Saltwater crocodile (*C. porosus*).

The nominate form of *C. novaeguineae* occupies the northern part of Papua New Guinea, but morphological differences in skull features and scalation between northern and southern populations (Hall 1989) have suggested that the latter may be a distinct taxon.

Recently, Murray *et al.* (2019) described the southern variant as a distinct new species (*C. halli*) on the basis of geometric morphometric techniques assessing cranial shape variation. Nonetheless, despite this important new finding, until such time as *C. halli* is formally accepted as a new species, *C. novaeguineae* will refer to both forms in this Action Plan.



Figure 2. *Crocodylus novaeguineae* at Wagu Village, Ambunti, Papua New Guinea, in 2009. Photograph: Jack Cox.

Most information on the biology and ecology of *C. novaeguineae* is from Papua New Guinea. *Crocodylus novaeguineae* is a mound-nesting crocodylian, with females becoming sexually mature at 1.6-2.0 m TL. There are significant differences in nesting ecology between northern and southern populations: the northern population nests during the dry season (August-October; Jelden 1981, 1985) whereas the southern population nests during the wet season (November-April); the northern population lays larger clutches of smaller eggs than the southern population; and, nests of the northern population are usually located on

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floating mats of vegetation in densely overgrown channels, lake fringes and scroll swales, and occasionally on stream banks or scroll levees (Cox 1985), whereas nests of the southern population are more frequently located on land (Hall and Johnson 1987).

Conservation and Status

Commercial hunting of *C. novaeguineae* commenced after World War II and peaked in the 1960s. Management programs have been developed in both Indonesia and Papua New Guinea, with the aim of regulating harvests of eggs, juveniles and/or wild skins for ranches at sustainable levels, while providing economic incentives to indigenous landowners.

- Papua New Guinea

In Papua New Guinea, the Government moved to regulate hunting by: introducing legislative controls in the late 1960s; and, establishing a regulated program in the 1970s based on cropping and ranching. Crocodiles are managed at sustainable levels for the benefit of indigenous landowners who own most of the land in Papua New Guinea. Crocodiles can be legally harvested by landowners for personal use (food and ritual), but commercial sale and export of skins is restricted by size at 18-51 cm belly width, which corresponds to crocodiles of approximately 0.9-2.1 m TL. The upper size limit is designed to protect breeding adults.

Early attempts to establish village level ranches floundered due to technical limitations, particularly feed (locally caught fish), water and management deficiencies (Hollands 1987). Trade in ranched *C. novaeguineae* hatchlings/ juveniles and eggs to large raising facilities continued until 1995, when the largest farm in the country ceased purchasing the species due to reduced market demand and the farm's focus on *C. porosus*.

Since that time, only harvesting of wild skins has continued. Exports of wild skins declined from over 20,000/year in 1977-1980, and have fluctuated between 10,000 and 21,000/year between 1981 and 2015 - average of 16,767 *C. novaeguineae* skins was exported annually in 2005-2015 (Solmu and Sine 2009; Solmu *et al.* 2016). Exports in 2016 and 2017 were lower than previously, at 9728 and 6132 skins, respectively (Solmu *et al.* 2018). Annual fluctuations in the wild skin harvest can be caused by environmental conditions such as drought, which allows easier access by hunters into wetland areas. However, market demand is also a factor to consider with the species.

Spotlight or aerial surveys are of limited utility for monitoring the *C. novaeguineae* population in open water areas, as these are also accessible to hunters, and so the population is both reduced (low densities) and wary, and they are not representative of the majority of the population, that occurs in thickly vegetated habitats (Montague 1981).

Harvest data or skulls of harvested animals are useful for

monitoring populations in areas that are not amenable to spotlight or aerial surveys, which are also logistically and economically impractical [see Hall (1990a,b); Hall and Portier (1994); Solmu (1994)]. Data from the skin harvest indicate the presence of an abundant *C. novaeguineae* population in Papua New Guinea, which has sustained an extensive harvest over a long period of time.

Nest counts have been used as an index of the *C. novaeguineae* population since 1981 (Hollands 1987). In 1995 the nest monitoring program was reviewed and found to be basically sound (Manolis 1995), and recommendations were subsequently adopted to improve the standardization of data collection and the availability of trained personnel, to provide timely and relevant analyses.

The *C. novaeguineae* nest index in the middle and upper Sepik River area indicates that the population has increased over time (1981-2014; Solmu *et al.* 2015, 2016), albeit annual nest production has fluctuated greatly between years. The latest nest survey carried out in October 2015 (Solmu *et al.* 2015) reported a significant decline in nest numbers relative to the previous survey (2013), which was considered to have been caused by El Niño conditions causing low water levels (many scrolls, oxbows and small lakes had dried up), and many nesting habitats subsequently being destroyed by fires. Such reductions in nest effort have occurred previously, and have also been reported for *C. porosus*.

Currently, the main threat to *C. novaeguineae* in Papua New Guinea is habitat alteration, particularly in the Sepik River area, due to introduced fish (*Piaractus brachypomum*, *Puntius gonionotus*). As *C. novaeguineae* nests during the dry season its habitats may be exposed to fire.

- Indonesia

Basic population surveys and development of egg and hatchling collection systems and ranches was undertaken during an extensive FAO-funded project between 1986 and 1992 (Cox 1992). During the same period, extensive illegal hunting and smuggling of skins was addressed and aggressive enforcement of regulations initiated.

In 1991, Indonesia began a detailed re-design of crocodile management in response to concerns raised by CITES, the CSG and other NGOs (Messel 1993; Thomsen 1993). With the assistance of expert consultants (Webb and Jenkins 1991) and reviews by the CSG (Messel *et al.* 1992; Messel 1993), a coordinated management program for *C. novaeguineae* (and *C. porosus*) was developed. A Crocodile Management Task Force (Satgas Buaya) was subsequently created in the CITES Management Authority (PHKA), resulting in the adoption of enabling legislation for crocodile conservation regulations, the development of a tracking system for both ranched and wild skins, and the establishment of an interlocking system of licenses, permits and tags intended to regulate collection, movement, trade, ranching, processing and export of crocodilian products.

From late-1994 to 1998, Indonesia imposed a moratorium on exports of all crocodile products (except personal effects) while implementation of the new system was under way. In 1997 a revised Crocodile Management Program for Indonesia was approved (PHKA 1997).

The current management regime for *C. novaeguineae* in Indonesia (Papua and West Papua Provinces) is similar to that in Papua New Guinea, with ranching of eggs/ juveniles and wild harvest of skins permitted. Trial egg harvests were carried out in the early 1990s, but were not considered economically feasible and discontinued (see Manolis and McInnes 2007). Manolis (2007) and Manolis and McInnes (2007) reported industry concerns that the system of allocation of quotas between farms may not be equitable.

In both countries trade in wild skins is subject to an upper size limit that aims to protect the proportion of the adult breeding population that typically exceeds that size. In Papua New Guinea, the size limits (18-51 cm belly width) apply to salted skins, whereas Indonesia's limits (25-51 cm) apply to wet blue processed skins. As salted skins shrink during processing by an average of 10%, the Indonesian size limits translate to around 28-57 cm belly width of salted skins.

The consequence of the differences in upper size limits between these neighboring Range States needs to be investigated. Harvest data from Papua New Guinea suggest that between 40% and 75% of nesting *C. novaeguineae*, as well as some nesting *C. porosus*, are smaller than the upper skin size limit, and are thus subject to harvest (Hall 1991b; Hall and Johnson 1987; Montague 1983, 1984; Cox 1985, 1992). The smaller lower size limit in Papua New Guinea may be biologically defensible, but it is economically wasteful due to the low prices offered for those sizes of skin. Hunting of *C. novaeguineae* within gazetted protected areas (eg Lorenz and Wasur National Parks) is prohibited (ROI 2017).

In 1998 a quota system was decreed by PHKA for juvenile and wild skin harvests of *C. novaeguineae*. Each year, PHKA proposes harvest levels in each Province, which are reviewed and assessed further by LIPI. Once quotas are finalised, PHKA issues an annual decree on the national allowable harvest. Only registered crocodile farms are allocated a share of the quotas.

Harvest quotas for *C. novaeguineae* skins have ranged from 3500 to 15,000/year. Between 2012 and 2016 the skin harvest quota was 15,000/year, which is equivalent to a skin export quota of 13,500/year (10% allowed for domestic use) - 64-80% of the export quota was achieved in 2012-2015, and 26% in 2016 (due to low market demand) (ROI 2017).

Quotas for juveniles <80 cm TL harvested for ranching were reduced in 2005 from 60,000 (quota mostly un-

utilized) to 15,000/year (Kurniati 2008). They were later reduced further, and in 2012-2016 the quota was 8500 per year, with 1-21% of the export quota of skins derived from ranched individuals being achieved in any year. Low market demand has affected the ranching of *C. novaeguineae* more so than the wild skin harvest, as farms are required to invest in the rearing of ranched animals to a culling size.

Direct monitoring of the *C. novaeguineae* population has been carried out irregularly, in the Mid-Zone Mamberamo River, with spotlight surveys carried out between 1987 and 2002 (see Kurniati and Manolis 2004) and in 2014-15 (ROI 2017). However, different areas have been surveyed at different times, with few areas consistently surveyed over time and/or under the same conditions. Of 20 sites surveyed in 2014-15, five had been surveyed in 2001-02, and three in 1987-92 (but over much smaller distances) (Kurniati and Manolis 2004; ROI 2017). On the basis of the most recent data, the monitored *C. novaeguineae* populations are considered to have been stable between 2001-02 and 2014-15, although caution must be exercised due to the low number of rivers involved and potential variation between years due to survey conditions, etc. In addition, areas that are accessible to survey teams are also accessible to hunters, and as observed in Papua New Guinea spotlight counts may not be good indices of the population in all habitats.

Monitoring of wild *C. novaeguineae* populations, and the extent to which Indonesia's current ranching program and skin exports are compliant with CITES, was considered by a CSG review in 2014. A recommendation was for a more detailed review to consider ways in which compliance could be improved, for both *C. novaeguineae* and *C. porosus* (Brien *et al.* 2014).

There seems little doubt that *C. novaeguineae* populations in Papua New Guinea and Indonesia have benefited from the vast areas of wetland habitats and low human population density. Notwithstanding the reduced market demand in recent years for *C. novaeguineae*, sustainable use of the species provides an important source of cash income for local communities.

Priority Projects

High priority

1. **Status of *Crocodylus halli*.** Confirmation of the status of *C. halli* (Murray *et al.* 2019) as a new species is required. The implications for the industry in Papua New Guinea and Indonesia, and CITES, are important. Molecular biology studies on northern and southern populations may be required to quantify genetic differences. In Papua New Guinea the majority of *C. novaeguineae* skins are taken from the southern population, mainly from Western (70%; eg Fly River) and Gulf (30%; eg Kikori, Purari, Turama and Vailala Rivers) Provinces (G. Mitchell, pers. comm. 2018).

2. **Review of crocodile management and regulations in Indonesia.** A detailed review should be carried out to assess ways in which monitoring of the wild population and on farms/tanneries can be improved, to ensure compliance with CITES, and that practical regulatory mechanisms are in place to ensure the sustainable use of *C. novaeguineae*.

Moderate priority

3. **Standardize harvest size limits between the two Range States at biologically optimal sizes.** Different size limits for trade in crocodiles remain in effect in the two neighboring Range States. Both countries should review existing data, conduct any necessary additional studies, and adopt a size limit that ensures sustainable use, protects the breeding adult stock and encourages sound economic use of the resource.

4. **Review population monitoring in Papua New Guinea.** Nest count surveys of *C. novaeguineae* in the Sepik River region are now conducted on a biennial basis due to funding constraints within Government. Results are inferred to represent population trends throughout the country, but this may be presumptive.

5. **Develop more cost-effective monitoring methods.** The nest monitoring program in Papua New Guinea relies on nest counts by helicopter, and this methodology is now very expensive. More cost-effective methods should be investigated (eg drones), to reduce monitoring costs but retain compatibility with the long-term historical dataset that is available (Solmu *et al.* 2018).

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