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Crested macaque
Macaca nigra Desmarest, 1822
Indonesia (Sulawesi)
(2016)

Lisa M. Danish, Daphne Kerhoas, Dominique Bertrand, Dwi Febriyanti, and Antje Engelhardt

Crested macaques are one of the seven macaque species endemic to the island of Sulawesi, Indonesia (Fooden 1969). Sulawesi is a biodiversity hotspot within the Wallacea eco-region characterized by a unique blend of Asian and Australian flora and fauna (Whitten *et al.* 1987) and by an extremely high degree of endemism, specifically among mammals (Musser 1987). The seven extant macaque species are of specific importance as they are living fossils of primate adaptive radiation and speciation (Riley 2010). All species are threatened by extinction, but only the crested macaques have been classified as “Critically Endangered” by the IUCN (IUCN Red List 2017) following an assessment in 2008 (Supriatna and Andayani 2008). Their population has decreased by more than 75-90% in the last 30 years, mainly due to poaching and illegal logging (Melfi 2010; Palacios *et al.* 2012).

Crested macaques are characterized by their distinctive thin strip of raised, longer hair extending from the forehead to the back of the head and their all black pelage; the only other coloration is on the ischial callosities, which are pink and a distinctive trait for separation of the species from their also black sister taxon, the Gorontalo macaque (*M. nigrescens*). Their tails are short (22mm in length), which in the past led to observers classifying them incorrectly as Celebes apes, instead of monkeys (Rowe 1996).

Crested macaques are diurnal primates that live in large multi-male, multi-female groups characterized by female philopatry and male dispersal (O’Brien and Kinnaird 1997, Duboscq *et al.* 2013, Marty *et al.* 2015). Although females form matrilineal groups, their social interactions are characterized by a broad net of social partners, low intensity and often bi-directional aggression, and high levels of reconciliation (Duboscq *et al.* 2013, 2014). Males, in contrast, fiercely fight for dominance, frequently migrate between groups, and mean alpha-male tenure is particularly short (Marty *et al.* 2015). Due to this high degree of male contest competition, crested macaques are sexually dimorphic, with males approximately twice as large as females (males: 12kg, Marty *et al.* 2015; females: 6kg, Thierry *et al.* 2004) and exhibiting larger canines (Thorén *et al.* 2006). Males have two sexual signals, loud calls, and a red coloration of their scrotum that reflect their dominance status (Engelhardt *et al.* 2009, Neumann *et al.* 2009). Females have a cyclic swelling of their perianal skin that indicates relatively reliably the time of ovulation (Higham *et al.* 2012). Although females typically mate with multiple males, male reproductive success is highly skewed towards alpha males (mean of 65% paternities, Engelhardt *et al.* in press).

Crested macaques survive best in primary and secondary forests (O’Brien and Kinnaird 1997), but can also sporadically be found in actively logged forests and plantations (Rosenbaum *et al.* 1998). Their habitat is highly seasonal with annual rainfall of 1,550 mm – 2,400 mm mostly falling from May - October (O’Brien and Kinnaird 1997). Crested macaques are semi-terrestrial, spending at least 60% of their day on the ground (O’Brien and Kinnaird 1997). Their diet consists primarily of fruit, supplemented with other plant parts as well as invertebrate and

vertebrate prey. Female-female competition for food resources seems to have a significant effect on foetal survival, whereas infants seem to be additionally threatened by the male reproductive strategy of infanticide (Kerhoas *et al.* 2014).

One stronghold of crested macaques, and the most likely viable natural remaining population of the species to survive, remains on the eastern coast of Sulawesi, inside the 8,867 hectare Tangkoko Reserve (Supriatna and Andayani 2008; Riley 2010; Palacios *et al.* 2012). The most recent survey indicates that one half of the park (Tangkoko) supports a population of 1,951 or 44.9 individuals per km² (Palacios *et al.* 2012). Another recent survey assessed 61.5 individuals/km² (Kyes *et al.* 2013), which comes close to population numbers of 76 individuals/km² from almost thirty years ago (Sugardjito *et al.* 1989). This survey was, however, mainly conducted close to a research station and primarily included habituated and daily observed groups. The robust presence of those animals is likely due to the permanent presence of researchers and the connected ongoing ecotourism (Macaca Nigra Project; www.macaca-nigra.org). Areas outside Tangkoko do not have such hopeful numbers; a census of 22 locations outside the park resulted in very few sighting of *M. nigra*, with most sites having from no to less than 10 individuals/km² (Melfi *et al.* 2007).

Significant reduction in population size in crested macaques are connected to habitat loss and hunting (Myers *et al.* 2000). Habitat loss is driven by mining, slash and burn agriculture, and cash crops (Melfi 2010). In addition, the consumption of macaque meat during holidays, weddings, and parties is a long-held tradition (Clayton and Milner-Gulland 2000), but hunting rates became unstable starting in the 1970's (O'Brien and Kinnaird 2000) and remain so to this day (Hilser *et al.* 2013). As farms expand into forests, macaques have started to include crops in their diet, thus fueling a human-wildlife conflict with farmers (Riley and Priston 2010).

A number of research and community outreach programs have been conducted successfully around the Tangkoko Nature Reserve (Kyes *et al.* 2013, Selamatkan Yaki 2017; Tangkoko Conservation Education Programme 2017, Tasikoki Wildlife Rescue Center 2017). However, conservationists are concerned that threats to this species are increasing and likely to get worse in the coming years. For example, illegal fires, used to clear forest land for cattle grazing, are encroaching greatly on the only Nature Reserve in their geographic range (Palacios *et al.* 2012). Thus, there is urgent action needed to stop the encroachment into protected areas. While recent population genetic analysis indicates that the Tangkoko crested macaques currently still remain a genetically viable population despite the severe conditions they have faced (Engelhardt *et al.* in press), further population decline could jeopardize the health of their gene pool.

Since most population surveys have been in Tangkoko (Sugardjito *et al.* 1989, Palacios *et al.* 2012, Kyes *et al.* 2013), where numbers are also expected to be highest, we do not currently know the precise number of crested macaques left on Sulawesi. While the Tangkoko population remains genetically viable (Engelhardt *et al.* in press), we have no data regarding the degree of genetic inbreeding or health status of the overall population. Thus, a proper assessment is urgently needed. As human populations continue to grow in the region, so will the interactions between humans and macaques. How they will continue to survive in the face of this anthropogenic habitat change remains to be seen.

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