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NON DETRIMENT FINDINGS (NDF): TOKAY GECKO IN INDONESIAN ARCHIPELAGO (Gekkonidae: *Gekko gecko*)

By:

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FOREWORDS

The Tokay gecko (*Gekko gecko*) was included in CITES Appendix II in 2019. The increase in the CITES status of the Tokay gecko is due to the uncontrolled hunting of wild-caught geckos of this species throughout its range in Indonesia, especially from Java Island. The export quota of Tokay geckos in 2019, which was recommended by the Scientific Authority (Indonesian Institute of Sciences-LIPI, former name of BRIN) rose very sharply in 2019 and was intended to accommodate the very large number of Tokay gecko individuals declared to be the result of captive breeding (F and C).

The export of Tokay geckos has always been very large, generally to China, where the species is used for consumption and raw material for TCM (Traditional Chinese Medicine). To control the use of Tokay geckos based on scientific data and the support for Government Regulation (PP) no. 8/1999 concerning Utilization of Wild Plant and Animal Species, the Scientific Authority (BRIN) is providing this NDF (Non-Detriment Findings) document as policy recommendations for the Management Authority (Ministry of Environment and Forestry- KLHK). The proposed recommendation is a strategy for determining the sustainable utilization of the Tokay gecko throughout the Indonesia Archipelago, except the western region of New Guinea, which are consisted of Papua and West Papua Provinces. The writing of this NDF document can be finalized with the contribution of Mr Ronald Lilley who helped in editing the English and gave valuable suggestions to improve this document.

Authors
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CHAPTER I
INTRODUCTION

1.1. Background

In terms of utilization, Indonesian reptiles for consumption and medicine are known as high-intensity export commodities. One of the species that has been very highly utilized in the past 10 years is the Tokay gecko (Gekko gecko). For many years, the export of Tokay geckos from Indonesia to China has taken place without control. Prior to 2019, the number of individuals exported was not limited because this species was not yet included in the Appendix List of CITES (CITES 2019). The Scientific Authority (BRIN) and the Management Authority (Ministry of Environment and Forestry-KLHK) had set a national quota, but it has only been used by pet traders in determining their requirements for export permits (Research Center for Biology 2018). Without sustainable utilization, the populations of this species could become rare, and potentially even extinct in nature. Biologically, the Tokay gecko is an important predator of invertebrates (insects, scorpions, centipedes), small snakes and young rats in wild and residential environments. It provides an environmentally friendly means of biological pest control and an alternative to the use of pesticides and other poisons (Aowphol et al. 2006; Bucol & Alcala. 2013). With its role as a natural predator, the extinction of the Tokay gecko in the wild will disrupt the balance of the ecosystem, as shown by the emergence of various teak tree caterpillars terrors in several areas in Java (see 4.7. Disaster due to Decreasing Population of Tokay gecko in the Wild).

For the sake of sustainability, the use of wild animals must be monitored and regulated by conservation efforts. Concerning this principle, the following question is often asked by importing countries to the Government of Indonesia: "Does the utilization of wildlife still maintain the sustainability of their populations in the wild?" To answer this question, the Scientific Authority (BRIN) conducted an assessment of the status of current species utilization and its potential impact on the species populations in the wild. The results of this assessment are presented in this document as the provision of NDF (Non-Detriment Findings) for the Tokay Gecko.

1.2. NDF Objective

The NDF document is the result of an analysis of the utilization of Wild Plants and Animals (WPA) and its purpose is an attempt to ensure that a WPA circulation will not have a negative impact on the survival of the proposed species (Res. Conf. 16.7; Rev.CoP17). The content of NDF in this document covers various biological aspects, including an analysis of taxonomy, distribution, ecology, growth, reproduction and population estimates; in addition, there was also an analysis of the socio-economic impacts of utilizing wild Tokay geckos.

This NDF document was compiled by the Scientific Authority (BRIN) to be used as a basis for policy-making by the Management Authority (KLHK). The proposed recommendations are strategies for implementing the sustainable use of WPA species.

1.3. NDF Scope

This NDF document contains biological and socio-economic information on the Tokay gecko based on the latest data, especially for these animals that live in Java, and can be applied to the utilization of Tokay geckos in Indonesia with the possibility of

applying innovations and methodological modifications of existing scientific and socio-economic approaches.

The data and information used in this assessment were obtained from field surveys in important locations that are known sources of Tokay geckos through all provinces except provinces in the Papua Region, in-depth interviews with active hunters, collectors and villagers in these locations, as well as from the literature and information obtained from internet-based media.

CHAPTER II
BIOLOGICAL ASPECT

2.1. Classification and Morphology Characteristics

The scientific classification of Tokay gecko currently is:

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Reptilia
Order	:	Squamata
Family	:	Gekkonidae
Genus	:	Gekko
Species	:	Gekko gecko (Linnaeus, 1758)

Morphology characteristics

The Tokay gecko has a large head that is bigger than its slender body, with a distinct and strong jaw (Figure 1). The fingers and toes are wide and flattened with claw tips that curl back. There are sticky pads on the ventral part of the forehands and hind feet, which function as adhesive when the gecko crawls on walls, and even make the gecko possible to walk on an upside-down platform (Zhouyi et al. 2010; Wang et al. 2015). The eyes are round and appear large when compared to the size of the head.

The skin on the back is rough, dotted with red or orange to the forehands and hind legs; in addition, there are bright-coloured transverse stripes that run from the back of the head to the tail. The base colour of the dorsal is bluish or reddish grey and can change to darker or lighter to match the colour of the surrounding habitat. The skin of the ventral surface is rough and plain white.

Figure 1. The morphology of Tokay gecko with a common colour pattern (Photo: Hellen Kurniati).

The tympanum is distinct, oval-shaped and almost perpendicular to the body axis. The maximum body length (SVL–Snout to Vent length) can reach 300 mm (McKay 2008) when coupled with the length of the tail can reach 350 mm. The tail can be dropped off (autotomy) when the Tokay gecko feels threatened. Male and female individuals can be easily distinguished after reaching sexual maturity; in males, there is a series of arc-shaped anal pores on the part before the cloacal opening, but absent in female individuals. Adult males will make loud calls to advertise their presence, control their territory, and also attract a mate. With its distinctive call, which sounds like "tokeee, tokeee"

(sometimes preceded by a series of short staccato notes), the intensity of the tokay's voice is particularly loud to human ears.

2.2. Distribution in Indonesia

The distribution of the Tokay gecko is very wide, from India, Bangladesh, southern China, and throughout Southeast Asia, including Indonesia (Figure 2). The distribution in Indonesia covers Sumatra, Kalimantan, Java, Bali, Sulawesi, Nusa Tenggara Islands and Maluku Islands (McKay 2008); but Reilly et al. (2019) stated that it has also been found in Papua. The wider distributions of the species may also be assisted by inter-island transportation, especially boats and ships (Reilly et al. 2019). Based on genetic studies, the Tokay gecko originated from mainland China. This species is estimated to have entered the Indonesian archipelago about 260 thousand years ago (Reilly et al. 2019).

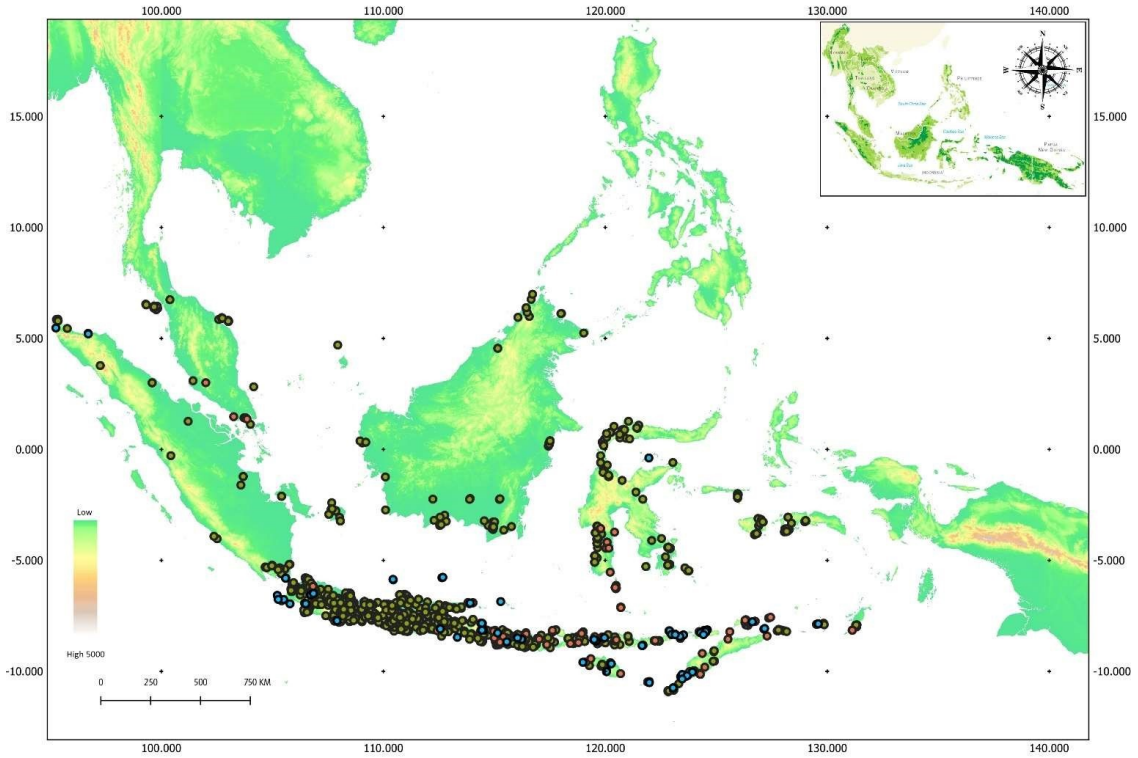


Figure 2. Distribution of Tokay geckos in Indonesia. Source of data: green dot = iNaturalist + field survey; blue dot = MZB collection; orange dot = GBIF (MVZ, USNM, UCM). The map was generated using QGIS Noosa, Shuttle Radar Topography Mission (SRTM) 90m database (https://srtm.csi.cgiar.org).

The long presence of the Tokay gecko in the Indonesian archipelago led researchers to suspect that this species has morphological differences between islands, especially populations in Sumatra, Java, Kalimantan, Sulawesi, the Moluccas, and Nusa Tenggara. However, in their research, Manzili et al. (2020) concluded that the differences in morphological characters between populations were not significant. Marine transportation modes appear to make it easier for the species to spread, and there are no massive barriers that cause isolation (Reilly et al. 2019).

2.3. Conservation Status

The Tokay gecko is indeed not among the protected wildlife species in Indonesia. Since this species was listed in the CITES Appendix II in 2019, utilization (harvesting) from the wild for international trade has been regulated through an annual quota

mechanism, based on the recommendations of the Indonesian Scientific Authority (BRIN), while utilization for domestic trade is not regulated. Until now, the Tokay gecko is included in the IUCN 'Least Concern' (LC) category, which means that its natural population is not known to have received any significant threats, although this status can be reviewed in the future.

Tokay gecko hunting is mostly done in habitats that have been modified by humans because it is easier to catch there. Apart from living in modified habitats, the Tokay gecko also lives in several conservation areas, such as Ujung Kulon National Park (Kurniati et al. 2001). Tokay geckos have also been recorded in another conservation area outside Java, namely in the Wanggameti National Park on Sumba Island, East Nusa Tenggara (Hamidy et al. 2017) and on Komodo Island (Ronald Lilley, personal communication) in Komodo National Park, East Nusa Tenggara; however, in Komodo Island was the only place where Tokay gecko called in a chorus of perhaps a hundred or more, calling all at once at dusk, around 5.30 pm, just as the sun was setting behind Gunung Ara.

The TokaygGecko is difficult to detect visually in the forest, because it is well camouflaged in the surrounding environment, and often it is only its unique calls that indicate its presence. The presence of Tokay geckos in conservation areas should guarantee that the germplasm of this species will remain safe, even if the populations in modified habitats are decreasing, or close to depletion due to hunting pressure.

2.4. Habitat

Figure 3. Several types of Tokay gecko habitats. Clockwise direction: A Tokay gecko inhabiting a cavity in an electric pole (Photo: Wahyu); a Tokay gecko nesting in a hole in a coconut tree (Photo: Wahyu Tri Laksono); a Tokay gecko coming out of a house ceiling (Photo: Wahyu Tri Laksono). The arrows indicate the individual Tokay geckos.

The vertical distribution of the Tokay gecko is very wide, ranging from 0 meters above sea level (ASL) to 1200 meters ASL (McKay 2008). Thus, Tokay gecko habitats

are very diverse and include primary forest, secondary forest, plantations, savanna and human settlements (McKay 2008), both in rural and urban areas (Aowphol et al. 2006; Bucol & Alcala. 2013). The places that Tokay geckos usually occupy in human settlements and surrounding areas are hidden micro-habitats (Figure 3), such as cavities in electric poles, holes in coconut tree trunks and the ceilings of houses. This is in line with Fauzan et al (2022) that conduct survey in Kepulauan Seribu (Seribu archipelago).

The results of interviews with Tokay gecko hunters in the Malang Regency, East Java, show that the hunters usually look for Tokay geckos in the fields, secondary forests, human settlements and quiet cemetery areas (Kurniati 2010). Teak plantations are a habitat where the Tokay gecko is easier to find. The habitats where the Tokay geckos are not found include swamps, rice fields and other aquatic habitats, as long as there are no woody trees around these waters. However, on occasion, a Tokay was seen to retreat into a vertical water-filled drain pipe and submerged its self completely for a while until it felt that the danger had passed (Ronald Lilley, personal communication).

2.5. Coexistence with Humans

Most of the villagers in areas where the Tokay gecko was found were not bothered by the existence of this species (Kurniati 2019). The results of interviews with 211 respondents in eight villages in the Gunung Karang area, Pandeglang, Banten, stated that they never killed Tokay gecko on purpose; but would only expel a Tokay gecko if it gets too close to them, for fear of being bitten by it. The group of female respondents mostly said they were afraid of Tokay gecko bites. Most community groups also think that the presence of the Tokay gecko in their house is a sign of "lucky" for the residents of the house. The same reaction was also expressed by most of the people in urban areas around the BRIN office in Cibinong, West Java (Kurniati, unpublished data). This belief shows that the Tokay gecko can coexist in harmony with the residents of the houses in which it also lives.

2.6. Growth

Tokay gecko body growth is quite fast, especially in the period after hatching until the age of three months (Nugrahani 2013). The growth from one to two years of age is still fast, but the growth of males is faster than that of females. At the age of more than one year, this difference in growth rate causes differences in body length (SVL) between males and females, where the average SVL of males is 28% longer than that of females (Kurniati & Phadmacanty 2022).

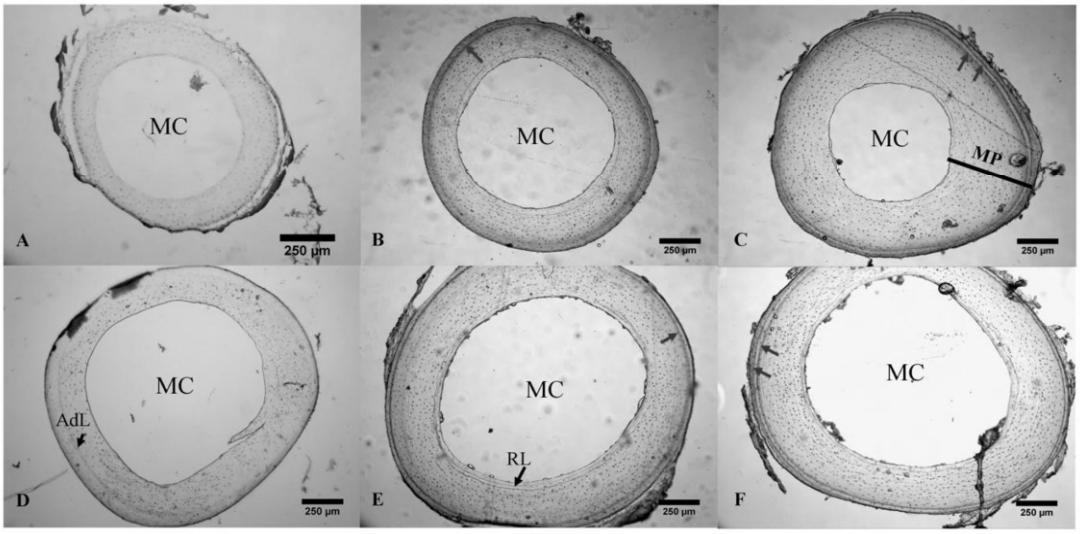


Figure 4. Cross sections (20 µm) of the femur diaphysis of *Gekko gecko*. (A) Immature female with no LAG (SVL: 90.0 mm) and RL has not occurred; (B) Mature female with one LAG (SVL: 135.0 mm) and RL has occurred; (C) Mature female with two LAGs (SVL: 144.0 mm) and thin RL has occurred; (D) Immature male with no LAG (SVL: 97.5 mm) and RL has not occurred; (E) Mature male with one LAG (SVL: 171.0 mm) and RL has occurred; (F) Mature male with two LAGs (SVL: 178.0 mm) and RL has occurred. Red arrow: LAG; MC: Marrow Cavity; AdL: Additional resting Line; RL: Resorption Line. Source: Kurniati & Phadmacanty (2022).

In reptiles, if the male body is much bigger than the female body, the adult male will have strong territorial behaviour (Andreone et al. 2005), and reptiles with strong territoriality are generally solitary (Manthey & Grossman 1997). Due to the strong territorial behaviour of male Tokay geckos, it is impossible for a group of males to live close together in one relatively small room; therefore, when several males are held captive in one cage with females, it will not be possible to produce offspring, because what often happens is that fights between males will occur.

Based on research by Kurniati & Phadmacanty (2022), females enter sexual maturity when they have an SVL of 98 mm, while mature males reach maturity when they have an SVL of 110 mm; having reached these sizes, both sexes enter a period of sexual maturity and are less than one-year-old. A total of 100 individual specimens were used in the study conducted by Kurniati & Phadmacanty (2022) (Figure 4), with ages ranging from hatchlings to adults. The maximum age of the Tokay geckos studied was two years; at this age, the female's SVL reaches 150 mm and male's SVL reaches 180 mm. In males with an SVL above 150 mm, the increase in body length slows down, while the maximum female SVL is 150 mm; female specimens with an SVL of more than 150 mm are very difficult to find in the field. Most of the male specimens with SVLs of 150 mm were one-year-old; whereas all female specimens with SVLs of 150 mm were two years old. From these results, the SVL of Tokay geckos eligible for harvesting can be determined in order for its utilization could be considered sustainable.

2.7. Reproduction

The Tokay gecko can reproduce all year round and is not affected by the seasons (Manthey & Grossman 1997). Females begin laying eggs before they are one-year-old; likewise, males have produced sperm with normal morphology before they are one-year-old (Kurniati & Phadmacanty 2022). Sexually mature females will release two eggs each time with an interval of one month from the first laying (Manthey & Grossman 1997). In

one year, the female produces an average of 12 eggs from six laying times. Because females produce eggs continuously, this results in slower growth of females compared to males. Within two years, when the SVL reaches 150 mm, the female is predicted to have produced 24 eggs. Thus, a strategy of limiting the SVL size harvested to ≥150 mm will give females the opportunity to contribute to nature by allowing them to produce about 24 eggs for the next generation before capture.

The egg incubation time is around 65 days (Das 2016). The eggs are not incubated by the female, but the male guards the nest (Figure 5). After 30 days, the female will lay eggs again (Manthey & Grossman 1997), while the previously released eggs have not hatched; then in a quite old nest, there will be a row of several eggs at difference "ages".

Figure 5. A male Tokay gecko is guarding a nest in the cavity of an electric pole (Photo: Trilaksono).

2.8. Preys and its predators

The prey of the Tokay gecko includes baby or young rats, lizards, and insects (Figure 6), which therefore gives it significantly, positive economic implications for humans. Rats or lizards that are preyed upon are smaller than the Tokay gecko body size, while the body size of insects that become prey varies widely. Immature Tokay geckos usually prey on small insects; the bigger the Tokay gecko's body, the larger insects it will eat. On the other hand, Tokay geckos also become prey for other vertebrates such as

tarantulas, owls, viper snakes (*Trimeresurus albolabris*), snakehead, flying snakes and cats.

Figure 6. Types of Tokay gecko prey. Prey can be small rats (left) or young rats, lizards (centre) and insects (right). Photo source: Bucol & Alcala (2013) and Aowphol et al. (2006).

CHAPTER III
POPULATION ESTIMATE

3.1. Survey Method

The Tokay gecko population survey method was conducted in most provinces in Indonesia followed Kurniati (2020). The surveyed area was a human settlement, which was the method also practised in India (Yashmita-Ulman & Singh 2022). The steps of work are as follows:

1. Determine the human settlements to be surveyed.
2. Conducting interviews with residents of every house in the village regarding the presence of geckos in their houses during the daytime.
3. Interviews were conducted to all residents in all houses in the village (Figure 7).

Figure 7. Interview activity with village residents during the daytime survey.

4. Visiting at night the houses where Tokay geckos were found from the interviews in the day, then visually observing the Tokay gecko and counting the number of the individuals found. The indication of the existence of the Tokay gecko was also from the sound it made.
5. Calculating the area of the surveyed village by using Google Maps (Figure 8).

Figure 8. Calculating the areas of the three surveyed villages.

6. Calculating the density of Tokay gecko by adding the number of Tokay gecko individuals found at night or the number of individuals as a result of interviews with the area surveyed. The unit of density is the number of individuals/hectare.
7. Comparing the densities from individual night counts with those from interviews. These two results are always different. The highest density per hectare will be selected.
8. Determining the estimated Tokay gecko habitat for a district where the surveyed villages were included in that district. This habitat does not include the area of rice fields, the area of the waters (lakes, rivers) and the area of the highlands above 1200 meters.
9. Determining the estimated population of Tokay gecko in one district based on the density of Tokay gecko in human settlements. The density of the Tokay gecko in human settlements was the lowest (YashmitaUlman & Singh 2022), so population estimates in the district areas were based on the lowest density of Tokay Gecko; this strategy was carried out to avoid over estimated population.
10. The implementation of the survey results is to determine the Tokay gecko annual quota for each province that was surveyed; however, several provinces cannot get an annual quota due to the low population estimated. The annual quota for each province in 2023 is 10% - 15% of the estimated population.

Based on the survey results in 2021 and 2022, estimates of the Tokay gecko population in several provinces in Indonesia are as follows:

3.2. Banten, West Java and Jakarta Provinces

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
West Java	Cianjur	5.88	82,996.0	488,016	
West Java	Sukabumi	5.28	114,192.0	602,934	
West Java	Karawang	0.65	34,910.0	22,692	

West Java	Purwakarta	6.54	55,341.0	361,930	
West Java	Subang	0.35	45,808.0	16,033	
West Java	Sumedang	3.17	27,082.0	85,850	
West Java	Tasik Malaya	2.18	204,147.0	445,040	
West Java	Cirebon	6.12	50,465.0	308,846	
West Java	Kuningan	6.00	61,696.0	370,176	
West Java	Majalengka	7.48	70,019.0	523,742	
West Java	Indramayu	2.76	88,178.0	243,371	
West Java	Ciamis	4.20	118,202.0	496,448	
West Java	Pangandaran	4.20	84,171.0	353,518	
West Java	Garut	1.70	236,632.0	402,274	
West Java	Banjar	1.03	110,117.0	113,421	
Banten	Serang	3.44	90,089.0	309,906	
Banten	Lebak	3.04	250,664.0	762,019	
Banten	Pandeglang	2.50	229,071.0	572,678	
		Total	**1,383,956.0**	**6,478,894**	**1,017,600**

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Jakarta	Tanggerang City	10.75	12,413.5	133,446	
Jakarta	Tanggerang	10.82	87,831.5	950,337	
Jakarta	DKI Jakarta	1.66	57,417.0	95,312	
Jakarta	Bekasi	20.09	20,560.1	412,970	
Jakarta	Kepulauan Seribu	13.60	877.0	11,927	
		Total	**179,099.2**	**1,603,992**	**160,500**

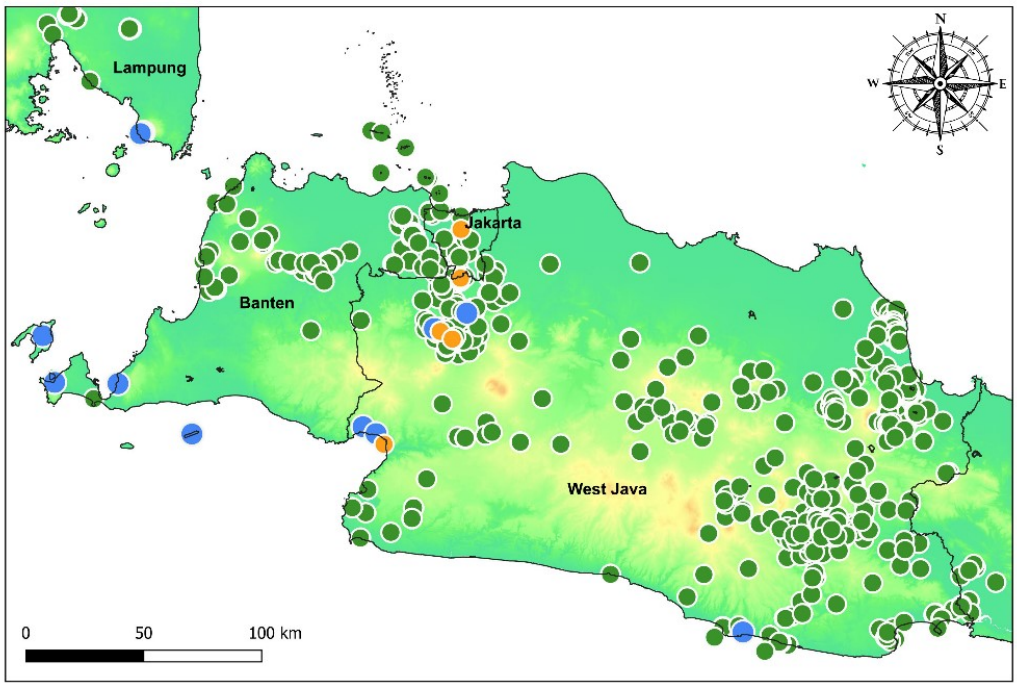


Figure 9. Distribution of Tokay gecko in Banten, West Java and Jakarta Provinces.

3.3. Central Java and Yogyakarta Provinces

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Central Java	Grobogan	2.50	31,854.0	79,635	
Central Java	Boyolali	6.31	25,290.0	159,580	
Central Java	Semarang City	4.08	17,897.5	73,022	
Central Java	Banjar Negara	20.36	21,164.0	430,900	
Central Java	Purbalingga	15.29	26,855.0	410,613	
Central Java	Banyumas	9.41	25,859.5	243,338	
Central Java	Cilacap	19.39	84,432.9	1,637,155	
Central Java	Kebumen	10.19	53,349.4	543,630	
Central Java	Kendal	6.56	32,626.5	214,030	
Central Java	Batang	14.76	30,984.7	457,334	
Central Java	Pekalongan	4.28	14,960.5	64,031	
Central Java	Pemalang	5.03	17,399.8	87,521	
Central Java	Tegal	7.46	14,157.0	105,611	
Central Java	Tegal City	3.72	1,794.0	6,674	
Central Java	Brebes	5.06	29,597.8	149,765	
Central Java	Blora	1.27	65,065.1	82,633	
Central Java	Pati	1.43	63,166.4	90,328	
Central Java	Kudus	3.69	21,570.9	79,596	
Central Java	Demak	3.21	5,410.9	17,369	
Central Java	Jepara	3.59	74,715.5	268,229	
Central Java	Rembang	2.60	29,550.6	76,831	
Central Java	Klaten	2.56	28,252.0	72,325	
Central Java	Sukoharjo	2.82	9,082.0	25,611	
Central Java	Surakarta	1.38	4,257.8	5,876	
Central Java	Sragen	1.70	47,960.0	81,532	
Central Java	Karanganyar	2.35	40,149.0	94,350	
Central Java	Wonogiri	2.01	117,388.0	235,950	
Central Java	Wonosobo	4.26	52,339.8	222,967	
Central Java	Purworejo	4.13	61,714.6	254,881	
Central Java	Temanggung	11.33	26,249.0	297,401	
Central Java	Magelang	6.94	19,789.0	137,336	
Central Java	Magelang City	62.92	1,304.9	82,101	
Central Java	Semarang	12.16	26,744.0	325,206	
Central Java	Salatiga	6.04	2,706.8	16,349	
		Total	**1,125,638.7**	**7,129,711**	**1,055,000**

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Yogyakarta	Sleman	2.49	26,810.6	66,758	
Yogyakarta	Kulon Progo	1.14	24,042.2	27,408	
Yogyakarta	Gunung Kidul	3.76	87,314.8	328,304	
Yogyakarta	Bantul	1.71	31,811.9	54,398	

Yogyakarta	Yogyakarta City	5.33	3,167.9	16,885	
		Total	**173,147.3**	**493,753**	**74,000**

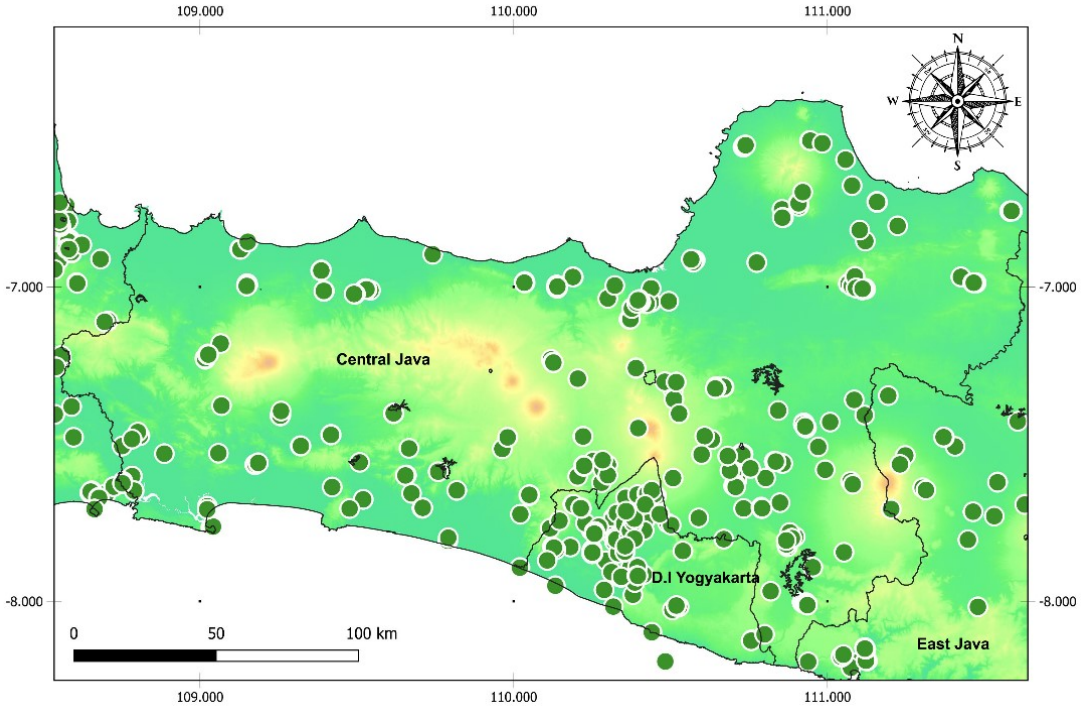


Figure 10. Distribution of Tokay gecko in Central Java and Yogyakarta Provinces.

3.4. East Java Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
East Java	Pacitan	1.62	120,810.4	195,713	
East Java	Madiun	4.98	64,580.5	321,611	
East Java	Ngawi	3.50	73,057.2	255,700	
East Java	Nganjuk	4.51	63,108.3	284,618	
East Java	Jombang	4.57	58,713.1	268,319	
East Java	Kediri	4.80	81,086.8	389,217	
East Java	Tuban	2.10	121,912.8	256,017	
East Java	Bojonegoro	0.85	130,942.5	111,301	
East Java	Lamongan	1.78	137,194.4	244,206	
East Java	Mojokerto	1.33	57,254.2	76,148	
East Java	Malang	1.07	278,860.0	298,380	
East Java	Blitar	0.75	98,788.4	74,091	
East Java	Tulungagung	1.95	75,775.9	147,763	
East Java	Sumenep	2.06	40,424.6	83,275	
East Java	Pamekasan	1.95	57,638.5	112,338	
East Java	Sampang	2.34	95,090.2	222,701	
East Java	Bangkalan	1.81	69,141.4	125,077	
East Java	Banyuwangi	0.63	506,128.0	317,848	
East Java	Situbondo	0.55	130,335.9	72,321	
East Java	Bondowoso	0.39	112,815.8	44,541	
East Java	Jember	0.52	217,263.1	112,770	

East Java	Lumajang	0.29	136,247.3	39,899	
East Java	Probolinggo	0.81	113,102.7	91,075	
East Java	Pasuruan	1.53	80,031.0	122,327	
		Total	**2,920,303.1**	**4,267,256**	**1,005,500**

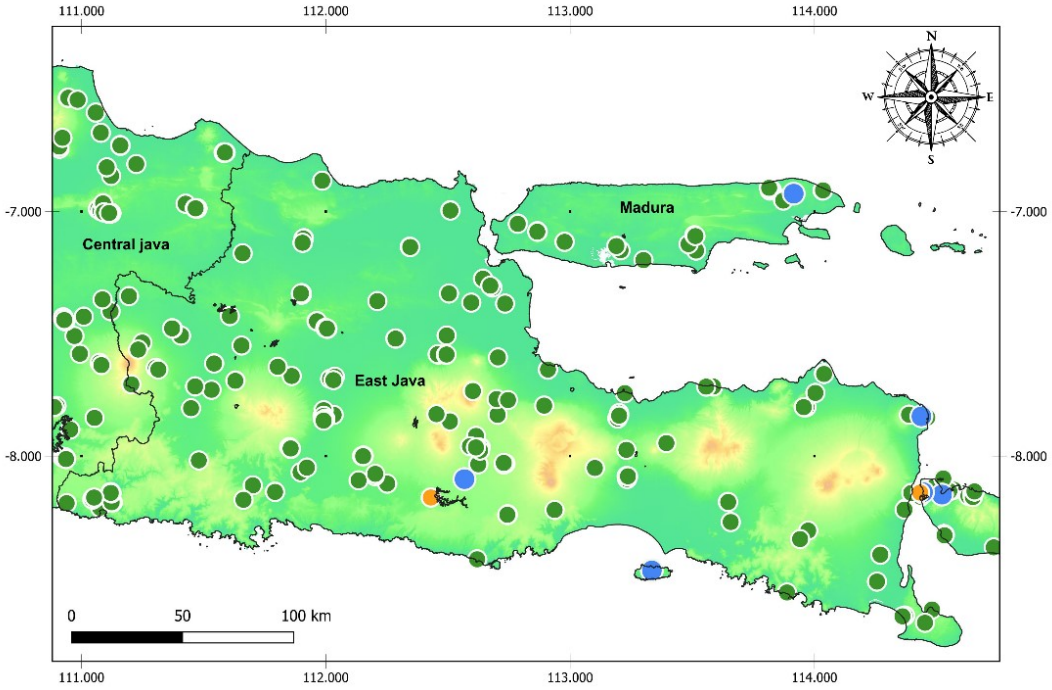


Figure 11. Distribution of Tokay gecko in East Java Province.

3.5. Bali Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Bali	Jembrana	8.36	32,632.8	272,810	
Bali	Tabanan	16.06	53,971.6	866,784	
Bali	Badung	8.87	28,798.6	255,444	
Bali	Gianyar	10.97	22,277.7	244,387	
Bali	Klungkung	29.31	26,650.5	781,126	
Bali	Bangli	27.72	20,843.4	577,780	
Bali	Buleleng	4.62	73,167.1	338,032	
Bali	Denpasar	24.00	9,618.6	230,846	
Bali	Karangasem	2.40	41,586.8	99,600	
		Total	**309,547.2**	**3,666,809**	**400,800**

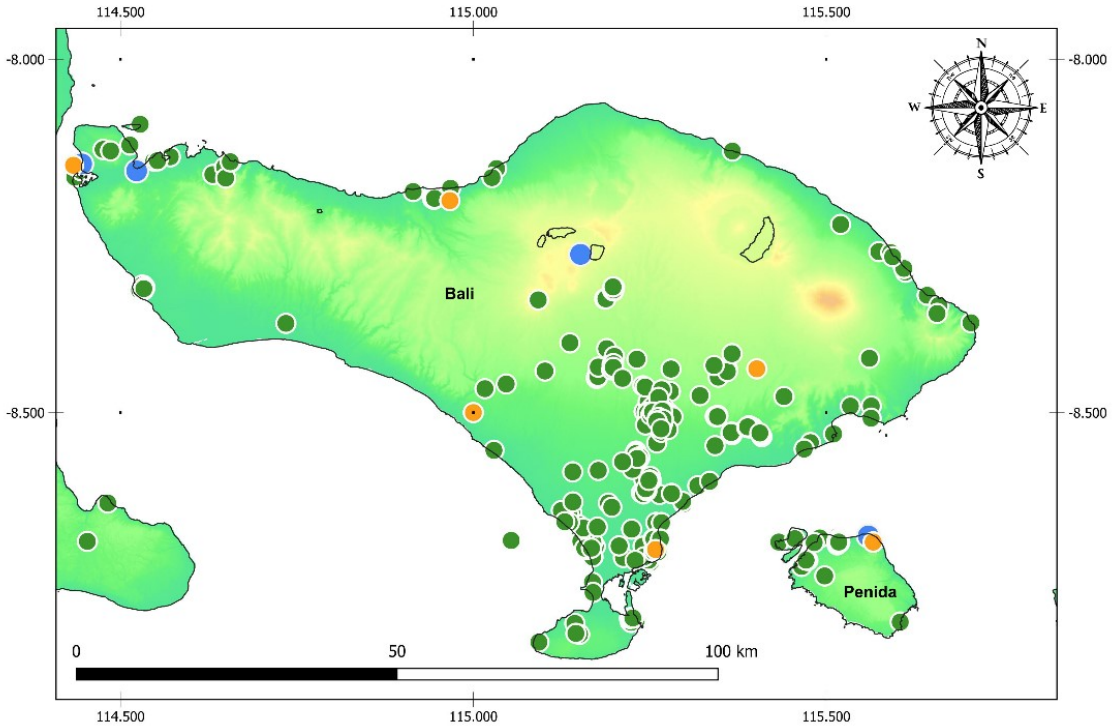


Figure 12. Distribution of Tokay gecko in Bali Province.

3.6. West Nusa Tenggara Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
West Nusa Tenggara	Lombok Barat	9.00	21,822.0	196,398	
West Nusa Tenggara	Mataram	15.69	4,970.9	77,994	
West Nusa Tenggara	Lombok Utara	8.97	29,582.0	265,264	
West Nusa Tenggara	Lombok Tengah	9.52	30,520.0	290,550	
West Nusa Tenggara	Lombok Timur	8.77	31,428.0	275,624	
West Nusa Tenggara	Sumbawa Barat	6.13	19,884.0	121,889	
West Nusa Tenggara	Sumbawa	0.98	82,180.0	80,536	
West Nusa Tenggara	Dompu	4.48	34,557.0	154,815	
West Nusa Tenggara	Bima City	2.07	4,559.0	9,437	
West Nusa Tenggara	Bima	2.26	90,234.0	203,929	
		Total	**349,736.9**	**1,676,437**	**255,500**

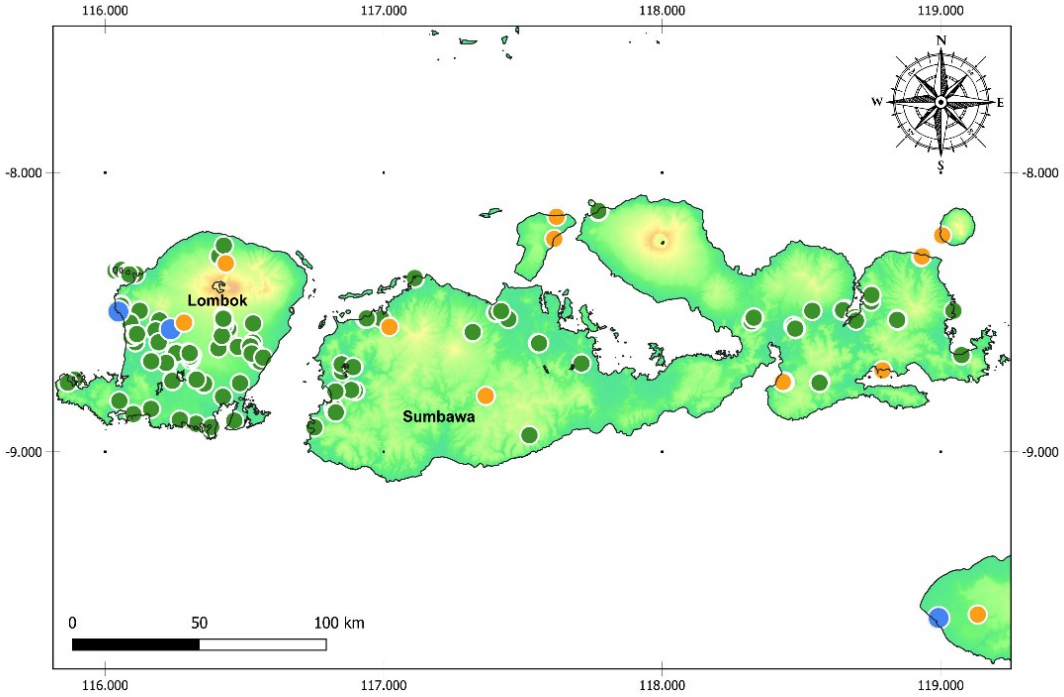


Figure 13. Distribution of Tokay gecko in West Nusa Tenggara Province.

3.7. East Nusa Tenggara Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
East Nusa Tenggara	Manggarai Barat	0.80	120,063.0	96,050	
East Nusa Tenggara	Manggarai	0.10	2,659,390.7	265,939	
East Nusa Tenggara	Ende	0.13	182,196.4	22,775	
East Nusa Tenggara	Ngada	2.14	138,711.0	296,842	
East Nusa Tenggara	Sikka	0.78	171,116.7	133,471	
East Nusa Tenggara	Kupang	0.47	449,850.2	212,329	
East Nusa Tenggara	Timor Tengah Selatan	5.25	58,737.8	308,374	
East Nusa Tenggara	Malaka	4.61	74,538.6	343,549	
East Nusa Tenggara	Belu	2.89	21,045.8	60,801	
		Total	**3,875,650.3**	**1,740,129**	**257,500**

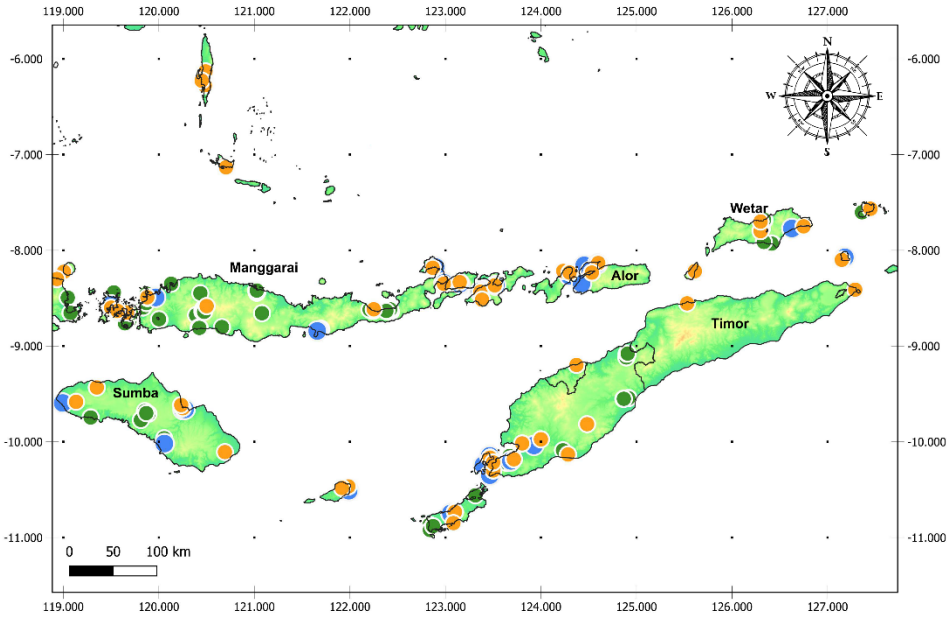


Figure 14. Distribution of Tokay gecko in East Nusa Tenggara Province.

3.8. Maluku (Moluccas) Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Maluku	Buru	0.60	492,531.8	295,519	
Maluku	Buru Selatan	0.76	505,726.1	384,352	
Maluku	Sulabesi	0.56	54,902.6	30,745	
Maluku	Babar & Wetang	0.29	66,261.0	19,216	
Maluku	Wetar	0.18	262,593.9	47,267	
Maluku	Maluku Barat Daya	0.78	56,309.8	43,922	
Maluku	Kepulauan Tanimbar	1.09	822,554.7	896,585	
Maluku	Ambon City	3.09	28,115.1	86,946	
Maluku	Maluku Tengah	2.08	186,681.9	387,365	
Maluku	Seram Barat	3.34	81,708.9	272,908	
		Total	**2,557,385.7**	**2,464,824**	**268,000**

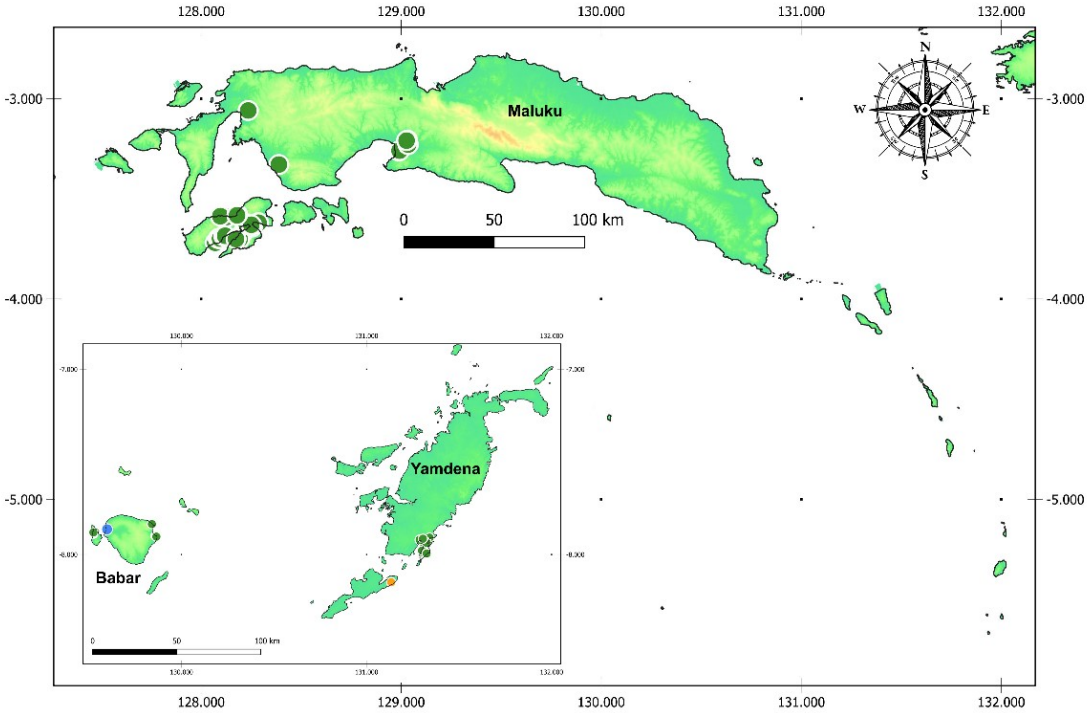


Figure 15. Distribution of Tokay gecko in Maluku Province.

3.9. Gorontalo and Central Sulawesi Provinces

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Gorontalo	Gorontalo	23.17	6,534.5	151,405	
		Total	**6,534.5**	**151,405**	**22,000**

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Central Sulawesi	Parigi Moutang	0.20	47,722.0	9,592	
Central Sulawesi	Sigi	0.02	232,448.0	3,719	
Central Sulawesi	Donggala	0.01	40,747.0	448	
Central Sulawesi	Toli-Toli	0.12	-	-	
Central Sulawesi	Buol	0.07	-	-	
		Total	**320,917.0**	**13,760**	**26,500**

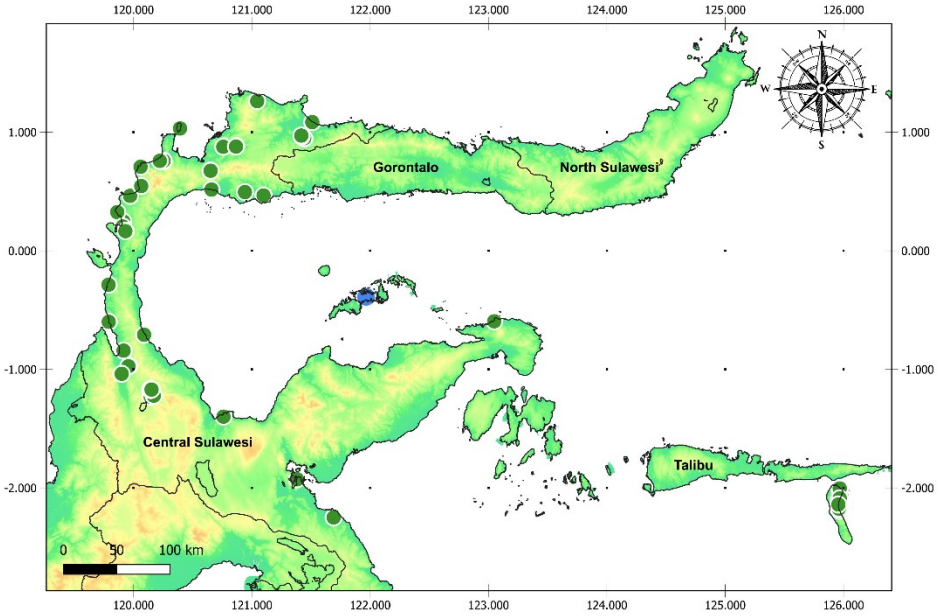


Figure 16. Distribution of Tokay gecko in Gorontalo and Central Sulawesi Provinces.

3.10. South-East Sulawesi and South Sulawesi Provinces

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
South-East Sulawesi	Buton Utara	34.09	16,351.0	557,406	
South-East Sulawesi	Buton	18.13	52,757.0	956,484	
South-East Sulawesi	Konawe Selatan	30.30	110,028.0	3,333,848	
		Total	**179,136.0**	**4,847,738**	**602,100**

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
South Sulawesi	Pangkajene	3.23	45,332.6	146,424	
South Sulawesi	Barru	5.60	37,098.0	207,749	
South Sulawesi	Pare-Pare	4.74	5,968.7	28,292	
South Sulawesi	Pinrang	4.28	16,710.5	71,521	
South Sulawesi	Sidenreng Rappang	8.19	25,963.5	212,641	
		Total	**131,073.3**	**666,627**	**225,050**

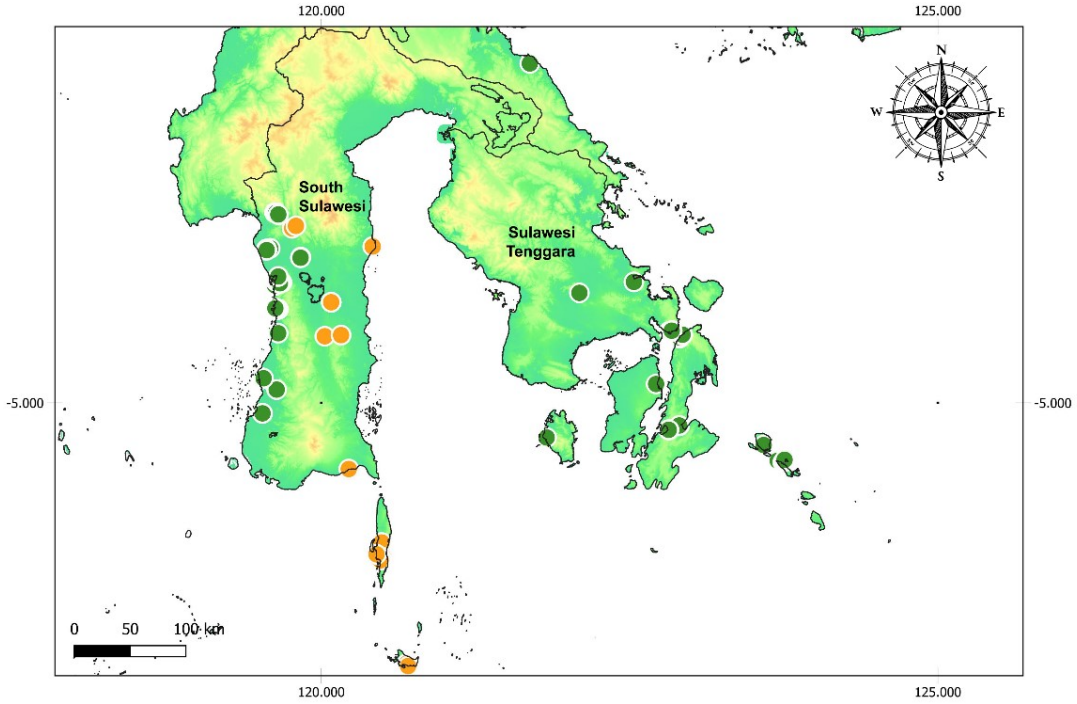


Figure 17. Distribution of Tokay gecko in South-East Sulawesi and South Sulawesi Provinces.

3.11. East Kalimantan Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
East Kalimantan	Kutai Timur	4.92	115,719.0	569,337	
		Total	**115,719.0**	**569,337**	**85,500**

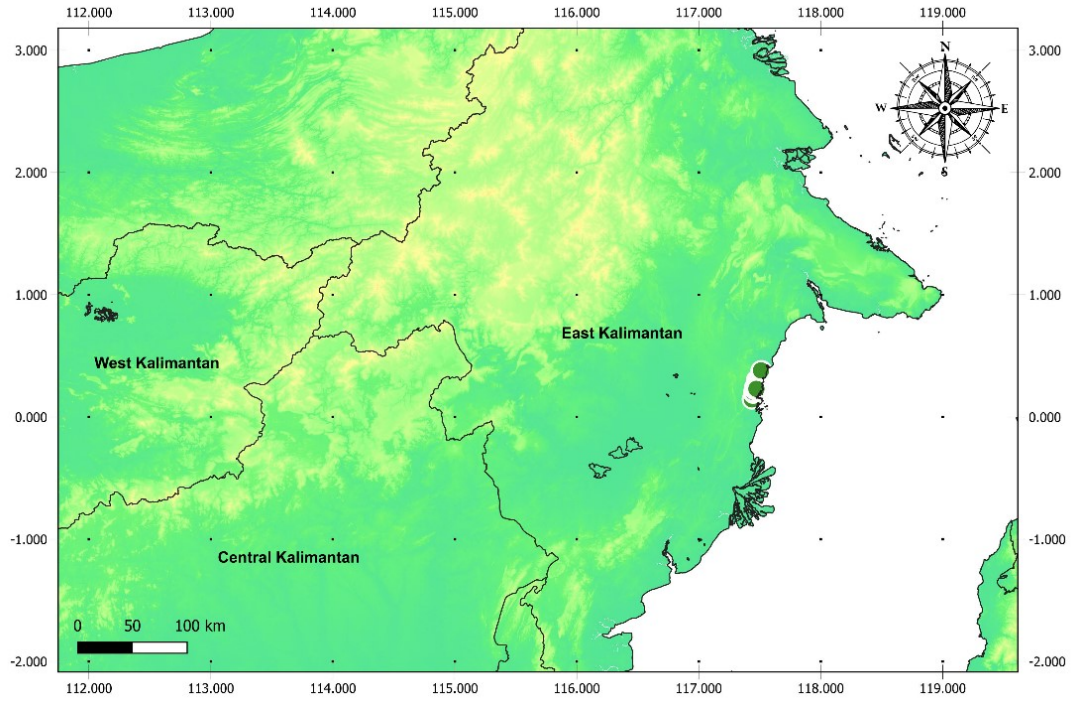


Figure 18. Distribution of Tokay gecko in East Kalimantan Province.

3.12. Central Kalimantan and South Kalimantan Provinces

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Central Kalimantan	Palangka Raya	1.72	284,030.0	487,111	
Central Kalimantan	Seruyan	0.02	15,566,235.0	365,807	
Central Kalimantan	Kotawaringin Timur	0.11	1,445,357.3	158,989	
Central Kalimantan	Kotawaringin Barat	1.10	206,321.0	226,953	
Central Kalimantan	Lamandau	0.88	130,527.0	114,864	
			17,632,470.3	**1,353,724**	**246,000**

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
South Kalimantan	Banjar	7.71	-	-	
		Total	**-**	**-**	**155,000**

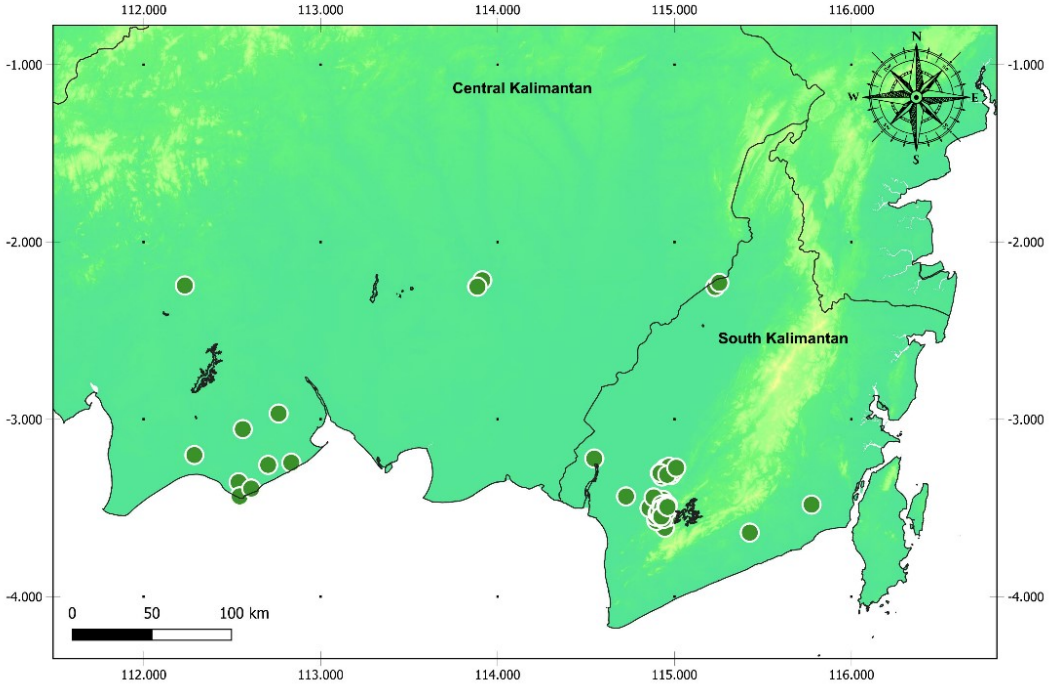


Figure 19. Distribution of Tokay gecko in Central Kalimantan and South Kalimantan Provinces.

3.13. West Kalimantan Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
West Kalimantan	Kubu Raya	0.70	336,238.0	235,367	
	Mempawah	0.80	255,786.0	204,629	
	Bengkayang	0.94	150,126.0	141,118	
		Total	**742,150.0**	**581,114**	**117,000**

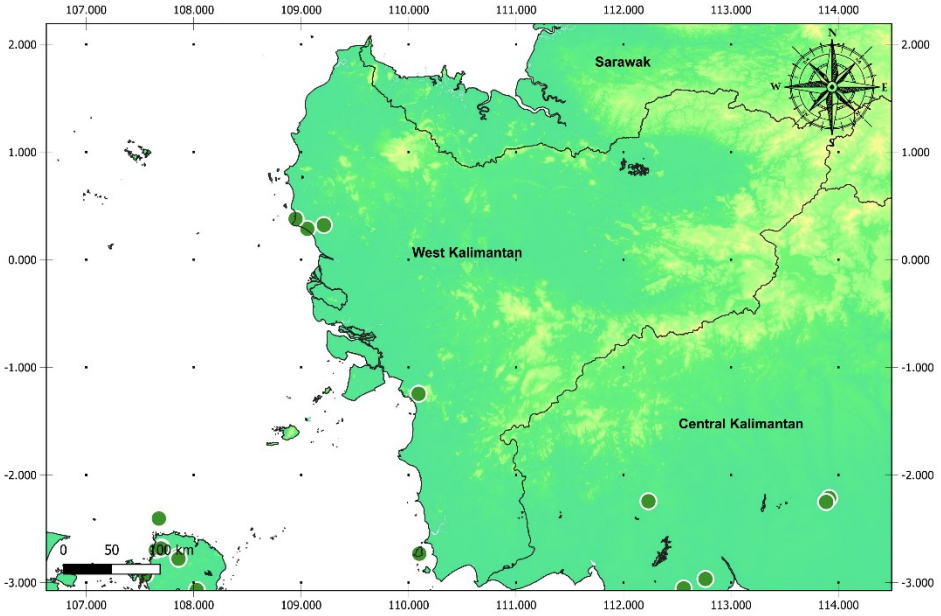


Figure 20 Distribution of Tokay gecko in West Kalimantan Province.

3.14. Aceh Province, Sumatra

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Aceh	**Sabang**	**0.42**	**1,173.5**	**493**	**0**

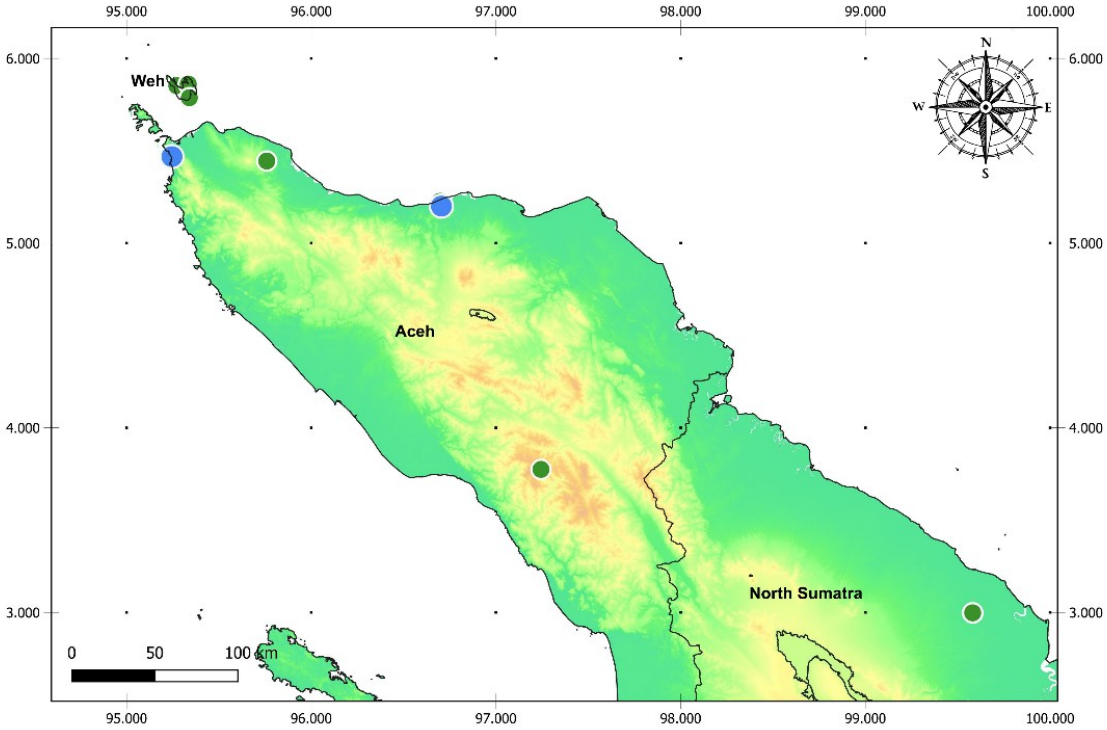


Figure 21. Distribution of Tokay gecko in Aceh Province, Sumatra.

3.15. Jambi Province, Sumatra

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Jambi	**Tanjung Jabang Timur**	**0.10**	**39,505.0**	**3,951**	**0**

3.16. South Sumatra/Bangka-Belitung Province

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
South Sumatra	Bangka	0.14	2,453.7	346	
South Sumatra	Belitung	5.99	8,693.4	52,073	
		Total	**11,147.1**	**52,419**	**7,800**

3.17. Lampung Province, Sumatra

Province	Regency	Density (per Ha)	Estimated Suitable Habitat (Ha)	Estimated Population	National Quota 2023
Lampung	Lampung Timur	1.20	126,961.0	152,353	
Lampung	Lampung Selatan	0.98	109,023.1	106,843	
Lampung	Tanggamus	3.11	163,786.7	509,377	
Lampung	Pringsewu	2.69	30,001.2	80,553	
Lampung	Lampung Tengah	1.38	266,582.0	366,550	
		Total	**696,354.0**	**1,215,676**	**120,000**

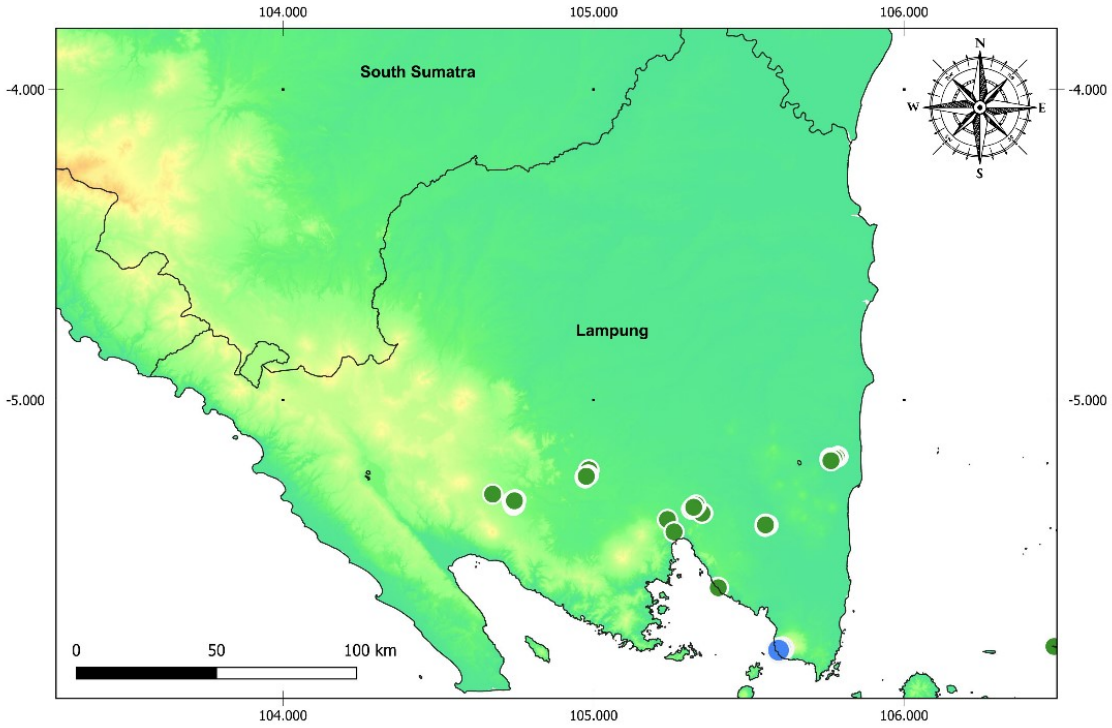


Figure 22. Distribution of Tokay gecko in Lampung Province, Sumatra.

CHAPTER IV
UTILIZATION ASPECT

4.1. Annual Quotas

The annual harvest quota of the Tokay gecko that was recommended by the Scientific Authority (BRIN) has been very dynamic. The quota for the 2010-2018 period ranged from 16,500-40,000 individuals, then increased dramatically in 2019 (Figure 23). Figure 23 was used by the international community to criticise the Indonesian Scientific Authority's policies regarding the drastic increase of the Tokay gecko quota in 2019.

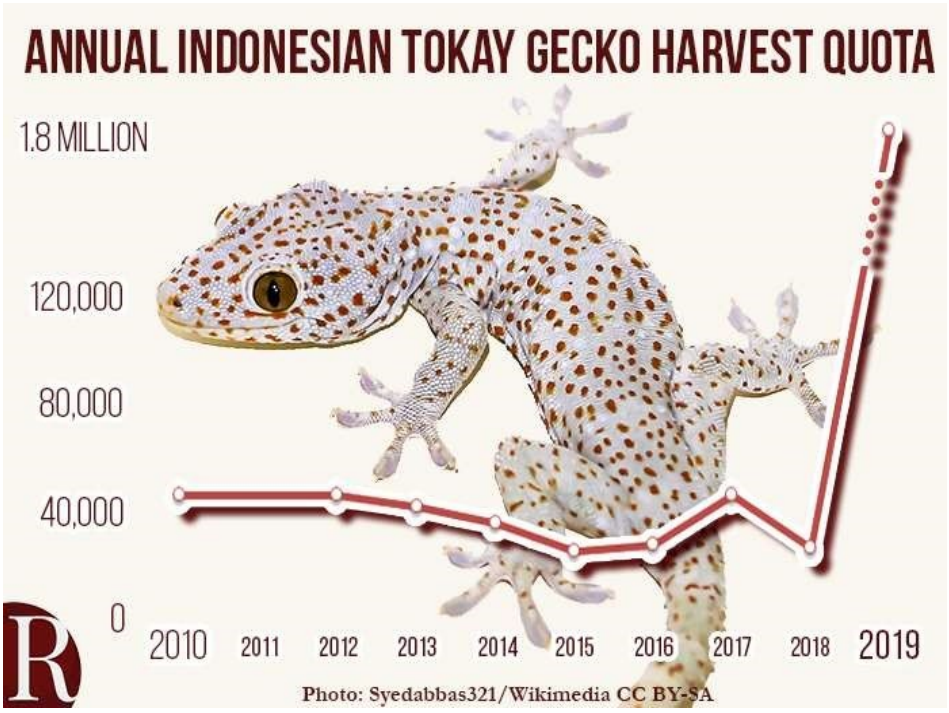


Figure 23. The quota of Tokay gecko for ten years (2010-2019) was set by the Indonesian Scientific Authority. (Source: https://therevelator.org/tokay-gecko-trafficking-protection/)

The annual harvest quotas for Tokay gecko recommended by the Scientific Authority before 2019 are primarily for pet exporter groups and not for consumption. For six consecutive years (2013-2018), the realization of these national annual quotas has always been less than the Management Authority set quota (Figure 24). The actual realization of exported Tokay geckos from 2013 to 2018 has been significantly higher than the export quota managed by the Management Authority (Figure 24). According to the certificate of origin and export approval letter (Surat Persetujuan Ekspor) published by the Ministry of Trade, at least 79,530,402 Tokay gecko individuals were exported between 2013 to 2019, while the Management Authority only reported 1,673,335 individuals. Tokay geckos were mainly exported for consumption to China (Figure 25).

The annual harvest quota is a national reference in controlling the harvest of Tokay geckos in terms of number, size and harvesting area. Setting quotas is also a system for reducing/preventing uncontrolled harvest of tokay geckos.

The differences in Tokay gecko export data between the Ministry of Trade and the Management Authority are due to regulations in effect at the time. Despite the fact that it was a wildlife product, the majority of export commodities are regulated by the Ministry of Trade. There is no obligation for the trader to report and obtain a permit from the Management Authority because the wildlife products traded are not listed on CITES or are not listed by the Management Authority. As long as the trader has a permit from the Ministry of Trade and Customs Agency, they can export it to foreign countries. The high number of Tokay gecko exports from 2013 to 2018 went unnoticed, even by management and scientific authorities. Since 2019, the Tokay gecko harvest quota from the wild has been increased from around 40,000 individuals to 1.6–1.9 million until 2021 to accommodate for the difference in the numbers between the annual quota and actual export realization. In 2022, the national harvest quota for Tokay gecko was increased to 8.2 million. The scientific and management authority established a harvest quota of 5.974.550 Tokay gecko individuals for 2022 for the first time, then increased it to 8,250,550 individuals as a result of research on Tokay gecko population estimation in several Indonesian locations such as Java, Sumatra, Borneo, and the Lesser Sunda Islands in 2021. The harvest quota of 8.2 million Tokay geckos is only about half of the total number of Tokay geckos that were exported in 2019.

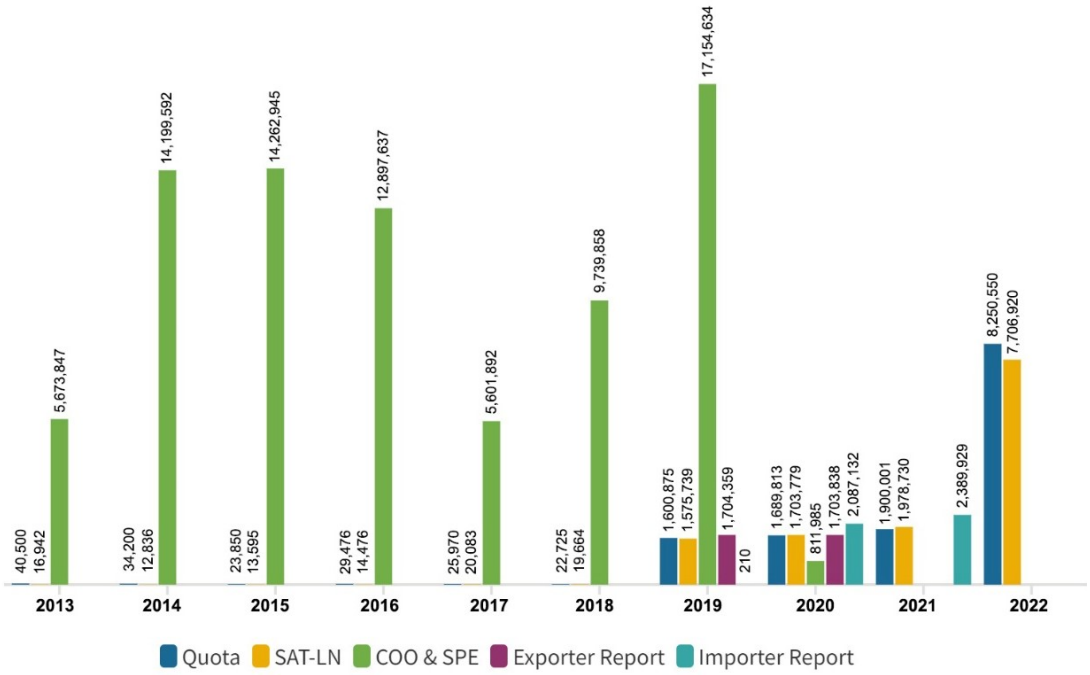


Figure 24. Annual national quota and the realisation of Indonesian Tokay gecko export (2013-2022). Export data is based on SAT-LN (legal export permit issued by the Management Authority), COO & SPE (Certificate of Origin & Export Approval Letter issued by the Ministry of Trade), exporter and importer reports (CITES trade database).

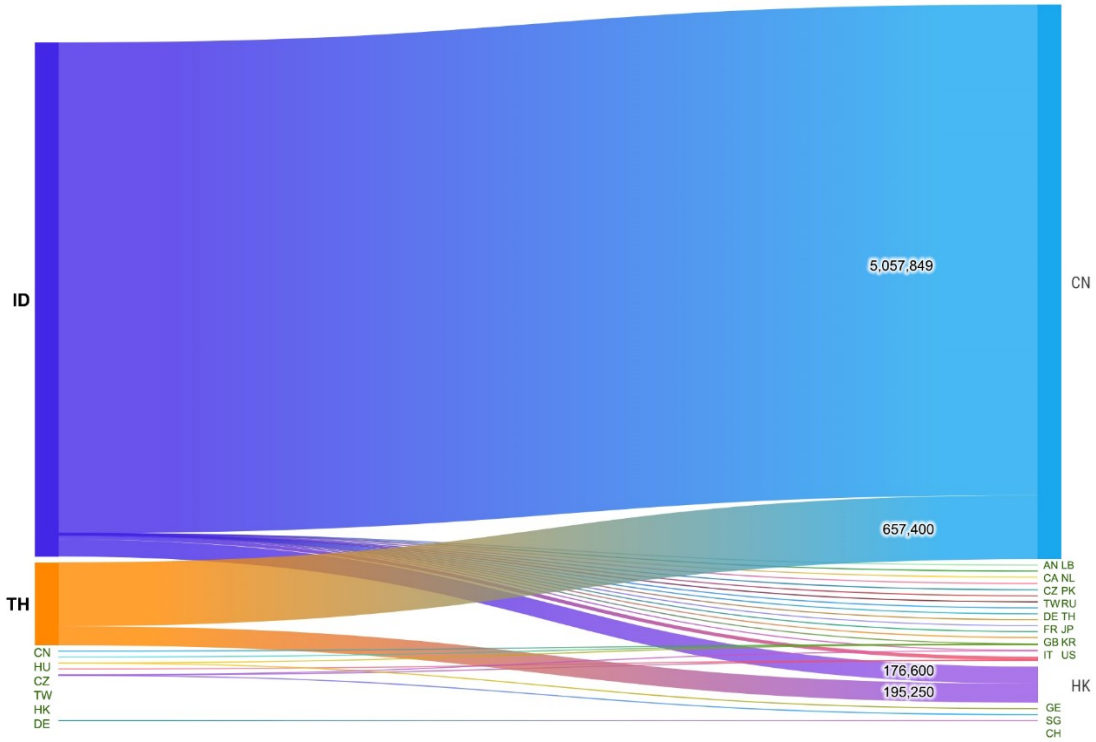


Figure 25. Tokay gecko export realisation (2019-2021) based on the number of SATS-LN (legal export permits for Indonesia) and CITES Trade database (countries except for Indonesia).

4.2. Captive Breeding Operation

The Scientific Authority is still questioning the truth of the Tokay geckos supposedly bred in captivity, both the first generation (F1) and the second generation (F2 or C) breeding for consumption purposes (Figure 26). The costs of captive breeding captivity Tokay geckos for at least two generations will certainly lead to a high selling price, and breeders would have to wait about one year for the first generation (F1) and two years for the second generation (F2). Actually, the hunters only fatten the Tokay geckos harvested from the wild to get a high selling price. This fattening process is then used to convince people that the wild-caught geckos are the result of captive breeding, which in concept, does not align with the CITES regulation for coding, and also does not support harvest sustainability at all. If captive breeding did occur, it would be for other reasons. The hunted wild Tokay gecko has a different colour from the one seen in geckos that are bred by pet breeders, and these captive-bred animals can be sold for a fairly high selling price for the first generation (F1). Tokay gecko exports beyond the annual quotas from 2013 to 2018 are classified as being the result of captive breeding (Figure 26). Due to the fact that no gecko captive breeding has been registered or reported to the management authority as of 2019, it is very likely that any previously declared exports of geckos as a result of captivity were collected from the wild population. According to this situation, the scientific authority decided the annual harvest quota for 2019, and in recent years has been only for wild populations, and it also suggested to the management authority that it begins developing a captive breeding program for Tokay geckos.

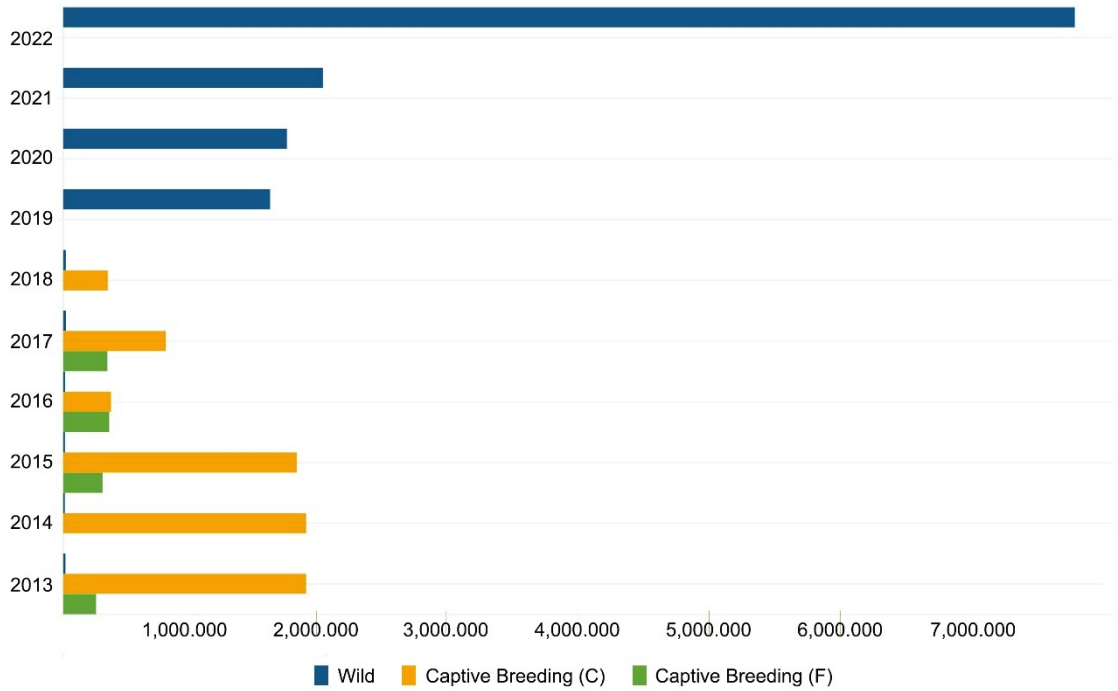


Figure 26. Tokay gecko export realisation based on the number of SATS-LN (legal export permits) from wild-caught (W), first-generation (F) and second-generation from captivity (C).

4.3. Trade

The selling price of Tokay gecko at the hunters' level is very low; individuals weighing one ounce (=100 grams) are valued at Rp. 5,000/individual (Kurniati 2010). In 2010, Tokay gecko hunters generally caught Tokay gecko from the wild with an average weight of less than 1 ounce. Generally, they fattened the individuals in their house to increase the weight to 1-2 ounces, which allowed them to increase the selling price. For a body weight of 1-2 ounces, the sale price was Rp. 15,000/individual. According to a large-scale Tokay gecko collector in East Java, when hunters go into debt with their "tauke" (collectors), the selling price of the Tokay gecko will drop to Rp. 3000-4000/individual, because the large collectors cut transportation costs owed in advance to the hunters (Didi Tokek, pers. comm. 3 October 2020). Value of Rp. 5,000 at that time was equal to $US 0.5; however, the price has not changed until now, even though the value of $US 1 is equal to Rp. 14,500.

The hunting of Tokay geckos in the districts of Grobogan, Boyolali and Banyumas, Central Java is unique; Tokay gecko hunters are called "night burners" (pengobor) who work for the collectors; a collector can employ 56-night burners. In the dry season, a night burner could get 20 geckos a night; with an average Tokay gecko collection of about 50-60 individuals per day or about 400 individuals a week. The geckos caught by the night burner are immediately killed by stabbing the back of the head toward the brain after being caught, then put into a plastic bag or sack. The night burners usually do not take the risk of keeping live Tokay geckos, for the reason that the geckos in the sack will bite each other and fight, causing damage to their bodies and skins, and consequently reducing the selling price; it is easier to transport them if they are already dead. All the Tokay geckos that were hunted that night were put in the freezer.

The quality of a dried Tokay gecko carcass is the benchmark selling price from the first collector to the larger sellers, and the quality is grouped based on the size of the top (=width of the skin at the anterior end, near the head) and bottom (=the width at the

posterior end, nearest to the tail) and the length of the skin (Figure 27). Three main size categories are accepted by exporters:

1. The width of the upper skin (= upper chest width) is at least 9 cm wide;
2. The width of the lower skin span is not less than 6 cm;
3. The length of the skin measured from the anterior edge of the shoulder near the neck back to the posterior edge of the skin perpendicular to the groin (=vent) is at least 9 cm in length.

Meanwhile, the size of the head or the length of the tail is not considered being a benchmark, as long as the head and tail are not damaged or broken. The aforementioned categories are used as standards for determining the quality and class of Tokay gecko that are suitable for trading. The sizes for class A are: (1)> 13 cm, (2)> 6.5 cm, (3)> 10.5 cm; class B are: (1) 9-13 cm, (2) 6-6.5 cm, (3) 9-10.5 cm; BS class is less than the size listed above. Due to the stretching and drying of the Tokay gecko being done by large collectors, the people who bring the live Tokay gecko beyond the standard size cannot be rejected by collectors, who are forced to buy live Tokay gecko on the grounds of their social sense for the community. This product is then classified as a small dry Tokay gecko size. The size of this group is usually: (1) the width of the shoulders is between 8-9 cm, (2) the width of the bottom is 5 cm, and (3) the length of the skin is 8 cm. This condition shows that at the hunter level, there is no selection of the size of the captured Tokay gecko.

The aforementioned categories are used as standards for determining the quality and class of Tokay geckos that are suitable for trading. The sizes for class A are: (1) > 13 cm, (2) > 6.5 cm, (3) > 10.5 cm; class B are: (1) 9- 13 cm, (2) 6-6.5 cm, (3) 9-10.5 cm; BS is less than the sizes listed above. Due to the stretching and drying of the Tokay gecko by the bigger buyers, the people who bring live Tokay geckos that are smaller than the standard sizes cannot be rejected by them. The buyers feel obliged to buy all sizes of live Tokay geckos because of their social responsibility towards the community around their residential; this product is then classified as the smallest dried Tokay gecko size. This shows that at the hunter's level, there is no selection of the size of the Tokay geckos being captured.

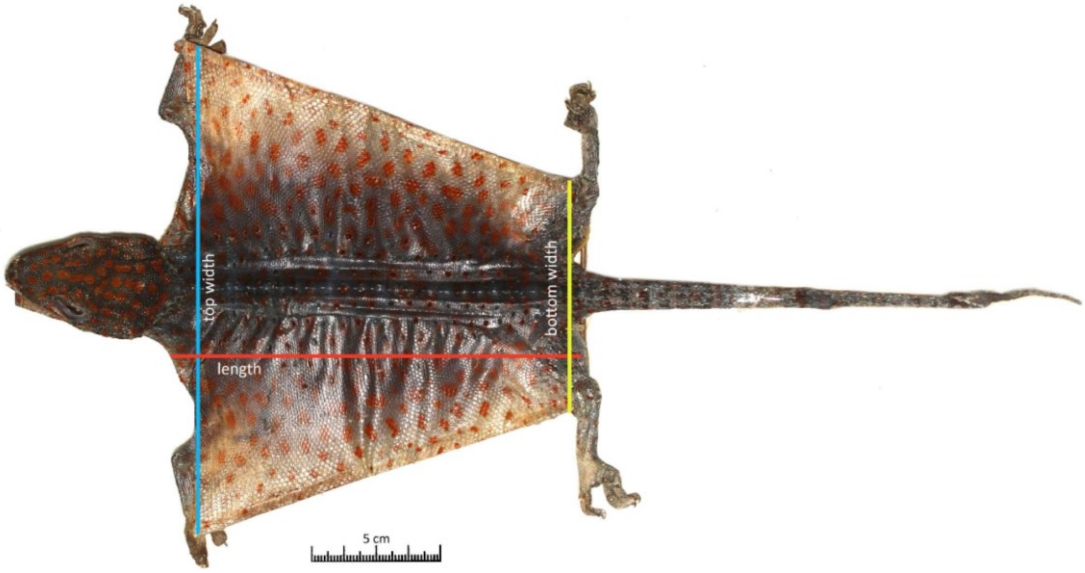


Figure 27. Measurements of the body size of a dried Tokay gecko, which are used as the basis for classifying carcass quality, affect the selling price at the Tokay gecko hunters' level (Photo: Misbahul Munir).

The Scientific Authority (BRIN) recommends the Tokay gecko capture quota in units of individual geckos, but in the international trade system, this species is exported in units of dry weight (kg). There are three groups of dried Tokay gecko carcasses that are exported, namely:

1. Class A: an individual with an upper chest width of 13-14 cm, an SVL of at least 15 cm, and a dry weight of 1 kg = 23-25 individuals (Figure 28). The tail in class A must be in intact.
2. Class B: is an individual with an upper chest width of 11-12 cm, an SVL of at least 12 cm, and a dry weight of 1 kg = 31-41 individuals (Figure 29). The tail in class B must be intact.
3. BS class: is an individual with an upper chest width of 9-10 cm, an SVL of at least 10 cm, and a dry weight of 1 kg = 49-57 individuals (Figure 30). Apart from these measures, the BS class is an individual with a broken/missing tail.

Figure 28. Tokay gecko dry carcasses class A. Upper chest width 13-14 cm, minimum SVL 15cm (Photo: Didik- UD. Andira).

Figure 29. Tokay gecko dry carcasses class B. Upper chest width 11-12 cm, minimum SVL 12cm (Photo: Didik- UD. Andira).

Figure 30. Tokay gecko dry carcasses of class BS. Upper chest width 9-10 cm, SVL minimum 10 cm (Photo: Didik-UD. Andira).

The results of SVL measurements on the wet and dry carcasses for the same Tokay gecko individuals were found to be similar (Table 1) because the specimens were dried using bamboo clamps with a length equal to the SVL of the specimen in a frozen condition (Figure 27). If the Tokay gecko's backbone is pulled, the skin would tear, which in the end will reduce the selling price.

Table 1. Measurement of SVL lengths of wet carcasses (cm) and oven-dried carcasses (cm) of Tokay geckos at UD. Bina Usaha Mandiri.

No.	SVL-wet (cm)	SVL-oven dry (cm)	Difference in length (cm)
1	16.6	17.2	0.6
2	17.0	17.1	0.1
3	16.9	17.0	0.1
4	17.0	17.1	0.1
5	16.5	16.9	0.4
6	16.7	17.0	0.3
7	17.1	17.2	0.1
8	16.5	16.9	0.4
9	16.1	16.3	0.2
10	17.0	17.0	0.0
11	16.0	17.0	1.0
12	16.0	16.5	0.5
13	16.2	16.5	0.3
14	16.0	17.0	1.0
15	18.0	17.6	0.4
16	16.6	17.5	0.9
17	17.1	18.0	0.9
18	16.9	17.6	0.7
19	16.3	16.6	0.3
20	15.9	16.1	0.2
Mean			0.425
Standard Deviation (SD)			0.323
Range			0-1

The trade of Tokay geckos on Java Island is a long trade route between provinces, before continuing at the export stage. Poaching without control started in the province of East Java, where the exporters of Tokay geckos for consumption mostly lived around the city of Surabaya. This uncontrolled exploitation triggered the emergence of hunting that spread to the provinces of Central Java and Yogyakarta; The Tokay geckos were then taken to a large buyer in East Java. When hunting yields in these two provinces decreased, the hunting shifted to the provinces of West Java and Banten. Poached animals from West Java and Banten are taken to large buyers in Cirebon and Cilacap; from these two cities, the geckos are taken to a larger buyer in East Java, and then to be exported to China via the city of Surabaya. At this time, Tokay gecko hunting occurs in all provinces of Java Island.

Since the Tokay gecko was listed in CITES Appendix II in mid-2019, harvesting of the wild population of this species for international trade has been regulated through an annual quota mechanism, based on the recommendations of the Indonesian Scientific Authority (BRIN). The Scientific Authority determined the number of Tokay geckos that could be harvested as well as the harvest locations based on the results of scientific research and other information provided by the scientific authority, universities, or the management authority in this case, the BKSDA in each province (Nature Conservation Agency). The Forestry Ministerial Decree (No.447/KPTS-II/2003) deals with the administration of the harvest and trade distribution of species of wild fauna and flora by regulating trade therein. It lays down the provisions for wild population flora and fauna harvest, an annual national quota, harvest locations both for commercial and non-commercial purposes, harvest permits, trade distribution, and trader permits, including import, export, and re-export, as well as internal Indonesian trade in specimens of species

listed and non-listed in CITES. It provides for the procedures and documents required for such trade (import and export permits, re-export certificates, import notifications, and internal trade certificates), and it regulates the movement of live specimens. Regarding the annual harvest quota, it was also mentioned that the management authority has an obligation to set up the harvest location in each province and also provide the bio-ecological information of the targeted harvest species, through the BKSDA (Figure 31). This quota setting is an instrument for the national gecko management plan.

Referring to CITES rules which require that every species traded must be traceable from capture to distribution abroad. Therefore, we need a mechanism that can track the Tokay gecko trade. Tracking mechanisms can take the form of awarding gifts/certificates/permits, logging, tagging, and even barcodes. In Indonesia, traceability of the use of the Tokay geckos has been recorded properly and completely, including data on harvesting localities, transportation, product processing, domestic and international distribution.

To prevent the excess export quota of the Tokay geckos as happened from 2013 to 2019. The Ministry of Trade issued Ministerial Regulation Number 122, the Year 2018, concerning the provisions for the export of wild flora and fauna that are not protected by Indonesian law and are included in the CITES list of species. According to the above ministerial regulation, the traders are not able to export the Tokay geckos without any permit from the Management Authority. Export of the Tokay geckos should be accompanied by legal permits from the Ministry of Environment and Forestry (SAT-LN) and a CITES export certificate. Both the Forestry Ministerial Decree and the Trade Ministerial Regulation aim to ensure the sustainable harvest of Indonesia's CITES-listed wild flora and fauna. The Ministerial Regulation issued by the Ministry of Trade had a significant impact on the actual export of the Indonesian Tokay gecko (Figure 24). It was also responsible for ensuring the one-door permit for Tokay geckos export.

Furthermore, in order to improve control function in use of the wild annimals and plants, the Director General of KSDAE issued a Standard Operational Procedures (SOP) through a decision no. SOP.1/KSDAE/SET.3/KSA.2/1/2022 concerning Supervision of Observance of Business Permits for Conservation of Wild Annimals and Plants. This regulation directs the steps of the Management Authority to carry out supervision to license holders trying to comply with applicable regulations and provide recommendations for administrative sanctions for violations.

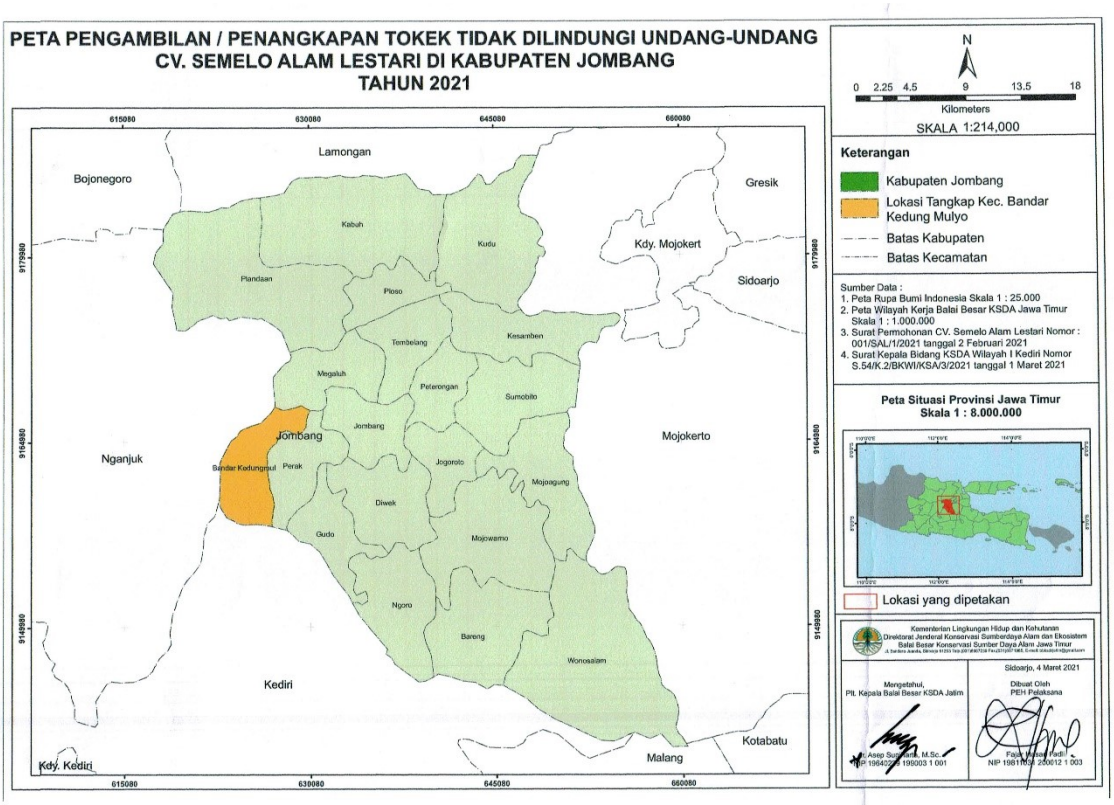


Figure 31 Example of Tokay gecko harvest's location 2021 for East Java province, provided by the East Java BKSDA (Keputusan Kepala Balai Besar Konservesi Sumber Daya Alam Jawa Timur/ SK.5/K.2/BIDTEK.1/KSA/2021.

4.4. Exports

The main export destination for Tokay geckos as a consumption commodity in China. Exported specimens are frozen or dry carcasses (Figure 32). The exported Tokay gecko body sizes vary widely. One large seller in East Java exports Tokay geckos with SVL lengths between 110-178 mm (Figure 33), which being quite small, is very crucial for the survival of the Tokay gecko in the wild, as the newly sexually mature individuals are being harvested; these individuals have not yet produced the next generation into the wild.

Figure 32. Forms of Tokay gecko export commodities - frozen specimens (left) (Photo: Syaripudin); and dried specimens (right) (Photo: Tokay gecko Exporters Association).

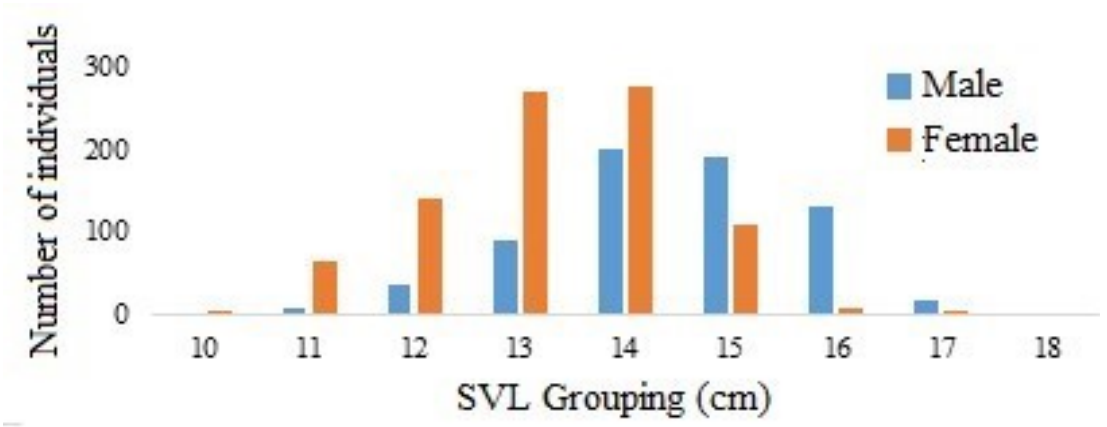


Figure 33. SVL of male and female Tokay geckos harvested in East and Central Java.

4.5. Utilization Abroad

Meat from Tokay geckos is used as a raw material for TCM (Traditional Chinese Medicine; Figure 34) in the export destination country, China (Caillabet 2013; Nijman et al. 2012; Sy & Shepherd 2020). Tokay gecko meat is believed to be a cure for HIV/AIDS, cancer and impotence in men (Caillabet 2013).

Figure 34. Typical TCM mix in dry form (Photo: Tradevistas.org).

4.6. Domestic Use in Indonesia

Tokay geckos are generally traded in traditional markets; an example is the sale of live Tokay geckos in a traditional market in Malang, East Java (Figure 35; Kurniati 2010). Based on information from the Tokay gecko sellers, buyers usually consume Tokay gecko meat as a remedy for fungal or bacterial infections on the skin. In addition, Tokay gecko meat is also believed to treat asthma.

At the national level, only small amounts of Tokay gecko meat are used for consumption for non-medicinal purposes. This situation is favourable for the Tokay gecko population because the consumption of meat is prohibited (haram) by Muslims. Followers of religions other than Islam also rarely consume Tokay gecko meat, because most Indonesians have good beliefs about Tokay Geckos. The presence of a Tokay gecko in or around a residence indicates that the residential environment is cool. The coolness of the dwelling is believed to bring good fortune to the occupants of the house (Kurniati 2019).

Figure 35. Live Tokay gecko individuals traded in traditional markets in Malang, East Java in 2010 (Photo: Hellen Kurniati).

4.7. Disaster due to Decreasing Population of Tokay gecko in the Wild

The main prey of the Tokay gecko is insects. Declines in Tokay gecko populations will certainly lead to an increase in insect pests. Hunters in the East and Central Java regions generally hunt Tokay geckos in teak tree plantations. In 2019, reports appeared in social media about the terror of teak tree caterpillars (which are the larvae of moths) which occurred at a time when Tokay geckos were being hunted without control. The loss of the Tokay Gecko, which is a predator of these caterpillars is a real disaster and has a significant impact on human life. Several social media that show the terror of the teak tree caterpillar are as follows:

-Teak caterpillar terror in Tuban: http://youtu.be/x0EF9BPjvmw

-Teak caterpillar terror in Sulang, Rembang Regency: http://youtu.be/fhLNHmxtOIY

-Teak caterpillar terror around Semarang: http://youtu.be/RbBAIL3rwus

CHAPTER V
THE SCORING OF NDF

The scoring of Tokay gecko is divided into four aspects, namely: biology, hunting pressure, trading pressure and management. The items assessed for these four aspects mostly follow Setyastuti & Wirawati (2019). The assessment of each item is guided by the description in CHAPTERS II and III, with the following details:

Table 2. Category and criteria for NDF score of *Gekko gecko* in Indonesia.

No.	Criteria	Category	Indicator	Score
Biological Aspect				
1	Taxonomy: Identify species level using morphological characters	Low – 1	Easily identify up to species level with morphological characters	1
		Medium – 2	It is a little difficult to identify the level of species with morphological characters	
		High – 3	Cannot identify to species level with morphological characters	
2	Reproduction season: Reproduction time is the mating season for a species.	Low – 1	Breed all year round	1
		Medium – 2	Breed in certain seasons (e.g., during the dry season or throughout the rainy season)	
		High – 3	Breed only once a year/uncertain or unknown	
3	Growth rate: Sexual maturity of Tokay geckos is less than 1 year in males and females. Females SVL 98 mm; males SVL 110 mm. The growth rate is faster than the other Gekkonidae species.	Low – 1	Fast both in growth rate and exual maturity	1
		Medium – 2	Moderate growth rate and moderate sexual maturity	
		High – 3	Slow growth rate and slow sexual maturity	
4	Egg cell susceptibility: Egg size is an important parameter for reproductive strategies. The larger the egg size (based on diameter) the greater the ability to adapt to maturity. The smaller the egg size, the more vulnerable it is.	Low – 1	Large egg size (>150 µm)	1
		Medium – 2	Medium egg size (100-150 µm)	
		High - 3	Small egg size (<100 µm)	
5	Life span: Maximum age. The shorter the age, the higher the level of vulnerability.	Low – 1	>10 years	1
		Medium -2	5-10 years	
		High – 3	<5 years	
6	Aggregated life habits: Life habits are categorized into (a) solitaire and (b) groups. In the Tokay gecko which has fast movement, the more varied its life habits, the lower its vulnerability due to natural factors (predators or fishing pressure	Low – 1	Solitaire	1
		Medium – 2	Solitaire but sometimes in group	
		High – 3	In group	
7	Cryptic behaviour/habits: Tokay gecko is including species that are cryptic in their life behavior, they hide in narrow cavities or other places to hide from their predator. The more hiding places it has, the lower its vulnerability to natural predation or hunting pressure.	Low - 1	If a type always has cryptic characters / hides in hidden cavities in trees, houses	
		Medium - 2	If a species is sometimes cryptic (for example, only during the day) but is exposed in open areas (at night) to find food	2
		High - 3	If a species always has a character that is always easy to find and exposed in open areas	
8	Geographical distribution: The more limited the distribution of a species, the higher the level of its vulnerability	Low – 1	Distributed throughout the Indonesian archipelago	1
		Medium – 2	Distributed in the majority of the Indonesian archipelago	
		High - 3	Distributed only in certain locations (locally endemic)	
9	Vertical distribution. This is an indicator of the species capability to adapt to different air temperatures.	Low – 1	0-1200 m asl	1
		Medium – 2	0-700 m asl	
		High – 3	700-1200 m asl	

10	Habitat: The more specific the habitat of a species, the higher the level of its vulnerability. In general, species with specific habitats have low adaptability, so if their habitat is damaged, it will have a direct impact on the species.	Low – 1	Not specific	1
		Medium – 2	Moderate	
		High - 3	Specific	
11	Habitat type: The more habitat types the Tokay gecko occupies, the lower its vulnerability. Tokay geckos can be found in almost all types of habitats, except those that contain water.	Low – 1	Occurs in all habitat types	1
		Medium – 2	Occurs in two types of habitats	
		High – 3	Occurs in only one habitat type	
12	Substrates: 3 types - (a) trees, (b) coarse house walls, (c) smooth house walls.	Low - 1	Occurs in all substrate types	1
		Medium - 2	Occurs in two substrate types	
		High – 3	Occurs only in one substrate type	
13	Threats of natural predators: The number of natural predator species	Low - 1	< 5 species	
		Medium - 2	5 – 10 species	2
		High - 3	> 10 species	
14	Population trends, determined from (1) data on trends in population abundance in nature; (2) coverage of catch distribution area; (3) results from interviews or data on catches of first-level hunters/collectors; (4) results from data collection on the types of hunters' livelihoods.	Low - 1	(1) The trend of abundance in nature is stable; (2) The trend of abundance in nature is increasing; The trend of abundance in nature decreases to a maximum of 20% of the previous population abundance data.	1
		Medium - 2	(1) The trend of abundance in nature has decreased by up to 70% from the previous population abundance data; The distribution of hunting areas is further away from the beginning of hunting efforts.	
		High - 3	(1) The trend of abundance in nature has decreased to >70% from the previous population abundance data; The distribution area is increasingly limited and fragmented, the Tokay gecko capture "hot spot" area is no longer found.	
15	Native or introduced species: Tokay gecko originates from mainland China, and entered the Indonesian archipelago 260 thousand years ago.	Low – 1	Invasive species	
		Medium – 2	Alien species	2
		High – 3	Native species	
Hunting Pressure Aspect				
16	Avaiablility of national production data.	Low – 1	Available – complete	1
		Medium – 2	Partly available – not complete	
		High – 3	Unavailable	
17	Availability of national production data based each harvested areas	Low – 1	Available at a national scale	1
		Medium – 2	Only available for some capture areas	
		High - 3	No data available	
18	Variation of capture tools: The types of capture tools determine the probability of Tokay gecko captures, although the type of capture tools that are often used depends on the type of habitat where the geckos occur.	Low – 1	1 (one type of capture tool)	1
		Medium – 2	2 (two types of capture tools)	
		High – 3	> 2 (more than two capture tool types)	
19	Harvest areas: Indonesia is an archipelagic country with more than 17,000 islands. If the hunting area of the Tokay gecko gets wider, its vulnerability will be low, because the hunting level is relatively low and spread out. If the hunting area is located in most parts of Indonesia, the hunting area is narrower, but the hunting pressure is medium. The limited/specific hunting areas will increase the vulnerability of the geckos to hunting pressure.	Low – 1	Wide range – in all parts of Indonesia	
		Medium – 2	In the majority areas of Indonesia	2
		High – 3	Limited areas – only at certain locations	

20	Hunting season (in a year): This affects the intensity of hunting pressure on a population. Hunting season is generally related to the weather conditions at the hunting locations.	Low – 1	<3 months	
		Medium – 2	3-6 months	2
		High - 3	>6 months	
Trade Pressure Aspect				
21	Recording of trade data: Complete information on volumes and species being traded is recorded.	Low – 1	Trade data are completely recorded (species, volume per species, species origins)	1
22	National/domestic trade volume	Low – 1	Low volume of domestic trading	1
		Medium – 2	Medium volume of domestic trading	
		High – 3	High volume of domestic trading	
23	Annual volume for international trade: Data from annual exports from the Management Authority (KLHK).	Low – 1	Low export volume	
		Medium – 2	Medium export volume	
		High – 3	High export volume	3
Management Aspect				
24	Management plan: Is there any for Tokay geckos conservation?	Low - 1	Fully implemented	1
		Medium - 2	Partially implemented	
		High – 3	Not yet implemented	
25	Documentation of data and information. All data and information is well documented and comprehensively represents all harvest localities.	Low – 1	Data has been recorded and covers all capture locations in Indonesia, or the available data covers at least 90% of capture locations in Indonesia	1
		Medium - 2	Data has been recorded but does not cover all the capture locations (25-90%)	
		High – 3	Available data is less than 25%	
26	Sustainable use regulations.	Low - 1	Available on nationally scale	1
		Medium - 2	Available on locally scale	
		High – 3	No available	
27	Implementation of sustainable sse regulations	Low – 1	Has been implemented on nationally scale	1
		Medium - 2	Has been implemented, but still on locally scale	
		High – 3	Not yet implemented	
28	Socialization of regulations. In this criterion, it is assessed whether there is socialization of existing regulations. Furthermore, whether the socialization has been carried out to all utilization related parties (KLHK/BKSDA, exporters, collectors and hunters).	Low - 1	All regulations have been socialized nationally to related parties	1
		Medium - 2	Some regulations have been socialized nationally	
		High – 3	There has been no socialization of regulations nationally	
29	Capture license. In this criterion, it is assessed whether are there any licensing rules associated with capturing the Tokay gecko in collector level.	Low - 1	All collectors have permits	1
		Medium - 2	Some collectors already have permits	
		High – 3	The collectors don't have permits	
30	Implementation of capture licensing. In this criterion, it is assessed whether the CITES licensing rules related to Tokay gecko have been implemented.	Low - 1	All implemented	1
		Medium - 2	Partially implemented	
		High – 3	Not yet implemented	
31	Restrictive harvested locations. It is assessed whether there are rules for restricting the capture locations of Tokay geckos, which determine allowable and not allowable locations for harvesting the species	Low – 1	Available at national level	1
		Medium - 2	Available but not at national level	
		High – 3	Not available	
32	Implementation of restrictive harvested locations.	Low – 1	Implemented at national scale	1
		Medium - 2	Implemented but not at national scale	
		High – 3	Not yet implemented	
33	Capture size restrictions. Assess whether there are rules to limit the size of the Tokay gecko that can be caught	Low – 1	Available at national level	1
		Medium – 2	Available but not at national level	
		High – 3	Not available	
34	Implementation of capture size restrictions.	Low - 1	Implemented at national scale	1
		Medium - 2	Implemented but not at national scale	
		High - 3	Not yet implemented	

35	Traceability of traded commodities.	Low - 1	The national system/mechanism already exists and is complete (covering data on capture areas, transportation, product processing, domestic distribution, and overseas distribution)	1
		Medium - 2	The system/mechanism already exists but is incomplete and not yet on a national scale	
		High – 3	There is no traceability system/mechanism	
36	Implementation of traceability system of traded commodities	Low - 1	Implemented at national scale	1
		Medium - 2	Implemented but not at national scale	
		High - 3	Not yet implemented	
37	Utilization regulation. This criterion assesses whether there is a licensing system that regulates Tokay gecko's utilisation (trading, breeding, specimen exchange, and research).	Low - 1	Utilisation regulation is completely available	1
		Medium - 2	Utilisation regulation is available but not complete	
		High – 3	No utilisation regulation is available	
38	Law enforcement. Assessed whether there is law enforcement against violations of the use of house geckos.	Low - 1	Law enforcement has been carried out in all cases of violations	1
		Medium - 2	Law enforcement has only been applied to some cases of violations	
		High – 3	There is no law enforcement	
39	Control of capture locations	Low - 1	Capture on urban areas	1
		Medium - 2	Apart from urban areas, it is also carried out in non-conservation areas	
		High – 3	Conducted in a conservation area	

Table 3. Summary of NDF scoring.

Aspect	Total Score	Total Criteria	Final Score
Biological	18	15	1.20
Hunting Pressure	7	5	1.40
Trade Pressure	5	3	1.67
Management	16	16	1.00

*Score ranking; 1.0-1.5 = low vulnerability; 1.6-2.5 = moderate vulnerability; 2.6-3.0 = high vulnerability.

Scoring of the NDF aspect shows that the biological, hunting pressure and management aspects are have a low vulnerability to the existence of the Indonesian Tokay geckos. From the biological aspects, there is no threat from habitat change or other significant disturbances. The establishment of annual harvest quotas, the determination of harvest locations and other management aspects by the Management Authority has relieved the Tokay gecko of the constant pressure of harvesting at only one location, as had previously occurred. While the trade pressure aspect still has moderate vulnerability to Tokay geckos, Trade pressure, both on a national and international scale, puts this species at moderate risk of local extinction; new regulations, such as proper captive breeding, are needed. Harvest body size restrictions should remain unchanged. The management authority should strictly enforce the law.

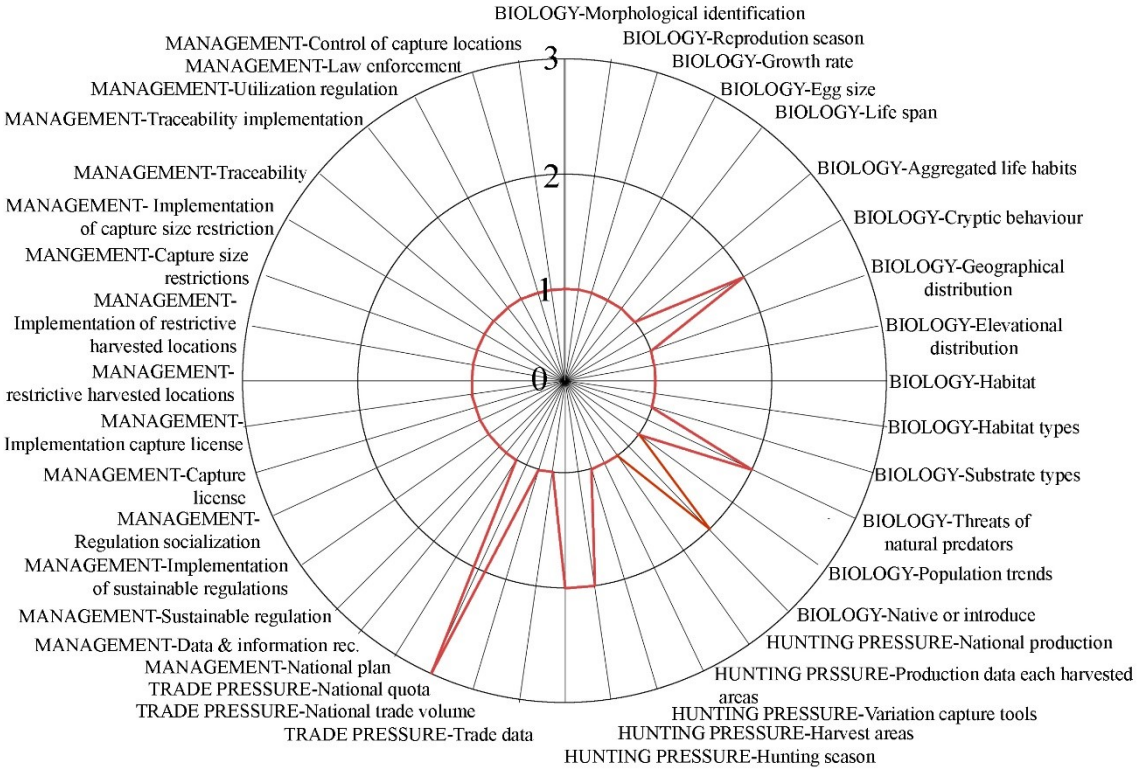


Figure 36. Radar plot of factors affecting to the management of *Gekko gecko* in Indonesia.

5.1. General Conclusion

From a biological point of view, the life of the Tokay gecko is not affected by habitat changes, because it is able to adapt to various types of habitats, whether they are 'original' habitats, such as primary forest or secondary forest, or modified habitats, such as plantations, or human settlements in rural and urban areas. Tokay gecko reproduction is also not much affected by natural conditions, such as seasons; Tokay geckos can breed throughout the year, and breeding begins before they are one-year-old. The heaviest pressure on Tokay geckos is from human activities, with people seeking economic benefits through trade.

CHAPTER VI
NDF RECOMMENDATION

Considering that Tokay geckos have a very essential predatory role in maintaining the balance of the ecosystem, the survival of their populations needs to be ensured. The assessment presented in this document is the result of an analysis of data and information obtained by the Scientific Authority (BRIN) from various sources (research results, scientific and non-scientific journals, interviews, and various social media as references). This assessment proposes several recommendations for developing regulations related to Tokay gecko utilization, especially for consumption commodities, because this economic sector exploits large amounts of Tokay geckos from the many habitats where it lives. The regulatory stages in Tokay Gecko's utilization are as follows:

6.1. Regulation for limiting the size of the body length (SVL) that can be captured (harvested)

Body length (SVL-snout to cloaca) that can be caught in the wild is longer than, or equal to 150 mm (SVL≥15 cm); this measure applies to both male and female individuals. The limitation of SVL will guarantee an individual female is two years old, and that she has contributed to nature by producing about 24 eggs.

Monitoring the implementation of this regulation in the field is likely to be difficult because so far hunters have captured Tokay geckos of various sizes; also, individuals weighing less than an ounce (=100 grams) will be maintained until they weigh one ounce or more. Therefore, monitoring at the collector level must be carried out regularly. However, monitoring the first collector will also be difficult, because hunters can bring specimens that do not comply with the rules. Large-scale collectors where Tokay gecko is ready to be exported only accept specimens from the original collectors. The implementation of SVL size limitation at these points in the trade chains is also likely difficult to monitor, due to the fact that importers in China will accept various sizes of specimens in dried condition. When it is difficult to implement the monitoring at this step, the second step of the regulation below will be carried out.

6.2. CITES monitoring of body size restriction rules

The policy for implementing Tokay gecko body size restrictions set by the Scientific Authority (BRIN) must obtain approval from the Management Authority (KLHK). For this policy to be effective, the Managing Authority must inform the CITES Secretariat by sending a notification. This notice clearly states that Indonesia imposes restrictions on the export of Tokay geckos with an SVL size more than or equal to 15 cm (>15 cm), in frozen or dry conditions. The policy of limiting the size of SVL> 15 cm can guarantee the sustainability of the house gecko, however, MA still applies quotas to ensure *traceability* and *legality*.

6.3. Strictly control of *Gekko gecko* captive breeding

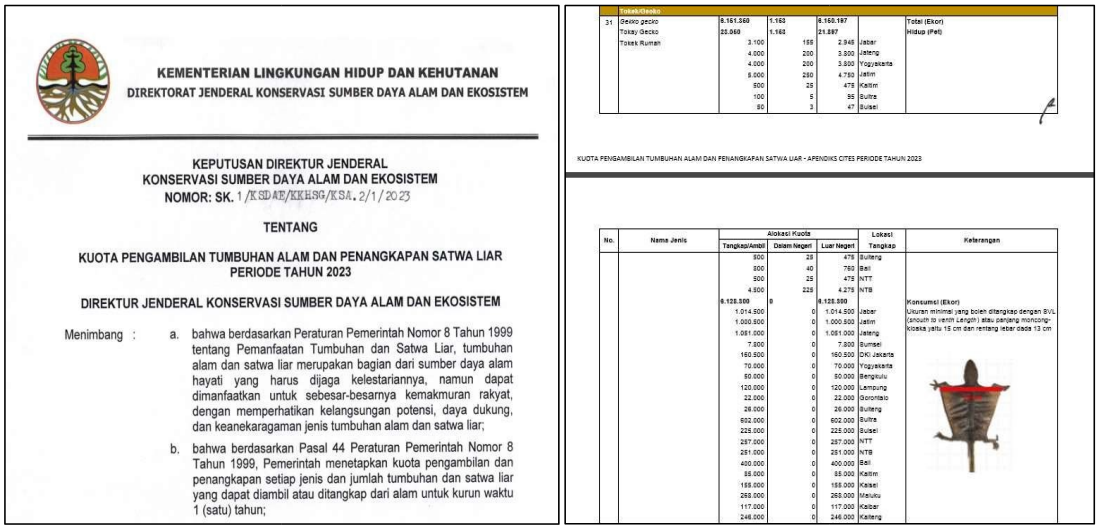
Close supervision must be carried out by all traders in the private sector who carry out captive breeding of Tokay gecko for consumption commodities. Generally, the Tokay gecko breeding cage contains many individuals packed into a small space. However, Tokay geckos in the wild have never been found living in groups, the adults always live in pairs and are far from other pairs, because the male individuals have strong territorial behaviour; this behaviour indicates that Tokay gecko is monogamy (Kurniati &

Phadmacanty 2021); males will repel other males who enter their territory. In the captive system, which accommodates many individual males in a small room, will trigger fights between males, and strong males will kill the weak males (smaller individuals). If the male geckos are more focused on the conflict with other males because of lack of space, then their reproductive activity will decrease.

Therefore, a model for cage design and husbandry still needs to be developed to encourage effective and viable captive breeding of Tokay gecko.

6.4. Annual quota setting in 2023

The implementation of restrictions size of wild Tokay gecko that can be exported for consumption purposes is started in the 2023 annual quota document (Figure 34). The quota was issued by the Ministry of Environment and Forestry (KLHK) as the Management Authority. It is the first time the photograph of the dry specimen was attached to the annual quota document. The specimen size with a minimum chest width of 13 cm which is equivalent to an SVL length of 15 cm that can be exported.



KEMENTERIAN LINGKUNGAN HIDUP DAN KEHUTANAN
DIREKTORAT JENDERAL KONSERVASI SUMBER DAYA ALAM DAN EKOSISTEM

KEPUTUSAN DIREKTUR JENDERAL
KONSERVASI SUMBER DAYA ALAM DAN EKOSISTEM
NOMOR: SK. 1/KSDAE/KKHSG/KSA.2/1/2023

TENTANG

KUOTA PENGAMBILAN TUMBUHAN ALAM DAN PENANGKAPAN SATWA LIAR
PERIODE TAHUN 2023

DIREKTUR JENDERAL KONSERVASI SUMBER DAYA ALAM DAN EKOSISTEM

Menimbang :

a. bahwa berdasarkan Peraturan Pemerintah Nomor 8 Tahun 1999 tentang Pemanfaatan Tumbuhan dan Satwa Liar, tumbuhan alam dan satwa liar merupakan bagian dari sumber daya alam hayati yang harus dijaga kelestariannya, namun dapat dimanfaatkan untuk sebesar-besarnya kemakmuran rakyat, dengan memperhatikan kelangsungan potensi, daya dukung, dan keanekaragaman jenis tumbuhan alam dan satwa liar;

b. bahwa berdasarkan Pasal 44 Peraturan Pemerintah Nomor 8 Tahun 1999, Pemerintah menetapkan kuota pengambilan dan penangkapan setiap jenis dan jumlah tumbuhan dan satwa liar yang dapat diambil atau ditangkap dari alam untuk kurun waktu 1 (satu) tahun;

KUOTA PENGAMBILAN TUMBUHAN ALAM DAN PENANGKAPAN SATWA LIAR - APENDIKS CITES PERIODE TAHUN 2023

Figure 37. Legal document of Tokay gecko annual quota for 2023 that was issued by the Management Authority (KLHK).

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