Evaluation on the Legal Trade of Tokay gecko (Lacertidae; Gekkonidae; Gekko gecko Linnaeus, 1758) in Indonesia

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Abstract
Tokay gecko (Gekko gecko) is a large-sized gecko from the genus of Gekko, which is most commonly found from South Asia, southern China, and Southeast Asia. In Indonesia, these species are common to inhabit human-modified habitat in Sumatera, Borneo, Java, Bali, Lesser Sundas, Sulawesi, and Moluccas. In recent years, the demand for Tokay gekko with high use-value in both national and international markets has increased, one of which is used for traditional medicine. This situation raised the concern on the decreasing of the wild population and the validity of captive breeding programs that produced a large number of individuals. Several reports had estimated millions of individuals have been exported from Indonesia either legally or illegally, however, the exact number never been reported. The purpose of this study is to evaluate the trend on the harvested Tokay gecko and its origin based on the source code information. The data were collected from government records, including specimens harvested from the wild and specimens produced from captivity during 2013 - 2018 (six years). The results showed that the legally exported specimens were sourced from wild (W) and captive breeding (C or F). The total numbers of individuals exported from the wild harvest are 97.146, and all export realization is below the wild harvest quota. However, there are the large numbers of individuals exported and declared as specimens produced from the captive breeding facilities (6.965.000 with source code F, and 1.236.000 with source code C). More importantly, the high level of specimens produced from captive breeding facilities is unlikely to match with the biological capacity of this species. Therefore, we predict that specimens labeled captive breeding were likely sourced from the wild.

Keywords: Captive breeding, Gekko gecko, Harvest, Trade, Wild population

Introduction
Family Gekkonidae consists of 83 genera and 670 species distributed in all continents [1]. Three species of genus Gekko are distributed in Indonesia, namely Gekko monarhicus, Gekko smithi and Gekko gecko. The Tokay gecko (Gekko gecko) is a large-sized gecko, most commonly found in Southeast Asia and widely spread in China, South India, Indochina, Malay Peninsula, Philippines, and Indonesia, including Sumatera, Borneo, Java, Madura, Bali, Sulawesi, Lesser Sundas, Moluccas and its satellite islands [2, 3, 4]. Gekko gecko has also been introduced to Florida, Hawaii, and Martinique (Caribbean) Brazil [4]. This species is often found to be abundant in the forest, plantations, agriculture, large trees, and walls of the house [2]. Based on food webs, Gekko is a predator for various insects and spiders. One of the factors causing the abundance of the G. gecko is a high adaptation level in the various habitat type so that they can compete with the other predator species. G. gecko is well-adapted to the human-modified habitat, such as the house in the city and rural area. This species is distributed from lowland to highland over 1000 masl [5]. Morpohologically, the adult male is bigger than the female. The adult male Gekko gecko has Snout Vent Length (SVL) 115-174 mm, and Total Length 250-300 mm, while the adult female has Snout Vent Length (SVL) 108-152 mm, and Total Length

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200-250 mm. The average weight of adult males is 50-60 grams, while adult females are 40-50 grams. They have brownish-gray and greenish body color. The dorsal is rough and decorated with prominent spots, usually reddish or white. The dorsal skin is covered by a faint scale (granular) and nodules. Upright pupils have jagged edges. The front and back toes grow perfectly, widening at the tips and sometimes with a membrane between the base of the finger. The tail has a similar color with the dorsal and complemented with spots at the tail. The soles of the front and back legs are equipped with adhesive pads called scanner. The pads are useful to climb the walls, trees, and poles [6].

The animal exploitation generally extends from the common species to endangered species. Recent findings show that protected animals were also traded directly and freely by the domestic market [7]. Two specific factors underlying the wildlife trading in a certain region are economic conditions and lack of community knowledge on the importance of conservation and the role of species in the ecosystem. This will be the main reason for massive exploitation in the wildlife as there is no restriction for the benchmark of conservation success of a region [8]. Based on the recent report, reptile is the second-largest trade animal used for commercial purposes after Aves or birds [8]. Large-scale illegal export of Tokay gecko (G. gecko) for the Asian region, especially from Indonesia, is still very high, and this is influenced by the difficulty of pursuing licensing access from the parties involved [9]. These results have been reported in the record that shows the exceeded quota of wild catches G. gecko (the previously agreed quota for individuals collected from the wild was 24,000 per year from Java). In 2006, there were three wholesalers from East Java who harvested approximately 1.2 million Geckos from wild, then dried and exported for the ingredient of traditional Asian medicine [9, 10]. Before entering the CITES Appendix II category in August 2019 [11], the Gecko exporting and importing countries were not required to report the number specimens being traded, so only a limited number of predictions or estimation are reported. In this research, we analyzed the government record of Tokay gecko exportation from 2013 – 2018 (six years) to give a definite level of harvesting along with the utility of Tokay gecko in Indonesia. The data will be useful to contribute to making of Non-detainment Finding (NDF) of the Tokay gecko in Indonesia.

Because this species is already included in appendix II CITES in 2019 [11], wild harvest for commercial purposes will need NDF to guarantee that level of the harvest will not be detrimental to the survival of Tokay gecko.

Material and Methods

We analyzed the legal record of Tokay gecko exportations from Indonesia for commercial use. In this study, the data of the domestic market was excluded, because the only small portion is involved (10 percent from the total quota of wild harvest). The recorded data were tabulated into an annual record which including the export quota and its realization per year for six years (2013 - 2018) when the Tokay gecko was not listed in appendix CITES yet (Table 1). The recapitulated data of exported Tokay gecko (G. gecko) was based on the record of export permits assigned by the Ministry of Environment and Forestry from 2013 until 2018. The data also recorded the number of individuals, and the source of specimens, either harvested from the wild or produced from captive breeding that was represented in the source code. The definition of each source code followed Lyons & Natusch (2011) [12] from the CITES website.

Results and Discussion

The export data of Indonesia during 2013 - 2018 were mostly originated from wild harvest source code W) or produced from captive breeding (source code F and C). None of the individuals were produced from the ranching program (source code R). According to this information, Indonesia has applied a quota system as compliance with CITES mechanism for Appendix II species, and the application of source code for the specimens exported for commercial use, although G. gecko has not yet listed in appendix CITES during 2013 – 2018 [11].
We obtained sample data from exporter companies and the collectors in the Central Java Region including Semarang (PT. Manta Pratama Unggul Perkasa), Boyolali (UD. Walang Sakti), Purwodadi (UD. Andi Makmur and UD. Tunggal Jaya), Purwokerto (UD. Harapan Rizki) with a total 642 individuals (115 individuals are live and 527 individuals are dead and ready to be processed). Of the total individuals both alive and dead dominated by female individuals with a total of 372 individuals and as many as 270 individuals males. While the data obtained from several regions in East Java included Bojonegoro (UD. Serbaguna), Probolinggo (UD. Andira Alternatif), and Kediri (UD. Bina Usaha Mandiri) the number of tokay gecko samples were obtained 981 individuals consisting of 630 male and 351 female individuals (Figure 2).

Tokay gecko (G. gecko) is categorized as Least Concern (LC) based on IUCN Redlist assessment [5]. This species is not listed in protected list species of Indonesia as it is commonly found on houses, both in rural areas or cities in Java. A massive harvest of G. gecko for the ingredient of Chinese Traditional Medicine (CTM) has raised global concern and discussed in the 18th Conference of the parties Meeting (CoP) CITES in August 2019. In this conference, G. gecko was uplisted to Appendix II CITES. Furthermore, the international trade of G. gecko will be monitored and all parties (countries) who ratified CITES must report the export and import data of G. gecko from December 2019 or 90 days after the decision of up-listing.

**Table 1. Source code and Definition of CITES Appendix**

| Source code | Description | CITES Appendix | Definition |
|-------------|-------------|----------------|------------|
| W           | Wild        | I, II, III     | Specimens taken from the wild |
| X           | Marine environment | I, II, III | Specimens taken from the marine environment, not under the jurisdiction of any State. |
| R           | Ranched animal | I, II, III | Specimens of animals reared in a controlled environment, taken as eggs or juveniles from the wild, where they would otherwise have had a very low probability of surviving to adulthood. |
| D           | Captive-bred animal or Artificially propagated plant | I | Appendix I animals bred in captivity for commercial purposes in operations included in the Secretariat's Register, following Resolution Conf. 12.10 (Rev. CoP15), and Appendix I plants artificially propagated for commercial purposes, as well as parts and derivatives thereof, exported under the provisions Article VII, paragraph 4, of the Convention. |
| A           | Artificially propagated plant | I, II, III | Plants that are artificially propagated following Resolution Conf. 11.11 (Rev. CoP15), as well as parts and derivatives thereof, exported under the provisions of Article VII, paragraph 5 (specimens of species included in Appendix I that have been artificially propagated for non-commercial purposes and specimens of species included in Appendices II and III). |
| C           | Bred in captivity | I, II, III | Animals bred in captivity following Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof, exported under the provisions of Article VII, paragraph 5. |
| F           | Born in captivity | I, II, III | Animals born in captivity (F1 or subsequent generations) that do not fulfill the definition of ‘bred in captivity’ in Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof. |
| U           | Unknown | I, II, III | Source of the specimen is unknown but must be justified. |
| I           | Confiscated or Seized | I, II, III | Specimens that have been confiscated or seized; this source code must be used in conjunction with another source code. |
| O           | Pre-Convention | I, II, III | Specimen acquired before the provisions of the Convention applied to it. If a certificate is issued by a Management Authority, then no other permit or certificate is required under the Convention to authorize export, import or re-export. |
ties of flora and fauna in Indonesia are the Ministry of Environment and Forestry, and Ministry of Fisheries and Marine Affairs, while the scientific authority is the Indonesian Institute of Sciences. However, the Indonesian CITES management authority is still under the single authority of the Ministry of Environment and Forestry. According to the Government Regulations No. 8 of 1999, the utilization of flora and fauna can be categorized into commercial and non-commercial uses, which consists of CITES-listed species and non-CITES species. The detailed regulations are arranged in the Decree of the Minister of Forestry Number 447/Kpts-II/2003. The harvest and trade of all CITES-listed species and non-CITES species are strictly controlled by the quota system. The quota was suggested by Scientific Authority through discussions involving a wide range of expertise from government research centers, Universities, and Non-Governmental Organizations (Figure 3). Individual species harvest quotas (Table 2) are determined based on the available data, including the biological information, population, distribution, general land-use, and potential threats in specific areas. The quota is set annually which includes the information of species name and number of harvested specimens per province. This harvest quota is legalized by the management authority through the Annual National Quota of harvest and export on flora and fauna. The export quota is typically established as 90% of the total harvest and 10% of it is used for domestic trade [13]. The wild-harvesting Gecko (G. gecko) is limited by the annual quota system. This includes harvesting and exporting processes for unprotected species to meet international market demands [14].

According to the Ministry of Environment and Forestry, the Tokay gecko harvested from the wild were approximately 25,250 individuals, with the export quota gecko reached up to 22,725 individuals. The samples were only allowed to be harvested from Aceh, North Sumatera, South Sumatera, Lampung, East Kalimantan, West Kalimantan, Central Kalimantan, Central Sulawesi, Southeast Sulawesi, West Java, Central Java, and East Java. The export realization and quota of Tokay gecko (G. gecko) was based on issued permits from 2013 until 2018 (Table 3).

Figure 5 shows the comparison between export realization and the quota data where the export realization data were always below the quota. The realization of export data was decreased in 2014 but steadily increased again in the following years. Overall, the export realizations were mostly below 50% during 2013 and 2014 and increased by more than 50% from 2015 until 2018. The Tokay gecko was mostly exported in dried form for the ingredient of Chinese Traditional Medicine (CTM). The selection of gecko for medicinal and consumption purposes should meet some particular characteristics, such as weight between 250 - 300 grams and complete tail [8]. However, dry weight does not always become the main requirement in trading. Moreover, it is difficult to monitor the number of individual intakes from the wild, thus individual units are considered to be the representative for trading criteria [17]. Harvest permits, domestic transport, and export permits were issued by the Ministry of Environment and Forestry. The total number of harvests should not exceed the amounts which issued by the provincial office of Ministry Environment and Forestry (BKSDA) following the annual quota referred to harvest permits. Fortunately, Indonesia has applied “legality” and “traceability” of harvested flora and fauna, both for listed appendix CITES species and non-CITES species.

Established from the statistical data in March 2014 by the Ministry of Environment and Forestry (KLHK), there were four companies in Indonesia with the highest export quota rates for Tokay gecko [9]. The above data were exceeded the national quota of wild harvest specimens. However, those companies have legal permits for captive breeding, thus it is likely that specimens exported from those companies were legally declared from captive breeding.

**Export from “captive breeding” facilities**

Indonesia regulates the captive breeding in Ministry Forestry Regulation No 19 of 2005 (P.19/ Menhut-II/2005). In this regulation, the permit to run the captive breeding program for non protected species is supposed to be issued by the local office of the Ministry of Environment and Forestry.
To monitor and supervise captive breeding facilities, the Indonesian government issued the Captive Breeding Production Plan (CBPP) since 2016. The CBPP consists of species name, company (captive breeding company) and the number of individuals predicted to be produced from captive breeding facilities. In 2019, CBPP changed its name into Maximum Production of Captive Breeding (MPCB) in 2019. The policy of CBPP or MPCB was not established through the recommendation of the Scientific Authority as the mechanism of wild harvest quota does. The Scientific Authority is involved in the auditing of captive breeding facilities. However, the audit of captive breeding, so far, is only limited for particular species that newly breed. This gap of evaluation from the Scientific Authority has caused a lack of scientific knowledge on determining the number of specimens that will be produced from captive breeding. As a result, the number of specimens in CBPP exceeded the biology capacity as criticized by Janssen and Chang [15].

Compare to wild harvest (W), the number of individuals produced from captive breeding was much larger in both individuals produced with C source code and F source code. Generally, when the quota for wild harvest was set lower than the market demand, the illegal harvest will be increased.

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**Table 2. The harvest and export quota for 2018 of Tokay gecko (Gekko gecko)**

| Species name | Quota | Annotation |
|--------------|-------|------------|
| Harvest      | Export| Harvest location |
| 25.250       | 22.725| life         |
| 1.000        |       | Aceh        |
| 2.000        |       | North Sumatra |
| 500          |       | South Sumatra |
| 750          |       | Lampung     |
| 5.000        |       | West Java   |
| 4.000        |       | Central Java |
| 8.000        |       | East Java   |
| 1.000        |       | Nusa Tenggara Barat |
| 500          |       | East Kalimantan |
| 500          |       | West Kalimantan |
| 500          |       | Central Kalimantan |
| 500          |       | Central Sulawesi |
| 500          |       | North Sulawesi |

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**Figure 3. The annual quota determination procedure for wild harvest specimens**
the captive breeding were significantly increased. This raised the concern on the validity of captive breeding that able to produce a huge number of individuals annually. In each year, the rate of gecko harvesting (G. gecko) is significantly increased in Indonesia, both originated from wild and captivity. This becomes evidence that Indonesia is one of the largest exporters for gecko in Southeast Asia [7]. Legal trade is a common phenomenon that occurs in public society, so it is not new for the community and exporters in developing countries.

Another concern raised from Tokay gecko is the wide utilization by the society, which has resulted in a significant increase in the market demand for G. gecko and difficult to control [9]. One strategy that can be applied to prevent over-exploitation of wildlife populations, especially G. gecko, is by promoting and supervising commercial or le-

Figure 4. Export realization data of Tokay gecko (Gekko gecko) from wild harvest from 2013-2018

Figure 5. Comparison of export realization of Tokay gecko (G. gecko) from wild harvest and captive breeding
The level of success of gecko development and reproduction is
containers 112,000 maintenance cages and 30,000 incubation
duals many as 14,000 produce one million geckos in one year
vant and optimal captivity captive breeding for
of gecko which ranges 0.20 to 0.40 USD requires high cost and not comparable with the price
space, and other husbandry treatment which re-
providing a large number of life insects, large
individuals in
regarding export and import quota
data bias will impact the arrangement of policies
origin, whether it's from captivity or wild. This
the quota number for each transaction and
ported animals which led to the data bias regarding
procedure is not being accompanied by transpar-
lation of the desired animal sometimes used as an excuse to exploit the popu-
procedure often does not give any benefit to the con-
servative and counterproductive sectors. It is
sometimes used as an excuse to exploit the popu-
lation of the desired animal [7, 9, 12, 16]. At pre-
ent, many countries make a massive export and import for animals bred in captivity. However, this
procedure is not being accompanied by transparent and complete data about the imported or exported animals which led to the data bias regarding the quota number for each transaction and its origin, whether it’s from captivity or wild. This data bias will impact the arrangement of policies regarding export and import quota [12].
Although G. gecko is not difficult to breed, due to the need of producing a large number of adult individuals in a year will require extra handling, providing a large number of life insects, large space, and other husbandry treatment which requires high cost and not comparable with the price of gecko which ranges 0.20 to 0.40 USD. The ideal captive breeding for G. gecko will need a ratio of 1:10 between males and females to produce relevant and optimal captivity [9]. For example, to produce one million geckos in one year, then as many as 14,000 males and 140,000 female individuals should be available. Besides, approximately 112,000 maintenance cages and 30,000 incubation containers are needed to raise that. The level of success of gecko development and reproduction is strongly influenced by the constant food supply, number of employees, and the gecko’s health [16]. Based on these analyses of biological capacity, producing a million Tokay gecko seems economically not durable, therefore we assume that the Tokay gecko declared to be produced from captivity seems to be wild-sourced. A recent study revealed that wild-sourced tokay geckos are laundered massively through registered captive-breeding facilities because it is economically not feasible to breed such large numbers and still make any profit, considering the enormous operational investments and the low sale prices [15, 18].

Further evaluation of the captive breeding of Tokay gecko is needed to manage the level of captive breeding which is economically feasible. Evaluation of the wild harvest specimens and the level of real intake and utility also are needed to understand the level of harvest trend during the last five years. This information will be useful to contribute information for the government in making Non-Detrimental Findings for tokay gecko. Therefore, the level of sustainable harvesting of G. gecko will be determined.

**Conclusion**
The high level of animal trade in Indonesia, especially gecko, is assumed to affect the wild population that affected Tokay gecko has uplisted to CITES Appendix II category in August 2019. Therefore, proper monitoring and supervision are strongly required to maintain the Tokay gecko population in harvest location. The evaluation of the captive breeding facilities needed to be improved to avoid laundry activities from wild harvest specimens.

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