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THE AMPHIBIANS AND REPTILES IN KOMODO NATIONAL PARK AND THE SURROUNDING AREA

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ABSTRACT

The Komodo National Park in the Wallacea region is the komodo dragon's primary habitats. Published report on the herpetofauna of this national park is mostly concentrated in Komodo island. To increase our knowledge of amphibian and reptile communities in Komodo National Park, we conducted a herpetofauna survey in Komodo and Rinca Island and the nearby coastal area to assess diversity and community similarity and developed a complete checklist of the herpetofauna of Komodo National Park. We conducted a Visual Encounter Survey and put glue traps from February-April 2018 at six locations on Komodo Island (Loh Liang, Loh Wau dan Komodo Village) and Rinca Island (Loh Buaya, Loh Baru, and Rinca Village); and three locations on coastal areas of Flores (Labuan Bajo and Cumbi Village) and coastal area of Sumbawa (Sape) adjacent to Komodo National Park. We found seven species of amphibians and 22 species of reptiles and, however, only two species of amphibians and 18 species of reptiles were found in Komodo and Rinca Island. The highest diversity (H' = 2.14) is in Loh Buaya (Rinca Island), and the highest evenness (E=0.58) is in Loh Baru (Rinca Island). The highest similarity occurs between Komodo Island and Rinca Island (IS = 0.8). Using data from other research, we have compiled a list of four species of amphibians and 39 species of reptiles occurring at three main islands of Komodo National Park: Komodo island, Rinca Island and Padar Island.

Keywords: *Herpetofauna diversity, Komodo National Park, Lesser Sunda Islands*

INTRODUCTION

Komodo National Park is a conservation area in the Wallacea region, known as the region with low biodiversity but rich in endemicity (Monk et al., 1997). As a conservation area, Komodo National Park primarily designated to preserve the charismatic and threatened species, komodo dragon (*Varanus komodoensis*), and its habitat. The national park comprises two large islands (Komodo and Rinca) and three smaller islands (Padar, Gili Motang, and Nusa Kode) inhabited by Komodo dragons. These islands are located between Sumbawa and Flores islands.

Since the national park focus is the conservation of the komodo dragon, there is a lack of study on the other species of reptiles or amphibians (see Ardiantiono et al. 2018, Ciofi et al., 1999, Jessop et al. 2018, Purwandana et al., 2016). During his research on the behavioral ecology of the komodo dragon (from 1969 to 1973), Auffenberg collected specimens of amphibians and reptiles in Komodo Island using accidental sampling. He reported two amphibians and 28 reptiles, including marine species in Komodo Island. For more than 30 years afterward, there has been no other report on amphibian and reptile species of Komodo National Park until Wahyuni (2012) reported 16 species of reptiles from 7 families from Padar Island. A few years later, a booklet on amphibian and reptile of Komodo National Park was written by Somaweera et al. (2018), which listed four species of amphibians and 39 species of reptiles, including marine species. The list was produced mainly based on accidental sighting and did not specify the distribution of the species within the islands of Komodo National Park. The list also did not identify the most abundant species and the herpetofauna community of each island.

Labuan Bajo in coastal Flores Island and Sape in coastal Sumbawa Island are the main entry points for tourism activity in the Komodo National Park. High mobility of sea transport between locations is considered as the pathway for the distribution of invasive species (Hulme et al., 2008). To increase our knowledge of amphibian and reptile communities in Komodo National Park, we conducted a herpetofauna survey in Rinca dan Komodo Island and the adjacent coastal area to assess the diversity and the similarity of the herpetofauna of Komodo National Park with the surrounding coastal area from the nearby mainland. Using additional information from Somaweera et al. (2018), Wahyuni (2012), and Auffenberg (1980), we then developed a complete list of amphibian and reptile of Komodo National Park.

RESEARCH METHOD

We conducted field surveys in six locations within two main islands of Komodo National Park and three locations outside of the national park. The locations within the national park were Komodo Village, Loh Liang, Loh Wau (Komodo Island); Rinca Village, Loh

Buaya, Loh Baru (Rinca Island); and locations outside the national park were Sape (coastal Sumbawa Island), Labuan Bajo, and Cumbi village (coastal Flores Island) (Fig 1). The habitat characteristic of each location is similar, mostly dry, and arid valleys with an elevation between 2-270 m a.s.l. The freshwater source was available in Komodo Village, and Loh Wau with stream flows throughout the year. However, in Loh Liang, there is no water sources, and the stream only flows during the rainy season. All locations in Rinca have water all year round. Labuan Bajo and Cumbi Village (Flores) are also considered dry; however, they were relatively wetter than Komodo and Rinca Islands. The Cumbi Village is near Wae Wuul Nature Reserve, a Komodo dragon habitat outside the national park (Ariefiandy et al., 2015). Water sources are plentiful and flow throughout the years in the area. Similarly, Sape in the eastern part of Sumbawa is also wetter, with water that flows all year round. Sape and Labuan Bajo are the main entry points to enter Komodo National Park (Figure 2a, b, c, and d).

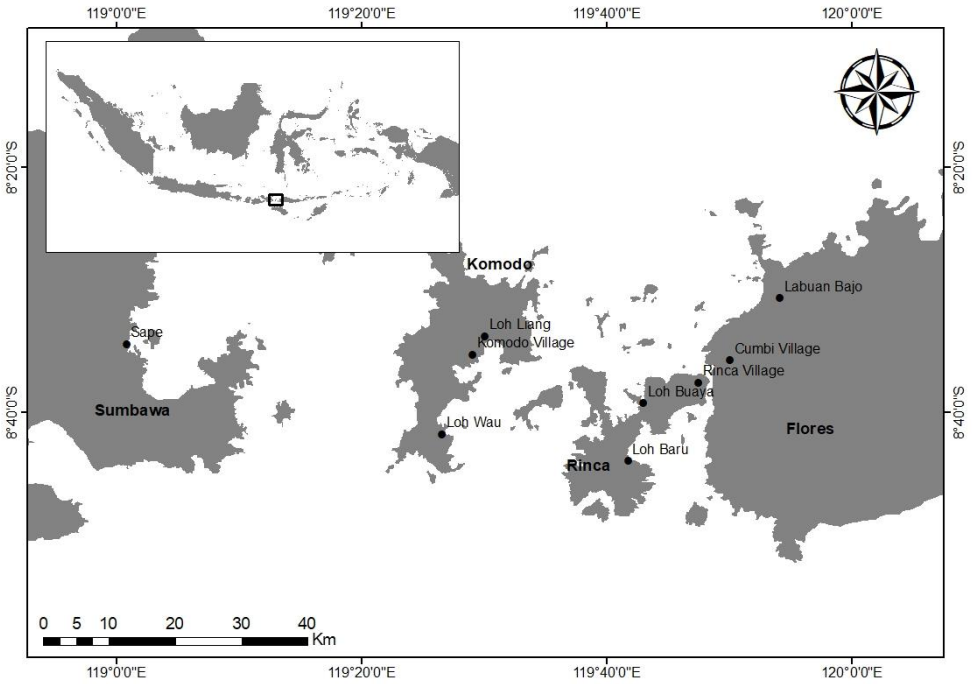

Figure 1 Map of Komodo National Park and its adjacent coastal area of mainland Flores and Sumbawa

Figure 2 Habitat condition in Loh Liang, Komodo Island (A), Loh Buaya, Rinca Island (B), Cumbi Village, coastal Flores Island (C), and Sape, coastal Sumbawa Island (D).

Data were collected at the end of the rainy season in February-April 2018. We concentrated the survey on the area within a maximum range of 100 m from water sources to make sure that we were able to observe amphibians. A Visual Encounter Survey method (Heyer et al., 1994) was carried out by randomly walking through the selected habitat by two-three surveyors. We actively searched the areas at night (19:00-21:00 Eastern Indonesian Time) on the forest floor, leaf litter, fallen logs, water bodies, and surrounding vegetation. During the day (08:00-10:00), we used a glue trap to capture small lizards and an active search for other reptiles. We put ten glue traps (size 30x30 cm) within ± 20 m of each other in locations that serve as a habitat for basking or feeding on the forest floor with leaf litter, stones, or fallen tree trunks. The total effort during the research was 654 person-hours.

We recorded locations, species, and date of capture at the time of capture. Habitat characteristics were noted. Frogs and reptiles were released after examination at the point of capture. Several individuals of amphibian and reptiles were preserved using 90% alcohol as voucher specimens, especially for species that have not been identified. Specimens were stored at the Museum Zoologicum Bogoriense, Research Centre for Biology, Indonesian Institute of Sciences (LIPI). There was no ethical clearance for collecting specimens as no such document was requested by the park management, other than permit to collect published by the national park management. However, we used guidance from Clemann et al. (2014) for the ethical collection of specimens and Kusrini (2019) for making specimens in an ethical manner. Nomenclature follows the reptile database https://reptile-database.reptarium.cz/ (Uetz and Etzold, 1996) and amphibian species of the world version 6.1 from the American Museum Natural History (AMNH) https://amphibiansoftheworld.amnh.org/ (Frost, 2020).

We constructed a checklist of amphibians and reptiles and grouped it based on Red List IUCN (International Union for Conservation of Nature), CITES Appendix (Convention on International Trade in Endangered Species of Wild Fauna and Flora), and Indonesian Law (*Peraturan Menteri Kehutanan and Lingkungan Hidup nomor 106 Tahun 2018*). We developed an accumulation curve for species obtained during each periodic survey, thus omitting species obtained outside sampling time but described in this report.

We measured diversity indices using the Shannon-Wiener diversity index (H') (Brower and Zar, 1997), Evenness (E), and Jackknife estimator for species richness (S) for each location. Data were analyzed using program PAST version 3.22 except for the Jackknife estimator for species richness (S), which was calculated following Heltse & Forester (1983). The community similarity index was measured using the Bray-Curtis index (Bray and Curtis, 1957).

RESULT AND DISCUSSION

1. Species compositions and relative abundance

During the survey, we found 29 species of herpetofauna (n=671), consisting of 7 species of amphibians from 4 families and 22 species of reptiles from 10 families (Table 1). We found two endemic amphibians (*Limnonectes kadarsani* and *Oreophryne jeffersoniana*) and five endemic reptiles (*Draco boschmai*, *Dendrelaphis inornatus*, *Coelognathus subradiatus*, *Malayopython timoriensis*, and *Varanus komodoensis*). Fifteen species are listed as Least Concern on IUCN Red List, 10 species are Not Evaluated, one species is listed as Near Threatened (*O. jeffersoniana*), and one species is listed as Vulnerable (*M. timoriensis*), and one species is listed as Endangered (*V. komodoensis*). There are three species listed in Appendix II CITES: *M. reticulatus*, *M. timoriensis*, *V. salvator*, and one species is listed in Appendix I CITES, *V. komodoensis* (Figure 3).

The cumulative curves for each location differed; however, it tend to increase in all locations (Fig. 4). This indicates that there is a possibility that additional observation will yield other species, i.e., *C. subradiatus, B. hoeseli, N. sputatrix,* which have been found by the first author outside the sampling time of this research.

Figure 3 Endemic species of reptile found during survey *Draco boschmai* (A), *Dendrelaphis inornatus* (B), *Coelognathus subradiatus* (C), *Malayopython timoriensis* (D), and *Varanus komodoensis* (E), except for *Varanus salvator* (F), which is listed in CITES Appendix 2

Table 1 Amphibian and reptile community comparison by location, endemicity (E), and conservation status based on the survey in February – April 2018.

No	Spesies	Komodo Island	Rinca Island	Coastal Flores	Coastal Sumbawa
	AMPHIBIANS				
	Bufonidae				
1	*Duttaphrynus melanostictus* (Schneider, 1799)	-	-	-	+
	Dicroglossidae				
2	*Fejervarya cancrivora* (Gravenhorst, 1829)	-	+	+	+
3	*Fejervarya limnocharis* (Gravenhorst, 1829)	-	-	+	+
4	*Fejervarya verruculosa*^{E} (Roux, 1911)	-	-	+	-
5	*Limnonectes kadarsani*^{E} (Iskandar, Boeadi, and Sancoyo, 1996)	-	-	+	-
	Microhylidae				
6	*Kaloula baleata* (Muller, 1836)	+	-	+	+
7	*Oreophryne jeffersoniana*^{E} (Dunn, 1928)	-	-	+	-
	Rhacoporidae				
8	*Polypedates leucomystax* (Gravenhorst, 1829)	-	-	+	-
	REPTILES				
	Agamidae/Lizard				
1	*Draco boschmai* (Hennig, 1936)	-	-	-	+
	Gekkonidae/ Gecko				
2	*Cyrtodactylus darmandvillei*^{E} (Weber, 1890)	+	+	+	+
3	*Hemidactylus frenatus* (Dumeril & Bibron, 1836)	+	+	+	+
4	*Hemidactylus platyurus* (Schneider, 1797)	+	+	+	+
5	*Gekko gecko* (Linnaeus, 1758)	+	+	+	+

No	Spesies	Komodo Island	Rinca Island	Coastal Flores	Coastal Sumbawa
6	*Gehyra mutilata* (Wiegmann, 1834)	+	-	-	-
	Scincidae/Skink				
7	*Sphenomorphus melanopogon* (Dumeril & Bibron, 1839)	+	+	+	-
8	*Sphenomorphus striolatus*^{E} (Weber, 1890)	+	+	+	+
9	*Cryptoblepharus renschi* (Mertens, 1928)	+	+	-	-
10	*Emoia similis*^{E} (Dunn, 1927)	-	+	-	-
11	*Lamprolepis smaragdina* (Lesson, 1829)	-	-	+	+
	Colubridae				
12	*Lycodon capucinus* (Boie, 1827)	+	+	+	+
13	*Dendrelaphis inornatus*^{E} (Boulenger, 1897)	+	-	+	-
14	*Coelognathus subradiatus*^{E} (Schlegel, 1837)	-	-	-	+
	Elapidae				
15	*Laticauda colubrina* (Schneider, 1799)	+	+	-	-
	Homalopsidae				
16	*Cerberus schneiderii* (Schlegel, 1837)	-	+	-	-
	Pythonidae				
17	*Malayopython timoriensis*$^{E,II,\#}$ (Peters, 1876)	-	+	-	-
18	*Malayopython reticulatus*^{II} (Schneider, 1801)	-	-	+	-
	Typhlopidae				
19	*Virgotyphlops braminus* (Wallach 2020)	-	+	-	-
	Viperidae				
20	*Trimeresurus insularis* (Kramer, 1977)	+	+	+	+
	Varanidae				
21	*Varanus komodoensis*$^{E,I,*,\wedge}$ (Ouwens, 1912)	+	+	-	-
22	*Varanus salvator*^{II} (Laurenti, 1768)	-	+	+	+
	N amphibian species	**1**	**2**	**7**	**5**
	N reptile species	**13**	**18**	**12**	**11**
	Number of herpetofauna species	**14**	**20**	**19**	**16**
	Jackknife index	**18**	**23**	**23**	**20**

Note: endemicity (E), conservation status (CITES, IUCN Red List, and *Indonesian Government regulation on Protected species or PP No. 106 MenLHK 2018*) for Komodo National Park and its surrounding, Nusa Tenggara, Indonesia (+ present; - absent). I, II denotes Appendix I and II in CITES, # represents vulnerable in IUCN Red List, * denotes endangered in IUCN Red List, and ^ denotes protected species

The presence of endemic species and species listed in threatened categories at IUCN Red List or in the protected category, i.e., *M. timoriensis*, *V. komodoensis*, and the blue-green *T. insularis*, which only found in the Nusa Tenggara region, shows the importance of Komodo National Park to ensure the existence of herpetofauna (De Lang, 2011). However, except for *V. komodoensis*, which is a protected species and well known, the presence of endemic snakes is under threat as snakes are often considered dangerous and thus killed by local people. During the survey, we encountered a dead *T. insularis*, which were most probably killed by the local people. Based on an interview with locals, the blue-green variant of *T. insularis* is often hunted and traded on the island of Sumbawa (Fig. 5).

The highest relative abundance of species was the Asian black-spined toad *D. melanostictus* in Sumbawa (114.81 ind/100 person-hours, Fig. 6). While the lowest relative abundance was the smooth-fingered narrow-mouthed frog *Kaloula baleata* and the common four-

clawed gecko *Gehyra mutilata* in Komodo Island (0.36 ind/100 person-hours each). The crab-eating frog *Fejervarya cancrivora* was the most abundant amphibian in Rinca and coastal Flores.

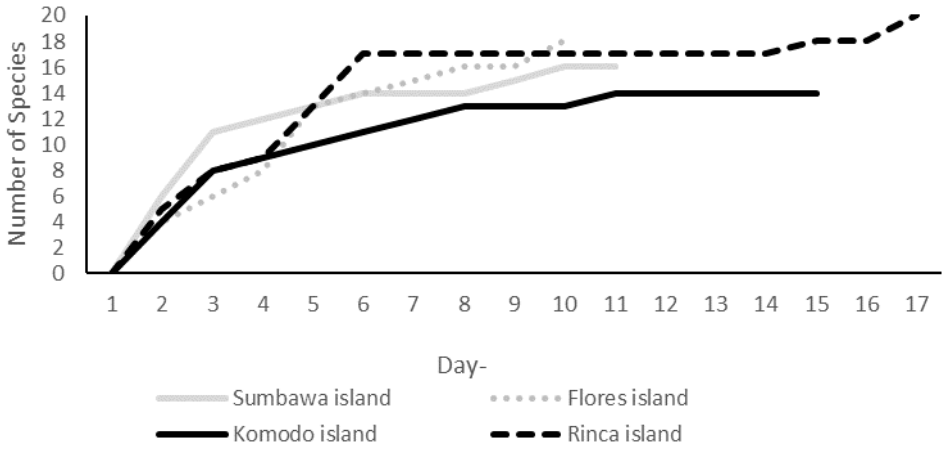

Figure 4 Species cumulative curves for amphibians and reptiles for each island

Figure 5 Color differences in *Trimeresurus insularis*; left: bluish-green color on Komodo Island and right: green coloration, the common coloration

Figure 6 The Asian black-spined toad (*D. melanostictus*) (A) is the most abundant toad in Sape (left) and considered a threat if it arrives in Komodo National Park, while the crab-eating frog (*F. cancrivora*) (B) might be a new immigrant to Komodo National Park

There has been a concern that the Asian common toad (*Duttaphrynus melanostictus*), considered as an alien species for the eastern part of Indonesia, might have been distributed in Komodo National Park (Reilly et al., 2017). However, there is no evidence that the species has been found in the national park, although it was abundant in Sape (Kennedi et al., 2020). There is a possibility that the absence of *D. melanostictus* in Komodo National Park is due to its intolerance to salinity and extreme dryness. Research has shown that *D. melanostictus* tadpole is unable to withstand salinity (Strahan, 1953) compared to *F. cancrivora* (Dunson, 1977). Research by Mogali et al. (2017) has shown that the tadpole of *D. melanostictus* has the plasticity to adapt with desiccation by increasing its metamorphic process but at the same time decreasing its body size. However, Mogali et al. (2017) showed that the tadpole of D. melanostictus still needs a minimum threshold period to complete development, with a minimum of 20 days. The rain-filled ephemeral water bodies in Komodo and Rinca islands and Labuan Bajo might not sustain enough time for *D. melanostictus* tadpole to survive and metamorphose. On the contrary, the wet condition of Sape during research might explain the relatively high abundance of this toad in the area.

During the survey, the crab-eating frog (*F. cancrivora*) was spotted in Loh Buaya and Loh Baru at Rinca Island (Fig. 6). The first encounter was on 15 March 2018 in Loh Buaya; the frog was calling in the water-buffalo mud puddle. There are two other records on the occurrence of this frog. Gilbert (2020) has found these species in April 2018, and Somaweera et al. (2018) also reported this species, although it was not clear the exact location. This species distributes widely in Asia (Islam et al., 2008) and adapts to a wide range of salinities (Dunson, 1977). It is unclear whether *F. cancrivora* has been established in Rinca for a long time or is a recent immigrant.

Table 2 Relative abundance (individual/100 person-hours) of herpetofauna at Komodo National Park and its surrounding areas based on islands. Data for amphibians were reported by Kennedi et al. (2020) but miscalculated as individual/person-hours.

No	Scientific Name	Komodo Island	Rinca Island	Coastal Flores	Coastal Sumbawa
Amphibians					
1	*Duttaphrynus melanostictus*	-	-	-	114.81
2	*Fejervarya cancrivora*	-	12.12	66.67	81.48
3	*Fejervarya limnocharis*	-	-	4.00	9.26
4	*Limnonectes kadarsani*	-	-	21.33	-
5	*Kaloula baleata*	0.36	1.21	18.67	3.70
6	*Oreophryne jeffersoniana*	-	-	5.33	-
7	*Polypedates leucomystax*	-	-	4.00	5.56
Reptiles					
8	*Gekko gecko*	1.44	1.62	6.67	16.67
9	*Hemidactylus frenatus*	16.22	7.68	7.68	24.07
10	*Hemidactylus platyurus*	14.05	8.48	2.67	14.81
11	*Gehyra mutilata*	0.36	0.81	-	1.85
12	*Cyrtodactylus darmandvillei*	7.93	5.66	12.00	7.41
13	*Sphenomorphus melanopogon*	7.21	6.06	6.06	-
14	*Sphenomorphus striolatus*	9.73	9.29	9.29	1.85
15	*Cryptoblepharus renschi*	2.52	1.62	1.62	-
16	*Emoia similis*	-	3.64	-	-
17	*Lamprolepis smaragdina*	-	-	2.67	-
18	*Draco boschmai*	-	-	-	1.85
19	*Lycodon capucinus*	3.60	3.64	1.33	7.41
20	*Dendrelaphis inornatus*	1.08	0.81	1.33	-
21	*Coelognathus subradiatus*	-	-	-	1.85
22	*Indotyphlops braminus*	-	0.81	-	-
23	*Trimeresurus insularis*	0.72	1.62	28.00	3.70
24	*Malayopython timoriensis*	-	0.40	-	-
25	*Malayopython reticulatus*	-	-	1.33	-
26	*Cerberus schneiderii*	-	-	-	-
27	*Laticauda colubrina*	-	-	-	-
28	*Varanus komodoensis*	2.16	1.62	-	-
29	*Varanus salvator*	-	-	1.33	11.11

The highest abundance of reptiles in Komodo Island was the common house gecko, *Hemidactylus frenatus* followed by the flat-tail gecko *H. platyurus*, the Flores banded skink *Sphenomorphus striolatus*, and Lesser Sunda dark-throated skink *S. melanopogon*. All four species were found in all survey sites on Komodo Island and also found in coastal Flores and Sumbawa (Table 2, Fig. 7).

2. **Diversity and Community Similarity**

The highest index of Shannon-Wiener diversity was found in Loh Buaya (Rinca Island) (H'=2.42), while the lowest index was in Komodo Village (H'=1.74). The highest evenness index was in Sape, while the lowest was in Rinca Village (E=0.38).

Shannon-Wiener index has been used widely to show species richness and abundance of ecosystems. It is most efficient to compare between sites, especially when the number of species richness is similar (Spellerberg and Fedor 2003). For instance, the number of species in Sape was similar to Loh Buaya, but the latter has the highest diversity due to higher evenness. The value of evenness in Sape, which was near the end of the spectrum (0.38), indicates single-species dominance (Stirling and Wilsey 2001), mostly the Asian black spined toad (D. melanostictus). The environmental conditions might affect the diversity of amphibian and reptile. The absence of running water sources might cause a low number of species in some locations, especially during dry weather and the lack of rain.

Figure 7 The four most abundant reptiles in Komodo Island: *Hemidactylus frenatus* (A), *H. platyurus* (B), *Sphenomorphus striolatus* (C), and *S. melanopogon* (D).

Table 3 Number of species, number of individuals, diversity, and evenness index of herpetofauna of Komodo, Rinca, coastal Flores, and coastal Sumbawa. Note: KPK=Kampung Komodo, LLG=Loh Liang, LBR=Loh Baru, LBY=Loh Buaya, KPR=Kampung Rinca, LWU=Loh Wau, CMB=Desa Cumbi, LBJ=Labuan Bajo, and SAP=Sape.

Index	Komodo Island			Rinca Island			Coastal Flores		Coastal Sumbawa
	KPK	LLG	LWU	LBY	KPR	LBR	CMB	LBJ	SAP
Number of Species	11	10	8	17	10	14	9	13	17
Number of individuals	66	70	52	71	47	51	85	66	166
Shannon Wiener Diversity Index (H')	1.74	1.99	1.86	2.42	1.79	2.31	1.87	1.94	1.95
Evenness Index (E)	0.40	0.47	0.47	0.55	0.43	0.59	0.42	0.46	0.38

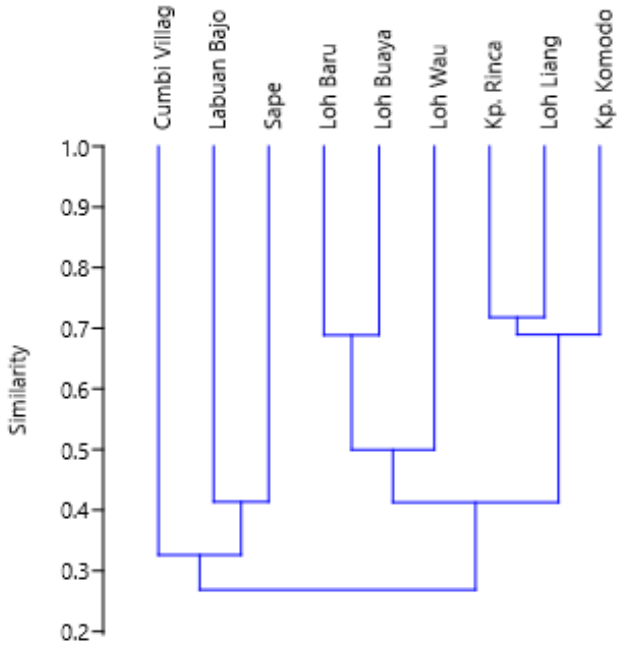

Figure 8 Dendrogram of paired group analysis depicting the Bray-Curtis similarity based on the occurrence and abundance of amphibian and reptile species in all locations.

The Bray-Curtis similarity is primarily used to quantify the differences in species populations between different species. Based on figure 8 There were two clusters of similarity between locations. The Locations at Komodo Island and Rinca Island belong to one cluster (with similarity of 0.45), where similar species can be found in locations within the islands. The similarity of ecosystems and the close distance between Komodo and Rinca Islands might explained the higher community similarity between these islands.

The community assemblages of coastal Flores and Sumbawa has formed a cluster with low similarity (0.35). This cluster is linked with Komodo-Rinca Islands cluster with lower similarity (0.28). The Bray-Curtis similarity indices distinguished compositional similarity of species assemblages by matching abundances of species in each community (Chao et al., 2005). Almost 80% of species found in Komodo and Rinca Island were found either in coastal Flores or Sumbawa. However, there were differences in abundance. In coastal Sumbawa, one species tended to dominate, whereas there was no dominance in other locations. The resulting clustering showed that the community assemblages between Komodo and Rinca Islands with adjacent coastal areas differed in abundance.

The number of species on an island is influenced by the size of the island and the distance to the main island, which both affect the rate of extinction and immigration (MacArthur & Wilson, 1967). Flores and Sumbawa, which are large (main) islands, should have higher species diversity than smaller islands such as Rinca and Komodo. However, our sampling was restricted to the selected coastal area in Flores and Sumbawa, which is only a tiny part of the entire island. Small islands usually have fewer species richness than the mainland, which has been explained by the theory of island biogeography (MacArthur & Wilson, 1967), as shown in this result.

All species in Rinca and Komodo Island were distributed either in Flores or Sumbawa, or both. For instance, *V. komodoensis* is not only found in Komodo National Park but also on Flores Island, i.e., Longos Island, Waewuul Nature Reserve, Tanjung Karita, and North Flores (Ariefiandy et al. 2021; Ciofi and De Boer, 2014). *C. schneiderii*, *E. similis*, *I. braminus,* and *M. timoriensis* were also found in Flores and Sumbawa (Reilly et al. 2020). Although the occurrence of amphibian and reptile in Komodo National Park are mostly secure due to the protected status of the area, it might be different on the mainland. For instance, Komodo distribution in Flores is mostly non-protected areas and at risk from anthropogenic threats (Ariefiandy et al., 2021; Azmi et al., 2021; Ciofi et al., 2002) and climate change (Jones et al., 2020).

3. A complete list of reptile and amphibian of Komodo National Park

Based on this research, combined with the report by Auffenberg (1980), Wahyuni (2012), and Somaweera et al. (2018), the herpetofauna of Komodo National Park comprised of four species of amphibians (Table 4, Figure 6) and 39 species of reptiles (Table 4). Our survey yielded only two species of amphibian out of three species reported by Auffenberg (1980) in Komodo Island

and about half of the Komodo Island reptiles and mostly terrestrial species. *O. jeffersoniana*, an endemic species was notably absent during our research in Komodo Island, although it was recorded in coastal Flores.

Wahyuni (2012) did not find any amphibian in Padar, a smaller and mostly dry island in Komodo National Park compared to Komodo and Rinca. Four species of reptiles reported by Wahyuni (2012) were absent in Komodo and Rinca island: *B. hoeseli*, and *C. subradiatus* (both endemic of Nusa Tenggara), *N. sputatrix*, and *C. yulensis*. There is a possibility of misidentification of Wahyuni for *C. yulensis*. The species was only reported from Yule Island in Papua New Guinea (Horner, 2007). No specimens or pictures were available from Wahyuni's work; thus, we omitted *C. yulensis* from the list of reptiles and amphibian species of Komodo National Park. A comparison between a list of herpetofauna published by Auffenberg (1980) on the Komodo Island showed that our study result was also lower. From 1969 through 1970, 1971, and 1973, Auffenberg discovered 30 species of herpetofauna, whereas our study only found 14 species in Komodo Island. However, three species found in this study (*F. cancrivora*, *M. timoriensis*, and *E. similis*) were not reported by Wahyuni (2012) in Padar or by Auffenberg (1980) in Komodo Island.

Table 4 List of amphibian and reptile species in three main islands of Komodo National Park based on Auffenberg 1980 (1), Wahyuni 2012 (2), this study (3), and Somaweera et al. 2018 (4).

No	Species	Komodo Island	Rinca Island[3]	Padar island [2]	Komodo NP[4]
AMPHIBIANS					
1	*Fejervarya cancrivora*	no	yes	no	yes
2	*Kaloula baleata*	yes[3]	yes	no	yes
3	*Kaloula pulchra*	no	no	no	yes
4	*Oreophryne jeffersoniana*	yes[1]	no	no	yes
REPTILES					
Geckoes					
1	*Cyrtodactylus darmandvillei*	yes[1,3]	yes	yes	yes
2	*Cyrtodactylus laevigatus*	yes[1]	no	no	yes
3	*Gehyra mutilata*	yes[1,3]	yes	yes	yes
4	*Gekko gecko*	yes[1,3]	yes	yes	yes
5	*Hemidactylus frenatus*	yes[1,3]	yes	yes	yes
6	*Hemidactylus platyurus*	yes[1,3]	yes	yes	yes
7	*Hemiphyllodactylus typus*	no	no	no	yes
8	*Lepidodactylus lugubris*	yes[1]	no	no	yes
Skinks					
9	*Cryptoblepharus burdeni*	yes[1]	no	no	yes
10	*Cryptoblepharus renschi*	yes[1,3]	yes	yes	yes
11	*Emoia similis*	yes[1]	yes	no	yes
12	*Eremiascincus emigrans*	yes[1]	no	no	yes
13	*Eutropis multifasciata*	yes[1]	no	no	yes
14	*Sphenomorphus melanopogon*	yes[1,3]	yes	yes	yes
15	*Sphenomorphus schlegeli*	yes[1]	no	yes	yes
16	*Sphenomorphus striolatus*	yes[1,3]	yes	yes	yes
Other lizards					
17	*Draco boschmai*	yes[1]	yes	no	yes
18	*Dibamus novaeguineae*	yes[1]	no	no	yes
19	*Varanus komodoensis*	yes[1,3]	yes	no	yes
20	*Varanus salvator*	no	yes	no	yes
Sea turtles					

No	Species	Komodo Island	Rinca Island[3]	Padar island [2]	Komodo NP[4]
21	*Chelonia mydas*	yes[1]	NA	no	yes
22	*Eretmochelys imbricata*	yes[1]	NA	no	yes
Crocodiles					
23	*Crocodylus porosus*	yes[1]	NA	no	yes
Sea snakes					
24	*Laticauda colubrina*	yes[1,3]	yes	no	yes[a]
Aquatic snakes					
25	*Acrochordus granulatus*	yes[1]	NA	no	yes
26	*Cerberus schneiderii*	yes[1]	yes	yes	yes
Land and tree snakes					
27	*Boiga hoeseli*	yes[1]	no	yes	yes
28	*Coelognathus subradiatus*	yes[1]	yes	yes	yes
29	*Dendrelaphis inornatus*	yes[1,3]	yes	yes	yes
30	*Lycodon capucinus*	yes[1,3]	yes	yes	yes
31	*Psammodynastes pulverulentus*	yes[1]	no	no	yes
32	*Malayopython timoriensis*	no	yes	yes	yes
33	*Naja sputatrix*	yes[1]	no	no	yes
34	*Daboia siamensis*	yes[1]	no	no	yes
35	*Trimeresurus insularis*	yes[1,3]	yes	yes	yes
Burrowing snakes					
36	*Cylindrophis opisthorhodus*	no	no	no	yes
37	*Indotyphlops braminus*	yes[1]	yes	yes	yes
38	*Indotyphlops schmutzi*	yes[1]	no	no	yes
39	*Sundatyphlops polygrammicus*	yes[1]	no	no	yes

Note: NA=Not Available (the survey was not carried out in its habitat).

The absence of several species in contrast to Auffenberg's (1980) was influenced by total search effort and seasonality. One amphibian and 17 reptiles were absent in this research as listed in Table 4. Auffenberg (1980) were based on almost three years' fieldwork, including the rainy season and the dry season, thus increasing the opportunity to get more species. Our survey was conducted at the end of the wet season. It is recommended that other sampling should account for the rainy season, especially during December-January, during the highest rainfall, due to the possibility of different encounters between the rainy season and dry season.

This survey did not record several marine reptiles' species because it mostly focused on terrestrial herpetofauna habitat. Based on Jackknife's calculations, there was still a possibility that more herpetofauna can be found on Komodo Island.

CONCLUSION

Our field surveys were recorded 22 species of reptiles and seven species of amphibians, but only 18 species of reptiles and two species of amphibian were from Komodo and Rinca Island. All species found in Komodo, and Rinca Island are also distributed in the mainland (Flores Island), and 80% of species of Komodo and Rinca Island were also recorded from coastal Flores and Sumbawa. The highest Shannon-Wiener diversity index (2.14) was in Loh Buaya (Rinca). The number of species in Loh Buaya was similar to Sape in coastal Sumbawa; however, the evenness index was higher (0.55) in Loh Buaya, which showed no dominant species in this area. Komodo National Park is home to 39 species of reptiles and four species of amphibians. As a conservation area, this national park is essential to ensure the survival of herpetofauna. Moreover, it serves as a habitat for protected species and highly endemic reptiles from the Lesser Sunda Islands.

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APPENDICES

Appendix 1. Specimens deposited at Museum Zoological Bogor (MZB).

No	Species	Code	MZB	Site	Island
1	*Cryptoblepharus renschi*	Lace	14906	Loh Wau	Komodo
2	*Cryptoblepharus renschi*	Lace	14907	Loh Wau	Komodo
3	*Cyrtodactylus darmandvillei*	Lace	14897	Kp. Komodo	Komodo
4	*Cyrtodactylus darmandvillei*	Lace	14898	Loh Liang	Komodo
5	*Sphenomorphus melanopogon*	Lace	14903	Kp. Komodo	Komodo
6	*Sphenomorphus melanopogon*	Lace	14904	Loh Buaya	Rinca
7	*Sphenomorphus striolatus*	Lace	14901	Kp. Komodo	Komodo
8	*Sphenomorphus striolatus*	Lace	14905	Loh Buaya	Rinca
9	*Sphenomorphus striolatus*	Lace	14902	Loh Buaya	Rinca
10	*Emoia similis*	Lace	14908	Loh Buaya	Rinca
11	*Emoia similis*	Lace	14909	Loh Buaya	Rinca
12	*Gehyra mutilata*	Lace	14910	Sape	Sumbawa
13	*Hemidactylus frenatus*	Lace	14899	Kp. Komodo	Komodo
14	*Hemidactylus frenatus*	Lace	14900	Kp. Komodo	Komodo
15	*Lycodon capucinus*	Ophi	6237	Loh Liang	Komodo
16	*Indotyphlops braminus*	Ophi	6236	Loh Buaya	Rinca
17	*Duttaphrynus melanostictus*	Amph	31740	Sape	Sumbawa
18	*Duttaphrynus melanostictus*	Amph	31741	Sape	Sumbawa
19	*Fejervarya cancrivora*	Amph	31738	Loh Buaya	Rinca
20	*Fejervarya verruculosa*	Amph	31739	Labuan Bajo	Flores
21	*Kaloula baleata*	Amph	31742	Loh Buaya	Rinca
22	*Limnonectes kadarsani*	Amph	31743	Wae Wuul	Flores
23	*Limnonectes kadarsani*	Amph	31744	Wae Wuul	Flores
24	*Oreophryne jeffersoniana*	Amph	31745	Wae Wuul	Flores
25	*Polypedates leucomystax*	Amph	31746	Labuan Bajo	Flores