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Where giants meet: the first photographic record of the Asian Water Monitor, *Varanus salvator* (Laurenti, 1768), on Komodo Island, Indonesia, with notes on natural history

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Commonly known as Monitor Lizards, the genus *Varanus* comprises more than 80 extant species of medium- to large-sized lizards that are widely distributed across Sub-Saharan Africa to Asia, Australia, and many Pacific islands (Auliya and Koch, 2020; Uetz et al., 2025). The genus includes the world's largest lizard species, the Komodo Dragon, *V. komodoensis* Ouwens, 1912, and the Asian Water Monitor *V. salvator* (Laurenti, 1768), both of which can exceed 3 m in total length (Pianka et al., 2004; Auliya and Koch, 2020). *V. komodoensis* is known to be restricted to a few islands in the Lesser Sunda Islands, Indonesia, within Komodo National Park and on Flores Island (Pianka et al., 2004; Koch et al., 2013; Auliya and Koch, 2020). In contrast, *V. salvator* is among the most widespread species of genus *Varanus*, occurring across much of southern and Southeast Asia, with the subspecies *V. s. bivittatus* (Kuhl, 1820) occupying extensive areas of Indonesia (Pianka et al., 2004; Koch et al., 2007; Auliya and Koch, 2020; Quah et al., 2021). On Flores Island and Rinca Island (part of Komodo National Park), *V. s. bivittatus* occurs in sympatry with *V. komodoensis* (Auffenberg, 1980; Koch et al., 2007; Forth, 2010; Kennedi et al., 2021; Quah et al., 2021). However, the presence of *V. s. bivittatus* on Komodo Island has remained ambiguous. Zug and Kaiser (2014) reported the presence of *V. s. bivittatus* on Komodo Island, citing Auffenberg (1980) and de Rooij (1915). However, Auffenberg (1980) explicitly stated that *V. salvator* is "clearly absent on Komodo," and de Rooij (1915) did not include Komodo Island within the documented distribution of *V. salvator*. This discrepancy suggests that the inclusion of Komodo Island by Zug and Kaiser (2014) may reflect a misinterpretation or secondary propagation of earlier sources rather than direct evidence. Surveys by Kennedi et al. (2021) that covered all islands within Komodo National Park did not record this species on Komodo Island, Forth (2010) explicitly stated its absence from Komodo Island, and Komodo was not included within the documented distribution of *V. s. bivittatus* by Quah et al. (2021) or Pianka et al. (2004). Nonetheless, Koch et al. (2007) noted that *V. s. bivittatus* had "only occasionally been encountered" on Komodo Island, based on personal observations by conservation biologist and varanid expert Claudio Ciofi. Apart from the brief mention, no photographic evidence or detailed natural history information was provided on Komodo populations of *V. s. bivittatus*. Our keyword search-based survey (using "Varanus salvator Komodo" and "water monitor Komodo") on Google, Flickr, Facebook, Instagram and iNaturalist also yielded no confirmed photographs of *V. s. bivittatus* taken on Komodo.

Here, we present, to our knowledge, the first verified photographic evidence on the presence of *V. salvator bivittatus* on Komodo Island and discuss the potential biogeographic, ecological, and anthropogenic factors that may have contributed to its previous absence from some literature. On 5 August 2025 at 12:30 h, under sunny conditions and an ambient temperature of 30 °C, a medium-sized monitor lizard (~60 cm total length) was observed walking along a dry creek bed at Komodo Village, Komodo Island, East Nusa Tenggara, Indonesia (8.5894°S, 119.4864°E, elevation 8 m) (Figs. 1B, 2D). The individual (Fig. 2A) was identified as *Varanus*

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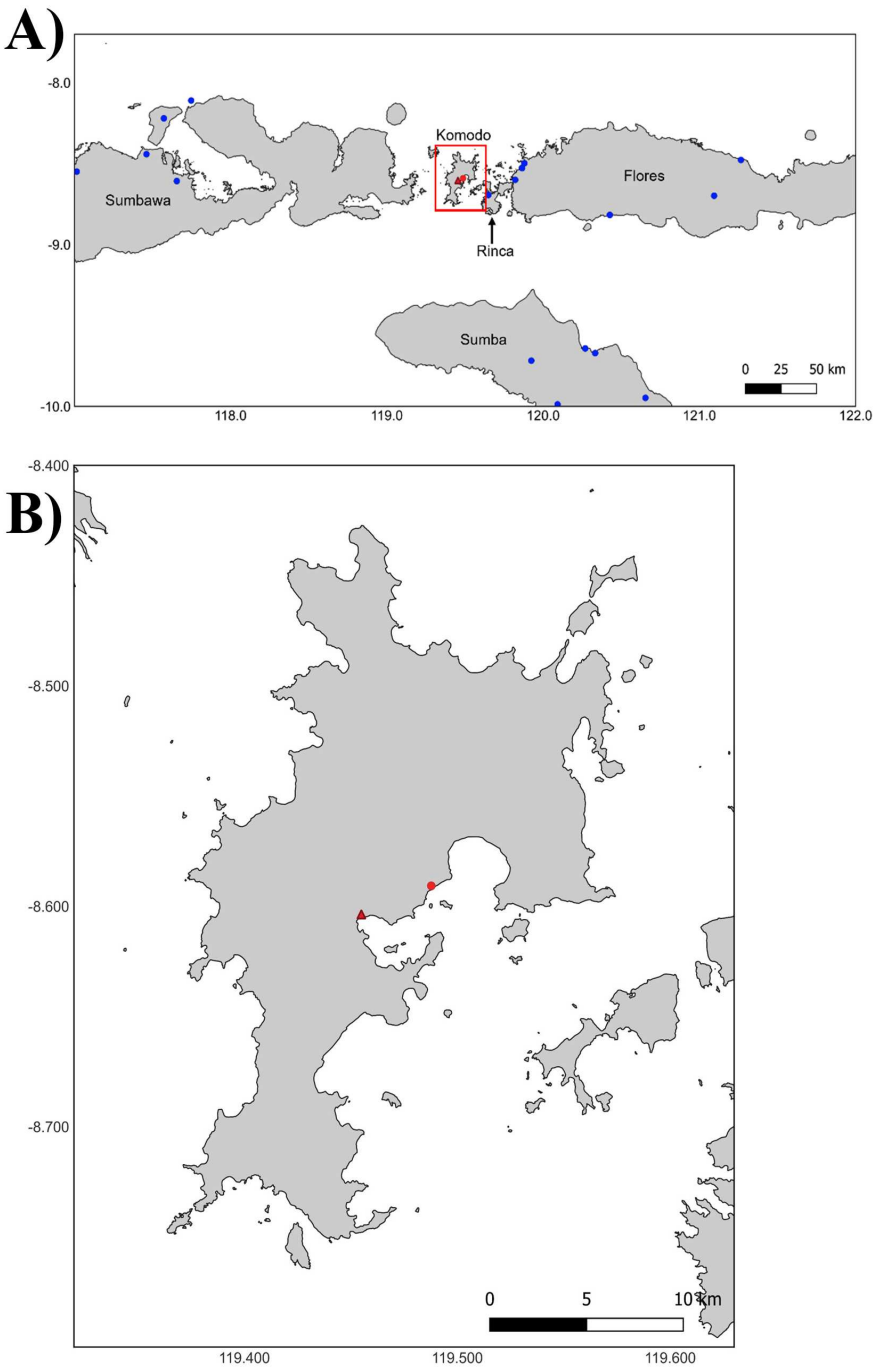

Figure 1. Occurrence of *Varanus salvator bivittatus* on Komodo Island and surrounding islands. Major islands are labelled. Axes represent latitude and longitude, with scale bars (km) shown at the lower right of each map. (A) Regional map of the study area. Blue circles denote *V. s. bivittatus* records obtained from GBIF.org (accessed 17 September 2025; GBIF Occurrence: https://doi.org/10.15468/dl.mmsjr5), while red symbols indicate new records from Komodo Island documented in this study. The location of Komodo Island is outlined by a red box. (B) Enlarged view of Komodo Island. The red circle marks the site of the photographed individual, and the red triangle represents an additional anecdotal record provided by J-J, one of the authors of this paper who serves as a ranger in Komodo National Park. Map created with QGIS 3.40 (QGIS.org, 2025).

Figure 2. (A) *Varanus salvator bivittatus* observed at Komodo Village, Komodo Island on 5 August 2025. (B) *V. s. bivittatus* recorded at the same location on 9 August 2025; note the lighter dorsal spots and more evenly patterned black and yellow caudal bands compared to the individual in (A). (C) *Varanus komodoensis* previously photographed at the same locality. (D) General view of the habitat of *V. s. bivittatus* at Komodo Village. Photos by Jianli Shen (A), Nachuan Yang (B, C), and Tianwei Kou (D).

salvator bivittatus on the basis of its laterally compressed tail, large yellow ocelli on the dorsum, and a pair of yellowish lines extending from below the temporal streak to the shoulder—characters consistent with this subspecies and in contrast to sympatric *V. komodoensis*, which exhibits a less compressed tail, smaller dorsal spots, and lacks the yellow shoulder lines as juveniles (Auliya and Koch, 2020). The observation lasted approximately five minutes, during which the lizard was observed from a distance before fleeing rapidly. A second sighting occurred on 9 August 2025 at 16:30 h at the same location, under cloudy conditions with an ambient temperature of 28 °C. This second encountered individual (Fig. 2B) had a similar estimated body size to the animal encountered four days before, however, it could be distinguished by faint dorsal pattern and difference in the patterns on its tail (Figs. 2A, 2B). This encounter was brief (< 1 min), with the lizard retreating quickly into a rock pile upon noticing the observers. During our previous visits to Komodo Island, adult *V. komodoensis* (Fig. 2C) were regularly observed at and around the same dry creek bed where we recorded *V. s. bivittatus*, however, we did not observe interactions between the two species. Additionally, one of the authors, Jahiding Jahiding (J-J), who serves as a ranger in Komodo National Park, has personally observed *V. s. bivittatus* in a mangrove habitat on Komodo Island in 2024. No photographs were taken at the time. The locality of this anecdotal observation is indicated in Figures 1A and 1B.

Based on the two photo-documented observations reported here, observation by J-J, and the notes by C. Ciofi cited in Koch et al. (2007), we propose that *V. s. bivittatus* is native to Komodo Island but its occurrence on the island is scarce. Its continued ambiguity in the literature may be attributable to a small population size, low encounter rates, and a general lack of awareness of this distributional gap.

Members of the *Varanus salvator* group are well known for their strong dispersal abilities, often using island chains and archipelagos as natural corridors (Welton et al., 2014). *V. s. bivittatus* exhibits a broad distribution across Southeast Asia, particularly Lesser Sunda Islands that include the islands of Flores, Rinca, and Sumbawa (Fig. 1A) (Koch et al., 2007; Forth, 2010; Koch et al., 2013; Kennedi et al., 2021; Quah et al., 2021). Therefore, environmental barriers such as the strait separating Komodo Island from other islands and strong sea currents are unlikely to limit the over-water dispersal of *V. s. bivittatus*. However, *V. salvator* is typically associated with aquatic microhabitats such as rivers, swamps, and mangroves (Auffenberg, 1980; Pianka et al., 2004; Quah et al., 2021), which are scarce on Komodo Island (Hidyarko et al., 2021; Rijal et al., 2023). Instead, the island is dominated by open grassland and woodland savannah habitats, which are more characteristic of, and regularly utilised by *V. komodoensis* (Auffenberg, 1980; Hidyarko et al., 2021; Rijal et al., 2023). The limited availability of suitable aquatic habitats may have limited the establishment of abundant populations of *V. s. bivittatus* on the island. In contrast, the surrounding islands of Sumbawa, Rinca, and Flores, where *V. s. bivittatus* has been more commonly documented (Auffenberg, 1980; Koch et al., 2007; Forth, 2010; Kennedi et al., 2021; Quah et al., 2021), are relatively wetter and support more abundant freshwater sources and mesic habitats (Auffenberg, 1980; Kennedi et al., 2021), which likely provide more favourable conditions for the species' persistence.

Furthermore, ecological interactions with *V. komodoensis* may also impact the potential population establishment of *V. s. bivittatus*. Both species exploit overlapping food resources such as small mammals and carrions (Auffenberg, 1980; Pianka et al., 2004; Auliya and Koch, 2020), but as the apex terrestrial predator on Komodo Island, the larger *V. komodoensis* may competitively exclude *V. s. bivittatus* or suppress its local abundance. Similar circumstances had been noted by Auffenberg (1980), on Flores Island, where *V. komodoensis* often dominates carrion scavenging when both species are attracted to the same food source. As both species are known to include reptiles in their diet, juvenile *V. s. bivittatus* may be particularly vulnerable to direct predation by *V. komodoensis*, and vice versa (Auffenberg, 1980; Pianka et al., 2004; Auliya and Koch, 2020).

Komodo Island, particularly Komodo Village, has served as an ecotourism hotspot for several decades (Hidyarko et al., 2021). However, research and tourism on Komodo Island have historically focused on *V. komodoensis* (Hidyarko et al., 2021), while the broad distribution of *V. salvator* may have led tourists (even herpetologists) to assume its wide presence on the island, without checking scientific literature. If a long-established population of *V. s. bivittatus* exists on the island, the absence of records may partly reflect this survey bias, other than difficulties in detection. Consequently, even if *V. s. bivittatus* had been observed previously, the significance of such records may have been overlooked, resulting in its occurrence on Komodo Island remaining underreported. Notably, Walter Auffenberg, who conducted extensive field studies on Komodo Island, explicitly denied the presence of *V. salvator* on the island (Auffenberg, 1980). It is also possible that the individuals reported in Koch et al. (2007) and this study may represent a more recent colonisation event or an anthropogenic introduction from surrounding islands where the species is more common.

In conclusion, our report presents, to our knowledge, the first photographic evidence of the occurrence of *V. s. bivittatus* on Komodo Island and provides natural history notes on its habitat use on the island. Based on the evidence presented here, together with the observations reported by Koch et al. (2007), we recommend that biodiversity databases, future field guides, and subsequent journal publications include Komodo Island within the documented distribution of *V. s. bivittatus*. However, significant knowledge gaps remain on this subspecies' biology and ecology. We recommend that future studies carry out targeted field surveys to evaluate habitat suitability for *V. s. bivittatus* on Komodo Island. Morphological and phylogenetic analyses of populations from Komodo and adjacent islands may help clarify population structure of *V. s. bivittatus* on those islands. Investigations into niche differentiation and interspecific interactions between *V. s. bivittatus* and *V. komodoensis* on Komodo, Rinca, and Flores would provide valuable insights into the coexistence of the world's two largest lizard species, and thus contribute to their conservation. In addition, we encourage continued documentation of *V. s. bivittatus* on Komodo and surrounding islands via citizen-science platforms such as iNaturalist. Ethnobiological surveys that incorporate local knowledge may further clarify *V. s. bivittatus*'s occurrence in both Komodo Island and Komodo National Park.

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