

VARANUS SALVATOR (Asian Water Monitor). DEEP DIVING.

Over 270 species of extant reptiles inhabit saline habitats on a permanent, seasonal, or occasional basis (Wilfred 1958. *Bull. Mar. Sci.* 8:1–97). Although lizards are the most speciose and diverse group of extant reptiles (Uetz et al. 2018. *The Reptile Database*, www.reptile-database.org), very few species have ventured into marine habitats (Rasmussen et al. 2011. *PLoS ONE* 6:e27373). No extant lizards are known to be strictly aquatic (Bauer and Jackman 2008. *Hydrobiologia* 595:581–586), but the Marine Iguanas of Galapagos feed exclusively on marine plants, therefore spend a considerable time diving and foraging in oceans (Trillmich and Trillmich 1986. *Behav. Ecol. Sociobiol.* 18:259–266). Few species of varanids (e.g., *Varanus dumerilli*, *V. indicus*, *V. komodoensis*, *V. niloticus*, and *V. salvator*) are known to occasionally visit marine habitats but records are limited to individuals foraging along the shoreline or in shallow waters at the edge (Wilfred 1958, *op. cit.*). Here we report three observations of a varanid diving in deeper water, potentially for foraging.

On 18 February 2019 at 1210 h, during a dive tour at USAT Liberty shipwreck in Tulamban in the island of Bali, Indonesia (8.2739°S, 115.5930°E; WGS 84), we observed an adult (ca. 150 cm total length) *V. salvator* at a depth of 10 m underwater clinging to the underside of an overhang within the wreck (Fig. 1). The wreck is over 50 m from shore. The water temperature was 30°C with a visibility of 12–15 m. No swell or currents were present at site. The lizard was utilizing air pockets within the overhang (Fig. 2) and moving in random directions. It was observed for a period of about 5 min before the dive team moved away.

On 30 March 2019, at 1230 h, a subadult *V. salvator* (ca. 120 cm total length) was observed swimming in open water ca. 100 m from the shoreline of Crystal Bay at Nusa Penida Island (8.71632° S, 115.45635°W; WGS 84), southeast of Bali, Indonesia. The individual then dove to ca. 6 m and grabbed on to a boulder coral (Fig. 3) as a result of being disturbed by the boat activity on surface. It was only observed for ca. 2 min before the dive team moved on.

Adult and subadult *V. salvator* are semi-aquatic, spending a substantial time of the day in freshwater (Karunaratna et al. 2017. *Mar. Freshw. Res.* 68:2242–2252; Wikramanayake and Dryden 1993. *Copeia* 1993:709–714), and can spend periods of at least 30 min totally submerged in freshwater (Gleeson 1981. *Physiol. Zool.* 54:423–429). They are also abundant in coastal habitats including mangroves, lagoons, estuaries and beaches in several parts of their large range, including Bali (Somaweera 2018. *A Naturalist's Guide*



FIG. 1. Adult *Varanus salvator* clinging on to the shipwreck at 10 m depth at Tulamban, Bali, Indonesia.



FIG. 2. Adult *Varanus salvator* with its head placed in an air pocket within the wreck.

to the Reptiles & Amphibians of Bali. John Beaufoy Publishing Ltd, Oxford, UK. 176 pp.). There are anecdotal records of them swimming in the open ocean between islands (Borden 2007. *Biawak* 1:84; Cochran 1944. *Rep. Smithson. Inst.* 1943:275–323) and feeding on marine fish in shallow waters close to the shore (Oldfield 2008. *Biawak* 2:99; Cota and Sommerlad 2013. *Biawak* 7:63–70). Their long and compressed tails and valvular nostrils are probably adaptations to a semi-aquatic existence and their ability to tolerate and traverse marine habitats could have also assisted its ability to colonize remote oceanic islands. Nevertheless we could not find any previous records of this species (or any varanid) doing deep dives in the ocean similar to our observation at Tulamban.

Few species of lizards can submerge for periods of time in water as an effective means of escaping predators and/or foraging for food (Pianka and Vitt 2003. *Lizards: Windows to the Evolution of Diversity*. University of California Press, Berkeley, California. 333 pp.). It is unlikely that the deep dive observed at Tulamban is a response to predator avoidance. Also there were no currents in this dive site and thus the diving should have been voluntary. The USAT Liberty shipwreck harbors a rich diversity of marine life, therefore it is likely that the animal was foraging in this environment. The availability of air pockets within the wreck must have assisted the lizard to venture deeper into the wreck and



FIG. 3. Subadult *Varanus salvator* holding on to a boulder at 6 m depth at Crystal Bay, Bali, Indonesia.

also forage for longer. This shipwreck is a popular dive site and the air exhaled by scuba divers create a regular supply of air pockets. *Varanus salvator* is known to use burrows that are completely submerged and utilize the air pockets within as observed here (Cota 2011. *Biawak* 5:44–47). This note adds to our understanding on the behavior and physiological capabilities of this common and widespread species.

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