

Bali starlings and the journey towards happiness: introduction and breeding in the Besikalung Wildlife Sanctuary, Bali, Indonesia

DITRO WIBISONO WARDI PARIKESIT^{*1} , JENTE OTTENBURGHS¹
I GEDE NYOMAN BAYU WIRAYUDHA², FRANSISCUS XAVERIUS SUDARYANTO³ and
DOUGLAS SHEIL^{1,4}

Abstract In 2001, only six Bali starlings *Leucopsar rothschildi* remained in the wild. In 2006, the NGO Friends of Nature, People and Forests established a second population on Nusa Penida Island through the release of captive-bred individuals, installation of nest boxes, and engagement with local communities, an approach later extended to Besikalung Wildlife Sanctuary. In this study, we evaluated breeding success in Besikalung in relation to location and nest box placement and examined the role of local cultural frameworks in supporting conservation. We assessed breeding outcomes from 34 nest boxes across sites and conducted interviews with key local stakeholders. Breeding success differed among locations, indicating that site-specific conditions influence reproductive outcomes. Interviews showed that conservation at Besikalung is reinforced by Indigenous law (*awig-awig*), grounded in the Balinese philosophy of *Tri Hita Karana*, and by the symbolic status of the Bali starling as an emblem of Bali, which together strengthen community support for its protection.

Keywords *Awig-awig*, Bali starling, habitat selection, nest box, *Tri Hita Karana*

The Bali starling *Leucopsar rothschildi* was on the brink of extinction in 2001, with only six wild individuals remaining (Sutomo et al., 2023). With West Bali National Park being the only remaining location where the bird persisted, there were concerns about the species' viability (Squires et al., 2024). In 2004, the NGO Friends of Nature, People and Forests (previously named Friends of National Park Foundation) developed a second location for the Bali starling with the local communities on Nusa Penida Island (Klungkung Regency, Bali Province, Indonesia). With support from The Gibbon and Begawan Foundations, Friends of Nature, People and Forests (represented here by author IGNBW), released 65 captive-bred individuals on Nusa Penida Island during 2006–2009, along with installation of nest boxes

to assist reproduction. The NGO collaborated with the local community to incorporate a prohibition on collection of the Bali starling on the island into their Indigenous law (*awig-awig*). Because of financial limitations, monitoring continued only until 2014. This population declined to < 30 individuals by 2013 (Riany & Aunurohim, 2013), prompting international attention and ecotourism initiatives. Assisted reproduction began in 2015, with volunteers installing additional nest boxes, and the population had increased to 80 individuals by 2019.

Building on these earlier conservation efforts, we evaluated the establishment of a new Bali starling population at Besikalung Wildlife Sanctuary, Tabanan Regency, Bali, a site that lies outside the species' previously recognized dry-climate range (Jarwadi Budi Hernowo & Haquesta, 2021; Sudaryanto et al., 2018), in a humid, high-elevation environment. Beginning in 2019, Friends of Nature, People and Forests, together with local stakeholders, initiated releases of captive-bred individuals under Indigenous law (*awig-awig*) banning hunting and promoting habitat stewardship. From 2019 to 2023, we monitored post-release survival, breeding activity and evidence of wild hatching at the site. Our study provides the first empirical assessment of Bali starling reproduction in a humid environment, addressing earlier concerns regarding climatic suitability (Pereyra, 2020; Pereyra & Guaişu, 2020; Warren, 2023).

Besikalung Wildlife Sanctuary covers land within a 5 km radius of Besikalung Temple, and includes Babahan Village; the first village to support this local Bali starling conservation programme. Nest boxes were placed in rice fields, settlements and mixed gardens, the latter known in Balinese as *tebe* (a space used for cultivation of various fruits and vegetables, and often for managing organic waste). During 2019–2023, 60 individuals were released, and a total of 31 installed nest boxes yielded 29 eggs, 16 hatchlings and 14 fledglings, of which 12 survived into wild-hatch adults (Friends of Nature, People and Forests, unpubl. data). Mixed garden habitats were particularly successful, with 50% of nest boxes occupied, compared to 31.6% in rice fields and 25% in settlements. This success may be due to the diverse vegetation in mixed gardens (Ceia et al., 2023). In addition, the Bali starlings modified their foraging behaviour to broaden their diet to include locally available food sources, as reported in West Bali National Park (Miller et al., 2022; see Plate 1). They appear to benefit

*Corresponding author, ditro.parikesit@gmail.com

¹Forest Ecology and Forest Management Group, Wageningen University and Research, Gelderland, The Netherlands

²Friends of Nature, People and Forests, Bali, Indonesia

³Udayana University, Bali, Indonesia

⁴Center for International Forestry Research, Bogor, Indonesia

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PLATE 1 Bali starlings *Leucopsar rothschildi* in the Besikalung Wildlife Sanctuary foraging on (a) biscuits from a religious offering (*canang*), (b) egg of an insect, (c) magnolia *Magnolia champaca* (L.) fruit, and (d) religious offering. Photographs: Ditro Wibisono Wardi Parikesit.

from the permanent water sources in Besikalung, a feature not available in West Bali National Park (Yuliantara et al., 2018). As there has not been any research on the adaptability of the Bali starling in the wild outside of its modern distribution, research on habitat carrying capacity is crucial for future planning. It has been estimated that Nusa Penida, for example, could support up to 300 Bali starlings because of the consistent availability of food resources in agroforestry areas (Hardini et al., 2023).

In July 2023, author DWWP conducted three open-ended interviews with two local leaders and the Chief Executive Officer of Friends of Nature, People and Forests. The interview with the Indigenous Leader (*Bendesa Adat*) aimed to gain a deeper understanding of the religious perspectives underpinning Bali starling conservation, to assess the alignment between nature conservation and Balinese Hindu beliefs, and to examine how these beliefs shape community behaviour and are practiced in daily life. The interview with the Babahan Village Head focused on the role of local government support, particularly administrative mechanisms and village-level regulations, in strengthening Bali starling conservation through law enforcement and community engagement. The interview with the Chief Executive Officer addressed the motivations behind the conservation programme and explored the

approaches used to engage local communities, including strategies to encourage farmers and householders to host nest boxes on their land. Across all interviews, we examined perceptions of Bali starling conservation at Besikalung Wildlife Sanctuary and documented concrete contributions to the programme, such as the enactment of hunting prohibitions, enforcement of local regulations, and community participation in conservation activities. Similarly, on Nusa Penida the prohibition on hunting or collection of Bali starlings since 2007 appeared to have helped the population of birds to increase (Sudaryanto et al., 2019). In the case of Besikalung Wildlife Sanctuary, community engagement and voluntourism were also seen to bring increased environmental awareness and new economic opportunities (Agoes & Agustiani, 2021).

We found that the increase of the Bali starling population in the Besikalung Wildlife Sanctuary is partly driven by local culture and leadership, with Indigenous law (*awig-awig*) enforcing protection measures through fines and social penalties for those who would harm or collect the birds (Suwitra et al., 2017). The Balinese community upholds *awig-awig* as both a spiritual practice and a foundation for mutual agreements, with high credibility as a legal base in Nusa Penida (Sudaryanto, 2020). *Awig-awig* applies to various aspects of life, including control of

deforestation (Christiawan, 2015), and is rooted in traditional education, law enforcement and rituals, with positive impacts on forest conservation (Sumarmi et al., 2020). It encompasses both physical (*skala*) and spiritual (*niskala*) aspects, gaining sacred status through the *Pasupati* ceremony, which endows the law with supernatural power (Relin, 2016). For believers, violating *awig-awig* brings punishment in both the present world and the afterlife. *Perarem* is a supplementary, adaptable regulation that complements *awig-awig*, serving as a detailed guideline that can be modified according to community needs, promoting social awareness and fostering respect for nature (Pinatih & Rahman, 2022).

In our interviews with the Chief Executive Officer, he explained that the protection of the Bali starling was admitted into *awig-awig* on Nusa Penida Island when he initiated the Bali starling conservation programme in 2006. When he initiated the programme in Besikalung Wildlife Sanctuary in 2019, the community was also willing to integrate the initiatives into their *awig-awig*. These prohibitions effectively prevent hunting and collection for the pet trade, despite the species' high market value in the past (USD 900 per pair; Jepson, 2016) posing a threat. This demonstrates the potential for species conservation following a community-based approach that has religious motivations, as noted in research elsewhere (e.g. Gupta et al., 2016; Talukdar & Gupta, 2018).

The Balinese community has integrated Bali starling conservation into their religious practices and daily life, rooted in a deep respect for wildlife. The Indigenous Leader highlighted the role of the Balinese-Hindu philosophy *Tri Hita Karana* (the Three Causes of Happiness), which includes *Parahyangan* (adherence to *awig-awig* and conducting rituals), *Pawongan* (emphasizing collective well-being), and *Palemahan* (environmental protection). This philosophy forms the foundation for community support in the Bali starling conservation programme in Besikalung Wildlife Sanctuary. The principles of *Tri Hita Karana* are reflected in *awig-awig* through three key aspects: *sukerta tata parahyangan* (regulating the relationship with God through religious practices), *sukerta tata pawongan* (governing human interactions to maintain harmony) and *sukerta tata palemahan* (nurture and respect for the environment; Agnes et al., 2020). For the Balinese, preserving the Bali starling is a source of pride and a way to maintain the balance of nature, directly applying the values of *Tri Hita Karana*. Such initiatives have wider potential for protecting threatened species in Bali as shown by other initiatives such as preventing the killing of the cattle egret *Bubulcus ibis* in Petulu Village in Ubud District, Gianyar Regency (Sudaryanto et al., 2022).

The successful establishment of the Bali starling in the humid, high-elevation environment of Besikalung Wildlife Sanctuary, outside the species' known ecological

range, contrasts with previous studies indicating the species is adapted to lowland, dry habitats in western Bali. Protecting the Bali starling through local laws and beliefs has been pivotal in fostering community commitment. Guided by the cultural philosophy of *Tri Hita Karana*, local efforts have successfully established a secure environment for the species. This cultural integration aligns modern conservation goals with local values and underscores the power of community-engagement strategies.

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Conflicts of interest None.

Ethical standards This research abided by the *Oryx* guidelines on ethical standards. All necessary permits were obtained through legal permit from the village authority, and free, prior, informed consent was secured from all interviewees. Our findings were presented at the 7th Indonesian Bird Observer and Researcher Conference and to relevant institutions, aligning with IUCN Species Survival Commission guidelines and national conservation priorities.

Data availability Data are available from the corresponding author (DWWP) upon reasonable request via author JO at Wageningen University, contingent on the consent of author IGNBW.

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