

Animal Welfare Evaluation of Bali Starling (*Leucopsar rothschildi*) at Sukahaji Market, Bandung

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ABSTRACT

Background: The Bali Starling (*Leucopsar rothschildi*) is a critically endangered endemic bird protected under Regulation of the Minister of Environment and Forestry No. 106/2018. Legal trade is restricted to captive-bred individuals of at least the second generation (F₂) or beyond. Animal welfare plays an important role in maintaining animal health, preventing zoonotic risks, and ensuring ethical and legal trading practices.

Aims: This study evaluated animal welfare implementation in Bali Starling trade at Sukahaji Bird Market, Bandung, using the five freedoms and five domains frameworks.

Methods: A quantitative census design was employed, involving all six traders at the study site through structured questionnaires and observational checklists.

Results: Results showed that all traders demonstrated good knowledge of the five freedoms, with implementation in the adequate-to-good categories. Based on the five domains framework, knowledge ranged from moderate to good, and implementation was evenly distributed between these categories. Spearman's correlation revealed a strong and significant positive relationship between knowledge and implementation for both frameworks.

Conclusion: Sustained synergy between traders and relevant stakeholders is essential to optimize animal welfare outcomes and support Bali Starling conservation.

INTRODUCTION

The Bali Starling (*Leucopsar rothschildi*) is an endemic bird species native to Bali Island, classified as Critically Endangered by the IUCN and listed under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Birdlife International, 2021). Its legal protection in Indonesia is stipulated under Regulation of the Minister of

Environment and Forestry No. P.106/MENLHK/SETJEN/KUM.1/12/2018. Legal trade of Bali Starlings is permitted only for captive-bred individuals of at least the second generation (F₂) or higher, as regulated under Ministerial Regulation No. 18/2024 on the utilization of protected wild species. Captive breeding may be conducted for commercial or non-commercial purposes by breeding units authorized

by the Directorate General of Natural Resources and Ecosystem Conservation. Since the issuance of Ministerial Regulation No. P.19/Menhut-II/2005, legally traded individuals must bear permanent leg rings and be accompanied by breeding certificates issued by the Natural Resources Conservation Agency (BKSDA).

Animal welfare is commonly evaluated using the five freedoms framework, which encompasses: freedom from hunger and thirst, freedom from discomfort, freedom from pain/injury/disease, freedom to express natural behaviors, and freedom from fear and distress (FAWC, 2009). This framework primarily focuses on preventing negative experiences and emphasizes basic physical and health-related indicators. In contrast, the five domains model provides a broader evaluation by incorporating nutrition, physical environment, behavioral interactions, health, and mental state as the primary welfare outcome (Mellor, 2016; Sulistiawati & Wulandari, 2022). Sukahaji Bird Market is the largest bird market in Bandung City, managed by Perumda Pasar Juara, where Bali Starlings are traded. Welfare considerations in wildlife trade settings are often overlooked, and the application of standardized welfare frameworks at critical trade points such as bird markets remains limited. Previous studies have predominantly focused on population-level conservation outcomes while neglecting the quality of life of individual animals during trade (Beausoleil, 2020). Therefore, this study was conducted to evaluate animal welfare practices for Bali Starlings at Sukahaji Bird Market, to identify existing welfare gaps, and to provide evidence-based recommendations for stakeholder.

MATERIALS AND METHODS

Study Design, Site, and Period

This study employed a quantitative research design using a census approach, incorporating all Bali Starling traders at the study site as respondents. Data were collected via structured questionnaires and observational checklists administered through face-to-face interviews and direct non-invasive observation, respectively (Creswell & Creswell, 2018). The study was conducted from August to September 2025 at Sukahaji Bird Market, Bandung City, West Java Province, Indonesia (6°55'41.0"S; 107°35'11.1"E).

Ethical Approval and Research Subjects

Ethical approval was granted by the Research Ethics Committee of Universitas Padjadjaran (No. 975/UN6.KEP/EC/2025), with additional research authorization from the Regional National Unity and

Political Agency (Kesbangpol) of Bandung City (No. PK.03.04.05/2046-BKBP/X/2025). Six Bali Starling traders operating at Sukahaji Bird Market constituted the study subjects. As this represented the entire trader population at the site, a census method was applied rather than probabilistic sampling. Bali Starlings available for sale were observed as study objects for welfare assessment. All observations were strictly non-invasive and visual; no physical handling, restraint, or invasive examination was performed.

Data Collection Instruments

Two instruments were employed. First, a structured questionnaire assessed trader's knowledge of animal welfare principles based on the Five Freedoms and Five Domains frameworks, measured using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Second, an observational checklist evaluated practical welfare implementation across corresponding indicators using a three-point ordinal scale: 1 (poor), 2 (moderate), and 3 (good) (Arnould & Niekerk, 2009). Both instruments underwent validity and reliability testing prior to deployment, with reliability assessed via internal consistency analysis (Sugiyono, 2019). Demographic variables collected included age, gender, educational background, trading experience, and number of Bali Starlings traded.

Data Collection Procedure

Interviews followed standardized field research protocols (Newing & Puri, 2010). Traders provided informed consent prior to participation, after which demographic and professional information was recorded. Structured questionnaire items pertaining to animal welfare knowledge were subsequently administered and scored using the five-point ordinal scale. Observational assessments were conducted through direct evaluation of welfare implementation for each checklist indicator, scored on the three-point scale.

Data Analysis

All questionnaire and checklist scores were aggregated and categorized using interval classification formulas to determine final assessment categories for each variable (Utama, 2011). The interval width was calculated as:

$$\text{Interval Width} = \frac{\text{Range}}{\text{Number of Categories}}$$

Spearman's rank-order correlation analysis was performed to examine the relationship between the

independent variable (trader's knowledge level) and the dependent variable (animal welfare implementation practices). Spearman's correlation was selected given the ordinal nature of the data and the small sample size. All statistical analyses were conducted using IBM SPSS Statistics (Sugiyono, 2019).

RESULTS AND DISCUSSION

Traders Characteristics

The characteristics of Bali Starling Traders can be seen in Table 1. The six Bali Starling traders participating in this study were predominantly over 35 years of age (66.67%), with a majority holding senior high school-level education (66.67%) and more than five years of trading experience (66.67%). Most traders maintained between one and three Bali Starlings per stall at the time of assessment. These demographic characteristics are relevant to understanding the patterns of knowledge and welfare implementation observed, as educational attainment and experience have been shown to influence animal husbandry practices and awareness of regulatory standards (Khanif & Mahmudiono, 2023).

Traders Knowledge and Implementation of Animal Welfare Based on the Five Freedoms

All six traders were categorized as having good knowledge of the five freedoms, with total scores ranging from 116 to 132 out of a maximum of 155 (Table 2). The weakest area was freedom from pain, injury,

and disease: several traders questioned the necessity of pre-trade health examinations, and routine vaccination and vitamin supplementation were not widely recognized as essential. The highest knowledge scores were observed for natural behavior expression, with most traders demonstrating strong familiarity with behavioral needs including flight activity, perch provision, and vocalization. Conversely, the weakest knowledge domain was freedom from pain, injury, and disease; several traders questioned the necessity of pre-trade health examinations, and routine vaccination and vitamin supplementation were not universally recognized as essential welfare components (Table 3).

Four traders were categorized as having good implementation (scores 45–47) and two as moderate (score 44), indicating that welfare knowledge has generally translated into practice, although inconsistencies remain across traders. Implementation scores were marginally lower than knowledge scores across several aspects of the five freedoms, suggesting a gap between theoretical understanding and applied practice. This discrepancy is consistent with reported constraints including facility limitations, habitual husbandry routines, and subjective perceptions among traders regarding the relative importance of specific welfare provisions (Nuruddin et al., 2020).

Traders Knowledge and Implementation of Animal Welfare Based on the Five Domains

Five traders demonstrated good knowledge (scores 107–115) and one was moderate (score 97). Weaker knowledge was observed in the health and mental

Table 1. Characteristics of Bali Starling Traders

No.	Traders Characteristics	Frequency (n)
1.	Age	
	<25 years	1 (16,67%)
	25-35 years	1 (16,67%)
	>35 years	4 (66,67%)
2.	Educational Level	
	Junior high school	1 (16,67%)
	Senior high school	4 (66,67%)
	≥ Bachelor's Degree	1 (16,67%)
3.	Trading Experience	
	<5 years	2 (33,33%)
	≥5 years	4 (66,67%)
4.	Number of Bali Starlings Traded	
	1 bird	1 (16,67%)
	2-3 birds	3 (50%)
	>3 birds	2 (33,33%)

state domains, particularly regarding stress indicators and behavioral abnormalities associated with suboptimal welfare (Table 4). This finding reflects the conceptual complexity of the five domains model compared to the five freedoms, as it requires traders to connect physical environmental conditions to psychological welfare outcomes a more abstract reasoning process that may require additional training and exposure (Mellor, 2016).

Practical implementation under this framework (Table 5) was more evenly distributed: three traders

achieved good scores (score 33) and three were classified as moderate (scores 30–32), highlighting variability in welfare management practices. Notably, the nutrition and behavioral interaction domains demonstrated higher implementation than corresponding knowledge scores. This pattern suggests that traders perform welfare-supportive practices for these domains intuitively through daily routines without consciously associating them with formal welfare terminology an important distinction when designing education and outreach interventions (Mellor et al., 2020).

Table 2. Implementation of Animal Welfare Based on the Five Freedoms Framework Among Bali Starling Traders

Traders	Five Freedoms Aspect Score (%)					Total	Category		
	1	2	3	4	5		Poor (30,5-72,17)	Moderate (72,18-113,85)	Good (113,86-155,53)
I	34 (85%)	27 (77.14%)	20 (80%)	28 (80%)	13 (65%)	122	-	-	✓
J	38 (95%)	29 (82.86%)	21 (84%)	29 (82.86%)	15 (75%)	132	-	-	✓
D	36 (90%)	26 (74.29%)	25 (100%)	28 (80%)	15 (75%)	130	-	-	✓
H	32 (80%)	35 (100%)	25 (100%)	25 (71.43%)	12 (60%)	129	-	-	✓
S	39 (97.5%)	28 (80%)	23 (92%)	23 (65.71%)	14 (70%)	127	-	-	✓
A	24 (60%)	32 (91.43%)	25 (100%)	23 (65.71%)	12 (60%)	116	-	-	✓

Notes 1. Freedom from hunger and thirst, 2. Freedom from discomfort, 3. Freedom to express normal behavior, 4. Freedom from pain, injury, and disease, 5. Freedom from fear and distress.

Table 3. Implementation of Animal Welfare Based on the Five Freedoms Framework Among Bali Starling Traders

Traders	Five Freedoms Aspect Score (%)					Total	Category		
	1	2	3	4	5		Poor (18,5-31,5)	Moderate (31,51-44,51)	Good (44,52-57,52)
I	9 (75%)	12 (66.67%)	8 (88.89%)	10 (83.33%)	5 (83.33%)	44	-	✓	
J	12 (100%)	12 (66.67%)	8 (88.89%)	10 (83.33%)	5 (83.33%)	47	-	-	✓
D	11 (91.67%)	12 (66.67%)	7 (77.78%)	10 (83.33%)	5 (83.33%)	45	-	-	✓
H	11 (91.67%)	14 (77.78%)	7 (77.78%)	8 (66.67%)	5 (83.33%)	45	-	-	✓
S	10 (83.33%)	13 (72.22)	7 (77.78%)	10 (83.33%)	5 (83.33%)	45	-	-	✓
A	10 (83.33%)	12 (66.67%)	7 (77.78%)	10 (83.33%)	5 (83.33%)	44	-	✓	-

Notes 1. Freedom from hunger and thirst, 2. Freedom from discomfort, 3. Freedom to express normal behavior, 4. Freedom from pain, injury, and disease, 5. Freedom from fear and distress

Correlation Analysis

Spearman's rank-order correlation analysis confirmed a strong and statistically significant positive relationship between knowledge and implementation for the five freedoms framework ($r = 0.926$, $p < 0.008$), indicating that higher knowledge levels are consistently associated with superior welfare practice. An equivalent strong positive correlation was observed for the five domains framework ($r = 0.820$, $p < 0.046$). These results confirm that improvements in trader

knowledge are significantly associated with improved welfare outcomes in wildlife trade settings, underscoring the value of targeted educational interventions (Ye et al., 2023; Rohmatillah et al., 2023).

Knowledge of both frameworks promotes preventive and health-oriented animal management, reducing disease prevalence, limiting pathogen transmission, and decreasing zoonotic risks (Figure 1; Figure 2). Reduced stress and enhanced immune function are critical in limiting zoonotic pathogen

Table 4. Knowledge Animal Welfare Based on the Five Domains Framework Among Bali Starling Traders

Traders	Five Domains Aspect Scores (%)					Total	Category		
	1	2	3	4	5		Poor (27,5-65,2)	Moderate (65,21-102,91)	Good (102,92-140,62)
I	36 (80%)	24 (80%)	24 (80%)	20 (57.14%)	26 (74.29%)	104	-	-	✓
J	43 (95.56%)	25 (83.33%)	21 (70%)	26 (74.29%)	28,75 (82,14%)	115	-	-	✓
D	41 (91.11%)	23 (76.67%)	25 (83.33%)	25 (71.43%)	28,5 (81.43%)	114	-	-	✓
H	37 (82.22%)	30 (100%)	28 (93.33%)	12 (34.29%)	26,75 (76.43%)	107	-	-	✓
S	44 (97.78%)	23 (76.67%)	25 (83.33%)	12 (34.29%)	26 (74.29%)	104	-	-	✓
A	29 (64.44%)	30 (100%)	27 (90%)	11 (31.43%)	24,25 (69.29%)	97	-	✓	-

Notes 1. Nutrition, 2. Physical Environment, 3. Behavioral Interactions, 4. Health, 5. Mental State; Mental state represents the average output of the other domains and is therefore not included in the score calculation.

Table 5. Implementation of Animal Welfare Based on the Five Domains Framework Among Bali Starling Traders

Traders	Five Domains Aspect Score (%)					Total	Category		
	1	2	3	4	5		Poor (13,5-23,17)	Moderate (23,18-32,85)	Good (32,86-42,53)
I	9 (100%)	9 (66.67%)	10 (66.67%)	3 (100%)	7.75 (77.5%)	31	-	✓	-
J	9 (100%)	10 (73.33%)	11 (80%)	3 (100%)	8.25 (82.5%)	33	-	-	✓
D	9 (100%)	10 (73.33%)	11 (80%)	3 (100%)	8.25 (82.5%)	33	-	-	✓
H	9 (100%)	11 (80%)	11 (80%)	2 (66.67%)	8.25 (82.5%)	33	-	-	✓
S	9 (100%)	10 (73.33%)	10 (66,67%)	3 (100%)	8 (80%)	32	-	✓	-
A	9 (100%)	9 (66.67%)	9 (60%)	3 (100%)	7.5 (75%)	30	-	✓	-

Notes 1. Nutrition, 2. Physical Environment, 3. Behavioral Interactions, 4. Health, 5. Mental State; Mental state represents the average output of the other domains and is therefore not included in the score calculation.

development, consistent with the one health concept emphasizing the interconnection between animal, human, and environmental health (FAO, OIE, & WHO, 2019; Mellor et al., 2020).

Most traders demonstrated awareness of the importance of nutrition and hydration, providing varied diets including fruits, seeds, pellets, and insects, consistent with the species natural frugivorous-insectivorous feeding behavior. Scientifically recommended daily diets include approximately 100–140 g banana or 70–100 g papaya, approximately 20 g mealworms or 10–20 crickets, and approximately 10 g formulated feed, essential for growth, reproduction, and immune function (Mas'ud, 2010; Dahlia et al., 2018; Star et al., 2020). However, some traders showed limited understanding of optimal feeding quantities and frequency. All traders used cages smaller than the recommended minimum size of 4 m × 1 m × 2.2–2.25 m, limiting behavioral expression, including flight and perching, and potentially inducing chronic stress. Such

conditions contradict the principle of freedom from discomfort and may compromise overall welfare (Rauch et al., 2014). Limited market space and conventional trading practices appear to be the primary drivers of suboptimal housing conditions.

Knowledge and implementation scores for the five freedoms were predominantly in the good category across all traders, suggesting that this framework is more readily understood and applied in daily trading practice. In contrast, five domains scores exhibited greater inter-individual variability, particularly in the health and mental state domains. These findings are consistent with the theoretical distinction between the two frameworks: the five freedoms model provides a practical, operationally straightforward tool appropriate for rapid welfare auditing and minimum-standard compliance monitoring, whereas the five domains model offers greater depth by integrating nutrition, environment, health, and behavioral interactions to derive mental state as the

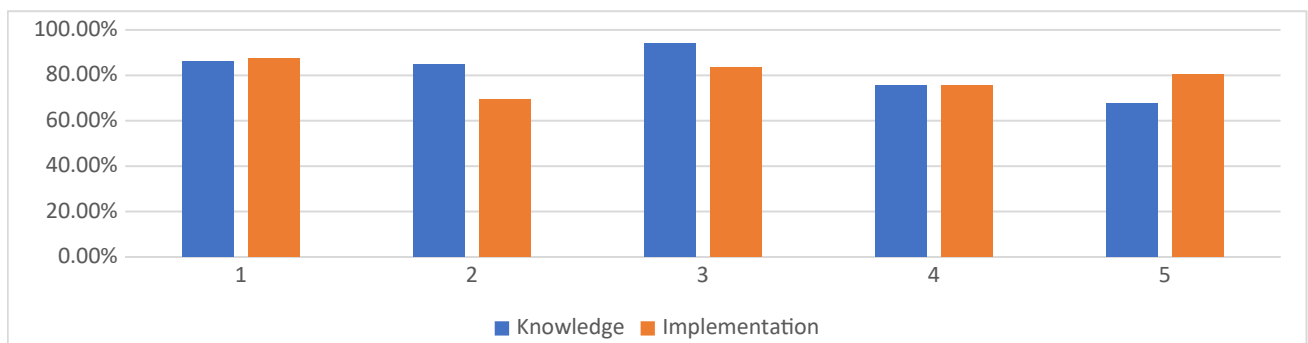


Figure 1. Traders Knowledge and Application of the Five Freedoms Principle. Notes: 1=Freedom from hunger and thirst, 2=Freedom from discomfort, 3=Freedom to express normal behavior, 4=Freedom from pain, injury, and disease, 5=Freedom from fear and distress.

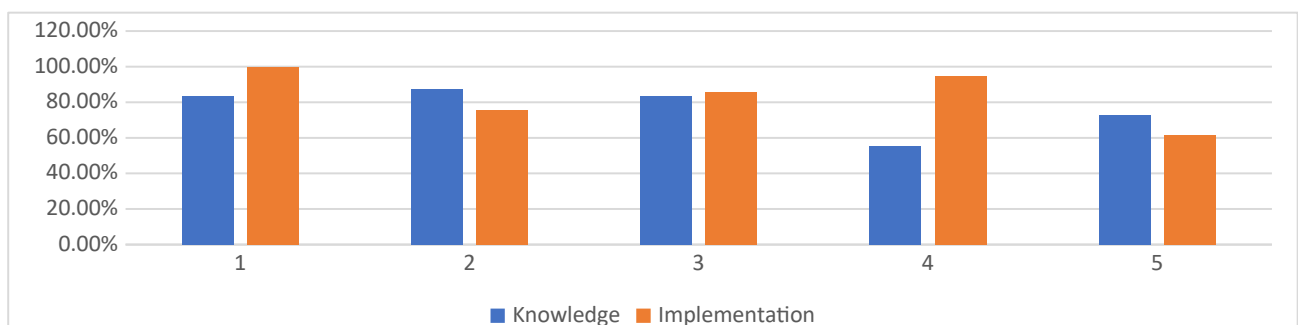


Figure 2. Traders Knowledge and Application of the Five Domains Principle. Notes: 1=Nutrition, 2=Physical Environment, 3=Behavioral Interactions, 4=Health, 5=Mental State.

overarching welfare outcome (Mellor, 2016; Beausoleil et al., 2023). The apparent conceptual complexity of the five domains model may yield lower average knowledge scores, yet it confers greater sensitivity in identifying nuanced welfare deficiencies that the five freedoms framework may not capture.

Several factors influenced trader's knowledge and implementation levels, including education, age, and trading experience. Traders with higher educational backgrounds consistently demonstrated better knowledge and implementation. Older traders showed lower performance in five domains knowledge compared to five freedoms, supporting the argument that the five domains model is conceptually newer and more complex, requiring longer adaptation for traders accustomed to conventional practices (Mellor, 2016; Manullang, 2024). Trading experience alone did not guarantee better welfare implementation: experienced traders tended to excel in physical care but were less sensitive to behavioral and mental welfare indicators (Whitham & Wielebnowski, 2013).

CONCLUSION

Trader's knowledge and implementation of animal welfare at Sukahaji Bird Market ranged from moderate to good, with a significant positive correlation between knowledge and field practical implementation in both frameworks (five freedoms and five domains). Periodic welfare monitoring, stakeholder coordination, and consistent regulatory oversight are essential to ensure compliance and support Bali Starling conservation.

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AUTHORS CONTRIBUTION

A.D.S.N. contributed to the conceptualization of the study, data curation, formal analysis, investigation, methodology development, manuscript drafting, and manuscript review and editing. E.S. contributed through supervision, validation of the results, and manuscript review and editing. W.P. contributed to

resource provision, supervision, validation, and manuscript review and editing. D.W.W. contributed through supervision, validation, and manuscript review and editing. All authors read and approved the final version of the manuscript.

"The author declares that there is no conflict of interest with the parties involved in this research".

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