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Community knowledge and attitudes toward bird conservation in Bagek Kembar, West Lombok, Indonesia

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Abstract. *Syazali M, Hadiprayitno G, Ilhamdi ML, Suana IW, Wirajagat GC, Manisa S, Larasati SAN. 2026. Community knowledge and attitudes toward bird conservation in Bagek Kembar, West Lombok, Indonesia. Biodiversitas 27 (2): d270202. https://doi.org/10.13057/biodiv/d270202*. Birds in Bagek Kembar, West Lombok, Indonesia, play an important ecological role and support emerging birdwatching ecotourism. However, habitat changes and human activities continue to threaten their sustainability. This study aims to (i) assess community knowledge, perceptions, and attitudes toward bird conservation, (ii) examine the influence of family and teacher roles, and (iii) analyze the structural relationships among knowledge, perception, and attitude using the knowledge attitude behavior framework. Data were collected from 140 respondents selected by stratified random sampling across four education levels using a 20 item Likert-scale questionnaire. Data were analyzed using ANOVA, Chi-square tests, Pearson correlation, and structural equation modeling. The results showed that community knowledge (2.29 ± 0.40), perceptions (2.04 ± 0.73), and attitudes (2.96 ± 0.55) were generally in the moderate category, with significant differences among education levels ($p < 0.01$). Teachers exerted stronger influence (67.29%) than families (51.47%), especially at higher education levels. Knowledge directly influenced attitudes ($\beta = 0.41$, $p < 0.001$) and indirectly through perception ($\beta = 0.36$, $p < 0.01$), with a good model fit (CFI = 0.93; RMSEA = 0.05). These findings demonstrate that improving ecological knowledge alone is insufficient without strengthening positive perceptions. Integrating conservation education into local schools and community based ecotourism is essential for sustaining bird conservation in Lombok.

Keywords: Bagek Kembar, behavior, birdwatching ecotourism, knowledge, Lombok

INTRODUCTION

Birds play crucial ecological roles as pollinators, seed dispersers, pest controllers, and bioindicators of environmental change. Variations in bird diversity and abundance often reflect habitat quality and the effectiveness of conservation management (Bennett et al. 2017; Decruse 2023). Indonesia is recognized as one of the world's megadiverse countries for avifauna; however, rapid land-use change, habitat degradation, and wildlife exploitation continue to threaten many bird species. On small islands such as Lombok, these pressures are particularly pronounced due to limited habitat availability and increasing human activities (Hadiprayitno et al. 2019; Asrori 2020). Bagek Kembar Mangrove Ecotourism Area in West Lombok, represents a rehabilitated coastal ecosystem that has undergone community-based restoration since 2012. Formerly degraded mangrove habitats have been transformed into an Essential Ecosystem Area supporting more than 50 bird species, including several protected taxa (Suyantri et al. 2023). Beyond its ecological importance, Bagek Kembar has emerged as a birdwatching-based ecotourism site, making community participation a central component of conservation sustainability. In such landscapes, conservation success depends not only on ecological integrity but also on the knowledge, perceptions, and attitudes of local communities toward wildlife (Bennett et al. 2017; Ardoin et al. 2023).

Human dimensions of conservation, particularly socio-psychological factors, play a critical role in shaping conservation outcomes. Studies in conservation social science and ethno-ornithology demonstrate that local values, experiences, and social norms strongly influence how communities interact with bird species (Sánchez-Mercado et al. 2020; Delfino 2024). Environmental education research further suggests that ecological knowledge can foster pro conservation attitudes, but this relationship is often mediated by individual perceptions and social reinforcement mechanisms (Braun et al. 2018; Härtel et al. 2023). Families and teachers have been consistently identified as key social agents influencing environmental awareness across different education levels, particularly in shaping early attitudes and long term conservation ethics (Könnel et al. 2025).

Empirical evidence from various regions supports the link between environmental knowledge and conservation attitudes. In China and Nepal, increased knowledge of flagship bird species has been associated with stronger conservation support (Ruan et al. 2022; Katuwal et al. 2024), while education and community based programs in Africa and Latin America have enhanced public engagement

in biodiversity protection (Sánchez-Mercado et al. 2020; Mundoga et al. 2025). These findings underscore the importance of integrating cognitive, affective, and social dimensions when designing conservation strategies.

Bird conservation studies in Indonesia have mainly emphasized biodiversity inventories, habitat conditions, and ecotourism development (Hadiprayitno et al. 2019; Ramadhani et al. 2020; Sulistyobudhi et al. 2024). In contrast, research addressing community socio-psychological factors, particularly the relationships among knowledge, perception, and conservation attitudes, remains limited. Previous studies in Banda Aceh, Kalimantan, and Maluku show that education and cultural values influence conservation participation (Leimena et al. 2022; Kurniawan et al. 2024; Latifah et al. 2025), yet integrated causal analyses are rare. Consequently, how knowledge shapes conservation attitudes is still unclear. The Knowledge Attitude Behavior (KAB) model offers a relevant framework to examine these processes and is suitably applied in the community-based ecotourism setting of Bagek Kembar (Härtel et al. 2023; Li et al. 2025).

Therefore, this study aims to (i) assess community knowledge, perceptions, and attitudes toward bird conservation in Bagek Kembar; (ii) examine the relative influence of family and teachers in shaping conservation awareness across education levels; and (iii) analyze the causal relationships among knowledge, perception, and attitude using the KAB framework. This is one of the few studies applying the KAB framework in the context of local bird conservation. The results are expected to inform community based strategies for biodiversity conservation in the Wallacea Region. To address these gaps, the present study integrates the complete KAB model by explicitly proposing and testing the following hypotheses: (i) knowledge positively influences perception; (ii) knowledge directly influences conservation attitude; and (iii) perception mediates the relationship between knowledge and attitude. By integrating socio psychological analysis with conservation research, this study contributes empirical evidence to the growing field of conservation social science in Indonesia and provides insights for designing education based and community driven bird conservation strategies in the Wallacea Region.

MATERIALS AND METHODS

Study area

This study was conducted in the Bagek Kembar Mangrove Ecotourism Area, Cendi Manik Village, Sekotong Sub-district, West Lombok District, Indonesia (8°44′52″S; 116°2′33″E). The site represents a community managed mangrove restoration area and an emerging birdwatching ecotourism destination. The area was selected because of its ecological importance for birds and active community involvement in conservation related activities.

Data collection

A total of 140 respondents were selected using stratified random sampling based on four educational levels: elementary (30), junior high (29), senior high (39), and university (42). Within each stratum, respondents were randomly drawn from community members living within two km radius of the mangrove zone who met the criteria. Selection criteria included: (1) active participation in community or conservation-related activities, (2) residency of ≥5 years in the area, and (3) voluntarily agreed to participate. This sampling strategy ensured proportional representation of key educational groups. Data were collected using a 20 item questionnaire consisting of three constructs: knowledge (8 items), perception (6 items), and attitude (6 items). All questionnaire items were originally developed and administered in Indonesian to ensure clarity and comprehension among respondents. No translation process was required, as all participants were native Indonesian speakers. The knowledge construct measured respondents' factual and conceptual understanding of birds and their ecological roles (e.g., awareness of birds' functions in ecosystem balance and habitat sustainability). Perception items captured value based judgments and subjective evaluations related to bird conservation, such as perceived benefits of conservation for community welfare and environmental sustainability. Attitude items assessed respondents' expressed support, willingness, and commitment toward bird conservation actions and community involvement. This construct distinction follows established approaches in conservation psychology, where knowledge represents cognitive understanding, perception reflects affective appraisal, and attitude indicates evaluative orientation toward conservation behavior. Responses were measured using five point Likert scale (1 = strongly disagree to 5 = strongly agree). Each construct was validated by experts in conservation education and community ecology. Reliability was confirmed using Cronbach's Alpha (1) Knowledge, $\alpha = 0.701$; (2) Perception, $\alpha = 0.723$; and (3) Attitude, $\alpha = 0.859$. No questionnaire items were removed after validation, as all items met reliability thresholds ($\alpha > 0.70$).

Participation was voluntary and based on informed verbal consent. No personal or sensitive data were collected, and respondent anonymity was maintained. Permission for data collection was obtained from local community leaders (no formal institutional review was required under local regulations). All respondents were clearly informed about the study objectives prior to participation. These procedures ensured compliance with general ethical standards for human subject research.

Data analysis

Data were analyzed using: (i) one-way ANOVA to test differences in knowledge, perception, and attitude among education levels; (ii) Chi-square tests to assess associations between education level and perceived family/teacher influence; (iii) Pearson correlation to assess relationships among constructs; and (iv) Structural Equation Modeling (SEM) to test structural relationships among knowledge, perception, and attitude. SEM analysis was conducted to evaluate the hypothesized Knowledge Attitude Behavior (KAB) framework. The model specified three main pathways: (i) knowledge → perception, (ii) knowledge → attitude, and (iii) perception → attitude. Model fit was assessed

using standard goodness of fit indices, including the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). Model adequacy was evaluated using commonly accepted thresholds (CFI ≥ 0.90; RMSEA ≤ 0.08). The proportion of variance explained (R^2) for attitude was also reported to indicate the explanatory power of the model.

RESULTS AND DISCUSSION

Respondent characteristics and community knowledge, perceptions, and attitudes

Mean scores (± SD) for knowledge, perception, and attitude across education levels are presented in Table 1. Overall, community knowledge (2.29 ± 0.40), perception (2.04 ± 0.73), and attitude (2.96 ± 0.55) toward bird conservation were categorized as moderate.

Based on Table 1, mean scores (± SD) of the three constructs across education levels are knowledge (overall mean = 2.29 ± 0.40), perception (overall mean = 2.04 ± 0.73), and attitude (overall mean = 2.96 ± 0.55). Based on predefined Likert interpretation thresholds (Low = 1.00-2.00; Moderate = 2.01-3.50; High = 3.51-5.00), all three constructs fall within the moderate category at the community level.

One-way ANOVA indicated significant differences among education levels for all three constructs: knowledge ($p < 0.001$), perception ($p < 0.001$), and attitude ($p < 0.001$) (Table 2). Post hoc Tukey HSD tests showed that respondents with university education scored significantly higher in knowledge, perception, and attitude compared to elementary, junior high, and senior high school groups ($p < 0.05$). No significant differences were detected among the three non-university education levels.

Table 1. Results of analysis of public knowledge, perceptions and attitudes towards bird conservation

Education level	Number of respondent	Variable		
		Knowledge (K)	Perception (P)	Attitude (A)
Elementary school	30	2.09±0.41	1.59±0.7	2.54±0.42
Junior high school	29	2.15±0.32	1.72±0.34	2.48±0.26
Senior high school	39	2.30±0.32	1.66±0.35	2.95±0.12
College	42	2.53±0.41	2.86±0.67	3.57±0.39
Total	140	2.29±0.40	2.04±0.73	2.96±0.55
Interpretation		Moderate	Moderate	Moderate

Note: Interpretation of value calculation, 1.00-2.00 (Low), 2.01-3.50 (Moderate), 3.51-5.00 (High)

Table 2. ANOVA results

Variable	F-value	df between	df within	p-value
Knowledge	9.14	3	136	<0.001
Perception	22.87	3	136	<0.001
Attitude	17.32	3	136	<0.001

The analysis results in Table 1 show the higher education level, the higher the scores obtained in these three aspects. Similar findings have been documented in Indonesia and abroad, emphasizing that formal education enhances environmental knowledge and pro-conservation behavior (van de Wetering et al. 2022; Restović and Bulić 2024; Aeschbach et al. 2025). The findings of this study are consistent with the results of research conducted by van de Wetering et al. (2022), which showed that education has a significant impact on increasing conservation knowledge and behavior. Formal education undergoes a crucial role in shaping ecological awareness and conservative attitudes towards the environment (Sharma et al. 2019; Kopnina et al. 2022). The results demonstrate that community knowledge, perceptions, and attitudes toward bird conservation in Bagek Kembar are generally moderate and differ significantly across education levels. The consistently higher scores among university-educated respondents indicate that formal education plays a critical role in shaping conservation awareness. The absence of significant differences among elementary, junior high, and senior high school groups suggests that conservation knowledge and attitudes may only increase substantially when individuals are exposed to higher education or specialized environmental learning. The observed educational gradient aligns with findings from previous studies showing that higher education enhances ecological literacy and pro-conservation attitudes. Formal education not only increases factual knowledge but also provides opportunities for structured reflection and engagement with environmental issues, which are essential for developing conservation-oriented attitudes.

The study shows that education, family, and teachers together shape conservation minded attitudes in rural communities. The observed gradient in knowledge and attitude across education levels suggests that ecological literacy is not evenly distributed and depends on exposure to formal and informal education. Similar gradients have been documented in Southeast Asia, where conservation awareness increases with educational attainment and access to environmental information (Dhakal et al. 2022; Chanvin et al. 2023). The significant role of teachers indicates that school-based programs remain a strategic platform for fostering conservation ethics. In contrast, families provide early emotional connections with nature, consistent with findings from parental influence studies in environmental education (Könnel et al. 2025). Therefore, conservation education should integrate both family participation and formal curricula to achieve long-term behavioral change.

The structural model confirmed the mediating role of perception between knowledge and attitude, emphasizing that cognitive understanding must translate into affective appreciation to produce conservation-oriented behavior. This mechanism echoes the theoretical framework of environmental psychology that positions perception as an emotional bridge between cognition and behavior (Ardoin et al. 2023). In practical terms, conservation campaigns in Bagek Kembar should therefore emphasize experiential learning birdwatching, habitat restoration, and community-based ecotourism-as emotional reinforcement of factual knowledge. Moreover, the overall positive attitude observed

despite varying perceptions suggests latent social norms favoring conservation. However, this may also reflect social desirability bias, as reported in similar studies (Sánchez-Mercado et al. 2020). Future surveys that combine behavioral observation and participatory mapping can validate whether positive attitudes translate into concrete conservation actions. In the broader context of conservation, these results reinforce that biodiversity protection in small island ecosystems like Lombok must consider socio-educational factors such as the role of families and teachers who participate in conservation activities as an integral component of ecological management (Bennett et al. 2017). Integrating bird conservation into local curricula, ecotourism programs, and cultural events could enhance both environmental and economic sustainability.

The study shows that community knowledge, perceptions, and attitudes toward bird conservation in Bagek Kembar are generally moderate. While ecological understanding exists, particularly among more educated groups, there are still notable gaps in deeper awareness and value based perceptions. This pattern is consistent with research across Asia and Africa, where education strongly influences conservation literacy and engagement (van de Wetering et al. 2022; Aeschbach et al. 2025). Knowledge alone, however, does not guarantee strong conservation attitudes, as emotional, experiential, and socio cultural factors also shape responses. Higher scores among university educated respondents support well established findings are strongly proven by several studies in Nepal (Katuwal et al. 2024), China (Ruan et al. 2022), and Latin America (Sánchez-Mercado et al. 2020), emphasizing the role of education in strengthening biodiversity understanding and conservation.

Family and teacher influence to community knowledge, perception, and attitude

In general, public knowledge, perceptions, and attitudes toward conservation at various levels of education are influenced by two main factors: the family environment and the school environment. Teachers have a higher proportion than families at all levels of education. Teachers had stronger influence (average 67.29%) than families (51.47%). Influence of family and teachers Chi-square analysis demonstrated significant associations between educational level and perceived influence of family and teachers ($\chi^2 = 12.45$, df = 3, $p < 0.01$). At elementary and junior high levels, family influence dominated, while teacher influence became stronger at senior high and university levels. Families dominated at elementary and junior high levels, while teachers were more influential in higher education (Figure 1).

Further analysis in Figure 1 shows that the proportion of family and teacher contributions in shaping community knowledge, perceptions, and attitudes toward bird conservation in Bagek Kembar varies by educational level. At the elementary and junior high school levels, families play a dominant role, particularly in shaping basic attitudes and perceptions toward conservation.

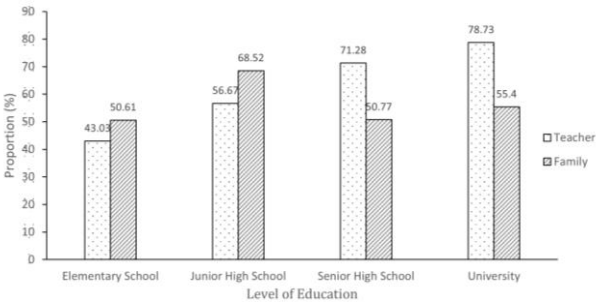

Figure 1. Proportion of family and teacher contributions at various levels of education related to community knowledge, perceptions and attitudes towards bird conservation

Consistent with these findings, Ahmetoglu (2019) stated that children's connection to nature is strongly influenced by the values and activities instilled by families. However, at the high school level, teachers' roles begin to increase in shaping ecological and conservation knowledge. This is in line with research conducted by Schneiderhan-Opel and Bogner (2020), which states that experiential learning can foster a stronger sense of conservation responsibility in students. Furthermore, Figure 1 indicates that a striking change occurs at the university level. Teachers or lecturers make the most dominant contribution to improving conservation knowledge and perceptions. Meanwhile, the role of families tends to decline. This is reinforced by research by Restović and Bulic (2024), which shows that conservation project-based learning at the university level significantly increases ecological awareness and conservation commitment in students. Thus, these results confirm that the bird conservation education strategy in Bagek Kembar must consider the dominant social roles at each level of education, including the family playing an important role in childhood (elementary school - junior high school), while the role of teachers or lecturers holds an important role in increasing conservation knowledge in education from high school to university. The analysis of social influences highlights the complementary roles of families and teachers in shaping conservation awareness. Families were more influential at lower education levels, reflecting their role in early value formation and emotional bonding with nature. In contrast, teachers exerted a stronger influence at senior high school and university levels, underscoring the importance of formal education in reinforcing ecological knowledge and conservation ethics. Similar patterns have been reported in environmental education studies emphasizing parental influence during childhood and teacher influence during adolescence and early adulthood (Könnel et al. 2025).

The significant role of teachers indicates that school-based programs remain a strategic platform for fostering conservation ethics. In contrast, families provide early emotional connections with nature, consistent with findings from parental influence studies in environmental education (Könnel et al. 2025). Therefore, conservation education should integrate both family participation and formal curricula to achieve long-term behavioral change.

Correlation among knowledge, perception, and attitude

The relationship between knowledge, perception, and attitude variables from the overall data without grouping by education level shows a positive correlation. This result indicates that communities with higher levels of knowledge have better perceptions and exhibit more positive attitudes toward bird conservation in Bagek Kembar. The relationship between community knowledge, perception, and attitudes toward conservation can be seen in Figure 2. Pearson correlation analysis showed significant positive relationships among the constructs: (knowledge - perception: $r = 0.58$, $p < 0.001$), knowledge – attitude: $r = 0.62$, $p < 0.001$), and (perception – attitude: $r = 0.55$, $p < 0.001$).

The analysis in Figure 2 shows a positive correlation between community knowledge, attitudes, and perceptions regarding bird conservation in Bagek Kembar. This correlation indicates that increased community knowledge about birds and conservation tends to be followed by an increase in positive perceptions of the importance of conservation, as well as the formation of stronger conservation attitudes. Communities with higher levels of knowledge tend to understand the ecological functions and threats to bird conservation. This understanding then influences community perceptions regarding preserving birds in the surrounding environment, ultimately strengthening conservation attitudes. This finding aligns with research conducted by Katuwal et al. (2021) and Ortega-Lasuen et al. (2023), which shows that ecological knowledge gained through education and participation in training activities significantly contributes to the formation of pro-conservation perceptions and behaviors. Increasing specific understanding of bird species and their habitats can increase community willingness to participate in bird conservation activities. Furthermore, Schneiderhan-Opel and Bogner (2020) stated that educational interventions can significantly change environmental perceptions and strengthen long-term ecological attitudes. However, changes in perception and attitude tend to occur gradually, starting with increased knowledge as a cognitive foundation. This is supported by the results of research conducted by Scopelliti et al. (2022), which stated that the relationship between environmental knowledge and conservation attitudes shows a positive correlation. The results of this study strengthen the argument that effective conservation programs must integrate educational aspects to build basic knowledge that can then influence public perceptions and attitudes. Thus, the results of the correlation analysis in the Bagek Kembar study indicate that knowledge plays a key role in shaping positive perceptions and strong conservation attitudes. Educational strategies that expand public knowledge about bird diversity and its ecosystem have great potential to increase public support and participation in efforts to carry out bird conservation activities in Bagek Kembar.

The results of further analysis using path analysis within SEM framework showed that the relationship between knowledge, perception, and attitude of the community towards bird conservation in Bagek Kembar showed that knowledge directly influenced perception and attitudes, and indirectly influenced attitudes through perception as a mediator (Figure 3). SEM analysis revealed both direct and indirect effects of knowledge on attitudes ($\beta = 0.41$ direct; $\beta = 0.36$ indirect via perception, $p < 0.01$), with satisfactory model fit (CFI = 0.93, RMSEA = 0.05, $R^2 = 0.42$).

Figure 3 shows that the higher the level of public knowledge about birds and their ecological value, the more positive the public's perception of the importance of conservation, which ultimately leads to stronger conservation attitudes. These findings confirm that knowledge acts as a primary driver shaping perception and, subsequently, conservation attitudes. This structural pattern supports the KAB framework commonly used in conservation psychology (Härtel et al. 2023; Katuwal et al. 2024; Li et al. 2025).

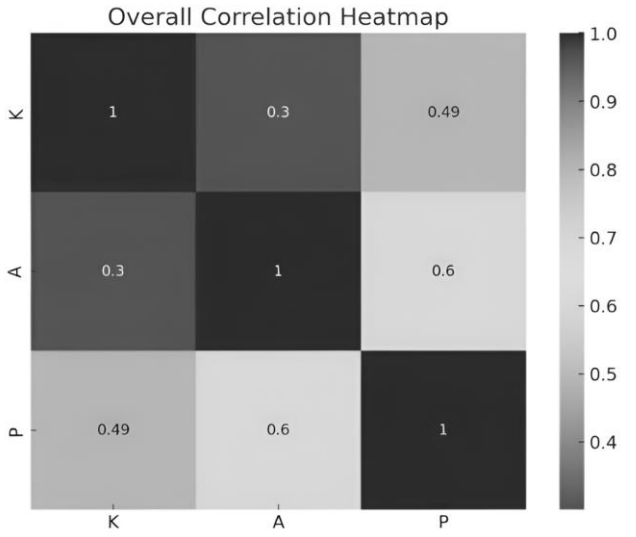

Figure 2. The correlation among community Knowledge (K), Perception (P), and Attitude (A) towards bird conservation

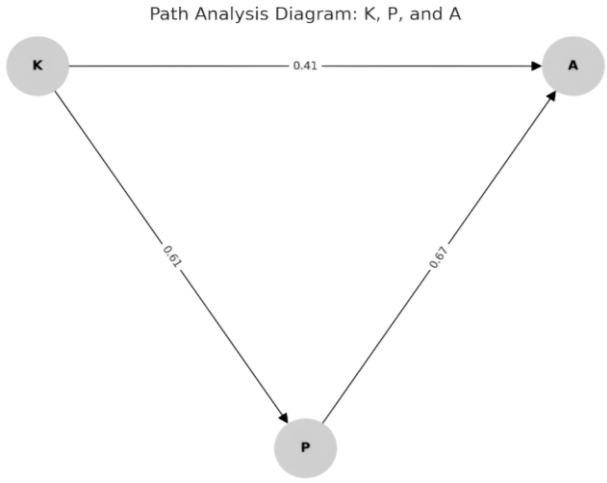

Figure 3. Path analysis of the influence of Knowledge (K), Perception (P), and Attitude (A) of the community towards bird conservation in Bagek Kembar, West Lombok, Indonesia

The role of perception as a mediator is further reinforced by Ardoin et al. (2022), who state that conservation perception acts as an affective driver that directs individuals toward conservation attitudes and behaviors. Thus, increasing knowledge is not only crucial for shaping positive perceptions but also plays a strategic role in strengthening public conservation attitudes.

Our findings support the KAB model, demonstrating that higher knowledge leads to stronger perceptions and more positive conservation attitudes. Education was a critical determinant, aligning with van de Wetering et al. (2022) and Aeschbach et al. (2025). The strong role of teachers in shaping attitudes echoes Maurer and Bogner (2020) and Chanvin et al. (2023).

Importantly, perceptions acted as a mediator, consistent with Ardoin et al. (2022), highlighting that knowledge alone is insufficient unless translated into meaningful perceptions. The positive correlations among knowledge, perception, and attitude indicate that greater understanding of birds and their ecological roles is associated with more favorable perceptions and stronger conservation attitudes. However, correlation alone does not imply causality. The SEM results provide further insight by confirming that perception partially mediates the relationship between knowledge and attitude. This finding supports the Knowledge – Attitude - Behavior framework, which posits that cognitive understanding must be translated into affective appraisal before influencing evaluative orientations and conservation behavior (Ardoin et al. 2023; Härtel et al. 2023; Li et al. 2025). The SEM results confirm that perception plays a partial mediating role in translating conservation knowledge into positive conservation attitudes, supporting the Knowledge – Attitude - Behavior framework in a community based conservation context.

Variation in perceptions suggests heterogeneity in exposure and cultural values, similar to findings in Venezuela (Sánchez-Mercado et al. 2020). Barriers such as limited access to environmental education and potential social desirability bias may explain why attitudes were generally positive despite low perceptions in some groups. Conservation programs in Bagek Kembar should target different demographics: (i) family based nature education for children, (ii) formal school curricula for adolescents, and (iii) community based ecotourism training for adults. Policymakers must integrate bird conservation into local development planning to ensure long-term sustainability. The mediating role of perception suggests that conservation programs focusing solely on information dissemination may be insufficient. Experiential and value-based approaches such as birdwatching activities, habitat restoration, and community-based ecotourism are likely to be more effective in strengthening positive perceptions and, ultimately, conservation attitudes. The relatively positive attitudes observed despite moderate perceptions may also reflect underlying social norms favoring conservation, although social desirability bias cannot be excluded, as reported in similar community-based studies (Sánchez-Mercado et al. 2020).

Moreover, the overall positive attitude observed despite varying perceptions suggests latent social norms favoring conservation. However, this may also reflect social desirability bias, as reported in similar studies (Sánchez-Mercado et al. 2020). Future surveys combining behavioral observation and participatory mapping could validate whether positive attitudes translate into concrete conservation actions. Integrating bird conservation into local curricula, ecotourism programs, and cultural events could enhance both environmental and economic sustainability.

In conclusion, this study demonstrates that (i) community knowledge, perception, and attitudes toward bird conservation in Bagek Kembar are generally at a moderate level and differ significantly across education levels, (ii) teachers and families play distinct but complementary roles in shaping conservation awareness, (iii) structural modeling further confirms that perception partially mediates the relationship between knowledge and attitude. The dominance of teacher influence at higher education levels supports findings that school based environmental education is a strategic pathway for building long-term conservation ethics. Meanwhile, the strong role of families at early education stages confirms that early emotional bonding with nature originates primarily from the household environment. Community based birdwatching ecotourism in Bagek Kembar presents a strategic opportunity to integrate experiential learning with local economic incentives. Strengthening collaboration between schools, families, village institutions, and tourism managers is essential to ensure sustainable bird conservation in coastal Lombok. Overall, these findings emphasize that bird conservation in community-managed ecosystems like Bagek Kembar requires integrated strategies combining education, family engagement, and experiential learning. Strengthening collaboration among schools, families, and local ecotourism initiatives can enhance both ecological sustainability and community participation in conservation.

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