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Research and Conserve Some Endangered, Precious, Rare Bird Species, Priority Species For Protection In Gia Lai Province

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Abstract
Gia Lai province's biodiversity has a diverse ecosystem with a combination of strongly fragmented and mountainous forest ecosystems, high average slopes and elevations. This is home to many animal species, including many endangered, precious, rare birds, and priority species for protection. The survey results from May 2022 to December 2023 identified 354 bird species belonging to 53 families and 17 orders recorded in Gia Lai province, 354 species occurring diversely in 5 habitats: Natural forests; Planted forests; Grasslands, shrubs, scattered trees; Residential areas, swidden fields; Rivers, streams, wetlands. Of which, 222 species were recorded from samples collected and directly observed, 115 species through documents, 59 species recorded directly through interviews, relics and photos of the species. CR level: SDVN (2007): 1 species (4.55%), IUCN (2023): 5 species (22.73%). According to IUCN (2023), the proportion of critically endangered species is significantly higher than that of SDVN (2007). This may indicate an increase in the level of endangered species in the bird fauna; EN level: SDVN (2007): 3 species (13.64%); IUCN (2023): 3 species (13.64%). The rate of endangered species according to both SDVN (2007) and IUCN (2023) is the same, showing the stability of the level of danger over time for this group of species; VU level: SDVN (2007): 9 species (40.91%); ND06 (2019): 5 species (22.73%); IUCN (2023): 5 species (22.73%). The rate of species at risk according to SDVN (2007) is higher than that of ND06 (2019) and IUCN (2023). This may indicate a decrease in the number of species at risk according to the new classification systems. The study also identified the distribution characteristics and proposed conservation solutions for endangered, precious and rare bird species in Gia Lai province.

Keywords: Biodiversity, birds, endangered rare, Gia Lai

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Introduction
Gia Lai is the province with the largest forest area in the Central Highlands and ranks 4th in the country (according to the published area data in 2023, by the Ministry of Agriculture and Rural Development [1]); is a province with a large natural area, many natural forest areas and diverse ecosystems. At the same time, Gia Lai is one of the provinces classified in the Central Truong Son priority landscape area (Tordoff et al. 2002) [2], is one of more than 200 "hot spots" of Biodiversity in the world, has high biodiversity value, is home to many rare and endangered species: Recorded animals include species such as: Urocissa whiteheadi, Emberiza aureola, Pitta nympha, Bubo nipalensis, Aquila clanca, Ptilolaemus austeni, Lophura edwardsi, Pavo muticus, Ciconia episcopus, Garrulax kongkakingens.

However, like many other provinces and cities, Gia Lai is facing many challenges when biodiversity conservation is closely related to economic development and social stability. Up to now, although there have been a number of research projects on the flora and fauna of forests in Gia Lai province, most of the individual research projects have focused mainly on special-use forests, the Kon Ka Kinh and Kon Chu Rang corridors, and there has been no in-depth, systematic research on species of flora and fauna with conservation value in the whole province. That is the reason why we conducted the research "Research and investigation, conservation of some endangered, precious, rare bird species, priority species for protection in Gia Lai province".

Research Subjects and Methods
Subjects
The research subjects are endangered, precious, rare birds, and priority species for protection in Gia Lai province.

Research methods
Interview method with hunters and local people
The method of collecting information in this study aims to learn about rare and precious forest plants and animals in a specific area.

The interviewees are mainly local residents, forest rangers, and people with experience in the forest. Important information includes the names, characteristics, and economic values of easily recognizable species, as well as their usage and distribution status. Open-ended interview questions allow participants to describe in detail and the interview process will be repeated and cross-checked. Information will be verified through photographs and related documents. This method focuses on interviewing hunters to determine the presence, distribution, and habits of animal species. Data collection took place in all villages within the survey area, combined with the collection of remains from hunters and nearby families.

Animal survey method by route

Based on information from document references, interviews, and in combination with topographic maps, the survey team selected research locations and survey routes to achieve the best results. The selected survey routes were typical, representing different habitat types of each research location, focusing more on areas and habitats where endangered, precious, and rare animal species are likely to be encountered. Bird species were recorded through direct information such as specimens, images, observations, calls, or indirect information such as relics, footprints, droppings, scratches, and feeding marks. Some specialized audio-visual equipment such as binoculars and cameras with telozoom lenses were used to observe and record the presence of birds and birds during the field survey. The survey time for bird groups was mainly focused on the day and some evenings.

Some typical places where birds are often found according to habitat: (1) Natural forest, (2) Planted forest, (3) Grassland, shrubs, scattered trees, (4) Residential areas, swidden fields, (5) Rivers, streams, wetlands.

Bird survey method by standard point/plot

For birds, a standard plot of 3 km^2 is established on the map, at the 4 corners of the main plot, a standard plot of 2000 m2 is established to investigate species composition. Select and use standard plots to investigate endangered, precious and rare plants to investigate animal composition. Animal species are recorded in the standard plot through indirect information such as relics, footprints, droppings, scratches, feeding marks left on the ground or tree trunks or direct observation. In addition to meticulously investigating traces in the standard plot, the observation range is also expanded in different directions to record the appearance of species. The observation distance depends on each specific species group, the weather on the day of the survey, and the time of day of the survey.

Night survey method using flashlights

The eyes of most birds usually respond when illuminated by a light. Flashlights or headlamps worn by ethnic minorities (spotlights) can be used to survey forest birds on dark nights. The most difficult problem with this method is accurate species identification. Since we usually only see the eyes, one of the important requirements is the ability to distinguish eye color, eye size, the distance between the two eyes, and the height of the eyes above the ground.

Call investigation method

Some bird species emit very characteristic calls, which is the basis for us to determine their presence in the reserve. Experienced investigators can easily recognize them when hearing the calls of owls, woodpeckers, cuckoos, lapwings, etc. Many local hunters are very good at listening and identifying the calls of many bird species. It is necessary to learn from their valuable experiences by learning directly and through recordings (Casette tapes recording the calls of species in the field).

Results and Discussion

Species composition.

Our surveys recorded 354 bird species belonging to 53 families and 17 orders recorded in Gia Lai province, 354 species occurring diversely in 5 habitats: Natural forests; Planted forests; Grasslands, shrubs, scattered trees; Residential areas, swidden fields; Rivers, streams, wetlands. Of which, 222 species were recorded from samples collected and directly observed, 115 species from documents, 59 species were recorded directly through interviews, relics and photos of the species.

Table 1. List of Bird species distributed by rank

Order	Family	Species		Note	Order	Family	Species	
		Quantity	%				Quantity	%
1. Galliformes	*Phasianidae*	11	3.1		14. Passeriformes	*Aegithinidae*	3	0.85
2. Ciconiiformes	*Ardeidae*	7	2			*Hirundinidae*	5	1.41
	Ciconiidae	1	0.3			*Paridae*	6	1.69
3. Coraciiformes	*Alcedinidae*	9	2.5			*Monarchidae*	1	0.28
	Meropidae	5	1.4			*Muscicapidae*	23	6.5
	Coraciidae	2	0.6			*Turdinae*	15	4.24
	Upupidae	1	0.3			*Timaliidae*	43	12.2
	Bucerotidae	4	1.1			*Sylviidae*	22	6.21
4. Piciformes	*Picidae*	15	4.2			*Nectariniidae*	11	3.11
	Capitonidae	8	2.3			*Zosteropidae*	1	0.28
5. Caprimulgiformes	*Caprimulgidae*	4	1.1			*Motacilidae*	8	2.26
6. Cuculiformes	*Cuculidae*	12	3.4			*Dicaeidae*	4	1.13
7. Columbiformes	*Columbidae*	10	2.8			*Sittidae*	2	0.56
8. Falconiformes	*Accipitridae*	16	4.5			*Passeridae*	4	1.13
	Falconidae	4	1.1			*Fringillidae*	2	0.56
9. Podicipediformes	*Podicipedidae*	1	0.3			*Corvidae*	7	1.98
10. Apodiformes	*Apodidae*	5	1.4			*Dicruridae*	7	1.98
11. Anseriformes	*Anatidae*	3	0.9			*Campephagidae*	9	2.54
12. Strigiformes	*Strigidae*	7	2			*Oriolidae*	3	0.85
	Tytonidae	2	0.6		15. Psittaciformes	*Psittacidae*	4	1.13
13. Trogoniformes	*Trogonidae*	2	0.6		16. Charadriiformes	*Scolopacidae*	2	0.56
14. Passeriformes	*Laniidae*	3	0.9			*Charadriidae*	2	0.56
	Pittidae	5	1.4			*Rostratulidae*	1	0.28
	Eurylaimidae	3	0.9		17. Gruiformes	Rallidae	2	0.56
	Irenidae	3	0.9			*Turnicidae*	2	0.56
	Sturnidae	8	2.3			*Heliornithidae*	1	0.28
	Pycnonotidae	13	3.7		**Total**		**354**	

The bird suborder consists of 17 orders, Passeriformes has 25 families, including 211 species (accounting for 59.6%), Piciformes has 2 families, including 23 species (accounting for 6.5%), Coraciiformes has 5 families, including 21 species (accounting for 5.96%), Falconiformes has 2 families, including 20 species (accounting for 5.65%), Cuculiformes has 1 family, including 12 species (accounting for 3.39%), Galliformes has 1 family, including 11 species (accounting for 3.11%), Columbiformes has 1 family, including 10 species (accounting for 2.28%), the remaining orders have 1 - 8 species. Timaliidae is the most dominant species with 43 species (12.15%), Muscicapidae has 23 species (6.5%), Sylviidae has 22 species (6.21%), Accipitridae has 16 species (4.52%), Picidae and Turdinae have 15 species (4.24%), Pycnonotidae has 13 species (3.67%) and the remaining families have 1 – 11 species. The study results show uneven distribution among bird families. The Passeriformes group is the most abundant with 43 species (12.15%), reflecting the diversity in the ecosystem. Some other notable families include Timaliidae (43 species) and Sylviidae (22 species). Within the order, Falconiformes has 20 species (5.65%), while Piciformes has 23 species (6.50%), reflecting the richness of birds of prey and woodpeckers. In contrast, some families such as Ciconiidae and Podicipedidae have only one species, indicating rarity or narrow distribution. Some other families have 2-5 species, reflecting their low abundance in the wild.

Distribution by habitat

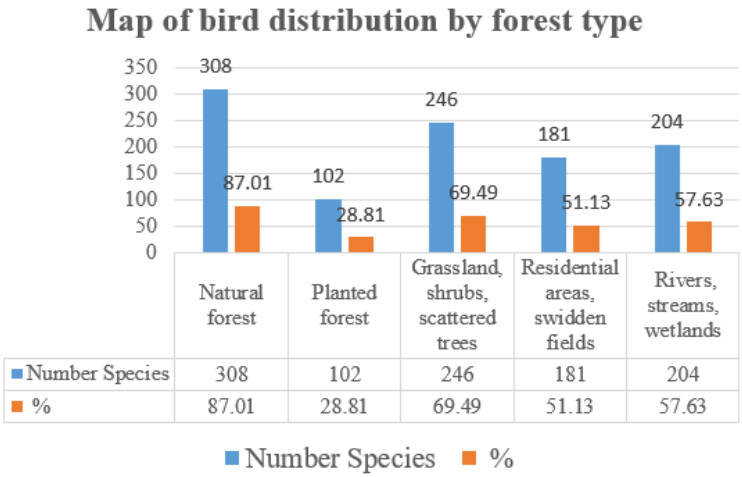
Table 2. Number of bird species and individuals recorded in forest types during the survey

Forest	Total		Batch 1		Batch 2		Batch 3	
	Species	Individual	Species	Individual	Species	Individual	Species	Individual
Natural forest	308	421	189	246	56	93	63	82
Planted forest	102	146	37	62	36	47	29	37
Grasslands, shrubs, and scattered trees	246	303	163	196	53	61	30	46
Residential area, fields	181	240	124	150	29	52	28	38
Rivers, streams, wetlands	204	261	147	186	29	34	28	41

The data show that natural forests have the highest biodiversity, with 308 species and 421 individuals. Residential areas and swidden areas have fewer, with 181 species and 240 individuals, indicating limited capacity to support biodiversity. Environments such as

grasslands, scrublands, streams, and wetlands have high numbers of individuals but are not as diverse as natural forests. Plantations have the lowest numbers of species and individuals, indicating unfavorable conditions for development. In summary, different environments have distinct species and individual distributions, ranging from rich in natural forests to limited in plantations. The order of bird species distribution by habitat is: (1) Natural forests, (2) Grasslands, scrublands, (3) Streams, wetlands, (4) Residential areas, swidden areas, (5) Plantations.

Table 4.3. Chart of number of bird species recorded by habitat



Natural forests are the most biodiverse environment with 87.01% of species, indicating a strong ability to support life. Grasslands, shrubs and scattered trees have 69.49% of species, also supporting diverse life. Rivers and wetlands have a lower species ratio, at 57.63%. Plantations have the lowest species number at 28.81%, reflecting the negative impact of humans on biodiversity. Residential areas support 51.13% of species, especially birds. Overall, natural forests maintain the greatest biodiversity, while other environments also contribute to the ecosystem.

Distribution by elevation

The study results show the number and percentage of bird species according to the two elevation categories. Below 1000m there were 335 bird species (94.63%), while above 1000m there were 161 species (45.48%). Some prominent bird families below 1000m include Timaliidae with 41 species (11.58%), Strigidae with 22 species (6.21%), and Muscicapidae with 23 species (6.50%). Above 1000m, Babblers remained dominant with 27 species (7.63%), while Sylviidae decreased to 13 species (3.67%)… Some families such as Alcedinidae had no species above 1000m, while Accipitridae and Psittacidae were evenly distributed between the two elevations.

Geographic similarity

Table 4.4. Correlation between geographic regions

	Kbang	*Mang Yang*	*Dăk Đoa*	*Krông Pa*	*Ia Pa*	*Ia Grai*	*Chư Pah*	*Ayun Pa*	*Chư Prông*	*Phú Thiện*	*Chư Sê*	*Kông Chro*	*Chư Pưh*	*Dăk Pơ*
Kbang	1													
Mang Yang	0.989	1												
Dăk Đoa	0.829	0.722	1											
Krông Pa	0.877	0.995	0.777	1										
Ia Pa	0.876	0.979	0.711	0.953	1									
Ia Grai	0.936	0.997	0.816	0.996	0.952	1								
Chư Pah	0.718	0.953	0.793	0.919	0.951	0.951	1							
Ayun Pa	0.838	0.757	0.911	0.918	0.732	0.860	0.796	1						
Chư Prông	0.685	0.653	0.839	0.793	0.982	0.970	0.958	0.899	1					
Phú Thiện	0.755	0.747	0.870	0.677	0.868	0.742	0.913	0.774	0.758	1				
Chư Sê	0.657	0.556	0.966	0.770	0.715	0.750	0.781	0.704	0.701	0.782	1			
Kông Chro	0.739	0.697	0.904	0.722	0.830	0.692	0.881	0.861	0.709	0.997	0.984	1		
Chư Pưh	0.644	0.894	0.756	0.970	0.981	0.938	0.987	0.788	0.992	0.835	0.703	0.984	1	
Dăk Pơ	0.842	0.700	0.933	0.803	0.791	0.294	0.747	0.953	0.701	0.859	0.960	0.893	0.735	1

Formula for calculating correlation coefficient

$$R = \frac{\sum_{i=1}^{n}\left[(X_i - \overline{X})(Y_i - \overline{Y})\right]}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}}$$

Use the correlation coefficient to evaluate the level of correlation.

$r = 0$	: No correlation
$\mid R \mid < 0,4$	: Poor correlation
$0,4 \leq \mid R \mid < 0,7$	: Weak correlation
$0,7 \leq \mid R \mid < 0,8$	: Fairly good correlation
$0,8 \leq \mid R \mid < 0,9$	: Good correlation
$0,9 \leq \mid R \mid$	: Close correlation

Most of the correlation levels of species diversity in Gia Lai province are highly correlated with each other ($0.9 \leq I R I \geq 1$). However, due to the characteristics of the ecosystem, some areas have good correlation indexes with each other such as: the similarity in the number of bird species between different areas, indicating that Mang Yang and Ia Grai districts have very high similarity indexes (close to 1) indicating similar ecological conditions. Meanwhile, Kbang and Chu Puh districts have low similarity indexes (0.644), although they are geographically close, indicating that factors other than distance such as habitat type and environmental quality also affect bird species distribution. Some areas that are close to each other still have low similarity indexes, such as between Chu Pah and Ayun Pa (0.796), indicating that specific ecological factors may cause the differences. The study highlights that bird species distribution depends on both geographical distance and ecological factors, which need to be considered to better understand bird diversity.

Number of rare species

Table 4.5. Summary of the number of bird species with conservation value

Conservation level	SĐVN (2007)		NĐ06 (2019)		IUCN (2023)	
	Number	%	Number	%	Number	%
Bird fauna conservation classification	1 (CR)	4.55	8 (IB)	36.36	5 (CR)	22.73
	3 (EN)	13.64	6 (IIB)	27.27	3 (EN)	13.64
	9 (VU)	40.91			5 (VU)	22.73
Total	**13**	**59.09**	**14**	**63.64**	**13**	**59.09**

Based on the classification systems of the Vietnam Red Book 2007 (VRED), Decree 06 of 2019 (NĐ06) and the International Union for Conservation of Nature (IUCN, 2023), we can see a significant change in the way the conservation status of the bird fauna is assessed.

+ CR level: VRED (2007): 1 species (4.55%), IUCN (2023): 5 species (22.73%). According to IUCN (2023), the rate of critically endangered species is significantly higher than that of VRED (2007). This may indicate an increase in the level of endangerment of species in the bird fauna.

+ EN level: VRED (2007): 3 species (13.64%); IUCN (2023): 3 species (13.64%). The endangered species rates according to both the Vietnam Red Book (2007) and IUCN (2023) are the same, indicating the stability of the endangered level over time for this group of species.

+ VU level: Vietnam Red Book (2007): 9 species (40.91%); NĐ06 (2019): 5 species (22.73%); IUCN (2023): 5 species (22.73%). The endangered species rates according to Vietnam Red Book (2007) are higher than those of NĐ06 (2019) and IUCN (2023). This may indicate a decrease in the number of species at risk according to the new classification systems.

According to the Vietnam Red Book (2007), only 1 bird species is classified as Critically Endangered (CR), while IUCN (2023) records 5 species at This level indicates that the threat level of bird species has increased. The proportion of endangered species (EN) remained stable at 13.64% according to both sources, while the proportion of species at Risk (VU) decreased from 40.91% to 22.73%, indicating a change in conservation status. The total number of species classified also differs: 13 species according to the Red List (2007), 14 species according to Decree 06 (2019), and 13 species according to IUCN (2023). These changes may reflect improvements in conservation or changes in classification. Differences between systems may be due to changes in assessment criteria, advances in research, or conservation efforts that have reduced the number of species at the threat levels. There is 1 endemic bird species recorded: Ianthocincla konkakinhensis.

Proposed Conservation Solutions

Regarding management organization solutions: Improve the capacity of officials at all levels to improve the effectiveness of forest resource management, protection and development; Strengthen inspection and patrol work to detect and handle violations in forest resource management and protection; Penalties must comply with policies and regulations of the law, have sufficient deterrence, and coordinate with local authorities in forest resource management and protection and handle violations according to regulations; Implement land and forest allocation policies in some areas to improve the effectiveness of management, ensuring compliance with legal regulations; Implement well the forest environmental service payment policy to supplement funding for forest protection and management, build facilities, invest in equipment to serve the professional activities of the Conservation Areas.

Expand and improve the effectiveness of management of natural heritage systems, nature reserves and biodiversity corridors.

Strengthen and expand natural areas of national and international importance.

Apply effective conservation measures in areas outside nature reserves.

Restore important natural ecosystems that have been degraded.

Conserve and restore endangered wildlife species, especially endangered, precious, rare animals that are prioritized for protection, and migratory species.

Strengthen the conservation of genetic resources, management of access to genetic resources, benefit sharing, and protection of traditional knowledge about genetic resources.

Assess and promote the benefits of biodiversity for sustainable development, natural disaster prevention, and climate change adaptation: Investigate, inventory, compile statistics, evaluate, and build a national database on biodiversity; Sustainable use of biodiversity and ecosystem services.

Conserve biodiversity to adapt to climate change.

Control activities that negatively impact biodiversity: Strictly control activities that change the purpose of land and forest use, unsustainable farming and exploitation methods, and activities that pollute the environment; Control illegal exploitation, captivity, trade, and consumption of wild animals and plants.

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