CONSERVATION MANAGEMENT PLAN

1st July 2022 – 30th June 2032

Phibsoo Wildlife Sanctuary

Department of Forests and Park Services

Ministry of Agriculture and Forests

Royal Government of Bhutan

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PHIBSOO WILDLIFE SANCTUARY

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Phibsoo Wildlife Sanctuary
Department of Forests and Park Services
Ministry of Agriculture and Forests

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ENDROSEMENT AND APPROVAL OF THE ROYAL GOVERNMENT OF BHUTAN

Conservation Management Plan of Phibsoo Wildlife Sanctuary (2022-2032)

"In accordance with the provisions of the Forest and nature Conservation Act of Bhutan, 1995".

Submitted for Approval:

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Phibsoo Wildlife sanctuary

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Recommended for Approval

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Ministry of Agriculture and Forests

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Royal Government of Bhutan
Ministry of Agriculture and Forests
Tashichho Dzong
Thimphu: Bhutan

SECRETARY

FOREWORD

Phibsoo Wildlife Sanctuary (PWS) is the smallest protected area in Bhutan with an area of 286.83 sq.km. However, it has the most variant southernmost sub-tropical Himalayan forest ecosystem. It is the only protected area in the country known for the presence of Spotted Deer (*Axis axis*). It is also the westernmost limit for the globally endangered Golden langur (*Trachypithecus geei*) besides being known for having natural Sal *(Shorea robusta*) reserve in the country.

Ever since its declaration as one of the ten protected areas in the country, the wilderness status of the sanctuary have been maintained. Due to strong protection measures put in place, the first management plan (2014-2017) period through constant wildlife monitoring, has highest wildlife sighting incidences per distance besides its contribution towards uplifting of rural livelihood.

This conservation management plan (2022-2032) will strive to enhance conservation of biodiversity and secure wildlife habitat, enhance sustainable management and utilization of natural resources, mitigate human wildlife conflict (HWC) and uplift rural livelihood and enhance efficiency and effectiveness of service delivery. The conservation management plan will also contribute significantly towards striking balance between biodiversity conservation and livelihood of sanctuary's residents.

Tashi Delek!

(Thinley Namgyel)

དཔལ་ལྡན་འབྲུག་གཞུང་། སོ་ནམ་དང་ནགས་ཚལ་ལྷན་ལས། ནགས་ཚལ་དང་སྐྱོང་ཀ་ཞབས་དེགས་ལས་ཁུངས།

Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Thimphu: Bhutan

DIRECTOR

PREFACE

It gives me immense pleasure to present the 2nd Conservation Management Plan of Phibsoo Wildlife Sanctuary (PWS) spanning for the period of ten years from July 2022 to June 2032. PWS, the smallest protected areas in Bhutan has made remarkable achievements in terms of biodiversity conservation in southern Bhutan adjoining the border of Assam and West Bengal besides uplifting livelihood in the wildlife sanctuary.

I am pleased to notice that this new plan has clear vision, mission and realistic time-bound goals that are all focused towards conservation of biodiversity, sustainable management of forest, addressing human wildlife conflict and effective service delivery to the residents of wildlife sanctuary.

The department will also attach great importance and strive for continued financial support bestowed by Royal Government of Bhutan (RGoB), Bhutan for Life (BFL) and other conservation donor agencies besides opening windows of opportunities in uplifting technical capacities of the staffs.

Lastly, I would like to offer my appreciation to the entire team of PWS for coming up with holistic conservation management plan, Nature Conservation Division for providing critical inputs and technical guidance and each and every individual of the management for hard work and sacrifices made in producing the plan.

Tashi Delek

Lobzang Dorji

དཔལ་ལྡན་འབྲུག་གཞུང་། སོ་ནམ་དང་ནགས་ཚལ་སྡེན་ལས། ནགས་ཚལ་དང་སྐྱོང་ཁ་ཞབས་ཏོག་ལས་ཁུངས།

Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Thimphu: Bhutan

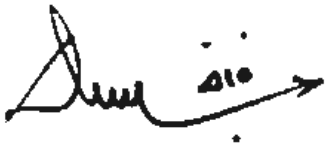
ACKNOWLEDGEMENT

Phibsoo Wildlife Sanctuary (PWS) is pleased to present the second management plan which will be implemented for the period of ten years (2022 to 2032). The plan will serve as an important document in fulfilling vision of the wildlife sanctuary. PWS management would like to convey sincere acknowledgement to the following for the successful completion of management plan preparation;

The Data Management Section (DMS) of PWS took a lead role in preparation of the plan from coordination meeting, data analysis, final plan write-up and bridging with field offices and sections of PWS. The management applauds the efforts put in by DMS. I would also acknowledge the efforts put in by section heads and range offices who were actively involved in various field biodiversity surveys.

Lastly, I would like to also offer heartfelt gratitude to Nature Conservation Division (NCD) and PWS focal at NCD for providing technical inputs, guidance and timely support.

Thank You!



Dorji Rabten

Chief Forestry Officer, PWS

List of Acronyms

GNH	Gross National Happiness
PWS	Phibsoo Wildlife Sanctuary
CF	Community Forest
LFMP	Local Forest Management Plan
NWFP	Non-Wood Forest Product
NCD	Nature Conservation Division
RGoB	Royal Government of Bhutan
SRFL	State Reserved Forest Land
FNCA	Forest and Nature Conservation Act
FNCRR	Forest and Nature Conservation Rules and Regulation
WBH	White Bellied Heron
SMART	Spatial Monitoring and Reporting Tool
GPS	Global Positioning System
GIS	Geographic Information System
BFL	Bhutan for Life
H'	Shannon's diversity
BA	Basal Area
RBA	Relative Basal Area
HWC	Human Wildlife Conflict
HEC	Human Elephant Conflict
METT+	Monitoring and Evaluation Tracking Tool Plus
G2C	Government to Citizen
DBH	Diameter at Breast Height
APA	Annual Performance Appraisal

Glossary of local terms

Chiwog	Lowest administrative unit formed by group of villages
Dzongkhag	District
Gewog	Block
Gup	An elected head of the Gewog
Tshogpa	Elected representative of the Chiwog
Chhu	River/Stream

Executive Summary

Phibsoo Wildlife Sanctuary (PWS) is the smallest protected areas in Bhutan with an area of 286.83sq.km. It encompasses Sarpang district to the east and Dagana district to the west with an area of 146.4sq.km and 140.43sq.km respectively. Connecting with Indo-Bhutan international border with Ripu-Chirang Reserved Forest and Raimona National Park on the Indian side, the wildlife sanctuary forms an important landscape for trans-boundary conservation of wildlife especially as a corridor for keystone species.

The first conservation management plan for the sanctuary was prepared for a period of five years (2012-2017) with fundamental objectives of reducing conservation threats posed due to human wildlife conflict (HWC), and wildlife poaching. Initial management plan also focused on strengthening infrastructure for effective management, capacity building of professional, and enhancing public knowledge on local biodiversity conservation. The current management plan is prepared for a period of ten years (2022-2032). It is based on findings of biodiversity and socio-economic assessments conducted in the wildlife sanctuary, lesson learnt, and from comprehensive review of previous management plan. The estimated amount required for the achievement of management goals in the current fund accounts to Nu.127.6m.

The current plan describes in detail the aspects of conservation strategy, challenges, threats, opportunities, and achievements from the past conservation management plan and strategic actions for the plan period. It aims to address the issues pertaining to species conservation including habitat management, zonation, research, HWC, security threats and other management challenges, and intents to achieve its defined strategic goals. The sanctuary shares contiguous natural forests with reserved forests of Indian state of Assam, which gives multi-fold opportunities for protection of large ranging and globally threatened wildlife from

direct conservation threats. The implementation of current management plan is scheduled to commence from the beginning of July 2022 till the end of June 2032.

The first chapter provides background, boundary descriptions, historical significance, conservation significance, vision, mission, goals, and salient features of plan and also zones of wildlife sanctuary.

The second chapter highlights current status of wildlife sanctuary including landscape characteristic, hydrological characteristics, flora and fauna diversity, and includes comprehensive socio-economic status of the sanctuary residents. Moreover, administrative and park infrastructure are also represented in the chapter. The findings of assessment and surveys conducted in the wildlife sanctuary. The biodiversity surveys included both flora and fauna species, mainly comprised of mammals, birds, fishes, herpetofuana, orchids, and other flora species. Through various biodiversity surveys, a total of 358 plants, 36 mammals, 418 birds, 23 fishes, 177 butterflies and 60 herpeto-fauna were recorded. Birds contribute highest to the faunal diversity with 59% followed by 25% butterflies, 8%, herpetofauna, 5% mammals and 3% fishes. The demographic feature of sanctuary is represented by a total of 151 households with a total population of 1037 individuals (male: 562 & female: 575) inside its boundary, whose primary source of livelihood is agriculture and livestock rearing. Service delivery to residents is represented through establishment of community forest, local forest management areas and non-wood forest product management groups.

The third chapter highlights the assessment of previous management plan and lesson learned through forest management, forest protection, habitat management, and research and monitoring, and conservation development programs. The key lesson learnt through implementation of various activities and programs are well

represented. The lesson learnt includes both positive and negative lessons and also recommendation for future management activities.

The fourth chapter describes conservation and management threats. Conservation threats include poaching, illegal logging, fishing, waste, invasive species and HWC, while management threats includes security threats due to porous international border, In-accessibility of area due to monsoon and improper network connectivity. Since the sanctuary is only protected area in the country to have natural Sal forest and viable population of Chital, and also harbors large spectrum of globally threatened wildlife, providing great opportunity to make PWS as exemplary conservation landscape in southern Bhutan.

Fifth chapter highlights various management strategies and activities to be conducted for the fulfillment of various defined goals. The management intends to achieve its vision and mission through 12 strategies all geared towards protecting the keystone species, mitigating human wildlife conflicts, enhancement of community base forest management, enhance sustainable local forest management, building community and ecosystem resilience from climate induce threats, enhancement of scientific management of wildlife habitat, adoption of zero poaching strategy, research and monitoring, and enhancement of community livelihood, and promotion of nature based high end ecotourism.

The chapter six highlight on implementation framework of various strategies to fulfill the goals while chapter seven details on monitoring and evaluation of activities using monitoring and evaluation tracking tool plus (METT+). The progress towards achievement of strategic goals will be periodically monitored as the indicators are explicitly stated in a comprehensive logical framework.

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Chapter One

Background

PWS is the smallest wildlife sanctuaries in the country. Historically, PWS origination dates back to as 1974 when it was first designated as Phibsoo Reserved Forest; it was upgraded to Phibsoo Wildlife Sanctuary in 1993 following the nationwide revision of protected areas system. While the conservation efforts begun in 1999, its first management plan was approved in 2012 for the period of five years covering an area of 269sq.km. Furthermore, with the expiration of its management plan in 2017, surveys were conducted to study the status of biodiversity and socio-economic status in the wildlife sanctuary. The management area boundary also got revised to 286.83sq.km in 2019 with the delineation of latest national parks and biological boundary. It covers two district of the country, Sarpang to the east and Dagana to the west. Relatively more geographical area (51.5%) of sanctuary falls in Singye geog under Sarpang Dzongkhag and (48.4%) in Nichula gewog under Dagana Dzongkhag. The northern part of wildlife sanctuary shares Beteni gewog boundary under Tsirang Dzongkhag between 26°51'51.04"N, 90°1'12.88"E to 26°50'58.69"N, 90°7'51.52"E with Biological Corridor (BC3) connecting the wildlife sanctuary on north eastern side. Eastern part of wildlife sanctuary falls in Singye gewog under Sarpang Dzongkhag between 26°51'0.02"N, 90°8'43.85"E to 26°46'22.37"N, 90°11'35.01"E. Its southern boundary follows Indo-Bhutan international border with Ripu-Chirang Reserved Forest and Raimona National Park on the Indian side starting from Border pillar 117/1 to 145/1 till Singye gewog. While it's western boundary shares the gewog boundary of Lhamoyzingkha, Deorali, and Tsendagang from 26°42'36.01"N, 89°51'40.45"E to 26°51'5.56"N, 89°59'26.59"E flanked by Sunkosh river (Figure 1).

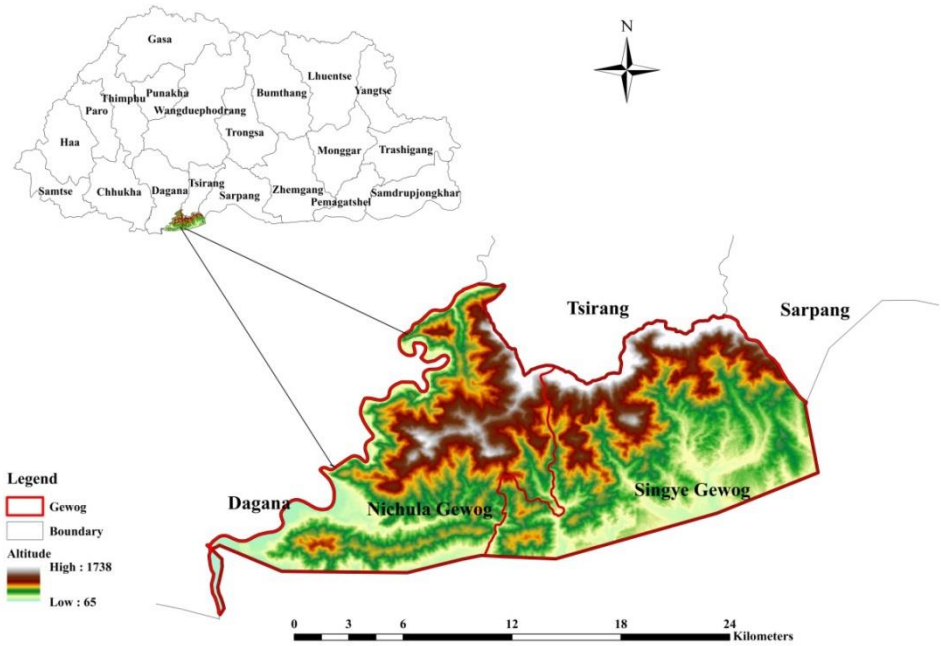


Figure 1: Map of PWS (Location map)

1.1 History and Significance of PWS in Bhutan

History of protected areas in Bhutan dates back to the 1960s with the designation of Game Sanctuary and later as Manas Wildlife Sanctuary in 1966 (now known as Royal Manas National Park). After Manas Wildlife Sanctuary in 1974, six other protected areas were created and further revisions in 1993 to the national protected areas system resulted in the current network of protected areas in Bhutan. The PWS, then the Phibsoo Resrve Forest was created in 1974 with five other protected areas. Later in 1993, it was upgraded to a wildlife sanctuary following a comprehensive review and revision of the national protected areas system. However, it only started its management independency in 2014 upon separation from Sarpang Forest Division with its conservation management plan 2012-2017. PWS encompasses an area of 286.83 km^2 making it as one of the

smallest among the ten protected areas in the country. It is located in the Himalayan foothills of south central Bhutan.

The sanctuary has great conservation significance for Bhutan, the region and the world at large. Not only does the sanctuary protects the country's southern most variant of sub-tropical Himalayan forest ecosystem but is also critical source of several seasonal and perennial water bodies which contribute to the fertility of the Assam Duars. The sanctuary indisputably serves as critical habitats in protecting some of the world's most endangered wildlife species. The sanctuary also happens to be the easternmost limit of spotted deer (*Axis axis*), common pea fowl (*Pavo cristatus*) and Sal (*Shorea robusta*) bearing forests (Figure 2). In-fact, PWS is the place where natural stand of Sal and Spotted deer can be sighted the most. At the same time, PWS is the westernmost limits of the globally threatened golden langur (*Trachypithecus geei*) and the rare and valuable agar tree (*Aquillaria malaccensis*). It also provides refuge to a number of charismatic and globally threatened species including the Asian elephant (*Elephas maximus*), Bengal tiger (*Panthera tigris tigris*), Chinese Pangolin (*Mani's pentadactyla*), Rufous-necked hornbill (*Aceros nipalensis*) and White-bellied Heron (*Ardea insignis*). Besides, lush alluvial grassland provides safe refuge to the prey species for keystone species.

Figure 2: Spotted Deer in Phibsoo Wildlife Sanctuary

1.2 Vision, Mission and Goals

1.2.1 Vision

A Sanctuary with viable wildlife population that flourishes into a high-end ecotourism destination and a collaborative trans-boundary protected area.

1.2.2 Mission

Strengthen subtropical biodiversity conservation while safeguarding the socio-economic well being of the communities.

1.2.3 Goals

2. To Enhance Conservation of Biodiversity and secure Wildlife Habitat
3. To Enhance Sustainable Management and Utilization of Natural Resources
4. To Mitigate Human Wildlife Conflict and uplift Rural Livelihood
5. To Enhance Efficiency and Effectiveness of Service Delivery

1.3 Salient features of the plan

The plan was prepared using biodiversity, socio-economic surveys and assessment reports produced over the years. The result of those surveys has assisted in aligning various indicators to achieve the goals, mission, and vision of conservation management plan at the end of ten years. With BFL as major funding sources for PWS in 10 years, the plan also calls management to explore various interested funding donors and agencies to achieve its goals.

The first chapter provides background, boundary descriptions, historical significance, conservation significance, vision, mission, goals, and salient features of plan and zones of wildlife sanctuary developed using zonation guidelines.
The second chapter highlights current status of wildlife sanctuary including landscape characteristic, hydrology and water resources, floral and faunal diversity. Besides that, livelihood source of people including agriculture, livestock and forestry resources are well represented. Service delivery to residents is represented through establishment of community forest, local forest management areas and non-wood forest product management groups. Moreover, administrative and park infrastructure are also represented in the chapter.

The third chapter pronouns the assessment of previous management plan and lesson learnt through forest management, forest protection, habitat management, research and monitoring, and conservation development programs. The key lesson learnt through implementation of various activities and programs were well represented. The lesson learnt includes both positive and negative lessons and also recommendation for future management activities.

The fourth chapter describes conservation and management threats including the threat ranking table. Conservation threats include poaching, illegal logging, fishing, waste, invasive plant species and HWC while management threats includes security threats due to porous international border, in-accessibility of area due to monsoon and communication issues.

Fifth chapter presents various management strategies and activities to be conducted for the fulfillment of various goals. The strategies include enhancement of community base forest management, enhance sustainable local forest management, enhancement of waste management, promotion of alternative energy sources, building community and ecosystem resilience from climate induce threats, enhancement of scientific management of wildlife habitat, adoption of zero poaching strategy, intensification of biodiversity and socio-economic research and monitoring, enhancement of community livelihood, adoption of human wildlife conflict mitigation measures and promotion of nature based high end ecotourism.

Sixth chapter, highlights on implementation framework of various strategies to fulfill the goals while chapter seven details on monitoring and evaluation of activities using METT+. It assists in identifying whether the plan is being implemented effectively and goals are being fulfilled**.**

1.4 Zones of the PWS

PWS is divided into four zones viz. Core, Transition, Buffer and Multiple use as per the Zonation Guidelines, 2020 (Figure 3). The detail descriptions of zones are as tabulated in Table 1.

Table 1: Zones of Phibsoo Wildlife Sanctuary

Type of Zone	Core	Transition	Buffer	Multipurpose Use	Total
Area (km^2)	63.02	151.0	35.8	37.01	286.83
(%)	21.98	52.64	12.48	12.9	100

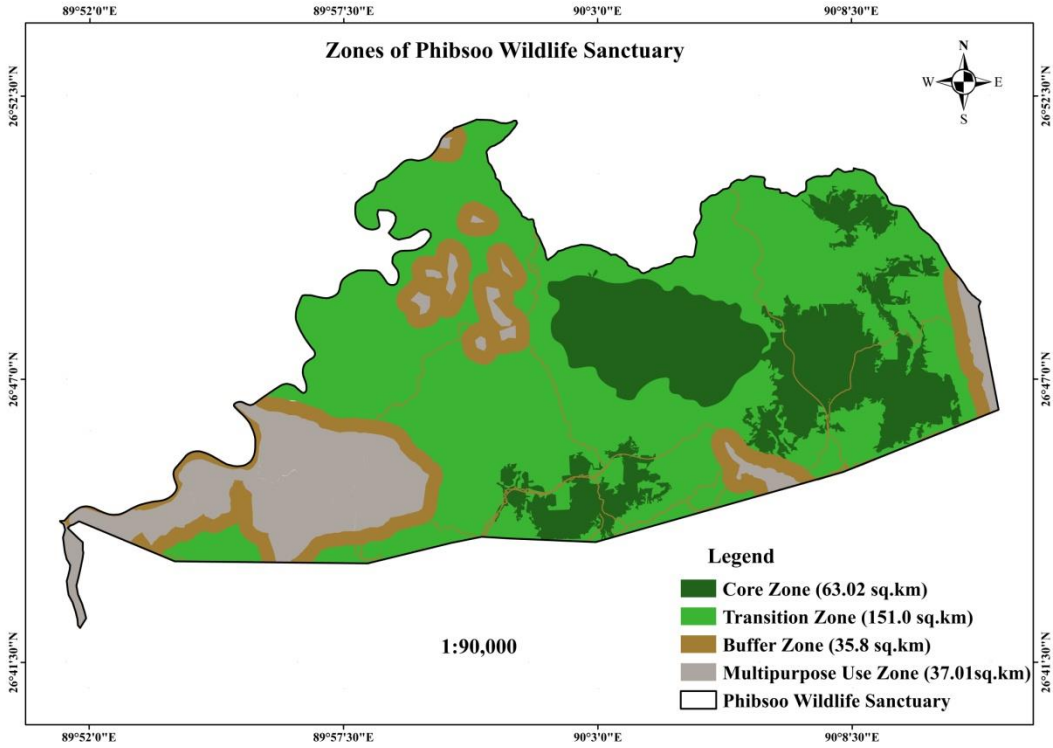


Figure 3: Zones of Phibsoo Wildlife Sanctuary

1.4.1 Core zone

An area of 63.02 km^2 has been designated as core zone for conservation of species with high conservation value and their critical habitat such as saltlicks, waterholes, wetlands, breeding ground, and spawning areas (Figure 4). Areas known to support feeding and roosting of endangered species such as White-bellied Heron, Rufous-necked Hornbill, Great Hornbill and Wreathed Hornbill are considered while delineating as core zone. Besides those important plant areas such as natural Sal forest area, teak forest and natural Agar wood were also prioritized for high level of conservation significance. The core zone of PWS also include sections of important streams such as Longa, Pinkhawa, Singye khola, Bagay, Garbu and Sukey, Phibsoo River, Kolamaji, Balam, Sunkosh and Nichula river which has high importance to golden masher. Important wildlife refuge like area of Tiger sighting, Leopard, Elephant, Spotted deer, Clouded leopard, Golden langur, Leopard cat, Hog deer, and Pangolin, Samber, Barking deer, wild pig and Guar were delineated as core zone after running through zonation software.

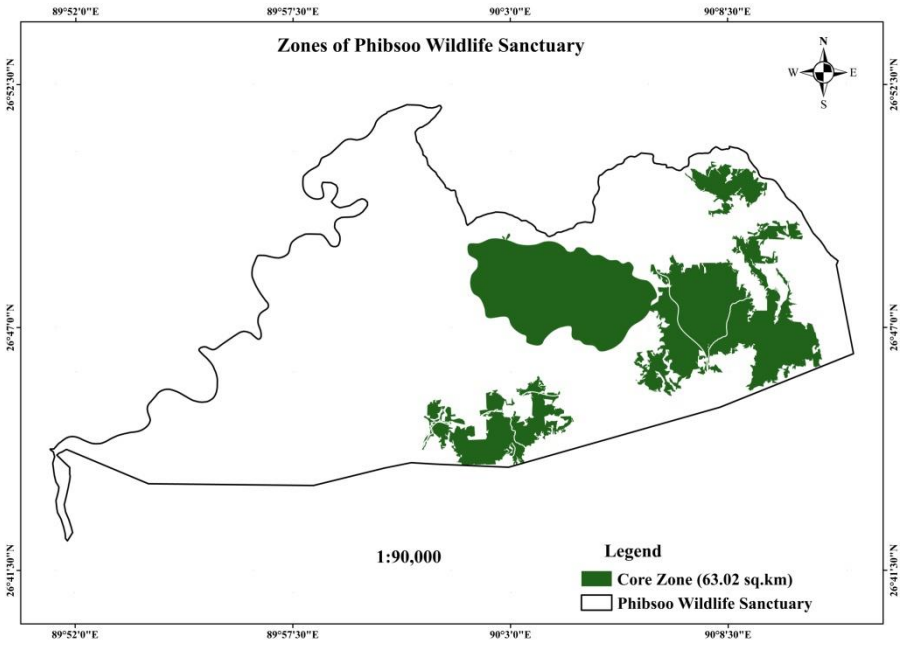


Figure 4: Core zone

1.4.2 Transition Zone

An area of 151 sq. km has been designated as transition zone in PWS (Figure 5). These are the areas which are equally important to that of core zones but with restricted human interference. This zone consists of important habitat patches or contiguous habitat that serves as an important refuge and safe corridor for movement of wildlife from core to other zones. Wildlife habitats like grassland and open forest patches are designated as transition zone. The areas are equally significant for wildlife diversity and richness to that of core zone but it involves time bound human interferences like management of grass lands in summer and winter. Areas adjacent to settlements with time bound human interventions are considered for transition zone. This zone is important for the functionality of the core zone.

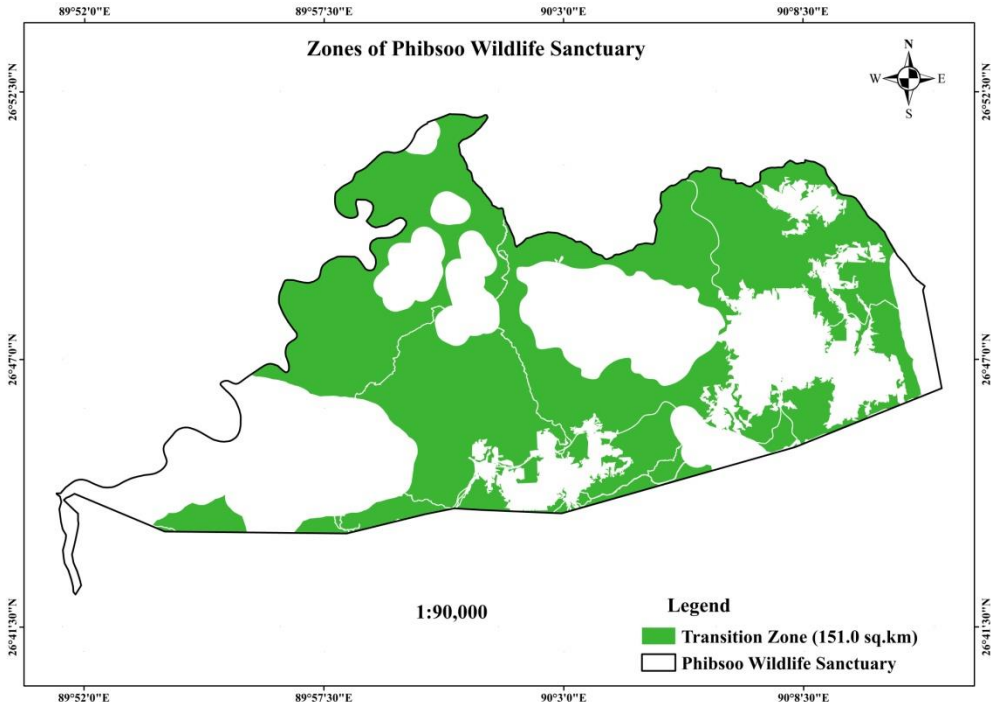


Figure 5: Transition Zone

1.4.3 Buffer Zone

An area of 35.8 sq. km has been designated as buffer zone (Figure 6). The buffer zones provide cushioning to the core and transition zone from human interferences. Multipurpose use zones which include settlement areas, community forest, local forest management and resources allocation sites are buffered with 500m radial distance to either side of boundary. Roads connecting Singye to Phibsoo has been buffered 50m on both sides of farm roads measured from the center of the road. The patrol routes and foot trails in PWS are buffered with 20m buffer from the center for trails.

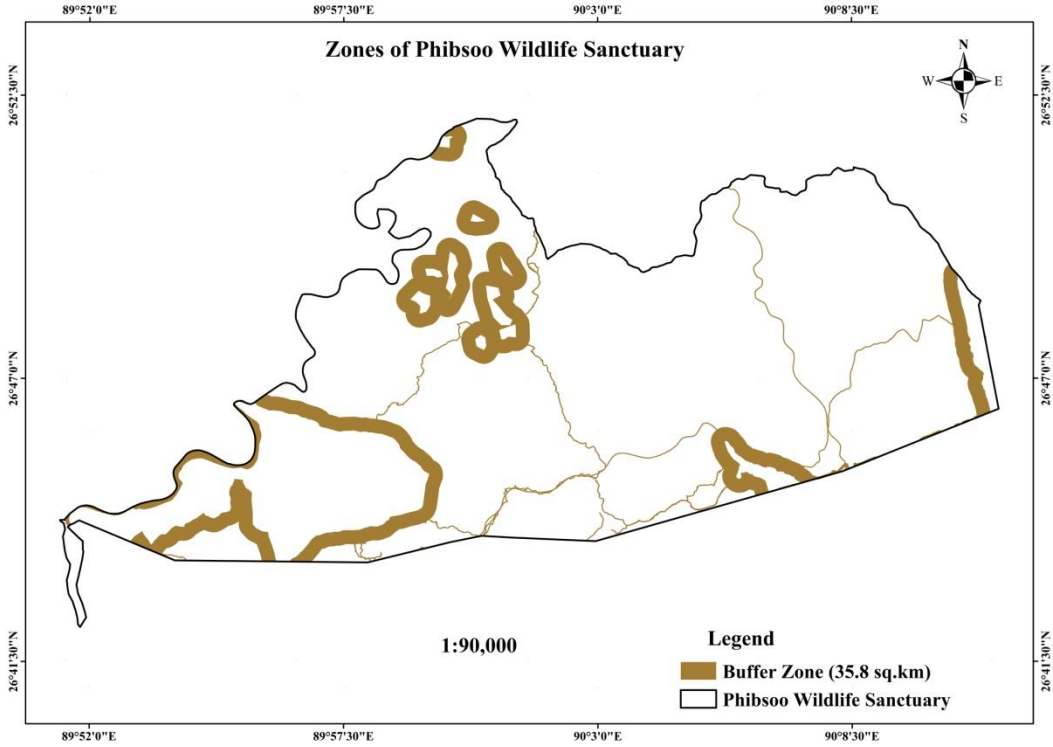


Figure 6: Buffer Zone

1.4.4 Multiple-Use Zone:

Multiple use zones in PWS include settlement areas, resources allocation sites, Community Forest (CF) and Local Forest Management Area (LFMA). An area of 37.01 sq. km has been designated as multipurpose use zone in the wildlife sanctuary (Figure 7). Areas for resource allocation (collection of fuel wood, timber, stone, sand, soil, grazing, etc.,) to meet the demand of the residents, areas for ecotourism and recreational purposes, areas for construction of transmission lines, road, government institutions and other developmental activities that involves leasing of State Reserved Forest Land (SRFL), agricultural farmlands and communal land and existing camping sites or potential camping sites.

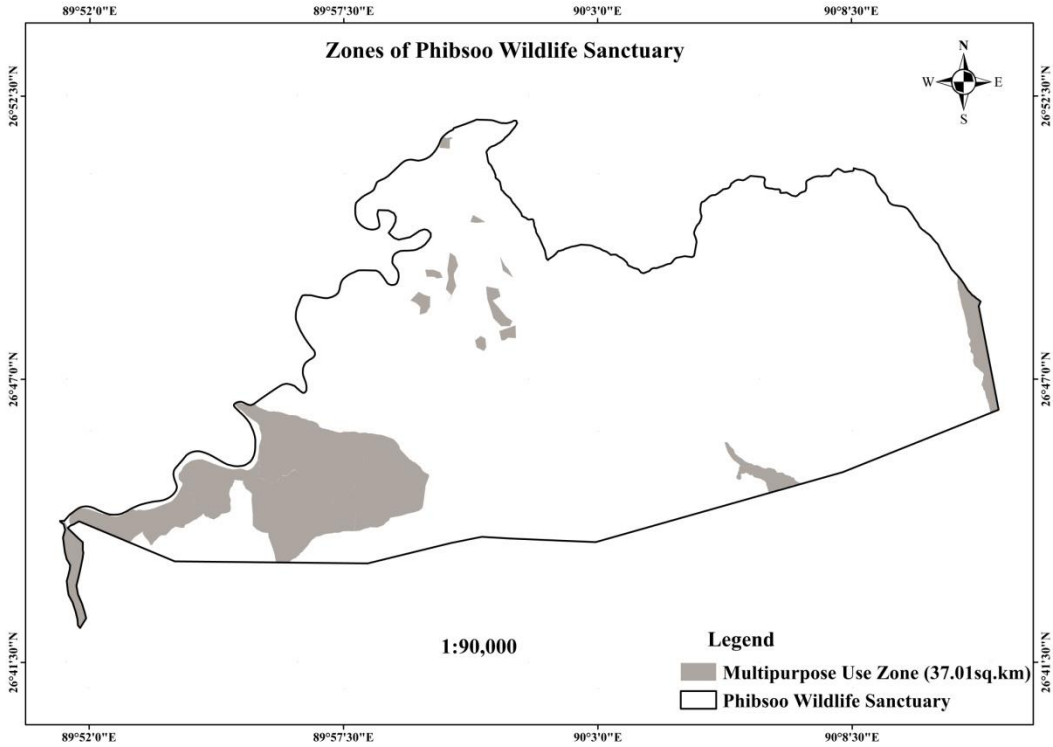


Figure 7: Multiple use zone

Chapter Two

Current Status of PWS

2.1 Landscape Characteristics

PWS shares the fertile soil of southern Bhutan with loamy and sandy loam soil covering the entire region. It is situated along the foothills and represents the subtropical landscape ecosystem of the country (Grieson, 1983). Falling under humid subtropical climate of the country, it experiences hot summer and moderately cold winter ranging its elevation from 65masl -1800masl. It is also known for the lowest recorded elevation range in Bhutan at Nichula gewog under Dagana Dzongkhag. PWS receives incessant summer rainfall which remains wet for the entire season while winter is often welcomed by dry and sunny weather (Figure:8).

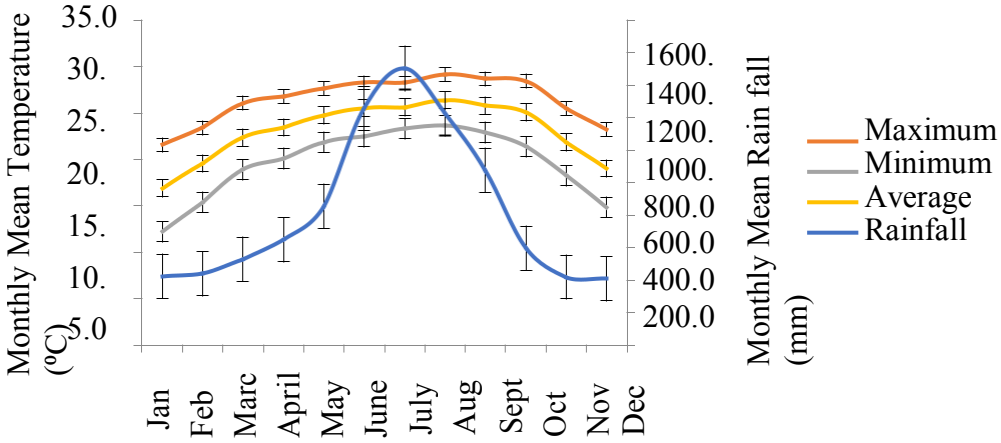


Figure 8: Graph Showing Monthly Mean Temperature and Rainfall

2.2 Hydrology and Water sources

The geo-physical features and biogeography elements within the PWS and adjoining landscapes are mainly forged by several perennial and seasonal rivers. These rivers namely; Singye chhu, Longa chhu, Pinkhawa chhu and Nichula chhu originate within the sanctuary. Sunkos River, which enters from mountainous terrains of adjoining district of Tsirang flows through sanctuary before entering the Indian state of Assam (Figure 9). These rivers swell during monsoon and shrinks to stream in winter. Overall PWS has water deficit in the winter as most of the rivers get dries up in the middle and lower plains. Rivers like Longa, Pinkhawa, Nichula and Puntsangchhu (Sunkosh) are critical habitat of the critically endangered White bellied Heron and Golden Masher. Water source survey in Nichula 2021, reported 23 numbers of water sources. It also results forest degradation, less rainfall, overgrazing, landslide and erosion and poor management as major source of water source drying. Waterholes are distributed in the wildlife sanctuary contributing to the functioning of ecosystem. It is densely distributed in lower foothills of the wildlife sanctuary.

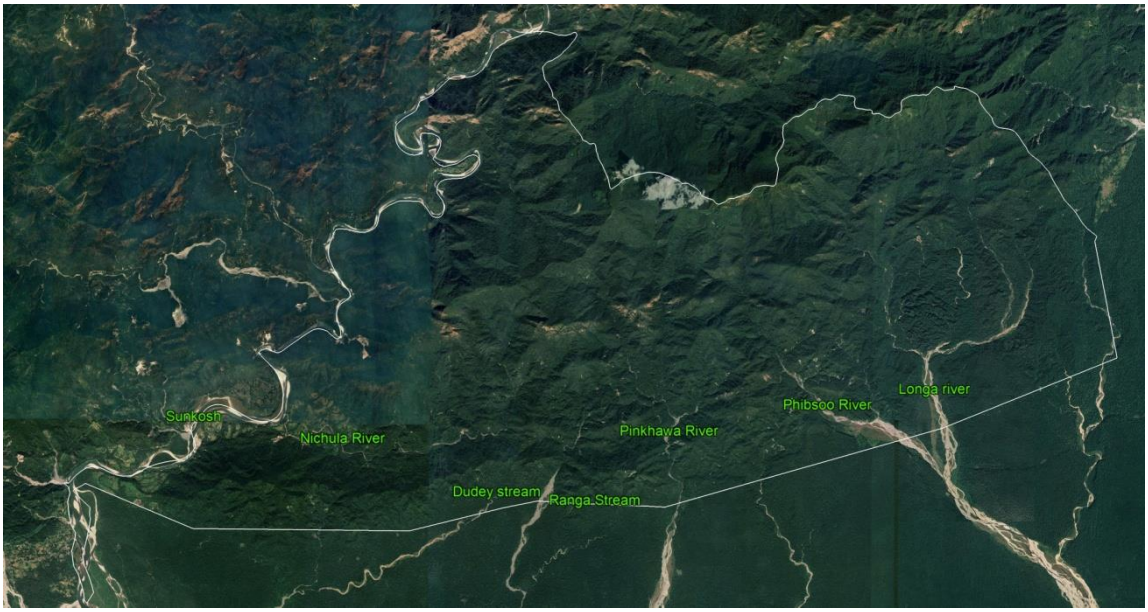


Figure 9: PWS Hydrological map

2.3 Floral Description

2.3.1 Forest Types

PWS straddles the Indo-Malayan bio-geographic realm and falls under the subtropical zone of Bhutan (75-2000m) with two different forest types, the sub-tropical forest and the warm-broadleaved forest (Figure 10) with forest as dominant land use land cover (LULC) (Figure 11).Subtropical forest ranges from 200-1000 m with dominant species such as *Acrocarpus fraxinifolius, Ailanthus grandis, Bombax ceiba, Crateva regiliosa, Dellinia pentgyna, Duabanga grandiflora. Gmelia arborea, Leea asiatica, Musa sp, Pandanus sp, Pterospermum aceriflolium, Shorea robusta* and *Tetremeles nudiflora.* Warm broadleaved forest ranges from 1000-1800masl includes species such as *Alangium chinensis, Bischofia javanica, Calicarpa arborea, Castanopsis indica, Cordia oblique, Dendrocalamus hookeri, Dichroa febrifuga, Engelhardia spicata, Macaranga pustulata, Maesa spp., Mussaenda roxburghii,Schima wallichii and Wandlandia sp.* The forest types along with their coverage are presented based on the elevation ranges (Table 2).

Table 2: Forest Types of PWS

Forest Type	Area (sq.km)	Altitude (masl)
Subtropical Forest	268.74	65-1000
Warm broadleaved Forest	18.09	1000-1738
Total Area	286.83	

Alluvial grassland occurs adjacent to the Longa, Phibsoo and Pinkhawa and Sunkosh rivers. These grasslands are very important to several wildlife species. Its management has been initiated in 50 hectors under Bhutan for Life (BFL) funding. Plantations dominated by teak (*Tectona grandis*) and Sal (*Shorea robusta*) comprise 4.5% of the area (1206.5 ha). The plantation area ranges from

3.5 ha to 1,169 ha were scattered along the international border forming modified habitat.

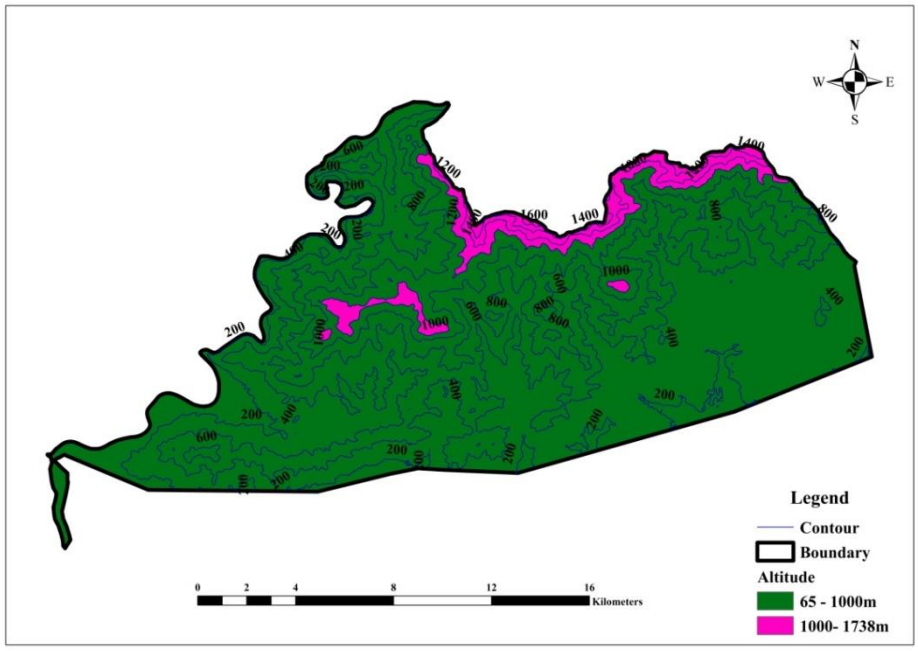


Figure 10: Forest type by Elevation:

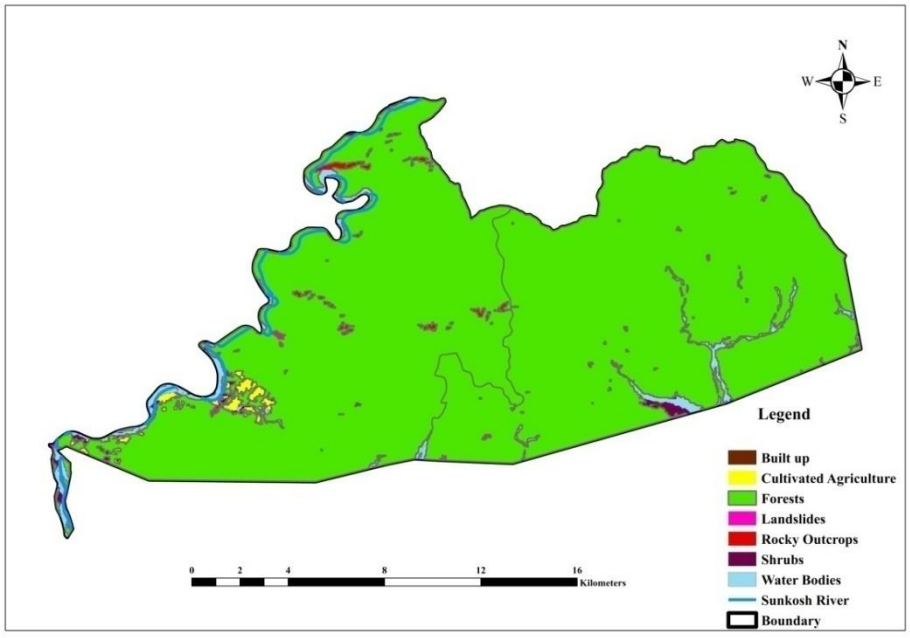


Figure 11: LULC of PWS

2.3.2 Vegetation survey and design methodology

Quantitative vegetation survey was done in 18 grids measuring 4x4 km with altitude ranging from 65-1738masl. A total of 54 plots with plot size of 12.62 m for tree and shrub layers, and herb of 0.57 m were assed. To understand the vegetation composition of grassland, systematic sampling was conducted in 75 hectors of grassland. A total of 48 sample plots were laid with sample distance of 150m. And surveys were compared in Block A and Block B. Within sample unit, tree vegetation was recorded in 20x20 meter quadrate with height greater than 1.3 meter. Ground cover recording was done in 2x2 meter quadrate following Bhutan Biodiversity Monitoring Protocol 2020. Relative abundance of trees and Shannon diversity (H') were compared in two blocks of grassland. Opportunistic surveys for orchids were carried out during wildlife surveys and Spatial Monitoring and Reporting Tool (SMART) patrolling. Sal survey was also carried out in 20 plots of 20x20m quadrate to understand its stem per hector and basal area.

2.3.3 Floral Diversity

Vegetation surveys recorded 358 species of plant belonging to 75 families. Total of 137 trees were distributed in 47 families (Figure 12), 81 shrubs in 30 families (Figure 13), 96 herbs in 31 families (Figure 14) and 44 orchids in orchidae family. *Acer oblongum, Syzygium jambosa, Aquillaria malaccensis* and *Shorea rousta* are rare. *Aquillaria malaccensis* is listed as Shedule I species in Forest and Nature Conservation Act of Bhutan, 1995.

Relative abundance of trees in 54 plots with sample size of 4x4 km, revealed *Walsura tabulata* as relatively abundant (8.96%, n=77), followed by *Persea* species (5.59%, n=48), *Schima wallichii* (4.89%, n=42), *Drypetes indica* (3.73%, n=32) and *Syzygium* species (3.61%,n=31) of the total (n=859) numbers recorded in 12.62m circular distance. Shannon's diversity of tree species resulted H'=4.1 and evenness E=0.86.Similarity index of trees were also compared using PAST software 4.01 for every tree species observed in the study area (Figure 15).Species curve of the trees in eighteen grids revealed fairly equal number of trees in every grids (Figure 16).

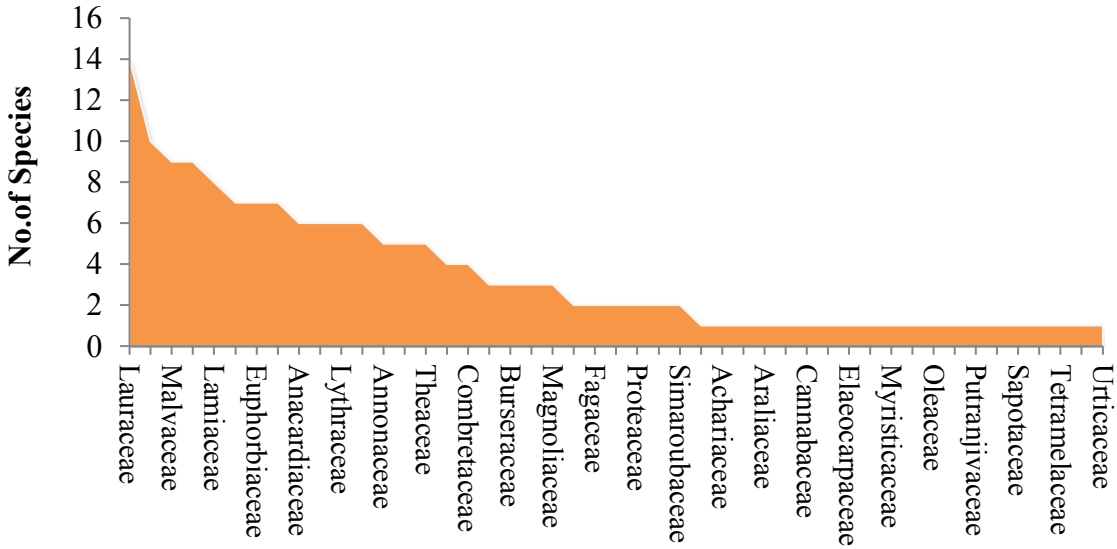


Figure 12: Family distribution of tree vegetation

Relative abundance of shrubs in 54 plots revealed *Phlogacanthus thyrsiformis* as relatively abundant (13.6% (n=2019), followed by *Chromolaena odorata* (10.7%, n=1593), *Polyganatum species* (9.4%, n=1397), *Psilanthus bengalensis* (8.4%, n=1250) *and Pogostemon bengalensis (*7%, n=1048) of the total (n=14897) numbers recorded in 12.62 m circular distance. Shannon's diversity of shrub species reveled H'=3.1 and evenness E=0.71.

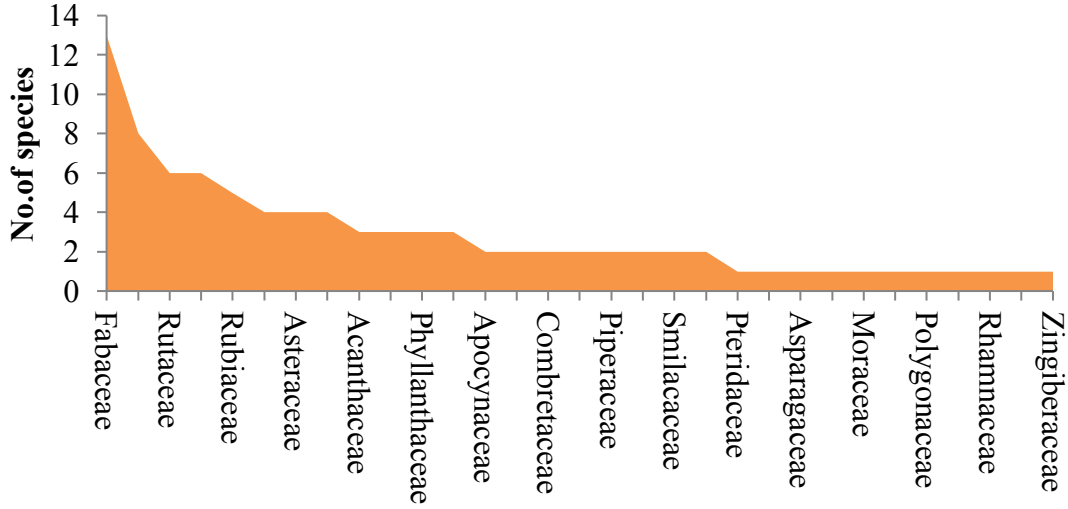


Figure 13: Family distribution of shrub vegetation

Relative abundance of herbs in 18 plots revealed *Polygonatum sp*. as relatively abundant (33.45%,n=199) followed by *Pogostemon sp.* (15.97%,n=95), *Digitaria sp.* (13.61%,n=81), *Pilea sp.* (12.27%,n=73) and *Strobilanthes sp.* (6.05% ,n=36) of the total (n=595) numbers recorded in 0.57m circular distance. Shannon's diversity of herb species reveled H'=2.1 and evenness E=0.69

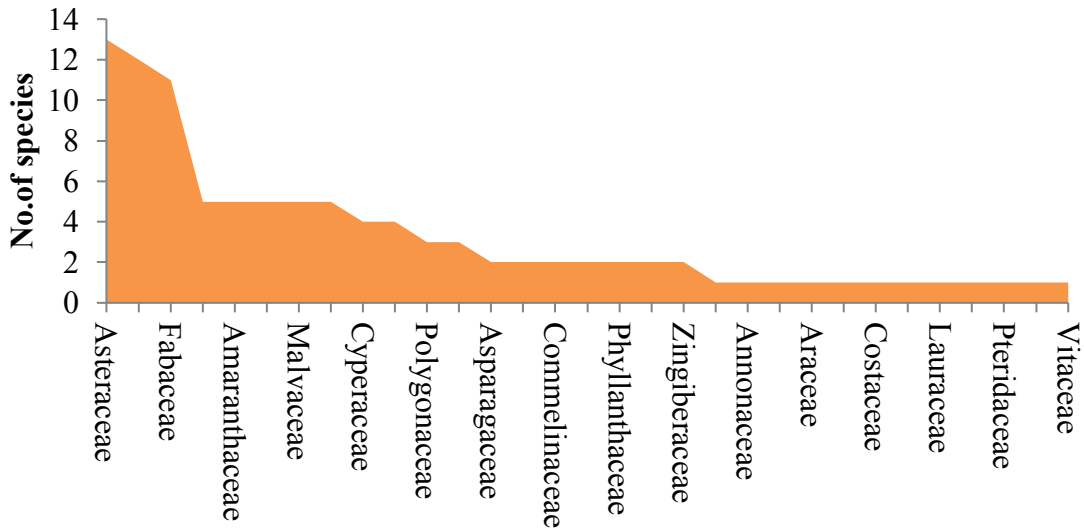


Figure 14: Family distribution of herb

Regeneration survey was conducted in 18 plots of 5.37m circular distance. 38 Quantitative regeneration survey has been conducted in 18 grids of 4x4 km. *Caesearia sp* was relatively abundant (17.45%, n=52), *Miliusa sp.* (14.77%, n=44), *Walsura tabulata* (12.75%, n=38), *Alchornea tilifolia* (11.41%, n=34) and *Phoebe lanceolata (*6.71 %, n=20) of the total (n=298) numbers recorded. Shannon's diversity of regeneration reveled H'=2.8 and evenness E=0.77.

In Block A of grassland, 35 different trees and shrubs species were recorded. Of 196 individuals counted, *Dalbergia sericea* was relatively abundant (n=45, 25%) followed by *Premna latifolia* (n=19, 9.69%) and *Flueggea virosa* (n=15, 7.65 %) Shannon diversity of Block A revealed H'=2.85 while evenness was E=0.8. Herb survey in Block A recorded 40 different species of 117 individuals counted. Relative abundance of the species are compared and results *Digitaris ciliaris* as

relatively abundant with (n=10, 8.55%) followed by *Chromolaena odorata* with (n=9, 7.69%) and *Achyranthes aspera* with (n=8, 6.84%). Shannon diversity revealed H'=3.39 with evenness E=0.96.

In Block B of grassland, 34 different trees and shrubs were recorded. Of 172 individuals counted, *Dalbergia sericea* was relatively abundant (n=40, 23.3%) followed by *Bombax ceiba* (n=34, 19.76%) and *Dalbergia sisoo* with (n=12, 6.97 %) Shannon diversity of Block B revealed H' =2.76 while evenness was E=0.78. Herb survey in Block B recorded 79 different species of 296 individuals counted. Relative abundance of the species are compared and revealed *Chromolaena odorata* and *Ageratum conizoides* as relatively abundant with (n=20, 6.75%) followed by *Mikania micrantha* and *Mimosa pudica* with (n= 13, 4.39%). Shannon diversity revealed H'=3.88 with evenness E=0.88.

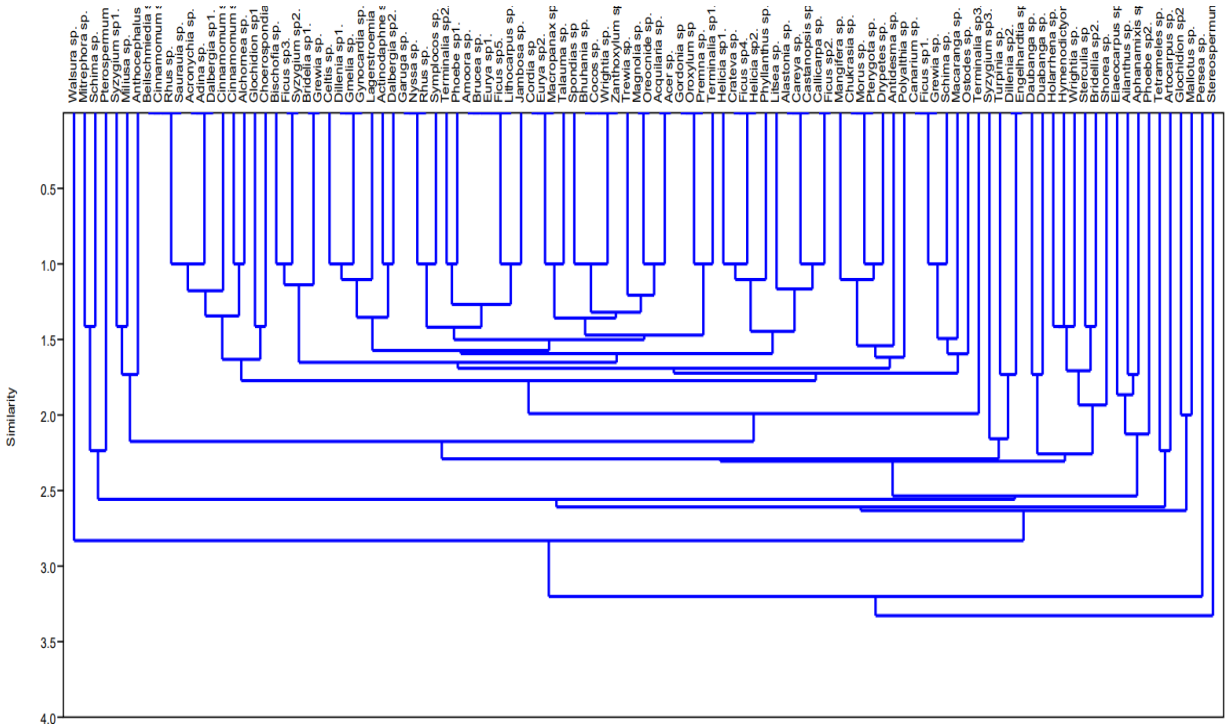


Figure 15: A cluster dendogram showing similarities of tree vegetation

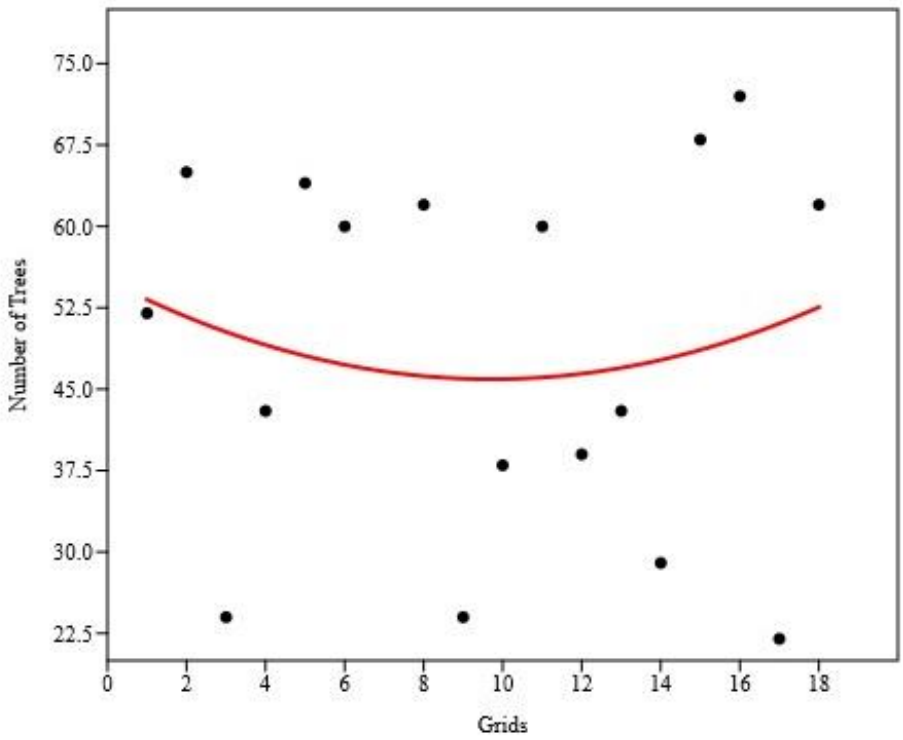


Figure 16: Number of Trees in different grids

2.3.4 Basal Area and Stem Density

A total of 70.83 m^2 of basal area (BA) was recorded in 18 grids of (4kmx4km). The highest BA (12.5 m^2) was recorded at grid 12 (948m) in subtropical forest while the lowest BA (1.16m^2) at grid 3 (466m) in subtropical forest (Figure 17). With total of 861 trees counted, the highest density was recorded in grid 16 with 72 trees per plot while the lowest at grid 17 with 22 trees per plot. Stem density of trees with diameter at breast height (DBH) class interval of 10cm has resulted inverse- J with decreases of stem with increase in DBH. Maximum density of stem was recorded in DBH class 10-20cm (Figure 18) indicating many of the enumerated trees are in pole stage. The mean height of the trees ranges from 9.9m to highest at 16.5 m (Figure 19). The trees in 18 grids result total growing stock of 982m^3. The highest growing stock was 189 m^3 recorded at grid 12 and lowest 11m^3 at grid 3 (Figure 20).

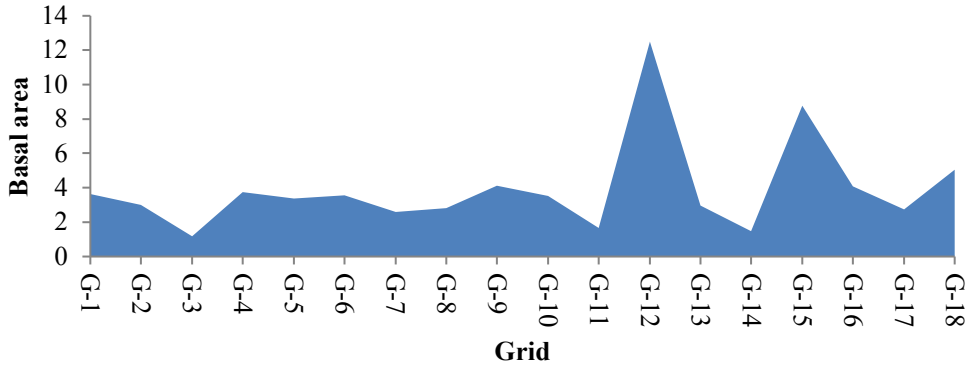


Figure 17: Basal area curve

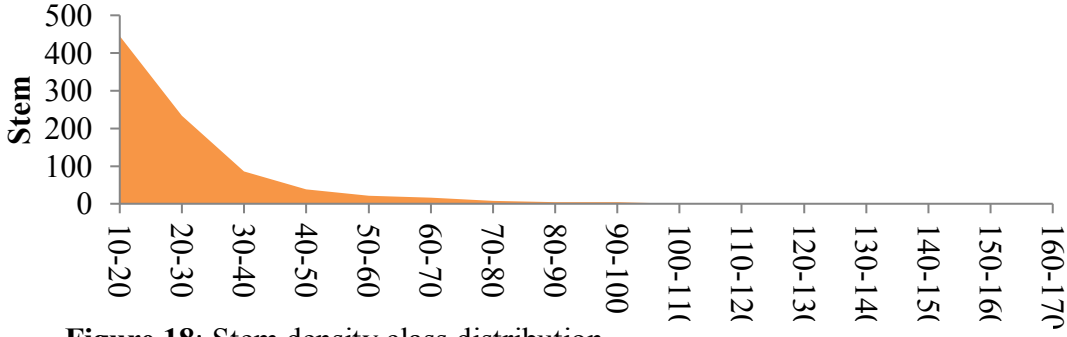


Figure 18: Stem density class distribution

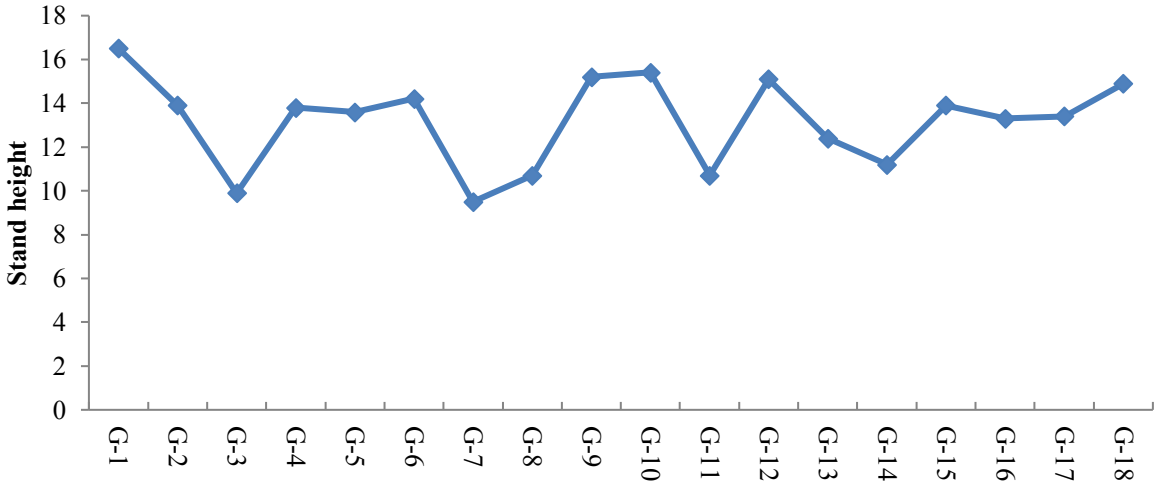
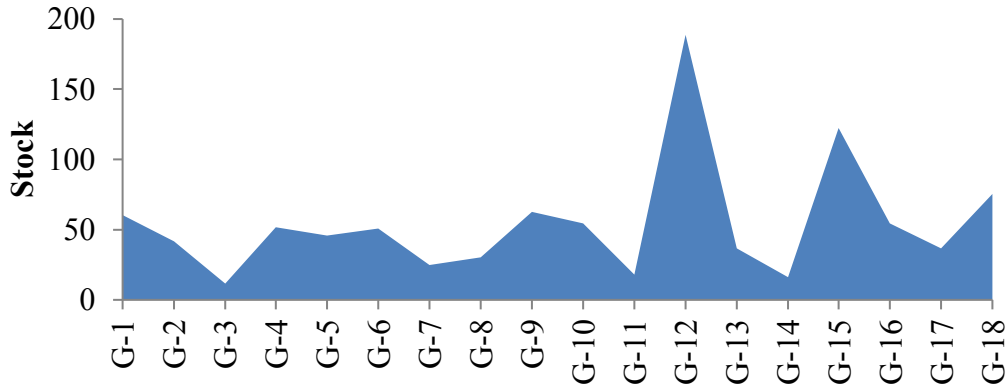


Figure 19: Stand height



2.3.5 Sal density and Basal Area

A total of 22 m^2 of basal area (BA) of Sal was recorded in 12 plots of (1.5 X1.5 km). However, no Sal has been recorded in remaining 8 plots of the study area. The highest BA (16.9m^2) was recorded in plot 16 while the lowest BA (0.1m^2) at plot 13 (Figure 21). With total of 53 trees counted, the highest density was recorded in plot 21 with 13 trees per plot. The survey covered with an elevation ranging from 203m to 657m.

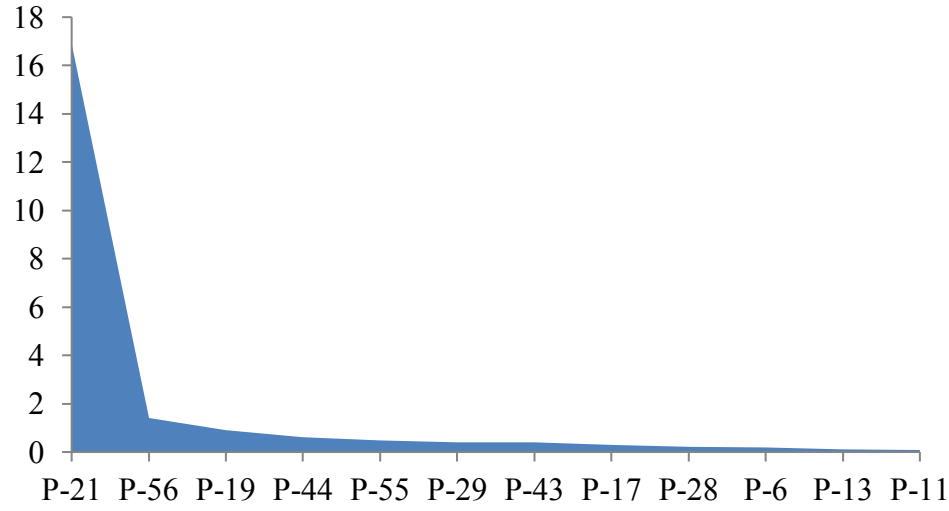


Figure 21: Basal area of Sal (Plot wise)

2.4 Faunal Diversity

Faunal diversity includes 36 mammals, 418 birds, 23 fishes, 177 butterflies and 60 species of herpetofauna (PWS, 2020). Birds contribute highest to the faunal diversity with 59% followed by 25% butterflies, 8% herpetofauna, 5% mammals and 3% fishes according to the latest rapid biodiversity assessment conducted in 2020.

2.5 Mammal

Intensive camera trapping from 2014 on annual basis recorded 36 species of mammals in the wildlife sanctuary (Annexure I). The most common recorded is the elephant (*Elephas maximus*) followed by Gaur (Bos *gaurus*) (ADB, 2018). Evidences from the rapid mammalian surveys suggested that there is a healthy prey such as gaur (*Bos gaurus*), spotted deer, barking deer *(Muntiacus mutjak*), sambar (*Cervus unicolor*), and wild pig (*Sus scrofa).* Abundance of prey correlates to increase in tiger numbers in the sanctuary. Till 2018, the successive camera trap survey revealed presence of only one tiger but with enhanced habitat management and anti-poaching activities tiger number increased to 7 tigers in 2021. PWS is now confirmed as tiger breeding site through camera trap pictures of lactating tigress with cub (Figure 22.). It is also home to six felid species in the country. Other predators like includes wild dog (*Cuon alpinus*) and Asiatic black bear (*Ursus thibetanus laniger*) and Bengal fox (*Vulpes bengalensis*). Overall PWS harbors about 17.5% of the country's mammal diversity and most of them being globally important (Figure 23).

Figure 22: Lactating tigress and Tigers with 3 cubs

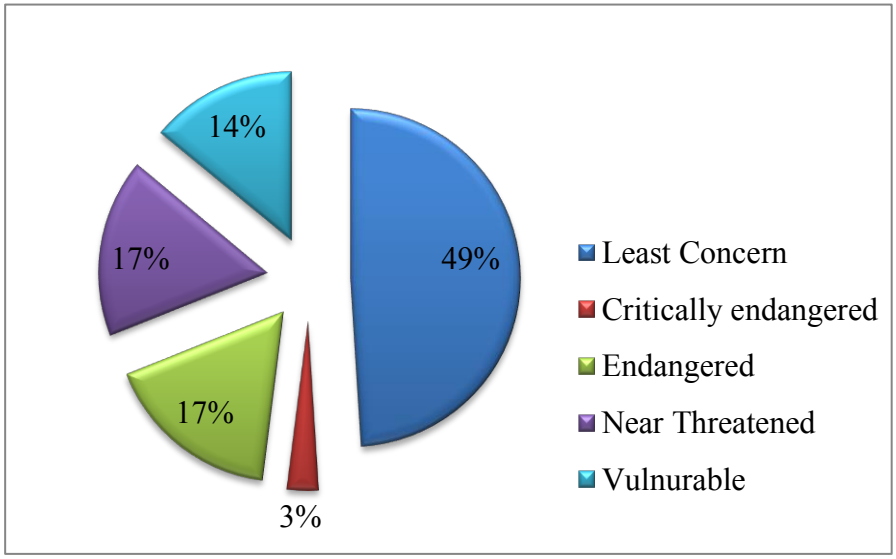


Figure 23: PWS Mammals as per IUCN status

2.6 Avifauna

Among faunal diversity 59% is avifauna and current status of bird record is 418 species belonging to 81 families. This is an increased of 83 species compared to 2010 record. Muscicapidae was recorded highest with 41 species followed by Accipitridae 22; Leiotrichidae 19; Cuculidae 17; Phylloscopidae 17 and Picidae 17 (Figure 24)

Among the new records 6 birds namely Pin-tail parrot finch (*Erythrura prasine)*, Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Isabiline shrike (*Lanius isabellinus)*, Brown Fish Owl (*Ketupa zeyloenensis)*, Indian Spot-billed Duck (*Anas poecilorhyncha)* and Short-tailed Shearwater (*Ardenna tenurostris)* are new records to the country (Wangdi &Tenzin, 2021; Phuntsho et al, 2022). Besides that, 2 species of birds White Cheeked Partridge (*Arborophila atrogulari)* and Great Slaty Woodpecker (*Mulleripicus pulverulentus*) are first pictorial records in Bhutan (Figure 25). PWS also harbors globally threatened birds such as Rufous-necked

hornbill (*Aceros nepalensis*) and critically endangered White-bellied Heron (*Adea insignis*) (Annexure II).

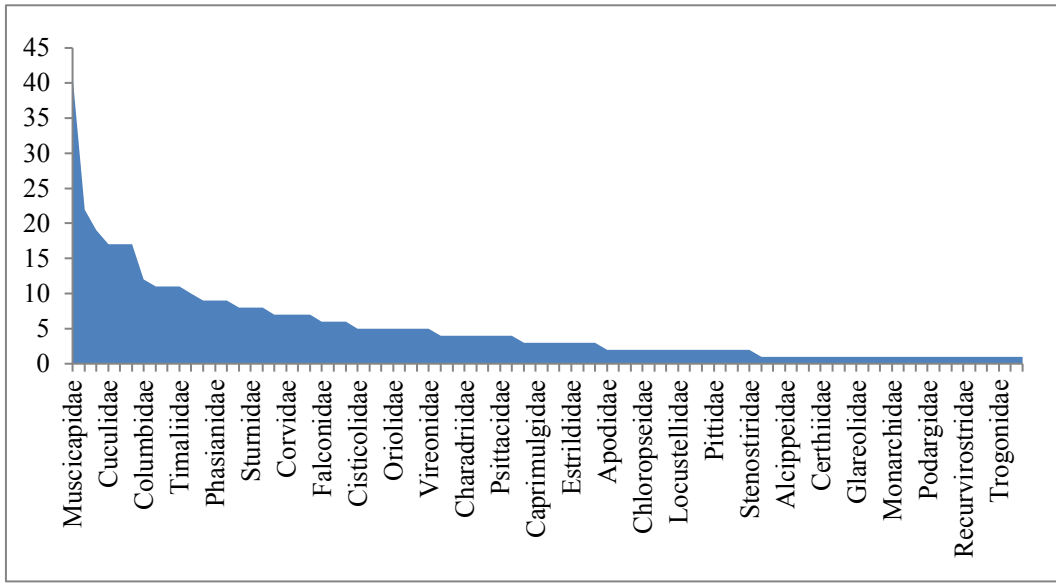


Figure 24: Bird diversity in Phibsoo Wildlife Sanctuary

(a): Great Slaty Woodpecker (Photo: Sonam Dorji)

(b)

(c)

(d)

(e)

(f)

(g)

Figure 25: : New record of birds in the country from PWS (a) Great Slaty Woodpecker (b) Pin-tailed Parrot finch, (c)Isabelline Shrike, (d) Brown Fish owl, (e) Rusty-tailed Flycatcher, (f) Short-tailed Shearwater, (g) White cheeked Partridge

2.7 Herpetofauna

The rapid biological survey on herpeto-fauna in 2020 results 60 species (Annexure III) belonging to 16 families. The recorded species of Amphibians constitute Bufonidae (3 species), Dicroglossidae (3 species), Rhacophoridae (4 species) and Ranidae (5 species).

Serpentine fauna were represented by Colubridae (16 species), Lamprophiidae (1 species), Pythonidae (2 species), Typhlopidae (1 species), Elapidae (5 species) and Viperidae (3 species) while lizards, geckos, turtules and tortoise constitute Agamidae (2 species), Gekkonidae (3 species), Scincidae (4 species), Varinidae (3 species), Geoemydidae (4 species) and Testudinidae (1 species) (Figure 26). Study of serpentine in wildlife sanctuary reported serpentine faces threat from killing by people due to lack of knowledge on venom of snakes (Phuntsho &Wangyal, 2021).

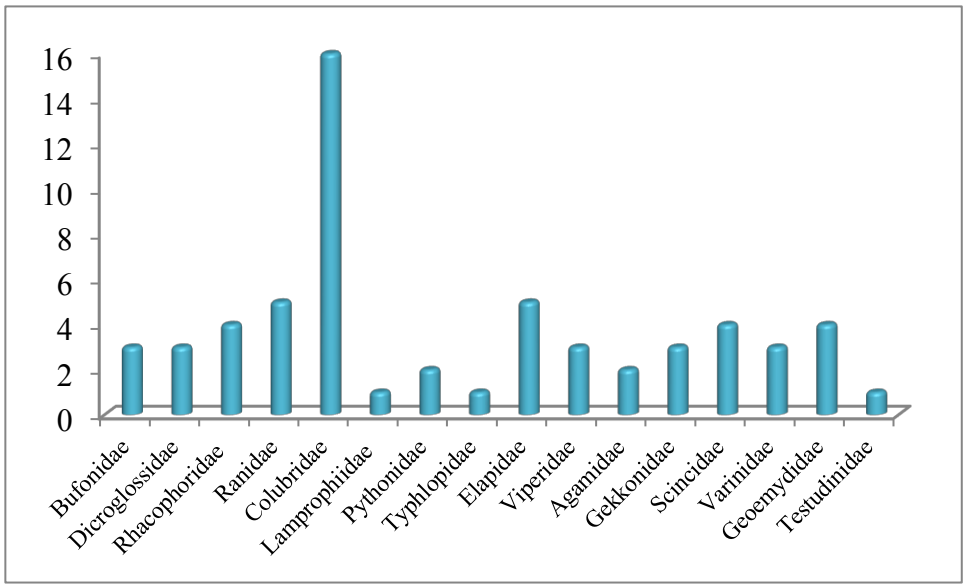


Figure 26: Herpetofauna diversity in PWS

2.8 Fish Diversity

Rapid fish survey conducted in 2020 has recorded 23 species (Annexure IV) of fishes belonging to 7 families. It consists of Badidae, Channidae, Cyprinidae, Cyprionodontidae, Mastacembelidae, Nemacheilidae and Siluridae (Figure 27). Moreover, PWS is home to golden mahseer (*Tor putitora*) in Bhutan.

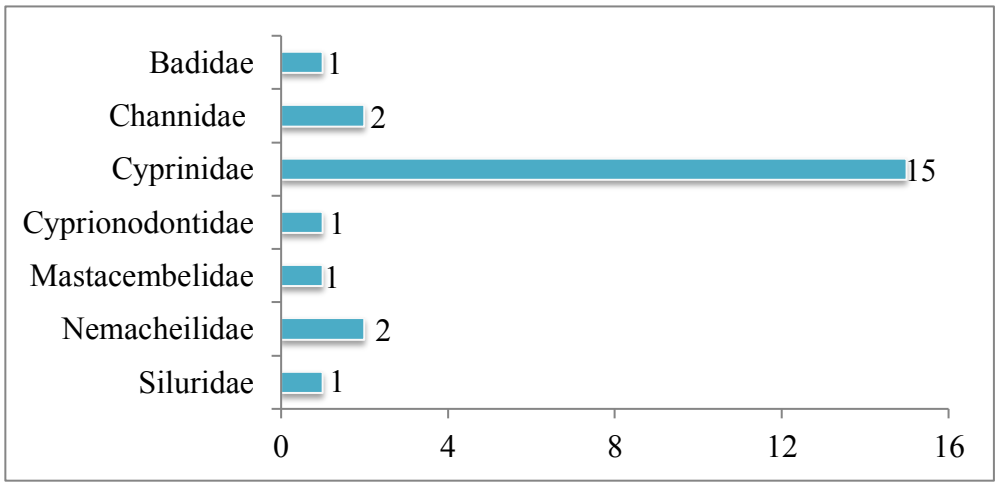


Figure 27: Fish Diversity

2.9 Butterflies

Rapid butterfly diversity conducted in 2020 recorded 177 species (Annexure: V) belonging to five families. Nymphalidae constitute 46% followed by Lycaenidae 18%, Pieridae 13% Papilionodae 12% and Hesperiidae 11% (Figure 28).

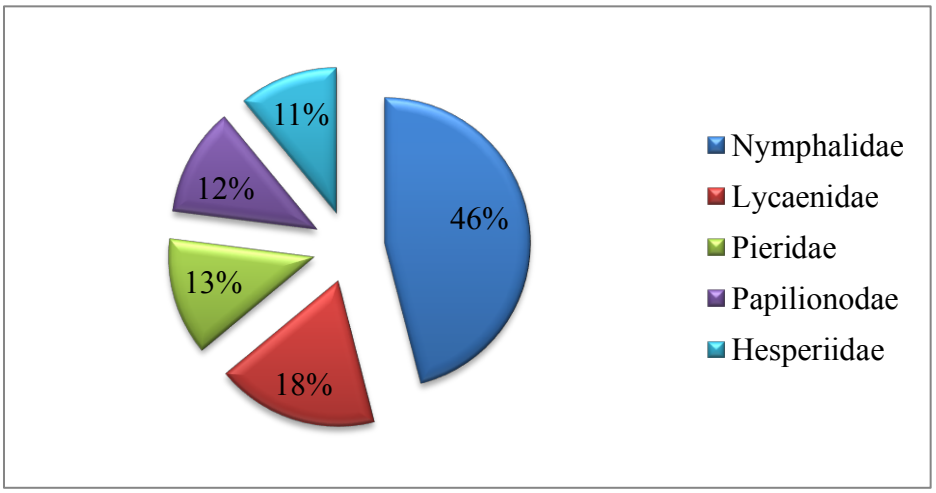


Figure 28: Butterfly Diversity

2.10 People and Livelihood

2.10.1 General Description

The policy of the Royal Government of Bhutan is to allow local communities those who are legally settled in and around the protected area to live and have right and access to the resource in line with the Forest and Nature Conservation Acts (FNCA) & rules (WCD, 2010). Like other protected areas in Bhutan, PWS also host local communities that co-exist and have been a part of ecosystem of the sanctuary. However, unlike most of the protected areas in the country, PWS has relatively low density of settlement inside the sanctuary.

The socio-economic survey carried out in 2017 listed 21 villages with population of 2981, of which 35.4% dwell inside the sanctuary (Table 3) and 64.6% adjacent to PWS. These populations interact constantly with forest ecosystem and primarily depend on forest produces such as timber, fuel wood, and grazing and NWFP collection. Around 151 households with population of 1032 that dwell in the periphery also depend on PWS for timber, fuel wood and grazing.

Table 3: Number of households and population in Nichula.

	Household			Population		
Chewog	**Resident**	**Gungtong**	**Total**	**Male**	**Female**	**Total**
Dramzekesa	17	6	23	74	91	165
Damchuna	26	2	28	104	127	231
Yarpheling	6	20	26	113	112	139
Dangreybu	28	7	35	124	126	250
Gangtokha	25	14	39	139	108	247
Others	0	0	0	8	15	24
Total	102	49	151	562	579	1056

Table 4: Number of households and population in Singye

	Household			Population		
Chewog	**Resident**	**Gungtong**	**Total**	**Male**	**Female**	**Total**
Rishong	25	1	26	113	105	218
Yarpheling	82	0	82	239	235	474
Sangaythang	62	12	74	258	246	504
Nyenyul	52	10	62	167	163	330
Lhabtsakha	43	8	51	106	127	233
Others	0	0	0	77	89	166
Total	264	31	295	960	965	1925

2.10.2 Settlement

PWS located in southern Bhutan and the area extends in Dagana and Sarpang districts. A gewog each of the two districts namely Nichula of Dagana and Singye gewog of Sarpang falls under the jurisdiction. Major percentage of settlement falls in Nichula gewog with 151 household that is restricted to western most corner of the sanctuary. PWS part of Singye gewog currently has no settlement. Although there are about 10 registered land holders at Phibsoo and Pinkhawa, the settlement is abandoned since 1990s. Around 295 household existed adjacent to the sanctuary and depends on sanctuary for timber, fuel wood and grazing.

The common forms of land use in the sanctuary settlement area are Chhuzhing (Wetland), Kamzhing (dry land) and some orchard for areca nut and mandarin. The most dominant agricultural land use type is dry land (kamzhing), accounting for 57 percent of the total agricultural land in Nichula gewog and 58 percent in Singye gewog. Wetland (chhuzhing) comprises 41 percent of the total agricultural land in Nichula gewog and 30 percent in Singye gewog while cash crop land comprises 2 percent of the total agricultural land in Nichula gewog and 12 percent in Singye gewog. Average land holding per household is 2.25 hectares (ha) in Nichula gewog and 1.71 ha in Singye gewog.

2.10.3 Livelihood Source

2.10.3.1 Crop

The communities in the sanctuary mostly practice subsistence farming and depend on agriculture for their livelihood. Agriculture is primary source of the farmers and they cultivate paddy, maize, millet and buckwheat. Paddy and maize constitute principle staple crop contributing to 45 percent of the total agricultural production in Nichula and Singye gewogs. Cash crop like areca nut, mandarin (orange) and bananas are also grown along with vegetables like potato, ginger, spinach, radish, and pumpkin. Mustard is grown as oilseeds. Crop products make up a key source of cash income for the local communities. In 2008, the farmers in Nichula gewog earned Nu.1.9 million, while those in Singye gewog earned Nu.13.19 million selling crop products, mainly fruits and cereals.

2.10.3.2Livestock Rearing

Other than agriculture, livestock farming is also important component of the farming system. Most of the farmers in the sanctuary rear cattle, goat, pigs, horses and poultry mainly to supplement the diet and income. Very few farmers rear sheep for meat and wool.

Sale of livestock and livestock products are a major source of cash income. Much of the income comes from sale of dairy products. In absence of the mechanized farming, the farmers in PWS maintain cattle for draught power. The livestock census of Nichula and Singye Gewog are detailed (Tabled 5);

Table 5: Livestock population of Nichula

Sl. No	Livestock Type	Number
1	Jersey Pure	25
2	Jersey Cross	91
3	Mithun	3
4	Doethra-Dothram	879
5	Horse	12
6	Local Pig (Swine)	20
7	Poultry (local)	903
8	Poultry (Layer)	150
9	Caprine (Local Goat)	591
10	Caprine (Improved Goat)	6
11	Feline (Cat)	83
12	Canine (Dog)	76
13	Common Carp	4500
14	Grass Carp	6500
15	Bee Hives	53

2.11 Subsidized Timber Allocation Information

The communities depends on forest for most of their basic needs such as timber, NWFP and other resources like sand, boulders and gravels for their socio-economic development. PWS through Government to Citizen (G2C) caters and allocates as per the provision of FNCA and FNCRR ever since PWS got autonomy from Sarpang Territorial Division in 2014. As of 2020, 15400 cft of subsidized timbers were allotted for new construction and house renovation that benefited 39 households (Figure 29). Average annual firewood and fencing post is 108 m^3 and 253 numbers respectively.

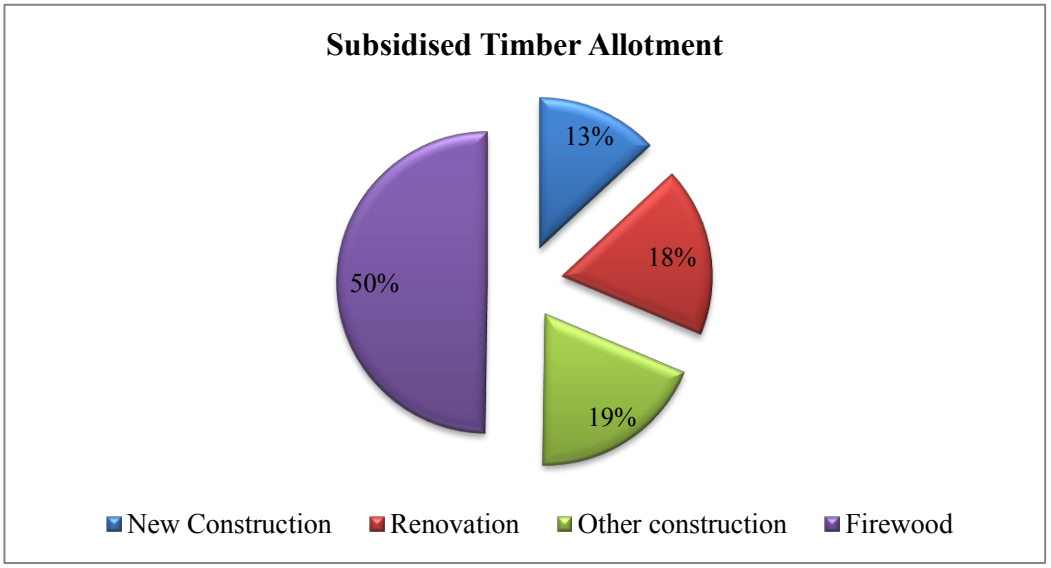


Figure 29: Subsidized Timber Allocation

2.12 Commercial Timber Allocation Information

PWS also allotted 68,381.3 cft of timber on commercial rate for developmental activities including new construction like office buildings, road and fencing of compound etc.

2.13 Non-Wood Forest Products (NWFP)

Non-Wood Forest Produce/Products are commonly used not only for consumption but also to keep up the traditional knowledge of healing. NWFP like pipla, ferns, cane, mushrooms, *Cinnamomum* plant roots, leaves and brooms are collected for domestic use on regular basis and there is no commercialization of the NWFP.

However, a NWFP Management group was formed with technical support from PWS basically as rural livelihood uplifting program. The group is formed by 46 household of Damchuna, Dramzeykesa and Yarphelling communities for sustainable

management of the NWFP resources in their area based on the approved Management Plan.

2.14 Traditional Practice and User Rights

The dominant community in PWS is *Lhotsampas* and practice Hinduism who also worship nature. People of Nichula practice tradition of conducting local rituals called "Devi Puja and Sansari Puja". They perform these pujas at water source and forest near rivers to appease the local deities for peace and prosperity to the community. Every community in Nichula gewog has their own sites for the rituals and it is conducted on annual basis.

2.15 Cowherds and Grazing Areas

Livestock rearing is another important farming of the sanctuary residents at Nichula Gewog. Improved pasture is almost nonexistent and free grazing in the forest is common practice. Cattles are herd in different cowherds at Dudey, Mawala and Chakramari. Annual livestock census 2019, Chakramari had 319 cattle belonging to 13 household; Mawla had 30 livestock belonging to 2 households. These grazing areas fall in the multipurpose and transition zones of PWS and the cattle owners do not have grazing ownership as required by law.

2.16 Forest Resource Area (CF, multiple use zones)

In order to encourage community to participate in the forest resources management and promote sustainable utilization of the resources Community Forest is encouraged to the sanctuary residents under the provision of FNCA and Rules. Two community forest management groups (CFMG) were created with technical support of PWS. In

total 703.96 acres of forest in Multiple Use Zone had been designated as Community Forest for the community of Dangreybu and Gangtokha under Nichula gewog.

2.17 Dangreybu Community Forest

Dangreybu Community Forest has an area of 345.80 acres was established and approved in 2019. It is managed by the CFMG of 29 households from Dangreybu community in accordance to the approved Management Plan.

The Dangreybu CF consist of good forest condition with average canopy density not more than 70% and the forest basal area of 12.5 m^3/ha. The CF consist tree species like Sal (*Shorea robusta*), Lampatey (*Daubanga grandiflora*), Tooni (*Tonna ciliate)*, Pakhasaj (*Terminalia tomentosa*), Angaray (*Phobe sp*), Lali (*Amaroo wallichia*), Latar, Champ (*Michelia champaca*) and siris (*Albizia species*).The community depends on forest area for timber, firewood, fodder, mushroom, bamboo and grazing. Annual Harvesting Limit (AHL) of Dangreybu CF is listed (Table 6).

Table 6: Annual Harvesting Limit of Dangreybu CF

AHL	Dangchung	Tsim	Cham	Drashing	Firewood
Total AHL	306	94	50	75	58
Annual Demand	0	0	30	47	29
Difference	306	94	20	28	29
Management options			Cham size to be retained to meet drashing over 10 years	Demand for cham and drashing will be met from it	

2.18 Gangtokha Community Forest

Gangtokha Community Forest with an area of 358.15 acres was established and approved in 2019. It is managed by the CFMG of 29 households from Gangtokha community in accordance to the approved Management Plan.

The Gangtokha CF consist of good forest condition with average canopy density not more than 70% and the forest basal area of 16.18 m^3/ha. The most dominant trees are Sal (*Shorea robusta*), Lampatey (*Daubanga grandiflora*), Tooni (*Tonna ciliate)*, Panisaj (*Terminalia tomentosa*), Angaray, Lali (*Amaroo wallichia*),Champ (*Michelia champaca*), siris (*Albizia species*) Jamuna, Khakar, Balay Champ and Borey. AHL of Gangtokha CF is also tabulated below (Table 7)

Table 7: Annual Harvesting Limit of Gangtokha CF

AHL	Dangchung	Tsim	Cham	Drashing	Firewood
Total AHL	80	66	71	60	278
Annual Demand	0	30	0	47	29
Difference	0	36	71	13	249
Management options		Demand for fencing post to be met from it.	Cham size to be retained to meet drashing over 10 years	Demand for cham and drashing will be met from it	

2.19 Local Forest Management Group

Recognizing the importance of the sustainability of the forest area and to cater the ever-increasing timber demand and other forest resources to the community outside the forest management regime, the Local Forest Management Plan (LFMP) was developed in line with the National Forest policy 2011. The Nichula LFMP with an

area of 1738.7 ha was developed and approved in 2021 with following main objectives.

- Sustainable management and utilization of forest outside existing management regimes.
- To meet timber, fuel wood and other forest produce demand of the communities outside the CF.
- To protect watershed, environment, wildlife and habitat.

The Nichula Gewog situated at the westernmost flank of the sanctuary depend on the forest area adjacent to their settlement. Currently there are 151 household with 1240 population that depends on the forest for their requirements like timber, firewood, fodder collection and NWFP collection and exerts pressure on the local resources from unregulated collection. In absence of motor-able bridge over Sunkosh, Nichula is cut off for resource transportation from outside and depend on area inside PWS. The important management regime including LFMG is mapped out (Figure: 30)

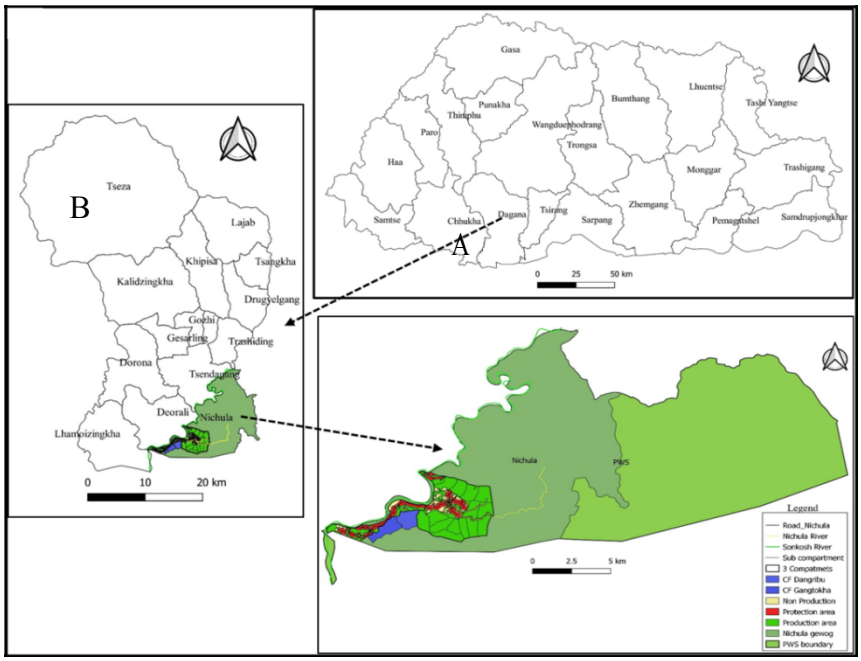


Figure 30:Gewog Location Map: (A); Bhutan map indicating Dzongkhags, (B); Dagana Dzongkhag indicating Nichula Gewog

The forest management area covers 1738.7 ha of forest land excluding areas which are inaccessible, far flung from settlement, slope exciding 45% and Community Forest area. Out of 1738.7 ha of LFMP, 72% of the LFMP area that comes around 1255.8 ha is considered as production area and remaining area non-production area (Table 8).

Table 8: Forest management area for LFMP

Area	Area in ha	Area in %
Non forest area	131.2	8
Protection area	279.4	16
Inoperable area	72.3	4
Total Non-production area	482.9	28
Total Production area	1255.8	72
Total LFMP area	1738.7	100.00

The Nichula LFMP consist of Subtropical Forest type and the area is commonly characterized by dense forest type and dominated by plants species such as *Bombax ceiba, Ostodes nudiflora, Mangifers spp., Ailanthus grandis, Daubanga grandiflora, Tetrameles nudiflora, Pterospermum acerifolium, Erythrina spp., Lagerstroemia spp., Gmelia arborea, Michelia Spp., Dillenia pentagyna, Oroxylum indicum, Schima wallichaii and Shorea robusta,* and weed species such as *Clerodendron spp., Mikania spp., and Chromonalena odorata*

The vegetation is mainly broadleaved with maximum of immature stands (43%) follow by young stand (34%), mature (21%) and mature (1%) of 100% natural forest. The condition of the forest is average to poor (64%) and (19%) respectively. Majority of the area has closure canopy with 45% and followed by open (34%). The average standing volume is 74 m^3/ha with the average basal area 11.1 m^3/ha.

The Non-Wood Forest Produce (Table 9) is found abundant in all area and it's managed by the NWFP user group.

Table 9: NWFPs occurrence and Important Forest Uses

NWFP	Abundant (%)	Sparse (%)	Forest Uses	Intensive (%)	Extensive (%)
Firewood	16	65.1	Grazing	27.1	52.9
Bamboo	4.5	19.6	Sokshing	0	0
Cane	12.2	8.3	Lopping	0	46.2

LFMP total area of 1738.7 ha is divided into three compartments and 19 sub-compartments for better management. LFMP Nichula is focused to meet the demand of timber, firewood and other forest produce for rural purpose. Simultaneously, maintaining the forest in good condition by implementing management intervention such as plantation and silviculture operations as per the forest condition is deemed necessary. Extraction is to be carried out to meet the average annual demand of 163.889 m^3 for rural construction and fencing purpose and for fuel wood (157.12m^3). Extraction will be guided by the established AAC of 775 m^3 with proper monitoring and records. Felling of only matured tree to be permitted under single tree selection system upon fully establishment of undergrowth.

2.20 Watershed management area

Nichula watershed covering an area of 2371 ha serves as critical water source to the communities of Nichula besides, being sources of various forest resources like timber and NWFPs (Figure 31). The watershed has more than 23 water source which supports 151 households of Nichula gewog. It source to drinking water purposes, irrigation and water for any developmental activities in the area. However, with rise in dependence on watershed for resource extraction, developmental activities and climate change, watershed has been impacted which requires intervention to protect for its future use.

Even though, some mitigation works like construction of drainage system along the roads were put in place by Nichula Gewog administration, other intervention measures like construction of retention walls, water tanks, flood protection works etc. has to be carried out in the watershed. The watershed management plan was developed through participatory process involving relevant stakeholders both in the field and at PWS. The plan development process started with scoping visits followed by consultation meetings and field assessments. Issues, causes, impact and intervention measures were collected during the consultation process. Extraction of resources, improper management of water sources, forest degradation, waste management and landslide are few pertinent issues in watershed. The issues were filtered using the log frame analysis tool and appropriate intervention activities were designed to address the goal and objectives of the plan.

Goal

- ✓ Nichula watershed actively managed to reduce human induce impacts and enhance watershed goods and services for continues supply of water to the communities.

Objectives:

- ✓ To mitigate degrading influences and improve watershed conditions
- ✓ To properly manage water sources in Nichula watershed
- ✓ To address waste management issues through proper coordination among stakeholders.

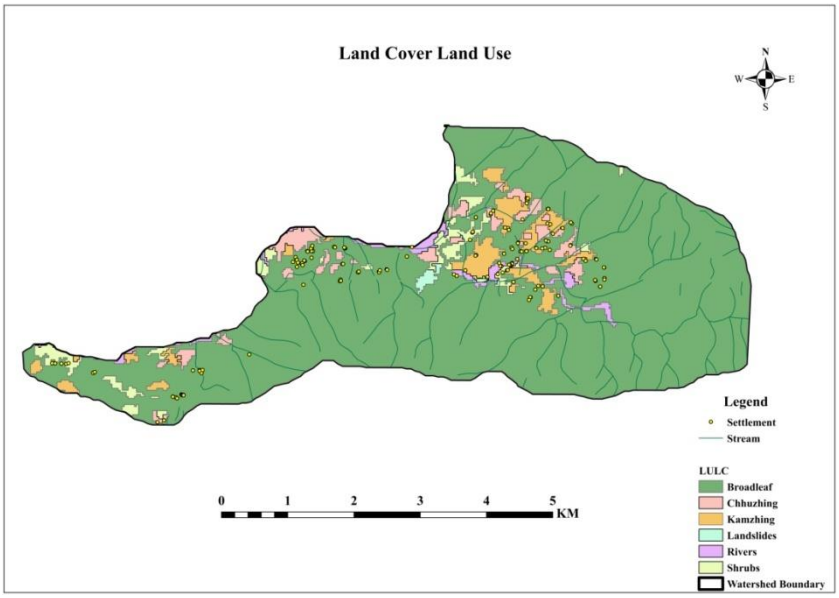


Figure 31: Nichula watershed and LULC

2.21 Administrative, Service delivery and Park Infrastructure

2.21.1 Administrative and Park Infrastructure

The current administrative and organigram set up of the PWS is in line with the organizational development exercise in 2020 (Figure 32). PWS has 4 technical sections, 2 administrative and Finance Section with 2 field Range offices and an Outpost office. The office is being assisted by 77 staffs at the moment (Figure 33).

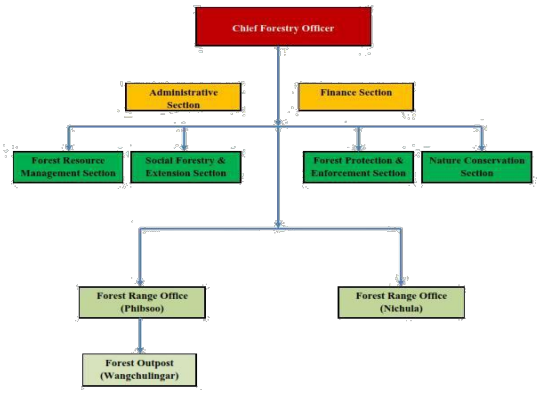


Figure 32: Organizational structure of Phibsoo Wildlife Sanctuary

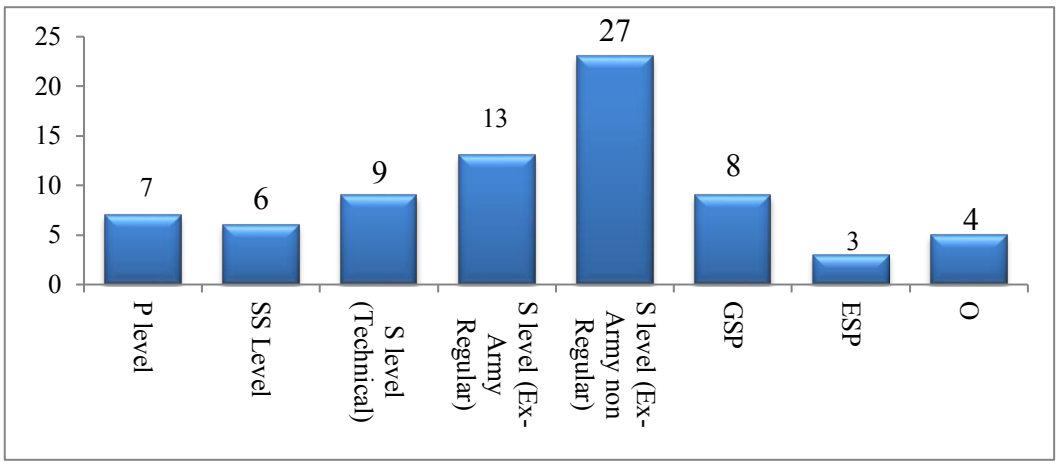


Figure 33*:* Current human resource strength

2.21.2 Service Delivery

PWS provides various services to the communities beside conservation of biodiversity. Services deliveries vary in terms of technical and nontechnical services. Technical service deliveries include allotment for forest produce through scientific management implementing silviculture system, creation of community conservation areas like CF, LFMP and NWFP areas. Beside those public service deliveries like providing of forestry clearance, general forest produces and timbers allotment, wildlife survey researches are carried out by the wildlife sanctuary. Non-technical service delivery includes human-wildlife conflict control activities, escort and duty at Phibsoo outpost.

Chapter Three

Review of Past Management Plans and Lesson Learnt.

3.1 Forest Protection

Poaching of wildlife and smuggling of timber had remained one of the most serious threats to conservation of biodiversity in the wildlife sanctuary. The intensity of wildlife poaching and smuggling of timber in borders have been the challenge of conservationist. Intense SMART have been carried out in wildlife sanctuary through increase of Rangers in both the ranges of wildlife sanctuary. Starting from 2017 to 2022 PWS has conducted 911 times of SMART patrolling. It includes 1483 days, 568 nights and distance of 15374 km. However, it has been learnt that joint and planned patrolling across the wildlife sanctuary is crucial in controlling the illegal activities.

3.2 Forest Management

Forest of PWS has been managed through allotment of timber, NWFP, sand and gravels and other forest produces in state reserve forest. However, with the establishment of community level forest management system, PWS has also started community forest, NWFP management areas and local forest management areas to allot forest resources.

3.3 Habitat Management

Habitat Management is important for species persistent and survival. Phibsoo wildlife sanctuary has been known for vast natural grasslands in Phibsoo outpost sharing the valleys till Pinkhawa. However, grasslands are often invaded by invasive species like *Chromlaena ordorata, Mikania micrantha, Sida acuata* and etc. Besides burning of invasive species, there wasn't any scientific management done in eradicating invasive species. Therefore, PWS with support from Bhutan for Life project has started to manage grassland through prescribe burning, enrichment planting and removal of exotic and prolific invasive species.

Saltlicks and waterhole enrichment activities were carried out since 2017 through constant monitoring and supplementing the salt in natural salt-lick areas. It has been

noticed that incidents of wildlife crop raids and HWC has decreased after habitat enrichment in natural saltlicks. Through the support of BFL project, artificial water holes have been created to reduce water scarcity problems to wildlife during winter. Even then, there are needs of expanding habitat enrichment through multiplication of artificial waterholes particularly in critical habitats where availability of water is still an existing issue. The waterholes and saltlick of wildlife sanctuary has been mapped to help in formulating habitat enrichment strategies in future.

3.4 Research and Monitoring

Ever since separation of PWS from Sarpang Forest Division, PWS has carried out various surveys and researches. Camera traps surveys on annual Tiger monitoring has started since 2014 which resulted into confirmation of presence of Tiger in the sanctuary. A male Tiger was recorded in 2014 and subsequently in 2020 two more male tigers were confirmed through camera traps (Table 10).Other researches like, national elephant surveys and spotted Deer surveys were conducted in the wildlife Sanctuary.

Table 10: Tiger Survey and Monitoring in PWS

Year	Method of Survey	Number of Tigers	Area
2014-2015	Camera Trap Survey	1	286.83 Sq. Km
2015-2016		1	
2016-2017		1	
2017-2018		1	
2018-2019		1	
2019-2020		2	
2021-2022		7	

3.5 Conservation Development Program

Various conservation development programs like supply of electric fencing, beekeeping facility, and public awareness were conducted with the residents of PWS. More than 40 km of electric fencing were initiated and maintained by PWS starting

from 2015. Since the HWC is the major challenge for residents solar fencing has been found to be most effective mitigation method while addressing this long prevailing issue. However, it is duplication of the activities of agriculture sector and hence all funding related to it diverted to agriculture sector. PWS focuses to enrich wildlife habitat through enrichment plantation in Nichula and Singye Gewog. Beekeeping is another trial activity initiated by PWS in Nichula gewog to drive elephant form the crop field. Even then there are needs to explore different local effective measure to mitigate HWC (**Table 11).**

Table 11: HWC Mitigation Activities carried out by PWS

Sl. No	Activities	Implementation Status
1	HWC Reduction	More than 40 Km electric fencing were initiated and maintained by PWS from 2015 to 2020. Moreover, Beeping was initiated in 2019 as mitigation measure to drive elephant form field.
2	Forestry	Established two community forest and a local forest management area at Nichula Gewog.
3	Habitat enrichment	Saltlicks and waterholes were enriched in natural saltlicks of Phibsoo and Nichula Range. Artificial waterholes were created and rehabilitated in Phibsoo outpost.
4	Environmental Awareness and Education	Various conservation awareness on importance of biodiversity, FNCRR, Waste was conducted in Nichula, Singye gewog and Schools in PWS.

Chapter Four

Threat Analysis

Conservation and management threat analysis forms an integral part of conservation management and planning. Threat ranking were also provided to prioritize strategic interventions.

4.1 Conservation Threats

4.1.1 Illegal Logging

Illegal logging or timber smuggling is another challenge of PWS. Though the wildlife sanctuary is known for natural Sal forest, natural agar wood and teak forest, its location to porous Indian border has heightened the risk in the conservation and protection of timber. More than 37 cases illegal logging has been encountered to SMART patrolling team in 2020 alone. SMART patrolling and joint patrolling along with arms forces are regularly being conducted to control the issues; however, it remains one of the challenges.

4.1.2 Fishing

Besides poaching and illegal logging, PWS has also challenges of illegal fishing issues. Though illegal fishing by residents under the wildlife sanctuary is very minimal, there are issues of illegal fishing by cross-border intruders who not only disturb the river bodies but also poison the river. More than 20 cases of illegal fishing were recorded through SMART since 2020. Therefore, it has been one of the main issues faced by the management.

4.1.3 Human-Wildlife Conflicts

Interactions with local communities during the PWS socio-economic survey in 2017, resulted crop depredation by wildlife as the farming challenge. 129 households in Singye gewog and 80 households in Nichula gewog reported that farmers lost crops to different wildlife in the last three years. Elephants, Wild pigs, Barking deer, Peafowl, Hare, Monkey, Porcupine, Hog Deer, Spotted Deer, Jungle fowl and Samber Deer are the crop raiders of Nichula (Figure 34) and Singye gewog (Figure 35).

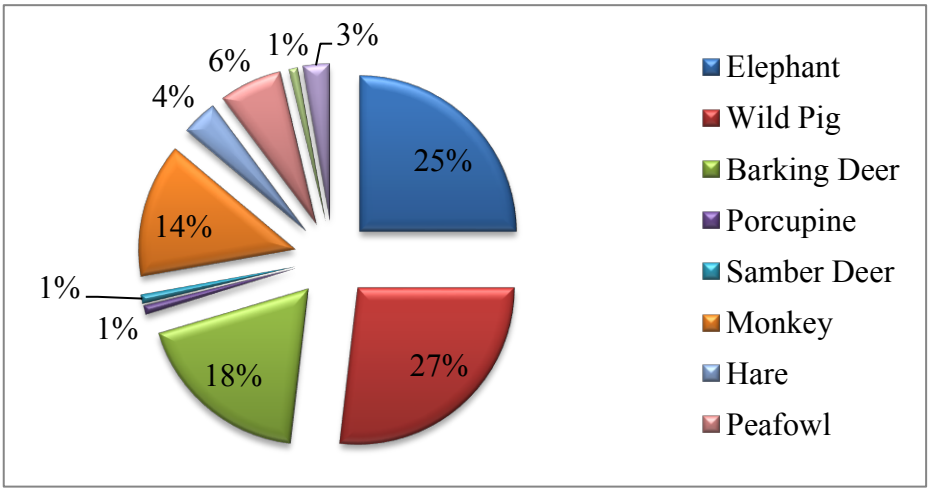


Figure 34: Crop Raiders in Nichula

In Nichula gewog wild pigs accounts for highest crop raiders with 27%, Elephant 25%,Barking Deer 18% Monkey 14%, Peafowl 6%, Hare 4%, and Spotted Deer 3% while Porcupine, Samber Deer and Jungle fowl account to 1% as crop raiders. Whereas in Singye gewog wild pigs account for 37%, Elephant 25%, Barking Deer 14% Monkey 3%, Peafowl 15%, Hare 4% and Porcupine 2% as crop raiders.

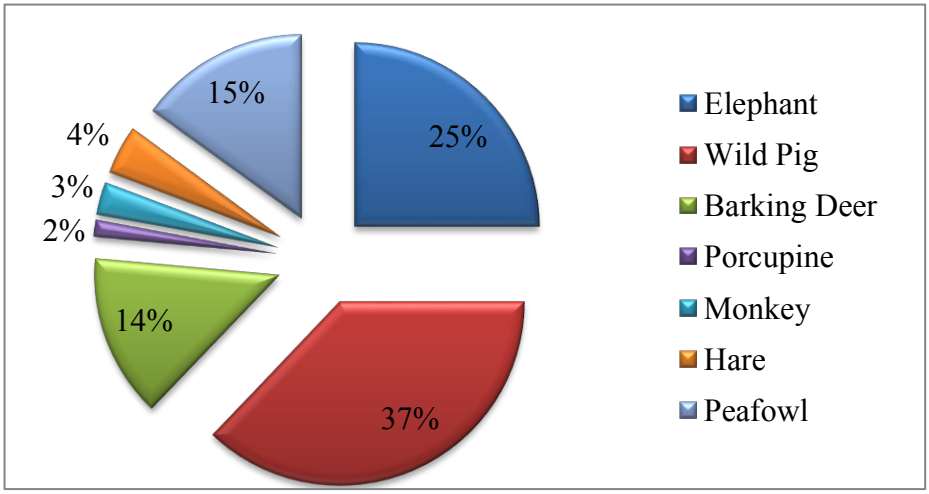


Figure 35: Crop Raiders in Singye

Socio-economic survey 2017, resulted leopard being highly problematic contributing to livestock depredation accounting to 77%, Dhole 12%, other cats 4%, Python 3%, Jackle and Tiger 2% (Figure 36). Mitigation of HWC involves certain management challenges. There is a challenge for the sustainability of funds for regular maintenance of materials like solar fencing. Since it duplicates the work of gewog agriculture section, the fund is being diverted to the section and gewog. Therefore, it will be a challenge for PWS management for sustainable maintenance. Another important challenge for the management is the lack of ownership from the community towards facilities provided by the management. Solar fencing has been kept without maintenance and care. The community lack sense of belongingness for the works done by the management. Coordination among different agencies for HWC mitigation is another challenge. Therefore, HWC/conservation advocacy, mitigation measures (solar fencing, bio fencing), habitat hanagement, rapid response team formation, capacity development, providing HWC response equipment, revamping of crop and livestock insurance scheme, Providing HWC response equipment, providing alternative income-generating activities (NWFP product development diversification and facilitate marketing) and development of integrated mitigation for livestock and agriculture are imperative to address the conflict.

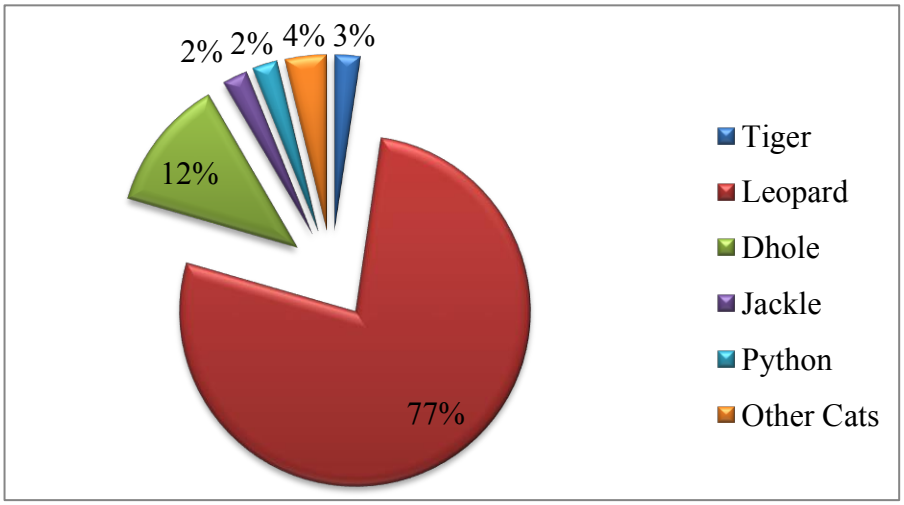


Figure 36: Livestock Depredation by wildlife in three years

4.1.4 Poaching

Poaching is a serious concern in PWS. The sanctuary harbors several species that are highly valued for their parts and products. Due to the porous international border, insurgency in the neighboring Indian state of Assam, proximity to regional wildlife trafficking routes, and the presence of a lucrative market for wildlife parts and products in the region make PWS highly vulnerable to poaching. In addition, adjacent Indian tribal communities, who have traditionally depended on game hunting and collection of non-timber forest products (NTFPs), are highly inclined to subsistence poaching in PWS. This is largely due to the increase in human population and consequent depletion of wildlife population in the neighboring Indian tribal areas. Poaching of wildlife is evident from the encounter of animal carcass and parts killed, camera trap images of wildlife poachers, camps and watch towers set by the poachers. Since 2017, more than 21 cases of poaching through indirect signs were encountered through SMART patrolling. A dearth of trained field staff and equipment for surveillance, communication, safety and defense, camping, and mobility make it difficult to combat poaching. In addition, the absence of a field-level anti-poaching coordination mechanism between Bhutanese and Indian authorities and the lack of regulatory procedures for dealing with poaching offenses by non-nationals impedes efforts to prevent and control cross-border poaching. Therefore, SMART patrolling intensification, enhancing trans-boundary Corporation and coordination, intervention of technology packages (real-time surveillance, poacher camera), formation of information network system and providing incentives, advocacy and capacity development which includes tactical patrolling, wildlife law enforcement crime scene investigation, first Aids and survival are crucial to address the threat.

4.1.5 Waste

Though awareness on waste management and cleaning campaigns are being conducted every month, the issues of waste still remain a challenge. The most serious waste issues arise in the border of Nichula where it shares the border with West Bengal,

India. However, counterpart talks and awareness were being conducted to reduce the issues of waste along the borders.

4.1.6 Invasive Species

Invasion of grassland in PWS is another challenge of PWS due to extreme characteristics of invasive (prolific seed dispersal, routing system, germination. The invasive species like *Chromolaena odorata, Mikania micrantha* and *Sida acuta* invades grassland inhibiting the growth of desired grass species. Surveys were carried out to understand the grassland ecosystem and ecology in PWS. It was carried out in 75 hectors of grassland which was divided into two blocks, Block A and Block B. The survey involves vegetation survey and regeneration survey. Trees and shrubs were studied in different blocks of grassland. 35 different trees and shrubs were observed in Block A, 34 species in Block B with 196 and 172 individuals respectively. Shannon diversity of Block A revealed H'=2.85, E=0.8, while for Block B H' =2.76 and E=0.78. For regeneration in Block A, H'=3.39, E=0.96 while in Block B, H'=3.88, E=0.88. The total individuals recorded were 40 species in Block A and 79 species in Block B. Therefore, grassland has been encroached with woody species beside palatable grasses. Study extent of invasive species and implement management intervention, revival of grassland (removal of invasive and woody species from natural grassland through prescribe burning and uprooting and introduction of native grasses are very crucial.

4.2 Management Challenges

4.2.1 Security Threats due to porous International Border

PWS in the last 10 years have been challenged with security threats from miscreants and militants costing the lives of Rangers. Even though Rangers are being equipped and well-trained in combating and facing the issues, the militants and insurgent problems remain unpredictable. Since 2000, rangers in PWS lost their lives on ambush to miscreants. Therefore, any operation of management activities requires escorting till

the completion of task. Resources including human are doubled compared to other protected areas due to the threat from poachers, miscreants and even through wildlife. Since the threat remains unpredictable, carrying out conservation activities as planned remains a challenge costing huge resources.

4.2.2 In-accessibility of area due to monsoon.

Unlike other protected area, PWS is operated with an outpost which is 25km away from HQ. The station is being connected by forest road which requires annual maintenance. Incessant monsoon leads to blockage of roads with flashfloods and erosion disconnecting the station. Swelling of rivers is frequent making it difficult to cross in summer. Therefore, rangers in outpost survive with limited food during summer. Besides that, SMART patrolling cannot be intensified as routes remains block during summer. As an intervention, patrol route connecting outpost has to be maintained yearly besides construction of different foot patrol routes.

4.2.3 Poor network connectivity

Mobile network in Phibsoo is only available in few fixed location. The wildlife sanctuary functions with the wireless communication systems which are also in the dearth of maintenance. Handsets and batteries get dead and require major maintenance and procurement. Therefore, alternatives on installation of network tower and proper repeater station are found crucial. Until then, the management will have communication challenge.

4.2.4 Lack of Electricity

PWS is only protected area without electricity connection in its field office especially at outpost. The outpost has been functioning without electricity since its initiation. Therefore, a proper energy source like solar system is found crucial and relevant.

4.2.5 Capacity development, Advocacy and Awareness

Capacity development to staffs, awareness and advocacies to public are crucial for the effective management of protected area. With different technical background to staffs with presence of uneducated army personal as ranger, regular capacity development

trainings and awareness are necessary. Besides that, far flung remote places like Nichula requires frequent awareness training programs.

4.3 Threat Ranking

Conservation threats have been ranked to see the intensity against each other. Illegal logging has been ranked high (n=5), followed by fishing (n=4), HWC (n=3), poaching (n=1), waste (n=1), grazing (n=) encroachment in grassland (n=1). The detail ranking has been provided in the table 12.

Table 12: Threat Ranking

Threats	**Poaching**	**Illegal logging**	**Fishing**	**Waste**	**Encroachment in grassland**	**HWC**
Poaching	X	Illegal logging	Fishing	Poaching	Encroachment in grassland	HWC
Illegal logging	X	X	Illegal logging	Illegal logging	Illegal logging	Illegal logging
Fishing	X	X	X	Fishing	Fishing	Fishing
Waste	X	X	X	X	Waste	HWC
Encroachment in grassland	X	X	X	X	X	HWC
HWC	X	X	X	X	X	X
Score	1	5	4	1	1	3

Chapter 5

Management Strategies

Strategies and actions (***management prescription)*** are defined based on the overall goal of the plan to achieve and maintain proper habitat, species conservation and enhanced social livelihood. These strategic actions will be to solve problems or overcome the barriers that prevent us from achieving the goals.

Goal 1: To enhance conservation of biodiversity and secure wildlife habitat

Strategy 1.1: Enhance scientific management of wildlife habitat

Action 1.1.1 Conservation of biodiversity and securing wildlife through habitat management activities:

i. Monitoring of natural grassland using biodiversity monitoring protocol
ii. Revival of Aldara lake in Nichula Gewog
iii. Rehabilitation of waterholes in PWS
iv. Removal of Invasive and woody species in grassland
v. Enrichment plantation in natural grassland
vi. Mineral composition study of saltlicks and enrichment.
vii. Carry out forest function mapping/recharge mapping in Nichula watershed.

Strategy 1.2: Zero poaching strategy adopted and strengthened

Action 1.2.1 Advocate communities and Local Government on forest and wildlife offence through following activities*:*

i. Implement SMART patrol for all forestry and conservation activities
ii. Procure patrol equipment (Surveillance cameras, real time surveillance cameras, poacher camera)
iii. Procure handsets and equip all range offices
iv. Maintenance of patrol routes connecting Singye and Phibsoo

Strategy 1.3: Intensify biodiversity and socioeconomic research and monitoring

Action 1.3.1 Develop conservation action plan for key species (spotted deer)

Action 1.3.2 Conduct annual tiger monitoring survey

Action 1.3.3 Study Predator-prey population dynamic

Action 1.3.4 Update checklist on butterflies, avifauna, herpeto-fauna, fishes, small mammal and orchids.

Action 1.3.5 Produce preliminary guide on moths, flowering plants and tree species

Action 1.3.6 Conduct socio-economic survey

Action 1.3.7 Revision of conservation management Plan

Goal 2: To enhance sustainable management and utilization of Natural Resources

Strategy 2.1: Enhance community base forest management

Action 2.1.1: Provide training, capacity development, technical inputs to communities on following activities:

i. Provide basic silviculture training like selection of trees for marking to CFMGs.
ii. Train CFMG, NWFP groups on record keeping, governance and leadership
iii. Facilitate establishment of nursery and maintenance to CFMG
iv. Create plantation and maintenance in CF
v. Carry out scientific thinning in CF
vi. Assist formation CFMG and NWFP network
vii. Annual and Mid-term monitoring of CF and NWFP groups
viii. Mid-term and terminal evaluation of CF
ix. Revision of NWFP management plan
x. Revision of CF management plan
xi.

Strategy 2.2: Enhance Sustainable Local Forest Management

Action 2.2.1 Implement LFMP plan and carry out following activities:

i. Carry out plantation in SFRL

ii. Carryout annual plantation maintenance in SFRL

iii. Carry out scientific thinning

iv. Develop annual operational plan

v. Annual and Mid-term monitoring LFMP

vi. Revision of LFMP

Strategy 3: Enhance Waste Management

Action 3.1 Initiate coordination and provide training among communities for effective waste management:

i. Conduct waste management advocacy programs to schools, communities and stakeholders.

ii. Community group training on development of biodegradable products and facilitate marketing

iii. Provide training to school/community group development of product from waste and facilitate marketing

iv. Procurement of machine/equipment for development of biodegradable product. Facilitate youth/community group in scrape dealing

v. Establishment of waste disposal and collection points at strategic location

vi. Install sinages at strategic locations

vii. Develop waste management SOP with picnic organizer at Nichula

Strategy 4: Promote alternative energy source

Action 4.1: Support and initiate following green energy sources in Phibsoo and adjoining communities

i. Support biogas programs at household level in collaboration with DoL
ii. Maintain solar lighting system and monitoring in Phibsoo outpost.
iii. Procure and install solar back-up system (HQ, ROs &POP)

Strategy 5: Build community and ecosystem resilience from climate induce threats

Action 5.1: Construction of retention wall in Nichula Range office to protect from landslide.

Action: Install weather station at Nichula range and Phibsoo Outpost.

Action: Support construction of common distribution and reserve tank in Nichula watershed area.

Goal 3: To mitigate human wildlife conflict and uplift rural livelihood

Strategy 3.1: Enhance Community livelihood

Action 3.1.1 NWFP product diversification and facilitate marketing

Strategy 3.2: Adopt HWC mitigation measures

Action 3.2.1 *Uplift rural livelihood through mitigation of HWC and initiate various activities*:

i. Develop rescue and rehabilitation facilities (transitional enclosure)
ii. Carry out HWC hotspot mapping
iii. Enhance beekeeping
iv. Establish and pilot bio-fencing
v. Install real-time surveillance camera in HWC wildlife entry and exit hotspots
vi. Support electric fencing in conflict hotspots
vii. Carry out habitat management

Strategy 3.3: Make PWS as ecotourism destination

Action 3.3.1: Implement various ecotourism activities as follows to make PWS tourist destination site.

i. Establish wilderness Safaris (Safari trails, watch towers, hide outs)
ii. Promote Singye home stays as ecotourism destination site
iii. Training on Safari management to PWS staffs
iv. Train community based nature guides
v. Establish rafting in to allow high-end fly fishing Nichula
vi. Establish community based recreational area (Service and infrastructure, game fishing).
vii. Establish soveinieer facility.
viii. Initiate adventure sporting facilities (zip line, Burma Bridge, rope climbing, canopy walk).

Objective 4: To enhance efficiency and effectiveness of Service Delivery

Strategy 4.1: Administrative and infrastructure developed for service delivery

Action 4.1.1: Carry out construction, maintenance and procurement of infrastructure for effective service delivery.

i. Construction of observation post or guard post
ii. Construction of visitor information center
iii. Construction of guest house
iv. Maintenance of offices
v. Maintenance of pool vehicle
vi. Procure Safari vehicle
vii. Procurement of office furniture
viii. Procurement of office equipment
ix. Establish and upgrade internet connectivity
x. Fix park boundary pillars

Chapter 6

Implementation plan and financial outlay

Financial supports are very crucial to fulfill the goals of management. PWS has been able to keep its ecological integrity, conserve its pristine Sal forest and make conducive environment for many keystones species like Tigers, elephants, WBH and etc, through financial support from government and various organization like, WWF Bhutan, BFTEC, RSPN and recently through BFL project.

The total budget outlay for 10-year conservation management plan period (2022-2032) is estimated at Nu. 127.6 million. Despite the approved funding support from BFL project estimated atNu.123.9m, a funding gap of 3.7m is estimated for which the management has to explore. The recurrent expenses like pay & allowances and management services will be met from RGoB funding based on the number of approved staff strength by RCSC and yearly budget allocation endorsed by the RGoB with 10% inflation consideration. In addition, an annual conservation operational plan should be developed based on the broad 10-year implementation plan period.

6.1 Implementation Framework

The implementation plan for the period of 10 years (2022-2032) was developed as per the ***implementation framework/format/Logical Framework*** (Table 13) with details including the required amount. The actions would be subjected for realignment when new issues and challenges, mitigation measures and threats are perceived. An ***Annual Operational Work Plan*** will be prepared and linked with ***Annual Performance Appraisal*** (APA) which will be based upon ***Five Year Plan*** of department and ministry.

Table 13: Logical Framework

Objectives	Strategy	Action	Budget (million) (Year)										
			Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10	Total
1. To enhance conservation of biodiversity and secure wildlife Habitat	1.1 Enhance Scientific management of Wildlife Habitat	Action .1.1 Conservation of biodiversity and securing wildlife through habitat management activities:											
		i. Removal of Invasive and woody species in grassland	1	1	1	1	1	0.6	0.6	0.6	0.5	0.5	7.8
		ii. Monitoring of natural grassland using biodiversity monitoring protocol	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2
		iii. Revival of Aldara lake in Nichula	0	0	1	0.5	0	0	0	0	0	0	1.5
		iv. Rehabilitation of waterholes	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2
		v. Enrichment plantation in natural grassland	0.2	0	0	0	0	0.2	0	0	0	0	0.4
		vi. Mineral composition study of saltlick and enrichment	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.2
		vi. Carry out forest function mapping in Nichula	0	0.5	0	0	0	0	0	0	0	0	0.5

		watershed											
		Action 2.2.1 Advocate communities and Local Government on forest and wildlife offence through following activities:											0
	1.2 Zero poaching strategy adopted and strengthened	i. Implement SMART patrol for all forestry and conservation activities	3	3	3	3	3	3	3	3	3	3	30
		ii. Procure patrol equipment (surveillance cameras, UAV, real time surveillance cameras, poacher camera).	2	0	0	3	0	0	3	0	0	0	8
		iii. Procure handsets and equip all range office	0	0.5	0	0	0	0	0	0.1	0	0	0.6
		iv. Maintenance of patrol routes connecting Phibsoo	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.2
	1.3 Intensify biodiversity and socioeconomic research and monitoring	Action 1.3.1 Develop conservation action plan for key species (spotted deer)	0	0	3	0	0	0	0	0	0	0	3
		Action 1.3.2 Conduct annual tiger monitoring survey	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8
		Action 1.3.3 Study Predator-prey population dynamic	0	0	0	0.1	0.1	0	0	0	0	0	0.2

		Action 1.3.4 Update checklist on butterflies, avifauna, herpeto-fauna, fish, small mammal, orchids	0	0	0.3	0.5	0	0	0	0	0	0	0.8
		Action 1.3.5 Produce preliminary guide on moths, flowering plants and tree species	0	0	0.3	0.2	0	0	0	0	0	0	0.5
		Action 1.3.6 Conduct socioeconomic survey	0	0	0	0	0	0	0	0	0	2	2
		Action 1.3.6 Revision of conservation management plan	0	0	0	0	0	0	0	0	0	0.6	0.6
2.To enhance sustainable management and utilization of Natural Resources	2.1 Enhance community base forest management	Action 2.1.1: Provide training, capacity development, technical inputs to communities on following activities:											0
		i. Provide basic silviculture training like selection of trees for marking to CFMGs.	0	0.1	0	0	0	0.1	0	0	0	0	0.2
		ii. Train CFMG, NWFP groups on record keeping, governance and leadership	0	0.1	0	0	0	0.1	0	0	0	0	0.2
		iii. Facilitate establishment of nursery and maintenance to CFMG	0	0.1	0	0	0	0.1	0	0	0	0	0.2
		iv. Assit plantation and maintenance in CF	0	0	0	0	0.1	0	0	0	0	0	0.1

		v. Carry out scientific thinning in CF	0	0	0	0	0	0	0	0	0	0	0
		vi. Assist formation CFMG and NWFP network	0	0	0.1	0	0	0	0	0	0	0	0.1
		vii. Annual and Mid-term monitoring of CF and NWFP groups	0	0	0	0	0	0	0	0	0.1	0	0.1
		viii. Mid-term and terminal evaluation of CF	0	0	0	0.1	0	0	0	0	0.1	0	0.2
		ix. Revision of NWFP management plan	0	0	0.1	0	0	0.1	0	0.1	0	0	0.3
		x. Revision of CF management plan	0	0	0	0	0	0	0	0.2	0	0	0.2
	2.2 Enhance Sustainable Local Forest Management	Action 2.2.1 Implement LFMP plan and carry out sustainable land management activities:											0
		i. Carry out plantation in SFRL	0	0	0	0	0	0	0	0.1	0	0	0.1
		ii. Carry out annual plantation maintenance in SFRL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
		iii. Carry out scientific thinning	0	0	0	0	0.1	0	0	0	0	0	0.1
		iv. Develop annual operational plan	0	0	0	0	0	0	0	0	0	0	0
		v. Annual and Mid-term monitoring LFMP	0	0	0	0	0	0	0	0	0	0	0

		vi. Revision of LFMP	0	0	0	0	0	0	0	0	0.5	0	0.5
	2.3 Enhance Waste Management	Action 1.3.1 Initiate coordination and provide training among communities for effective waste management:											0
		i. Conduct waste management advocacy programs to schools, communities and stakeholders.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1
		ii. Community group training on development of biodegradable products and facilitate marketing	0	0.3	0	0	0	0	0	0	0	0	0.3
		iii. Provide training to school/community group development of product from waste and facilitate marketing	0	0	0.3	0	0	0	0	0	0	0	0.3
		iv. Procurement of machine/equipment for development of biodegradable product. Facilitate youth/community group in scrape dealing	0	0	0.8	0		0	0	0	0	0	0.8
		v. Establishment of waste disposal and collection points at strategic location	0	0	0	0.1	0	0	0	0	0.1	0	0.2

		vi. Install sinages at strategic locations	0	0	0.1	0	0	0	0.1	0	0	0	0.2
		vii. Develop waste management SOP with picnic organizer at Nichula	0	0.2	0	0	0	0	0	0	0	0	0.2
	2.4 Promote alternative energy source	Action 1.4.1: Support and initiate following green energy sources in Phibsoo and adjoining communities											0
		i. Support biogas programs at household level in collaboration with DoL	0	0	0	0	0.4	0	0	0	0	0	0.4
		ii. Maintain solar lighting system and monitoring in Phibsoo outpost	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2
		iii. Procure and install solar back-up system (HQ, ROs &POP)	0	0	0	0	1	0	0	0	0	0	1
	2.5 Promote smart green infrastructure development	Action 1.5.1: Conduct assessment, advocacies, studies and development of HR Capacity.											0
		i. Develop HR capacity on smart green infrastructure	0	0	0.3	0	0	0	0	0	0	0	0.3
		ii. Conduct advocacy on smart green infrastructure principles to policy makers, LG, institutions, and communities.	0	0	0	0.2	0	0	0	0	0	0	0.2

		iii. Revival of natural waterholes through soil moisture and rain water conservation technology	0	0	0	0.1	0	0	0	0	0	0	0.1
	2.6 Build community and ecosystem resilience from climate induced threats	Action 2.6.1 Construction of retention wall in Nichula Range office to protect from landslide	0	1	0	0	0	0	0	0	0	0	1
		Action 2.6.2 Install weather station and Nichula Range and Phibsoo	0	1	1	0	0	0	0	0	0	0	2
		2.6.3 Support construction of common distribution and reserve tanks in Nichula watershed area	0	0	1	0	0	0	0	0	0	0	1
3. To mitigate human wildlife conflict and uplift rural livelihood	3.1 Enhance Community livelihood	Action 3.1.1 NWFP product diversification and facilitate marketing	0	0	0	0.1	0	0	0	0	0	0	0.1
	3.2 Adopt HWC mitigation measures	Action 3.2.1 Uplift rural livelihood through mitigation of HWC and initiate various activities:											0
		i. Develop rescue and rehabilitation facilities (transitional enclosure)	0	0	0.2	0	0.2	0	0	0	0	0	0.4
		ii. Carry out HWC hotspot mapping	0.1	0	0		0.1	0	0	0	0	0	0.2
		iii. Enhance beekeeping	0	0	0	1	0	0	0	0	0	0	1
		iv. Pilot bio-fencing in	0	0	0.5	0	0	0	0	0	0	0	0.5

		Phibsoo											
		v. Install real-time surveillance camera in HWC wildlife entry and exit hotspots	0	0	1	0	0	0	0	0	0	0	1
		vi. Provide technical support in HWC hotspot areas	0	0.1	0	0	0.1	0	0	0	0	0	0.2
	3.3 Make PWS as ecoutourism destination	Action 3.3.1: Implement various ecotourism activities as follows to make PWS tourist destination site.											0
		i. Establish Wilderness Safaris (Safari trails, watch towers, hide outs)	0	0.4	0.2	0	0	0	0	0	0	0	0.6
		ii. Promote Singye homestays	0	0	2	1	0	0	0	0	0	0	3
		iii. Training on Safari management	0	0.2	0	0	0	0	0	0	0	0	0.2
		iv. Train community based nature guides	0	0.2	0.2	0	0	0	0	0	0	0	0.4
		v. Establish rafting to allow high-end in fishing in Nichula	0	0	1	0	0	0	0	0	0	0	1
		vii. Establish community based recreational area (Service and infrastructure, game fishing).	0	0	0	1	0	0	0	0	0	0	1
		vii. Establish soveinieer facility	0	0	0	1	0	0	0	0	0	0	1

		viii. Initiate adventure sporting facilities (zip line, Burma Bridge, rope climbing, canopy walk).	0	0	0	0	2	0	0	0	0	0	2
4. To enhance efficiency and effectiveness of Service Delivery	4.1 Administrative and infrastructure development for survey delivery	Action 4.1.1: Carry out construction, maintenance and procurement of infrastructure for effective service delivery.											0
		i. Construction of observation post or guard post	0	0	0	3.4	0	0	0	0	0	0	3.4
		ii. Construction of visitor information center	0	6.5	0	0	0	0	0	0	0	0	6.5
		iii. Construction of Guest House	0	0	0	5	0	0	0	0	0	0	5
		iv. Maintenance of offices (all structures)	0	0	0	0	1	0	0	0	0	0	1
		v. Maintenance of pool vehicle		0.8	0.8	0	0	0	0.8	0	0	0	2.4
		iv. Procure Safari vehicle	0	0	0	3	0	0	0	0	3	0	6
		vii. Procurement of office furniture	0	0.5	0	0	0	0	0	0	0.6	0	1.1
		viii. Procurement of office equipment	0	0	0.4	0	0	0	0.7	0	0	0	1.1
		ix. Establish and upgrade internet connectivity		1	0	0	0	0	0	0.7	0	0	1.7
		x. Boundary pillar fixation	0.2	0	0	0	0	0	0	0	0	0	0.2
		Total	**8.9**	**19.5**	**20.6**	**26.3**	**11.1**	**6.2**	**10.2**	**6.8**	**9.9**	**8.1**	**127.6**

CHAPTER 7

Monitoring and Evaluation

Achieving management objective and strategies requires continuous monitoring and evaluation. The department of forest and park services will be the parent organization of PWS management authority in providing various technical inputs and putting regular system of technical and financial progress reports. The monitoring and evaluation will be part of management plan and based on its activities will be monitored and evaluated following the guidelines and requirement of PA monitoring framework (Table 14).

7.1 Monitoring

Monitoring provides a continuous assessment that provides detail information on progress of activities carried out in the wildlife sanctuary. It will also provide an insight on the status of ongoing activities and its implementation stage. It will determine if the outputs, indicators and activity planned has been achieved so that correct action can be taken to correct the deficiencies.

The monitoring in field will be done by implementers especially two range offices (Nichula Range &Phibsoo Range) with technical support from the management using PA Monitoring Framework.The monitoring aims to;

- ✓ Ensure effective monitoring and evaluation to address emerging conservation and management challenges.
- ✓ Provide a platform to ensure information and experiences are shared so that conservation strategies are fulfilled. And,
- ✓ Ensure inter and intra wildlife sanctuary coordination amongst different stakeholders for effective management of wildlife sanctuary activities.

7.2 Evaluation

It is an assessment initiative to understand the state of wildlife sanctuary and determine interventions that could be recommended to further enhance the management

effectiveness. It will assist in identifying whether the plan is being implemented effectively and goals are being fulfilled. Bhutan Management Effectiveness and Tracking Tool Plus (METT+) will be used to understand the management of Wildlife Sanctuary. It is an assessment tool designed to measure how effectively a protected area is managed. Therefore, the assessment of wildlife sanctuary will be based on the 35 questions of the Bhutan METT Plus. Its result will be the benchmark in monitoring the progress of wildlife sanctuary.

Table 14: Monitoring framework

Objectives	Strategy	Action	Output Indicator	Baseline	Unit	Yearly Target									
						Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10
1. To enhance conservation of biodiversity and secure wildlife Habitat	1.1 Enhance Scientific management of Wildlife Habitat	Action .1.1 Conservation of biodiversity and securing wildlife through habitat management activities:													
		i. Removal of Invasive and woody species in grassland	Invasive species removed and grassland managed	50	Hectare	50	50	50	70	70	70	70	70	70	70
		ii. Monitoring of natural grassland using biodiversity monitoring protocol	Grassland minitoring carried out	50	Hectare	50	50	50	70	70	70	70	70	70	70

		iii. Re vival of Aldara lake in Nichula	Aldara lake revived	0	Number				1						
		iv. Reh abilitation of waterholes	Waterholes rehabilitated	10	Number	10	10	10	10	10	10	10	10	10	10
		v. Enrichm ent plantation in natural grassland	Enrichment plantation in grassland carried out	0	Hectare	5				5					
		vi. Mineral composition study of saltlick and enrichment	Mineral composition study carried out	0	Number	1									
		vi. Car ry out forest function mapping in Nichula watershed	Forest function apping carried outin watershed area	0	Number		1								

		Action 2.2.1 Advocate communities and Local Government on forest and wildlife offence through following activities:													
	1.2 Zero poaching strategy adopted and strengthened	i. Implement SMART patrol for all forestry and conservation activities	SMART implemented in Range offices and HQ with total of 3000km yearly	15374	km	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
		ii. Procure patrol equipment (surveillance cameras, UAV, real time surveillance cameras, poacher camera).	Equipments procured for SMART implementation	0	Number	5			5			5			

		iii. Procure handsets and equip all range office	Handsets procured and distributed to all range office		Number	20						20			
		iv. Maintenance of patrol routes connecting Phibsoo	Patrol route maintained	25	Kilometer	25	25	25	25	25	25	25	25	25	25
	1.3 Intensify biodiversity and socioeconomic research and monitoring	Action 1.3.1 Develop conservation action plan for key species (spotted deer)	Action plan for spotted deer developed	0	Number			1							
		Action 1.3.2 Conduct annual tiger monitoring survey	Tiger monitoring carried out in 18 grids		Grids	18	18	18	18	18	18	18	18	18	18
		Action 1.3.3 Study Predator-prey population dynamic	Predator-prey population dynamic studies report produced		Report				1	1					

		Action 1.3.4 Update checklist on butterflies, avifauna, herpeto-fauna, fish, small mammal, orchids	Checklist updated	6	Number				6						
		Action 1.3.5 Produce preliminary guide on moths, flowering plants and tree species	Preliminary guide produced	0	Number			2	1						
		Action 1.3.6 Conduct socioeconomic survey	Socio-economic survey conducted	1	Number										1
		Action 1.3.6 Revision of conservation management plan	Conservation management plan revised	1	Number										1

2.To enhance sustainable management and utilization of Natural Resources	2.1 Enhance community base forest management	Action 2.1.1: Provide training, capacity development, technical inputs to communities on following activities:													
		i. Provide basic silviculture training like selection of trees for marking to CFMGs.	Silviculture training provided and number of communities trained	0	participants		20				20				
		ii. Train CFMG, NWFP groups on record keeping, governance and leadership	Number of participants CFMG,NWFP groups trained	6	participants		20				20				

		iii. Facilitate establishment of nursery and maintenance to CFMG	Nursery establishment facilitated		Number		2				2				
		iv. Assist plantation and maintenance in CF	Plantation and maintenance assisted in CF		Hectare					2					
		v. Carry out scientific thinning in CF	Scientific thinning carried out		Hectare	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
		vi. Assist formation CFMG and NWFP network	CFMG and NWFP network formed	3	Number			1							
		vii. Annual and Mid-term monitoring of CF and NWFP groups	CFMG and NWFP group monitored		Times	1	1	1	1	1	1	1	1	1	1
		viii. Mid-term and terminal evaluation of CF	Evaluation carried out	0	Number				1					1	

		ix. Revision of NWFP management plan	Plan revised	1	Number			1			1			1	
		x. Revision of CF management plan	Plan revised	2	Number								2		
	2.2 Enhance Sustainable Local Forest Managemen t	Action 2.2.1 Implement LFMP plan and carry out sustainable land management activities:													
		i. Carry out plantation in SFRL	Plantation carried out	2	Hectare								4		
		ii. Carry out annual plantation maintenance in SFRL	Maintenance carried out	2	Hectare	2	2	2	2	2	2	2	2	2	2
		iii. Carry out scientific thinning	Scientific thinning carried out	5	Hectare				5						

		iv. Develop annual operational plan	Operation plan developed	1	Report	1	1	1	1	1	1	1	1	1	1
		v. Annual and Mid-term monitoring LFMP	Monitoring carried out	1	Number	1	1	1	1	1	1	1	1	1	1
		vi. Revision of LFMP	Plan revised	0	Number									1	
	2.3 Enhance Waste Management	Action 1.3.1 Initiate coordination and provide training among communities for effective waste management:													
		i. Conduct waste management advocacy programs to schools, communities and stakeholders	Advocacies and awareness carried out	2	Number	1	1	1	1	1	1	1	1	1	1

		.												
		ii. Community group training on development of biodegradable products and facilitate marketing	Training conducted and marking facilitated	0	participants		20							
		iii. Provide training to school/community group development of product from waste and facilitate marketing	Training provided	0	participants			20						

		iv. Procurement of machine/equipment for development of biodegradable product. Facilitate youth/community group in scrape dealing	Machines procured	0	Number			1							
		v. Establishment of waste disposal and collection points at strategic location	Disposal site established	0	Number				5					5	
		vi. Install sinages at strategic locations	Sinaged installed	0	Number			5				5			

		vii. Develop waste management SOP with picnic organizer at Nichula	SOP developed	0	Number		1								
	2.4 Promote alternative energy source	Action 1.4.1: Support and initiate following green energy sources in Phibsoo and adjoining communities													
		i. Support biogas programs at household level in collaboration with DoL	Bio gas facilities provided	0	HH				20						
		ii. Maintain solar lighting system and monitoring in Phibsoo	Maintenance carried out	0	Number	1	1	1	1	1	1	1	1	1	1

		outpost													
		iii. Procure and install solar back-up system (HQ, ROs &POP)	Solar backup installed		Number					3					
	2.5 Promote smart green infrastructure development	Action 1.5.1: Conduct assessment, advocacies, studies and development of HR Capacity.													
		i. Develop HR capacity on smart green infrastructure	HR Capacity developed through training		Number			10							

		ii. Conduct advocacy on smart green infrastructure principles to policy makers, LG, institutions, and communities.	Advocacies carried out		HH				20						
		iii. Revival of natural waterholes through soil moisture and rain water conservation technology	Waterholes revived through soil moisture		Number				1						
	2.6 Build community and ecosystem resilience from climate induced threats	Action 2.6.1 Construction of retention wall in Nichula Range office to protect from landslide	Retention wall constructed		Number		1								

		Action 2.6.2 Install weather station and Nichula Range and Phibsoo	Weather station established		Number		1	1							
		2.6.3 Support construction of common distribution and reserve tanks in Nichula watershed area	Distribution tank constructed	0	Number			7							
3. To mitigate human wildlife conflict and uplift rural livelihood	3.1 Enhance Community livelihood	Action 3.1.1 NWFP product diversificati on and facilitate marketing	NWFP product diversification carried out and market facilitated		Number				2						
	3.2 Adopt HWC mitigation measures	Action 3.2.1 Uplift rural livelihood through mitigation of HWC and initiate various													

		activities:													
		i. Develop rescue and rehabilitation facilities (transitional enclosure)	Rescue and rehabilitation facilities developed	1	Number			1		1					
		ii. Carry out HWC hotspot mapping	HWC mapping carried out		Number	1	1	1	1	1	1	1	1	1	1
		iii. Enhance beekeeping	Beekeeping enhanced		Number				20						
		iv. Pilot bio-fencing in Phibsoo	Bio fencing piloted		km			5							
		v. Install real-time surveillance camera in HWC wildlife entry and exit hotspots	Surveillances camera installed		Number			5							

		vi. Provide technical support in HWC hotspot areas	Technical support and support provided		Number		5			5					
	3.3 Make PWS as ecotourism destination	Action 3.3.1: Implement various ecotourism activities as follows to make PWS tourist destination site.													
		i. Establish Wilderness Safaris (Safari trails, watch towers, hide outs)	Safari trails and watch towers constructed		Number		3								
		ii. Promote Singye home stays	Home stays promoted		Number			3							
		iii. Training on Safari management	No. of staffs trained		Number		10								

		iv. Train community based nature guides	Community based nature guides trained		Number		5	5							
		v. Establish rafting to allow high-end in fishing in Nichula	Rafting established		Number			1							
		vii. Establish community based recreational area (Service and infrastructure, game fishing).	Recreational area established		Number				2						
		vii. Establish souvenir facility	Souvenir facility established		Number				1						

		viii. Initiate adventure sporting facilities (zip line, Burma Bridge, rope climbing, canopy walk).	Adventure facilities created in Nichula		Number					3					
4. To enhance efficiency and effectiveness of Service Delivery	4.1 Administrative and infrastructure development for survey delivery	Action 4.1.1: Carry out construction, maintenance and procurement of infrastructure for effective service delivery.													
		ii. Construction of observation post or guard post	Guard post/OP constructed	1	Number				1						

		iii. Construction of visitor information center	Visitor information constructed		Number		1								
		iv. Construction of Guest House	Guest house constructed		Number				1						
		v. Maintenance of offices (all structures)	Office maintained	2	Number					1					
		vi. Maintenance of pool vehicle	Vehicle maintained	3	Number		1	1				1			
		vii. Procure Safari vehicle	Vehicle procured	0	Number				1					1	
		viii. Procurement of office furniture	Furniture procured in two office		Number		1							1	

		ix. Procurement of office equipment	Office equipment procured in two office		Number			1				1			
		x. Establish and upgrade internet connectivity	Internet connectivity established in Nichula and Phibsoo		Number		1					1			
		xi. Boundary pillar fixation	Boundary fixed		Number	20									

Annexure I: Mammals of PWS

Sl. No.	Common Name	Scientific Name	Family
1	Asian Bear Cat	*Arctictis binturong*	Viverridae
2	Asian Elephant/ Indian Elephant	*Elephas maximus*	Elephantidae
3	Asian Palm Civet/ Common Palm Civet	*Paradoxurus hermaphroditus*	Viverridae
4	Asiatic Golden Cat	*Catopuma temminckii*	Felidae
5	Assam Macaque	*Macaca assamensis*	Cercopithecidae
6	Axis Deer/ Spotted Deer/ Chital	*Axis axis*	Cervidae
7	Barking Deer	*Muntiacus muntjac*	Cervidae
8	Bat	*Species not determined*	
9	Bengal Tiger	*Panthera tigris tigirs*	Felidae
10	Bison/ Gaur	*Bos gaurus*	Bovidae
11	Black Giant Squirrel/ Malayan Giant Squirrel	*Ratufa bicolor*	Sciuridae
12	Chinese Pangolin/ Scaly anteater	*Manis pentadactyla*	Manidae
13	Clouded leopard	*Neofelis nebulosa*	Felidae
14	Common Langur/ Northern Plains Gray Langur	*Semnopithecus entellus*	Cercopithecidae
15	Common Leopard	*Panthera pardus*	Felidae
16	Common Mongoose/ Grey Mongoose/ Indian Gray Mongoose	*Herpestes edwardsii*	Herpestidae
17	Crab-eating Mongoose	*Herpestes urva*	Herpestidae
18	Dhole/ Asiatic Wild Dog/ Indian Wild Dog/ Red Dog	*Cuon alpinus*	Canidae
19	Chinese Ferret Badger	*Melogale personata*	Mustelidae

20	Golden Langur	*Trachypithecus geei*	Cercopithecidae
21	Himalayan Goral	*Naemorhedus goral*	Bovidae
22	Himalayan Black bear/ Asiatic Black Bear	*Ursus thibetanus*	Ursidae
23	Hispid hare/ Assam Rabbit/ Bristly Rabbit	*Caprolagus hispidus*	Leporidae
24	Hog Deer/ Indian Hog Deer/ Indochina Hog Deer	*Axis porcinus*	Cervidae
25	Pin-tailed Porcupine		Hystricidae
26	Large Indian Civet	*Viverra zibetha*	Viverridae
27	Leopard Cat	*Prionailurus bengalensis*	Felidae
28	Malayan Giant Squirrel	*Ratufa bicolor*	Sciuridae
29	Marbled cat	*Pardofelis marmorata*	Felidae
30	Rhesus Monkey/ Rhesus Macaque	*Macaca mulatta*	Cercopithecidae
31	Sambar/ Sambar Deer	*Rusa unicolor*	Cervidae
32	Serow		Bovidae
33	Small Indian Civet/ Oriental Civet	*Viverricula indica*	Viverridae
34	Squirrel		Sciuridae
35	Wild Pig/ Wild Boar	*Sus scrofa*	Suidae
36	Yellow Throated Marten	*Martes flavigula*	Mustelidae

Annexure II: Birds of PWS

Common Name	Scientific Name	Family
Lesser Adjutant	*Leptoptilos javanicus*	Ciconiidae
Abbott's Babbler	*Malacocincla abbotti*	Pellorneidae
Golden Babbler	*Stachyridopsis chrysaea*	Timaliidae
Black-eared Shrike Babbler	*Pteruthius melanotis*	Vireonidae
Grey-throated Babbler	*Stachyris nigriceps*	Timaliidae
Jungle Babbler	*Turdoides striata*	Leiotrichidae
Pin-striped Tit Babbler	*Mixornus gularis*	Timaliidae
Puff-throated Babbler	*Pellorneum ruficeps*	Pellorneidae
Pygmy Wren Babbler	*Pnoepyga pusilla*	Pnoepygidae
Rufous-capped Babbler	*Stachyridopsis ruficeps*	Timaliidae
Rufous-fronted Babbler	*Stachyridopsis rufifrons*	Timaliidae
Rusty-cheeked Scimitar Babbler	*Pomatorhinus erythrogenys*	Timaliidae
Scaly-breasted Wrem Babbler	*Pnoepyga alldiventer*	Pnoepygidae
Streak-breasted Scimitar Babbler	*Pomatorhinus ruficllis*	Timaliidae
Rufous-throated Wrem Babbler	*Spelaeornis caudatus*	Timaliidae
White-browed Shrike Babbler	*Pteruthius flaviscapis*	Vireonidae
Blue-eared Barbet	*Megalaima australis*	Megalaimidae
Blue-throated Barbet	*Megalaima asiatica*	Megalaimidae
Coppersmith Barbet	*Megalaima haemacephala*	Megalaimidae
Golden-throated Barbet	*Megalaima franklinii*	Megalaimidae
Great Barbet	*Megalaima virens*	Megalaimidae
Lineated Barbet	*Megalaima lineata*	Megalaimidae
Hoary-throated Barwing	*Actinodura nipalensis*	Timaliidae
Rusty-fronted Barwing	*Actinodura egertoni*	Timaliidae

Black Baza	*Aviceda leuphotes*	Accipitridae
Jerdon's Baza	*Aviceda jerdoni*	Accipitridae
Blue-bearded Bee-eater	*Nyctyornis athertoni*	Alcedinidae
Blue-tailed Bee-eater	*Merops philippinus*	Meropidae
Chestnut-headed Bee-eater	*Merops leschenaulti*	Meropidae
Green Bee-eater	*Merops orientalis*	Meropidae
Besra	*Accipiter virgatus*	Accipitridae
Great Bittern	*Botaurus stellaris*	Ardeidae
Grey-winged Blackbird	*Turdus boulboul*	Turdidae
White-collared Blackbird	*Turdus albocinctus*	Turdidae
Asian Fairy Bluebird	*Irena puella*	Irenidae
Blue throat	*Luscinia svecica*	Turdidae
Himalayan Blue tail	*Tarsiger rufilatus*	Muscicapidae
Long-tailed Broadbill	*Psarisomus dalhousiae*	Eurylaimidae
Silver-breasted Broadbill	*Serilophus lunatus*	Eurylaimidae
Ashy Bulbul	*Hemixos flavala*	Pycnonotidae
Black Bulbul	*Hypsipetes leucocephalus*	Pycnonotidae
Black-crested Bulbul	*Hypsipetes flaviventris*	Pycnonotidae
Himalayan Bulbul	*Pycnonotus leucogenys*	Pycnonotidae
Mountain Bulbul	*Ixos mcclellandii*	Pycnonotidae
Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae
Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae
Striated Bulbul	*Pycnonotus striatus*	Pycnonotidae
White-throated Bulbul	*Alophoixus flaveolus*	Pycnonotidae
Crested Bunting	*Melophus lathami*	Emberizidae
Grey-necked Bunting	*Emberiza buchanani*	Emberizidae
Little Bunting	*Emberiza pusilla*	Emberizidae
Grey Bushchat	*Saxicola ferreus*	Muscicapidae
Siberian stonechat	*Saxicola maurus*	Muscicapidae

Barred Button quail	*Turnix suscitator*	Turnicidae
Common Buzzard	*Buteo buteo*	Accipitridae
Himalayan Buzzard	*Buteo burmanicus*	Accipitridae
Long-legged Buzzard	*Buteo rufinus*	Accipitridae
Oriental Honey-buzzard	*Pernis ptilorhynchus*	Accipitridae
Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae
Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae
Oriental Darter	Anhinga melanogaster	Anhingidae
Greater Coucal	*Centropus sinensis*	Cuculidae
Lesser Coucal	*Centropus bengalensis*	Cuculidae
Eastern Jungle Crow	*Corvus levaillantii*	Corvidae
House Crow	*Corvus splendens*	Corvidae
Large-billed Crow	*Corvus macrorhynchos*	Corvidae
Asian Emerald Cuckoo	*Chrysococcyx maculatus*	Cuculidae
Asian Koel	*Eudynamys scolopaceus*	Cuculidae
Banded Bay Cuckoo	*Cacomantis sonneratii*	Cuculidae
Chestnut-winged Cuckoo	*Clamator coromandus*	Cuculidae
Common Hawk Cuckoo	*Hierococcyx varius*	Cuculidae
Drongo Cuckoo	*Surniculus lugubris*	Cuculidae
Eurasian Cuckoo	*Cuculus canorus*	Cuculidae
Grey-bellied Cuckoo	*Cacomantis passerinus*	Cuculidae
Himalayan Cuckoo	*Cuculus saturatus*	Cuculidae
Indian Cuckoo	*Cuculus micropterus*	Cuculidae
Jacobin Cuckoo	*Clamator jacobinus*	Cuculidae
Lesser Cuckoo	*Cuculus poliocephalus*	Cuculidae
Large Hawk Cuckoo	*Hierococcyx sparverioides*	Cuculidae
Plaintive Cuckoo	*Cacomantis merulinus*	Cuculidae
Black-winged Cuckooshrike	*Coracina melaschistos*	Oriolidae
Large Cuckooshrike	*Coracina macei*	Campephagidae

Himalayan Cutia	*Cutia nipalensis*	Leiotrichidae
Brown Dipper	*Cinclus pallasii*	Cinclidae
Dollar bird	*Eurystomus orientalis*	Coraciidae
Barred Cuckoo Dove	*Macropygia unchall*	Columbidae
Emerald Dove	*Chalcophaps indica*	Columbidae
Oriental Turtle Dove	*Streptopelia orientalis*	Columbidae
Red Collared Dove	*Streptopelia tranquebarica*	Columbidae
Spotted Dove	*Stigmatopelia chinensis*	Columbidae
Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae
Black Drongo	*Dicrurus macrocercus*	Dicruridae
Bronzed Drongo	*Dicrurus aeneus*	Dicruridae
Crow-billed Drongo	*Dicrurus annectans*	Dicruridae
Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae
Lesser Racket-tailed Drongo	*Dicrurus remifer*	Dicruridae
Spangled Drongo	*Dicrurus hottentottus*	Dicruridae
Common Shelduck	*Tadorna tadorna*	Anatidae
Ferruginous Duck	*Aythya nyroca*	Anatidae
Lesser Whistling Duck	*Dendrocygna javanica*	Anatidae
Ruddy Shelduck	*Tadorna ferruginea*	Anatidae
Red-crested Pochard	*Netta rufina*	Anatidae
Gadwall	*Anas strepera*	Anatidae
Common Teal	*Anas crecca*	Anatidae
Mallard	*Anas platyrhynchos*	Anatidae
Black Eagle	*Ictinaetus malayensis*	Accipitridae
Common Merganser	*Mergus merganser*	Anatidae
Short-tailed Shearwater	*Puffinus tenuirostris*	Procellariidae
Changeable Hawk Eagle	*Nisaetus limnaeetus*	Accipitridae
Rufous-bellied Eagle	*Lophotriorchis kienerii*	Accipitridae
Crested Serpent Eagle	*Spilornis cheela*	Accipitridae

Mountain Hawk Eagle	*Nisaetus nipalensis*	Accipitridae
Pallas's Fish Eagle	*Haliaeetus leucoryphus*	Accipitridae
Steppe Eagle	*Aquila nipalensis*	Accipitridae
Cattle Egret	*Bubulcus ibis*	Ardeidae
Little Egret	*Egretta garzetta*	Ardeidae
White-bellied Erpornis	*Erpornis zantholeuca*	Vereonidae
Peregrine Falcon	*Falco peregrinus*	Falconidae
Collared Falconet	*Microhierax caerulescens*	Falconidae
White-throated Fantail	*Rhipidura albicollis*	Rhipiduridae
Yellow-bellied Fantail	*Chelidorhynx hypoxantha*	Stenostiridae
Fire-breasted Flowerpecker	*Dicaeum ignipectus*	Dicaeidae
Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	Dicaeidae
Plain Flowerpecker	*Dicaeum minullum*	Dicaeidae
Scarlet-backed Fowerpecker	*Dicaeum cruentatum*	Dicaeidae
Yellow-vented Flowerpecker	*Dicaeum chrysorrheum*	Dicaeidae
Asian Brown Flycatcher	*Muscicapa dauurica*	Muscicapidae
Blue-throated Blue Flycatcher	*Cyornis rubeculoides*	Muscicapidae
Brown-breasted Flycatcher	*Muscicapa muttui*	Muscicapidae
Dark-sided Flycatcher	*Muscicapa sibirica*	Muscicapidae
Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Stenostiridae
Little Pied Flycatcher	*Ficedula westermanni*	Muscicapidae
Pale Blue Flycatcher	*Cyornis unicolor*	Muscicapidae
Pale-chinned Flycatcher	*Cyornis poliogenys*	Muscicapidae
Pygmy Blue Flycatcher	*Ficedula parva*	Muscicapidae
Red-breasted Flycatcher	*Ficedula parva*	Muscicapidae
Rufous-gorgeted Flycatcher	*Ficedula strophiata*	Muscicapidae
Rusty-tailed Flycatcher	*Muscicapa ruficauda*	Muscicapidae
Slaty-blacked Flycatcher	*Ficedula hodgsonii*	Muscicapidae
Snowy-browed Flycatcher	*Ficedula hyperythra*	Muscicapidae

Taiga Flycatcher	*Ficedula albicilla*	Muscicapidae
Verditer Flycatcher	*Eumyias thalassinus*	Muscicapidae
White-gorgeted Flycatcher	*Anthipes monileger*	Muscicapidae
Bar-winged Flycatcher-Shrike	*Hemipus picatus*	Vangidae
Black-backed Forktail	*Enicurus immaculatus*	Muscicapidae
Little Forktail	*Enicurus scouleri*	Muscicapidae
Slaty-backed Forktail	*Enicurus schistaceus*	Muscicapidae
Hodgson's Frogmouth	*Batrachostomus hodgsoni*	Podargidae
Spotted Forktail	*Enicurus maculatus*	Muscicapidae
Black Francolin	*Francolinus francolinus*	Phasianidae
Nepal Fulvatta	*Alcippe nipalensis*	Alcippeidae
Rufous-winged Fulvetta	*Pseudominla castaneceps*	Pellorneidae
Yellow-Throated Fulvetta	*Pseudominla cinerea*	Pellorneidae
Greater Goldenback	*Chrysocolaptes lucidus*	Picidae
Crested Goshawk	*Accipiter trivirgatus*	Accipitridae
Great Crested Grebe	*Podiceps cristatus*	Podicipedidae
Common Greenshank	*Tringa nebularia*	Scolopacidae
Hen Harrier	*Circus cyaneus*	Accipitridae
Indian Pond Heron	*Ardeola grayii*	Ardeidae
Malayan Night Heron	*Gorsachius melanolophus*	Ardeidae
Striated Heron	*Butorides striata*	Ardeidae
White-bellied Heron	*Ardea insignis*	Ardeidae
Eurasian Hobby	*Falco subbuteo*	Falconidae
Oriental Hobby	*Falco severus*	Falconidae
Common Hoopoe	*Upupa epops*	Upupidae
Great Hornbill	*Buceros bicornis*	Bucerotidae
Oriental Pied Hornbill	*Anthracoceros albirostris*	Bucerotidae
Rufous-necked Hornbill	*Aceros nipalensis*	Bucerotidae
Wreathed Hornbill	*Rhyticeros undulatus*	Bucerotidae

Ibisbill	*Ibidorhyncha struthersii*	Ibidorhynchidae
Red-niped Ibsi	*Pseudibis papillosa*	Threskiornithidae
Common Iora	*Aegithina tiphia*	Aegithinidae
Common Kestrel	*Falco tinnunculus*	Falconidae
Black-capped Kingfisher	*Halcyon pileata*	Alcedinidae
Blyth's Kingfisher	*Alcedo hercules*	Alcedinidae
Common Kingfisher	*Alcedo atthis*	Alcedinidae
Crested Kingfisher	*Megaceryle lugubris*	Alcedinidae
Oriental Dwarf Kingfisher	Ceyx erithaca	Alcedinidae
Pied Kingfisher	*Ceryle rudis*	Alcedinidae
Ruddy Kingfisher	*Halcyon coromanda*	Alcedinidae
Stork-billed Kingfisher	*Pelargopsis capensis*	Alcedinidae
White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae
Black Kite	*Milvus migrans*	Accipitridae
Black-eared Kite	*Milvus lineatus*	Accipitridae
Black-winged Kite	*Elanus caeruleus*	Accipitridae
Red-wattled Lapwing	*Vanellus indicus*	Charadriidae
River Lapwing	*Vanellus duvaucelii*	Charadriidae
Bengal Bushlark	*Mirafra assamica*	Alaudidae
Greater Short-toed Lark	*Calandrella brachydactyla*	Alaudidae
Sand Lark	*Calandrella raytal*	Alaudidae
Blue-winged Laughingthrush	*Garrulax squamatus*	Leiotrichidae
Chestnut-crowned Laughingthrush	*Garrulax erythrocephalus*	Leiotrichidae
Greater Necklace Laughing thrush	*Garrulax pectoralis*	Leiotrichidae
Grey-sided Laughing thrush	*Garrulax caerulatus*	Leiotrichidae
Lesser Necklaced Laughing thrush	*Garrulax monileger*	Leiotrichidae

Rufous-necked Laughing thrush	*Garrulax ruficollis*	Leiotrichidae
Striated Laughing thrush	*Garrulax striatus*	Leiotrichidae
White-crested Laughing thrush	*Garrulax leucolophus*	Leiotrichidae
White-throated Laughingthrush	*Garrulax albogularis*	Leiotrichidae
Golden-fronted Leaf bird	*Chloropsis aurifrons*	Chloropseidae
Orange-bellied Leaf bird	*Chloropsis hardwickii*	Chloropseidae
Red-faced Liocichla	*Liocichla phoenicea*	Leiotrichidae
Common Green Magpie	*Cissa chinensis*	Corvidae
Green-billed Malkoha	*Rhopodytes tristis*	Cuculidae
Asian House Martin	*Delichon dasypus*	Hirundinidae
Nepal House Martin	*Delichon nopalense*	Hirundinidae
Sand Martin	*Riparia riparia*	Hirundinidae
Merlin	*Falco columbarius*	Falconidae
Silver-eared Mesia	*Mesia argentauris*	Leiotrichidae
Grey-chinned Minivet	*Pericrocotus solaris*	Campephagidae
Long-tailed Minivet	*Pericrocotus ethologus*	Campephagidae
Scarlet Minivet	*Pericrocotus speciosus*	Campephagidae
Red-tailed Minla	*Minla ignotincta*	Leiotrichidae
Black-naped Monarch	*Hypothymis azurea*	Monarchidae
Common Moorhen	*Gallinula chloropus*	Rallidae
Scaly-breasted Munia	*Lonchura punctulata*	Estrildidae
White-rumped Munia	*Lonchura striata*	Estrildidae
Bank Myna	*Acridotheres ginginianus*	Sturnidae
Common Hill Myna	*Gracula religiosa*	Sturnidae
Common Myna	*Acridotheres tristis*	Sturnidae
Great Myna	*Acridotheres grandis*	Sturnidae
Jungle Myna	*Acridotheres fuscus*	Sturnidae
Grey Nightjar	*Caprimulgus jotaka*	Caprimulgidae
Large-tailed Nightjar	*Caprimulgus macrurus*	Caprimulgidae

Savanna Nightjar	*Caprimulgus affinis*	Caprimulgidae
Large Niltava	*Niltava grandis*	Muscicapidae
Rufous-bellied Niltava	*Niltava sundara*	Muscicapidae
Small Niltava	*Niltava macgrigoriae*	Muscicapidae
Beautiful Nuthatch	*Sitta formosa*	Sittidae
Chestnut-bellied Nuthatch	*Sitta cinnamoventris*	Sittidae
White-tailed Nuthatch	*Sitta himalayensis*	Sittidae
Velvet-fronted Nuthatch	*Sitta frontalis*	Sittidae
Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae
Indian Golden Oriole	*Oriolus kundoo*	Oriolidae
Maroon Oriole	*Oriolus traillii*	Oriolidae
Slender-billed Oriole	*Oriolus tenuirostris*	Oriolidae
Osprey	*Pandion haliaetus*	Pandionidae
Brown Hawk Owl	*Ninox scutulata*	Strigidae
Brown Fish Owl	*Ketupa zeylonensis*	Strigidae
Collard Scops Owl	*Otus lettia*	Strigidae
Mountain Scops Owl	*Otus spilocephalus*	Strigidae
Oriental Scops Owl	*Otus sunia*	Strigidae
Spot-bellied Eagle Owl	*Bubo nipalensis*	Strigidae
Tawny Fish Owl	*Ketupa flavipes*	Strigidae
Asian Barred Owlet	*Glaucidium cuculoides*	Strigidae
Collared Owlet	*Glaucidium brodiei*	Strigidae
Jungle Owlet	*Glaucidium radiatum*	Strigidae
Spotted Owlet	*Athene brama*	Strigidae
Alexandrine Parakeet	*Psittacula eupatria*	Psittacidae
Red-breasted Parakeet	*Psittacula alexandri*	Psittacidae
Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae
Slaty-headed Parakeet	*Psittacula himalayana*	Psittacidae
Pin-tailed Parrotfinch	*Erythrura prasina*	Estrildidae

Hill Partridge	*Arborophila torqueola*	Phasianidae
Rufous-throated Partridge	*Arborophila rufogularis*	Phasianidae
White-cheeked Partridge	*Arborophila atrogularis*	Phasianidae
Grey Peacock Pheasant	*Polyplectron bicalcaratum*	Phasianidae
Indian Peafowl	*Pavo cristatus*	Phasianidae
Kalij Pheasant	*Lophura leucomelanos*	Phasianidae
Red Junglefowl	*Gallus gallus*	Phasianidae
Speckled Piculet	*Picumnus innominatus*	Picidae
Common Pigeon	*Columba livia*	Columbidae
Green Imperial Pigeon	*Ducula aenea*	Columbidae
Mountain Imperial Pigeon	*Ducula badia*	Columbidae
Pin-tailed Green Pigeon	*Treron apicauda*	Columbidae
Thick-billed Green Pigeon	*Treron curvirostra*	Columbidae
Orange-billed Green Pigeon	*Treron bicinctus*	Columbidae
Wedge-tailed Green Pigeon	*Treron sphenurus*	Columbidae
Blyth's Pipit	*Anthus godlewskii*	Motacillidae
Olive-backed Pipit	*Anthus hodgsoni*	Motacillidae
Paddy field Pipit	*Anthus rufulus*	Motacillidae
Richard's Pipit	*Anthus richardi*	Motacillidae
Rosy Pipit	*Anthus roseatus*	Motacillidae
Blue-naped Pitta	*Pitta nipalensis*	Pittidae
Hooded Pitta	*Pitta sordida*	Pittidae
White-browed Piculet	*Sasia ochracea*	Picidae
Little Ringed Plover	*Charadrius dubius*	Charadriidae
Long-billed Plover	*Charadrius placidus*	Charadriidae
Small Pratincole	*Glareola lactea*	Glareolidae
Black-throated Prinia	*Prinia atrogularis*	Cisticolidae
Hill Prinia	*Prinia superciliaris*	Cisticolidae
Plain Prinia	*Prinia inornata*	Cisticolidae

Rufescent Prinia	*Prinia rufescens*	Cisticolidae
Common Quail	*Coturnix coturnix*	Phasianidae
Black Redstart	*Phoenicurus ochruros*	Muscicapidae
Blue-fronted Redstart	*Phoenicurus frontalis*	Muscicapidae
Hodgson's Redstart	*Phoenicurus hodgsoni*	Muscicapidae
Plumbeous Water Redstart	*Rhyacornis fuliginosa*	Muscicapidae
White-bellied Redstart	*Hodgsonius phoenicuroides*	Muscicapidae
White-capped Redstart	*Chaimarrornis leucocephalus*	Muscicapidae
Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae
White-tailed Robin	*Myiomela leucura*	Muscicapidae
Indian Roller	*Coracias benghalensis*	Coraciidae
Common Rosefinch	*Carpodacus erythrinus*	Fringillidae
Siberian Rubythroat	*Luscinia calliope*	Muscicapidae
Common Sandpiper	*Actitis hypoleucos*	Scolopacidae
Green Sandpiper	*Tringa ochropus*	Scolopacidae
White-rumped Shama	*Copsychus malabaricus*	Muscicapidae
Shikra	*Accipiter badius*	Accipitridae
Bay-backed Shrike	*Lanius vittatus*	Laniidae
Brown Shrike	*Lanius cristatus*	Laniidae
Grey-backed Shrike	*Lanius tephronotus*	Laniidae
Isabelline Shrike	*Lanius isabellinus*	Laniidae
Long-tailed Shrike	*Lanius schach*	Laniidae
Long-tailed Sibia	*Heterophasia picaoides*	Laniidae
Black-eared Shrike Babbler	*Pteruthius melanotis*	Vireonidae
Blyth's Shrike Babbler	*Pteruthius aeralatus*	Vireonidae
White-browed Shrike Babbler	*Pteruthius flaviscapis*	Timaliidae
Long-tailed Sibia	*Heterophasia picaoides*	Leiotrichidae
Rufous Sibia	*Malacias capistratus*	Leiotrichidae

Bar-throated Siva	*Siva strigula*	Leiotrichidae
Blue-winged Siva	*Siva cyanouroptera*	Leiotrichidae
Eurasian Tree Sparrow	*Passer montanus*	Passeridae
House Sparrow	*Passer domesticus*	Passeridae
Eurasian Sparrowhawk	*Accipiter nisus*	Accipitridae
Little Spiderhunter	*Arachnothera longirostra*	Nectariniidae
Streaked Spiderhunter	*Arachnothera magna*	Nectariniidae
Asian Pied Starling	*Gracupica contra*	Sturnidae
Chestnut-tailed Starling	*Sturnia malabarica*	Sturnidae
Spot-winged Starling	*Saroglossa spiloptera*	Sturnidae
Black-winged Stilt	*Himantopus himantopus*	Recurvirostridae
Temminck's Stint	*Calidris temminckii*	Scolopacidae
Common Stonechat	*Saxicola torquatus*	Muscicapidae
Black Stork	*Ciconia nigra*	Ciconiidae
Black-throated Sunbird	*Aethopyga saturata*	Nectariniidae
Wooly-necked Stork	*Ciconia episcopus*	Ciconiidae
Crimson Sunbird	*Aethopyga siparaja*	Nectariniidae
Green-tailed Sunbird	*Aethopyga nipalensis*	Nectariniidae
Purple Sunbird	*Cinnyris asiaticus*	Nectariniidae
Ruby-cheeked Sunbird	*Chalcoparia singalensis*	Nectariniidae
Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae
White-throated Needletail	*Hirundapus caudacutus*	Apodidae
Red-rumped Swallow	*Cecropis daurica*	Hirundinidae
Common Tailorbird	*Orthotomus sutorius*	Cisticolidae
Mountain Tailorbird	*Phyllergates cuculatus*	Scotocercidae
Chestnut-headed Tesia	*Oligura castaneocoronata*	Scotocercidae
Grey-bellied Tesia	*Tesia cyaniventer*	Scotocercidae
Slaty-bellied Tesia	*Tesia olivea*	Scotocercidae
Great Thick-knee	*Esacus recurvirostris*	Burhinidae

Indian Thick-knee	*Burhinus indicus*	Burhinidae
Black-throated Thrush	*Turdus atrogularis*	Turdidae
Blue Rock Thrush	*Monticola solitarius*	Muscicapidae
Blue-capped Rock Thrush	*Monticola cinclorhynchus*	Muscicapidae
Blue Whistling Thrush	*Myophonus caeruleus*	Muscicapidae
Chestnut-bellied Rock Thrush	*Monticola rufiventris*	Muscicapidae
Long-tailed Thrush	*Zoothera dixoni*	Turdidae
Orange-headed Thrush	*Zoothera citrina*	Turdidae
Scaly Thrush	*Zoothera dauma*	Turdidae
Tickell's Thrush	*Turdus unicolor*	Turdidae
Black-throated Tit	*Aegithalos concinnus*	Aegithalidae
Great Tit	*Parus major*	Paridae
Green-backed Tit	*Parus monticolus*	Paridae
Sultan Tit	*Melanochlora sultanea*	Paridae
Yellow-browed Tit	*Sylviparus modestus*	Paridae
Yellow-cheeked Tit	*Parus spilonotus*	Paridae
Brown-throated Treecreeper	*Certhia discolor*	Certhiidae
Collared Treepie	*Dendrocitta frontalis*	Corvidae
Grey Treepie	*Dendrocitta formosae*	Corvidae
Rufous Treepie	*Dendrocitta vagabunda*	Corvidae
Red-headed Trogon	*Harpactes erythrocephalus*	Trogonidae
Himalayan Vulture/ Griffon	*Gyps himalayensis*	Accipitridae
Citrine Wagtail	*Motacilla citreola*	Motacillidae
Forest Wagtail	*Dendronanthus indicus*	Motacillidae
Grey Wagtail	*Motacilla cinerea*	Motacillidae
White Wagtail	*Motacilla alba*	Motacillidae
White-browed Wagtail	*Motacilla maderaspatensis*	Motacillidae
Yellow Wagtail	*Motacilla flava*	Motacillidae
Wallcreeper	*Tichodroma muraria*	Sittidae

Aberrant Bush Warbler	*Cettia flavolivacea*	Cettiidae
Ashy-throated Warbler	*Phylloscopus maculipennis*	Phylloscopidae
Black-faced Warbler	*Abroscopus schisticeps*	Scotocercidae
Blyth's Leaf Warbler	*Phylloscopus reguloides*	Phylloscopidae
Buff-barred Warbler	*Phylloscopus pulcher*	Phylloscopidae
Chestnut-crowned Bush Warbler	*Cettia major*	Scotocercidae
Dusky Warbler	*Phylloscopus fuscatus*	Phylloscopidae
Green-crowned Warbler	*Seicercus burkii*	Phylloscopidae
Greenish Warbler	*Phylloscopus trochiloides*	Phylloscopidae
Grey-cheeked Warbler	*Seicercus poliogenys*	Phylloscopidae
Grey-sided Bush Warbler	*Cettia brunnifrons*	Scotocercidae
Grey-hooded Warbler	*Phylloscopus xanthoschistos*	Phylloscopidae
Humes's Bush Warbler	*Cettia brunnescens*	Scotocercidae
Hume's Leaf Warbler	*Phylloscopus humei*	Phylloscopidae
Large-billed Leaf Warbler	*Phylloscopus magnirostris*	Phylloscopidae
Lemon-rumped Leaf Warbler	*Phylloscopus chloronotus*	Phylloscopidae
Russet Bush Warbler	*Bradypterus mandelli*	Locustellidae
Smoky Warbler	*Phylloscopus fuligiventer*	Phylloscopidae
Thick-billed Warbler	*Locustella naevia*	Locustellidae
Tickell's Leaf Warbler	*Phylloscopus affinis*	Phylloscopidae
Whistler's Warbler	*Seicercus whistleri*	Phylloscopidae
White-spectacled Warbler	*Seicercus affinis*	Phylloscopidae
Yellow-bellied Warbler	*Abroscopus superciliaris*	Scotocercidae
Yellow-browed Warbler	*Phylloscopus inornatus*	
Yellow-vented Warbler	*Phylloscopus cantator*	Phylloscopidae
White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae
Baya Weaver	*Ploceus philippinus*	Ploceidae
Oriental White-eye	*Zosterops palpebrosus*	Zosteropidae

Bay Woodpecker	*Blythipicus pyrrhotis*	Picidae
Crimson-breasted Woodpecker	*Dendrocopos cathpharius*	Picidae
Darjeeling Woodpecker	*Dendrocopos darjeelensis*	Picidae
Fulvous-breasted Woodpecker	*Dendrocopos macei*	Picidae
Great Slaty Woodpecker	*Mulleripicus pulverulentus*	Picidae
Greater Yellownape	*Picus flavinucha*	Picidae
Grey-capped Pygmy Woodpecker	*Dendrocopos canicapillus*	Picidae
Grey-headed Woodpecker	*Picus canus*	Picidae
Greater Goldenback	*Chrysocolaptes lucidus*	Picidae
Himalayan Goldenback	*Dinopium shorii*	Picidae
Lesser Goldenback	*Dinopium benghalense*	Picidae
Rufous Woodpecker	*Micropternus brachyurus*	Picidae
Common Woodshrike	*Tephrodornis pondicerianus*	Vangidae
Large Woodshrike	*Tephrodornis virgatus*	Vangidae
Ashy Woodswallow	*Artamus fuscus*	Artamidae
Eurasian Wryneck	*Jynx torquilla*	Picidae
Black-chinned Yuhina	*Yuhina nigrimenta*	Zosteropidae
Stripe-throated Yuhina	*Yuhina gularis*	Zosteropidae
Lesser Yellownape	*Picus chlorolophus*	Picidae
Striated Yuhina	*Staphida castaniceps*	Zosteropidae
Whiskered Yuhina	*Yuhina flavicollis*	Zosteropidae
White-naped Yuhina	*Yuhina bakeri*	Zosteropidae

Annexure III: Herpetofauna of PWS

Sl.No	Family	Common Name	Sceintific Name
1	Bufonidae	Common Asian Toad,	*Duttaphrynus melanostictus,*
2	Bufonidae	Marbled Toad,	*Duttaphrynus cf. stomaticus*
3	Bufonidae	Indian Bull Frog,	*Hoplobatrachus tigerinus*
4	Dicroglossidae	Asian Grass Frog,	*Fejervarya limnocharis*
5	Dicroglossidae	Ornamented pygmy frog	*Microhyla cf.ornate*
6	Dicroglossidae	Indian skipper frog	*Euphlyctis cyanophlyctis*
7	Rhacophoridae	Common Tree Frog,	*Polypedates maculatus,*
8	Rhacophoridae	Bird shit frog group,	*Theloderma species*
9	Rhacophoridae	Bird shit frog,	*Theloderma asperum*
11	Rhacophoridae	Common Tree Frog,	*Polypedates leucomystax*
10	Ranidae	Assam Forest Frog,	*Hydrophylax leptoglossa*
12	Ranidae	Marbled Cascade Frog,	*Amolops marmoratus*
13	Ranidae	Skittering Frog Group,	*Miniryara species*
14	Ranidae	Yellow-striped Frog,	*Hylarana tytleri*
15	Ranidae	Long-tongued Frog,	*Hydrophylax leptoglossa*
16	Colubridae	Red necked keelback,	*Rhabdophis subminiatus*
17	Colubridae	Buff Striped Keel back,	*Amphiesma stolatum*
18	Colubridae	St. John's Keelback,	*Fowlea cf. sacntijohannis*
19	Colubridae	Twin speckled wolf snake,	*Lycodon Jara*
20	Colubridae	Indian Rat snake,	*Ptyas mucosa*
21	Colubridae	Indo-Chinese Rat snake,	*Ptyas korros*
22	Colubridae	Bronzed Backed Tree Snake,	*Dendrelaphis species,*

23	Colubridae	Tawny Cat Snake,	*Boiga ochracea*
24	Colubridae	Copper headed trinket snake,	*Coelognathus radiatus*
25	Colubridae	Nikhil's Kukri Snake	*Oligodon cf. nikhili*
26	Colubridae	Himalayan black-striped Snake,	*Liopeltis species*
27	Colubridae	Green Cat Snake	*Boiga ochracea*
28	Colubridae	White barred kukri:	*Oligodon albocinctus*
29	Colubridae	Common Wolf Snake:	*Lycodon aulicus*
30	Colubridae	Arrow backed tree snake:	*Boiga gocool*
31	Colubridae	Collard Black headed Snake,	*Sybynophis collaris*
32	Lamprophiidae	Mock Viper,	*Psammodynastes pulverulentus*
33	Pythonidae	Indian Python,	*Python molorus,*
34	Pythonidae	Burmese Python	*Python molorus bavittatus*
35	Typhlopidae	Brahminy blind snake,	*Indotyphlops braminus*
36	Elapidae	Banded Krait,	*Bungarus fasciatus*
37	Elapidae	Black Krait,	*Bungarus niger*
38	Elapidae	Monocled Cobra,	*Naja kaouthia*
39	Elapidae	King Cobra,	*Ophiophagus Hannah,*
40	Elapidae	Spectacled Cobra,	*Naja naja,*
41	Viperidae	White Lipped Pit Viper,	*Trimeresurus cf. albolabris*
42	Viperidae	Pope's Pit Viper,	*Trimeresurus popeiorum*
43	Viperidae	Green Chinese Tree Viper,	*Trimeresurus stejnegeri*
44	Agamidae	Oriental Garden Lizard,	*Calotes visicolor*
45	Agamidae	Variegated mountain	*Japalura variegate*

		lizard,	
46	Gekkonidae	Bent-toed Gecko Group,	*Cyrtodactylus species*
47	Gekkonidae	Tokay Gecko,	*Gekko gecko*
48	Gekkonidae	Flat-tailed House Gecko,	*Hemidactylus platyurus*
49	Scincidae	Many Lined Sun Skink,	*Eutropis multifasciata,*
50	Scincidae	Spotted Little Skink,	*Sphenomorphus maculatus,*
51	Scincidae	Bronze grass skink,	*Eutropis macularia*
52	Scincidae	Fence Skink,	*Lygosoma species*
53	Varanidae	Asian Water Monitor	*Varanus salvator*
54	Varanidae	Common Indian Monitor Lizard	*Varanus bengalensis*
55	Varanidae	Yellow Monitor	*Varanus flavescens*
56	Geoemydidae	Keeled box turtle	*Cuora mouhotii*
57	Geoemydidae	Indian Black Turtle,	*Melanochelys trijuga,*
58	Geoemydidae	Tricarinate hill turtle	*Melanochels tricarinata*
59	Geoemydidae	Assam Leaf Turtle,	*Cyclemys gemei*
60	Testudinidae	Elongate Tortoise,	*Indotestudo enlongata,*

Annexure IIII: Fishes of PWS

Sl.No	Sceintific Name	Family
1	*Badis sp*	Badidae
2	*Channa sp*	Channidae
3	*Channa stewartii*	Channidae
4	*Barilius*	Cyprinidae
5	*Barilius bendelisis*	Cyprinidae
6	*Ctenopharyngodon idella*	Cyprinidae
7	*Cyprinion semiplotus*	Cyprinidae
8	*Cyprinion semiployus*	Cyprinidae
9	*Danio cf. assamlia*	Cyprinidae
10	*Danio dangila*	Cyprinidae
11	*Danio rerio*	Cyprinidae
12	*Devario aquipinnatus*	Cyprinidae
13	*Garra annandalei*	Cyprinidae
14	*Garra gotylagotyla*	Cyprinidae
15	*Labeo dyocheilus*	Cyprinidae
16	*Neolissochilus hexagonolepis*	Cyprinidae
17	*Raiamas bola*	Cyprinidae
18	*Tor putitora*	Cyprinidae
19	*Pethia conchonius*	Cyprionodontidae
20	*Mastacembelus armatus*	Mastacembelidae
21	*Paracanthocobitis sp*	Nemacheilidae
22	*schistura sp.1*	Nemacheilidae
23	*Pterocryptis cf. barakensis*	Siluridae

Annexure IV: Butterflies of PWS

SL.No	Common Name	Scientific Name	Family
1	Black-tufted Bob	*Arnetta atkinsoni*	Hesperiidae
2	Brown Awl	*Badamia exclamationis*	Hesperiidae
3	Common Awl	*Hasora badra*	Hesperiidae
4	Dark Velvet Bob	*Koruthaialos butleride*	
5	Orange Awlet	*Bibasis jaina*	Hesperiidae
6	Orange Tail Awl	*Bibasis sena*	Hesperiidae
7	Chestnut Bob	*Iambrix salsala*	Hesperiidae
8	Common Banded Demon	*Notocrypta paralysos*	Hesperiidae
9	Conjoined Swift	*Pelopidas conjuncta*	Hesperiidae
10	Himalayan Dart	*Ptanthus dara*	Hesperiidae
11	Pale Palm Dart	*Telecota*	Hesperiidae
12	Restricted Demon	*Notocrypta curvifascia*	Hesperiidae
13	Small Branded Swift	*Pelopidas mathias*	Hesperiidae
14	Tiger Hopper	*Ochus subvittatus*	Hesperiidae
15	Chestnut Angle	*Odontoptilium angulata*	Hesperiidae
16	Common Spotted Flat	*Celaenorrhinus leucocera*	Hesperiidae
17	Dusky Yellow Breasted Flat	*Gerosisphisara phisara*	Hesperiidae
18	Fulvous Pied Flat	*Pseudocoladenia dan*	Hesperiidae
19	Indian Skipper	*Spialia galba*	Hesperiidae
20	Water Snow flat	*Tagiades litigiosa*	Hesperiidae
21	Purple Sapphire	*Heliophorus epicles*	Lycaenidae
22	White Bordered Copper	*Lycaena pavana*	Lycaenidae
23	Banded Line Blue	*Prosotas aluta coelestis*	Lycaenidae
24	Bright Sun Beam	*Curetis bulis*	Lycaenidae
25	Common Pierrot	*Castalius rosimon*	Lycaenidae
26	Common Quaker	*Neopithecops zalmora*	Lycaenidae
27	Elbowed Pierrot	*Celeta elna*	Lycaenidae
28	Forget-Me-Not	*Catochrysops strabo*	Lycaenidae
29	India Cupid	*Everes lacturnus*	Lycaenidae
30	Lesser Grass Blue	*Zizina otis*	Lycaenidae
31	Large Hedge Blue	*Celastrina huegelii*	Lycaenidae
32	Malayan	*Megisba malayan*	Lycaenidae
33	Metallic Cerulean	*Jamides alecto*	Lycaenidae
34	Pale Grass Blue	*Pseudozizeeria maha*	Lycaenidae

35	Pea Blue	*Lampides boeticus*	Lycaenidae
36	Transparent 6-Lineblue	*Nacaduba kurava*	Lycaenidae
37	Common Gem	*Poritia hewitsoni*	Lycaenidae
38	Dark Judy	*Abisara fylla*	Lycaenidae
39	Plum Judy	*Abisara echerius*	Lycaenidae
40	Punchinello	*Zemeros flegyas*	Lycaenidae
41	Tailed Punch	*Dodona eugenes*	Lycaenidae
42	Chocolate Royal	*Remelana jangala*	Lycaenidae
43	Club Silver Line	*Spindasis syama*	Lycaenidae
44	Common Acacia Blue	*Surendra quercetorum*	Lycaenidae
45	Common Emperial	*Cheritra freja*	Lycaenidae
46	Common Tit	*Hypolycaena erylus*	Lycaenidae
47	Fluffy Tit	*Zeltus amasa*	Lycaenidae
48	Large Oakblue	*Arhopala amantes*	Lycaenidae
49	Orchid Tit	*Chliaria othona*	Lycaenidae
50	Slate Flash	*Rapala manea*	Lycaenidae
51	Western Centaur Oakblue	*Arhopala pseudocentaurus*	Lycaenidae
52	Yamfly	*Loxura atymnus*	Lycaenidae
53	Black Prince	*Rohana parisatis*	Nymphalidae
54	Courtesan	*Euripus nyctelius*	Nymphalidae
55	Indian Purple Emperor	*Apatura ambica*	Nymphalidae
56	Painted Courtesan	*Euripus consimilis*	Nymphalidae
57	Pasha	*Herona marathus*	Nymphalidae
58	Angled Castor	*Ariadne ariadne*	Nymphalidae
59	Common Castor	*Ariadne merione*	Nymphalidae
60	Great Nawab	*Polyura narcaea*	Nymphalidae
61	Pallid Nawab	*Cethosia biblis tisamena*	Nymphalidae
62	Black Rajah	*Charaxes solon*	Nymphalidae
63	Tawny Rajah	*Charaxes bernardus*	Nymphalidae
64	Yellow Rajah	*Charaxea marmax*	Nymphalidae
65	Veriegated Rajah	*Charaxes kahruba*	Nymphalidae
66	Common Map	*Cyrestis thyodamas*	Nymphalidae
67	Common Maplet	*Chersonesia risa*	Nymphalidae
68	Popinjay	*Stibochiona nicea*	Nymphalidae
69	Tabby	*Pseudergolis wedah*	Nymphalidae
70	Common Crow	*Euploea core*	Nymphalidae

71	Striped Blue Crow	*Euploea mulciber*	Nymphalidae
72	Magpie Crow	*Euploea radmanthus*	Nymphalidae
73	Chocolate Tiger	*Parantica melaneus*	Nymphalidae
74	Dark BlueTiger	*Tirumala septentrionis*	Nymphalidae
75	Blue Tiger	*Tirumala limniace*	Nymphalidae
76	Glassy Tiger	*Parantica aglea melanoides*	Nymphalidae
77	Striped Tiger	*Danaus genutia*	Nymphalidae
78	Plain Tiger	*Danaus chrysippus*	Nymphalidae
79	Yellow Coster	*Acraea issoria*	Nymphalidae
80	Large Yoeman	*Cirrochroa aoris*	Nymphalidae
81	Cruiser	*Vindula erota*	Nymphalidae
82	Leopard Lacewing	*Cethosia cyane*	Nymphalidae
83	Red lacewing	*Cethosia biblis*	Nymphalidae
84	Vagrant	*Vagrans egista*	Nymphalidae
85	Indian Fritillary	*Agyreus hyperbius*	Nymphalidae
86	Common Leopard	*Phalanta phalantha*	Nymphalidae
87	Common Beak	*Libythea lepita*	Nymphalidae
88	Club Beak	*Libythea myrrha*	Nymphalidae
89	Commander	*Moduza procris*	Nymphalidae
90	Commodore	*Limenitis danava*	Nymphalidae
91	Knight	*Lebadea martha*	Nymphalidae
92	Small Staff Sergeant	*Athyma zeroca*	Nymphalidae
93	Blackvein Sergeant	*Athyma ranga*	Nymphalidae
94	Staff Sergeant	*Athyma selenophora*	Nymphalidae
95	Dot-Dash Sergeant	*Athyma kanwa*	Nymphalidae
96	Colour Sergeant	*Athyma nefte*	Nymphalidae
97	Common Sailer	*Neptis hylas*	Nymphalidae
98	Orange Staff Sergent	*Athyma cama*	Nymphalidae
99	Pale Green Sailer	*Neptis zaida*	Nymphalidae
100	Spotted Sailer	*Neptis magadha*	Nymphalidae
101	Sullied Sailer	*Neptis soma*	Nymphalidae
102	Common Lascar	*Pantoporia hordinia*	Nymphalidae
103	Yellow Jack Sailer	*Lassipa viraja*	Nymphalidae
104	Streaked Baron	*Euthalia alphedajama*	Nymphalidae
105	Grey Count	*Taneaecia lepidea*	Nymphalidae
106	Plain Earl	*Tanaecia jahnu*	Nymphalidae

107	Common Earl	*Tanaecia julii*	Nymphalidae
108	Dark Archduke	*Lexias pardalis*	Nymphalidae
109	Common Jester	*Symbrenthai hippoclus*	Nymphalidae
110	Indian Tortoiseshell	*Aglaiscashmiriensis*	Nymphalidae
111	Blue Pansy	*Junonio orithiye*	Nymphalidae
112	Grey Pansy	*Junonia atlites*	Nymphalidae
113	Chocolate Pansy	*Jinonia iphita*	Nymphalidae
114	Lemon Pansy	*Junonialemonias*	Nymphalidae
115	Peacock Pansy	*Junonia almanac*	Nymphalidae
116	Great Egg fly	*Hypolimnasbonila*	Nymphalidae
117	Autumn leaf	*Doleschalliabisaltide*	Nymphalidae
118	Orange Oakleaf	*Kallimainachus*	Nymphalidae
119	Jungle Glory	*Thaumantisdiores*	Nymphalidae
120	Banded Tree Brown	*Lethe confuse*	Nymphalidae
121	BrighteyeBushbrown	*Mycallesisnicotia*	Nymphalidae
122	Dark Brand Bushbrown	*Mycalesismineus*	Nymphalidae
123	Common Bushbrown	*Mycalesis perseus*	Nymphalidae
124	Common Evening Brown	*Melannitisleda*	Nymphalidae
125	Common Fivering	*Ypthimabaldus*	Nymphalidae
126	Dark Evening Brown	*Melanitisphedima*	Nymphalidae
127	Himalayan Fivering	*Ypthimasakra*	Nymphalidae
128	Jezebel Palmfly	*Elymniasvasudeva*	Nymphalidae
129	Long Brown Bushbrown	*Mycalesisvisala*	Nymphalidae
130	Nigger	*Orsotrioenamedus*	Nymphalidae
131	Straight Banded Treebrown	*Lethe verma*	Nymphalidae
132	White Bar Bushbrown	*Mycalesisanaxias*	Nymphalidae
133	Blue Striped Mime	*Chilasaslateri*	Papilionodae
134	Common mormoon	*Papiliopolytes*	Papilionodae
135	Common Batwing	*Atrophaneuravaruna*	Papilionodae
136	Common Birdwing	*Thoides Helena*	Papilionodae
137	Common Bluebottle	*Graphiumsarpedon*	Papilionodae
138	Common Jay	*Graphiumdoson*	Papilionodae
139	Common mime	*Chilasaclytia*	Papilionodae
140	Common Raven	*Papilio castor*	Papilionodae
141	Common Rose	*Atrophaneuraaristolochiae*	Papilionodae
142	Common Windmill	*Atrophaneurapolyeuctes*	Papilionodae

143	Five Bar Swordtail	*Graphiumantiphates*	Papilionodae
144	Four bar sword tail	*Graphiumagetes*	Papilionodae
145	Great Mormon	*Papiliomemnon*	Papilionodae
146	Lesser Batwing	*Atrophaneuraaidoneus*	Papilionodae
147	Lesser Zebra	*Graphiummacareus*	Papilionodae
148	Lime Butterfly	*Papiliodemoleus*	Papilionodae
149	Paris Peacock	*Papilioparis*	Papilionodae
150	Red Helen	*Papiliohelenus*	Papilionodae
151	Spot Swordtail	*Graphiumnomius*	Papilionodae
152	Tailed Jay	*Graphium Agamemnon*	Papilionodae
153	Yellow Helen	*Papilionephelus*	Papilionodae
154	Common Emigrant	*Catopsilia Pomona*	Paridae
155	Common Grass Yellow	*Euremahecabe*	Paridae
156	Dark Clouded Yellow	*Coliasfieldii*	Paridae
157	Mottled Emigrant	*Catopsilliapyranthe*	Paridae
158	One Spot Grass Yellow	*Euremaandersoni*	Paridae
159	Three Spot Grass Yellow	*Euremablanda*	Paridae
160	Tailed Sulphur	*Dercasverhuelli*	Paridae
161	Tree Yellow	*Gandacaharina*	Paridae
162	Chocolate Albastross	*Appiaslyncida*	Paridae
163	Common Gull	*Ceporanerissa*	Paridae
164	Great Orange Tip	*Hebomoiaglaucippe*	Paridae
165	Large Cabbage White	*Pierisbrassicae*	Paridae
166	Lesser Gull	*Ceporanadina*	Paridae
167	Pale Wanderer	*Pareronia avatar*	Paridae
168	Plain Puffin	*Appiasindra*	Paridae
169	Psyche	*Leptosianina*	Paridae
170	Spot puffin	*Appiaslalage*	Paridae
171	Red Base Jezebel	*Deliaspasithoe*	Paridae
172	Red spot Jezebel	*Deliasdescombesi*	Paridae
173	Spotted Sawtooth	*Prioneristhestylis*	Paridae
174	Pale Jezebel	*Delias Sanaca*	Paridae
175	Yellow Jezebel	*Deliasagostina*	Paridae
176	Yellow Orangetip	*Ixias pyrene*	Paridae

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