

I. Introduction

A. Background of the Study

The Philippines used to have rich tropical rainforests but much has been reduced during the latter half of the twentieth century. The loss of habitats for the many different species can lead to their extinction. Effective action must be taken to preserve the remaining habitats and the species inhabiting them [1].

The Philippines is identified as one of the world's biologically richest countries. Many endemic species are confined to forest fragments that cover only 7 percent of the original extent of the hotspot [2].

The threat to the specific biodiversity hotspot, the rain forest on Mount Isarog, located in Camarines Sur, is both tragic and severe. Studies in the park demonstrated that 27 species of birds found in the park by Professor Rabor's field team in 1961 had become locally extinct by 1988—20 percent of the total of 135 species. All of these locally extinct species are among the 64 that live (or lived) in lowland rain forest. The Isarog shrew-rat and two other species of mammals that are known only from Mount Isarog are now listed as endangered in the *Red Data Book* of the IUCN (International Union for the Conservation of Nature and Natural Resources) [3].

B. Statement of the Problem

There is a tremendous urgency to identify factors that result in major impacts on biodiversity, especially in light of rapid species declines and extinctions [4]. The primary threat to biodiversity is habitat alteration and loss caused by destructive resource use, development-related activities and human population pressure [5]. Even if we can see some of the major factors affecting biodiversity, it would still better to identify other factors that could affect biodiversity.

Biologists are gathering vast amounts of data. Biodiversity databases are as complex as molecular and medical biology resources, yet serve a broad audience as do general-use digital libraries [6]. There is already a need for the development of information infrastructure to better support the collection, management, dissemination, and application of biodiversity data and information [7].

The Mt. Isarog Protected Area Office is responsible for the administration of the Park. It has an extension office [054.472-8018] at the Provincial Environment and Natural Resources Office (PENRO) in Panganiban Drive, Naga City. Research and information centers, museum and a training hall are part of the Protected Area Office compound. The gate has a ticket booth where visitors pay upon entering the Park. The Office employs rangers tasked to apprehend violators, do surveillance and monitoring activities, promote and inform people on environmental issues, guide and assist visitors, conduct and research, monitor and control forest fires and perform many other tasks [8].

At present, there is no computerized online system dealing with biodiversity issues in Mt Isarog. This means that biodiversity data in Mt Isarog is not readily available for interested people like researchers, students, etc.

C. Objectives

The objective of the system is to create an online biodiversity database particular to Mt Isarog with the following functionalities:

- 1) Allows the Mt. Isarog Protected Area Office biologist to
 - a) update the database of species found in Mt Isarog
 - b) store gathered environmental factors (e.g. rainfall, temperature, humidity) in Mt Isarog
 - c) edit the list of environmental factors
 - d) view graphical representation of environmental data of Mt Isarog (rainfall, temperature, humidity etc)
 - e) view the map of Mt Isarog
 - f) post/view messages regarding biodiversity issues in Mt Isarog
 - g) edit account information

- 2) Allows the general user to
 - a) request for an account
 - b) view the map of Mt Isarog

- c) view the list of species in Mt Isarog and know which of them are endemic and which are endangered
- d) view the areas in Mt Isarog that are open to the public
- e) view graphical representation of environmental data of Mt Isarog (rainfall, temperature, humidity etc)
- f) view FAQ's in biodiversity issues in general in Mt Isarog
- g) post/view messages regarding biodiversity issues in Mt Isarog
- h) edit account information

3) Allows the government representative to

- a) update local and national legislations pertinent to Mt Isarog
- b) post/view messages pertaining to public interest in Mt Isarog (e.g. areas open to the public, security issues etc)
- c) edit account information

4) Allows the system administrator to

- a) update user accounts
- b) moderate message board
- c) edit account information

D. Significance of the Study

A biodiversity informatics system may greatly satisfy the need to systemize the data in a format, which is usable by the decision-making individuals and institutions, particularly the Mt Isarog Protected Area Office Biologist. The availability of some information online satisfies the need for larger publicity and access to information about the biological diversity with the aim to increase the public awareness about its preservation [9]. The system will be another useful source for researchers on biodiversity of Mt Isarog. Data will also be secure and kept accurate because data is entered by authorized users.

E. Scope and Limitations

The species refers to the different plants and animals present in Mt Isarog. But the system will focus only on the endemic and endangered species seen in Mt Isarog.

II. Review of Related Literature

A group of students from the University of Missouri-Rolla (and surrounding senior and junior high schools) work together to ask questions about biodiversity. They go to a local conservation site and collect data to answer their questions, and they work together to come up with ways to store, analyze, and present their data and findings [10].

Plant scientists from the University of Oxford are embarking on a major project with the University of the West Indies (UWI) to establish a biodiversity monitoring system for Trinidad and Tobago [11]. The project created an online detailed vegetation map of the islands and linked the plant collections of Oxford and the UWI for the first time online.

Within the EMAN (ECOLOGICAL MONITORING AND ASSESSMENT NETWORK) context, the objective of monitoring biodiversity change is to gain an understanding of what is changing in the ecosystems and why [12]. By integrating long-term information on species trends/cycles with the abiotic data and land-use change information and with the results of other ecosystem (process, attribute, etc.) research from the same area, a more complete profile of an ecosystem can be prepared, and evidence of change and/or condition documented.

Entomological Data Information System (EDIS) (<http://www.insects-online.de/>), is a joint national biodiversity information initiative which was implemented during the course of three years with support from the German Federal Ministry of Education and

Research (BMBF) as part of the research program BIOLOG [13]. The "Global Register of Migratory Species" (<http://www.groms.de>), is a cross-sectional database and geographical information system, specialising on migratory species [13]. The "Inventory of biological research collections in Germany (ZEFOD)" is collecting metadata on biological collections in Germany (www.genres.de/zefod).

SYNTHESSYS (Synthesis of systematics resources) is a collaboration project of 20 European natural history museums and botanic gardens led by the Natural History Museum in London and funded by the European Commissions 6th Framework Programme. The BGBM (Botanic Garden and Botanical Museum Berlin-Dahlem) coordinates informatics and IT tasks for the project in Networking Activity D of SYNTHESSYS. Networking Activity D will build on and actively incorporate results of initiatives such as BioCASE (Biological Collection Access Service for Europe) and ENHSIN (European Natural History Specimen Information Network), which have laid the base for a European collection information service, and aims to take the research work from these initiatives as the core of a practical, sustainable, Europe-wide information network for users of taxonomic information. It provides interaction with global biodiversity informatics infrastructure, represented by GBIF (Global Biodiversity Information Facility), and related European projects, such as ENBI (European Network for Biodiversity Information) [14].

BioCASE (Biological Collection Access Service for Europe) is a 35-partner research and development project co-ordinated by the BGBM, starting Nov. 1, 2001. Financed under the European Union's 5th Framework Programme, Research Infrastructures until Jan. 31, 2005, to be carried on by the partnership at least until August 2006. The BGBM is responsible for over-all co-ordination and for the development of the access system [14]. BioCASE is a transnational network of biological collections of all kinds. BioCASE enables widespread unified access to distributed and heterogeneous European collection and observational databases using open-source, system-independent software and open data standards and protocols [15].

The World Biodiversity Database (WBD) is a continuously growing taxonomic database and information system that allows you to search and browse a number of online species banks covering a wide variety of organisms [16].

The Terrestrial and Freshwater Biodiversity Information System (TFBIS) Programme supports the conservation of New Zealand's indigenous biodiversity, by increasing awareness of and access to fundamental data and information about terrestrial and freshwater biota and biodiversity [17]. The purpose of the TFBIS Programme is to support the conservation of New Zealand's indigenous biodiversity, by increasing awareness of and access to fundamental data and information about biota and biodiversity. The Programme initiates and funds projects which enhance terrestrial and freshwater biodiversity information systems.

The Department of Conservation (DOC) is implementing a new natural heritage management system (NHMS). To support this, a national monitoring system for biodiversity is required. The monitoring system provides a framework for monitoring biodiversity and reporting on its status and trend. It includes the development of sophisticated databases and a range of tools to assist managers in defining outcomes, planning and prioritising natural heritage work, and selecting and implementing projects [18].

III. Theoretical Framework

A. Biodiversity

Biological diversity has no single standard definition. One definition holds that biological diversity is a measure of the relative diversity among organisms present in different ecosystems. Diversity in this definition includes diversity within species and among species, and comparative diversity among ecosystems. Biodiversity is the variety of life: the different plants, animals and micro-organisms, their genes and the ecosystems of which they are a part.

Another definition, simpler and clearer, but more challenging, is the *totality of genes, species, and ecosystems of a region* [19]. An advantage of this definition is that it seems to describe most instances of its use, and one possibly unified view of the traditional three levels at which biodiversity has been identified:

- genetic diversity - diversity of genes within a species. There is a genetic variability among the populations and the individuals of the same species
- species diversity - diversity among species
- ecosystem diversity - diversity at a higher level of organization, the ecosystem (richness in the different processes to which the genes ultimately contribute)

The lattermost definition, which conforms to the traditional five organisation layers in biology, provides additional justification for multilevel approaches. The 1992 United Nations Earth Summit in Rio de Janeiro defined *biodiversity* as "the variability among living organisms from all sources, including, *inter alia*, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems" [19].

This is, in fact, the closest thing to a single legally accepted definition of biodiversity, since it is the definition adopted by the United Nations Convention on Biological Diversity. The parties to this convention include all the countries on Earth, with the exception of Andorra, Brunei Darussalam, the Holy See, Iraq, Somalia, Timor-Leste, and the United States of America [19].

If the gene is the fundamental unit of natural selection, thus of evolution, some, like E. O. Wilson, say that the real biodiversity is the genetic diversity. However, the species diversity is the easiest one to study. For geneticists, *biodiversity* is the diversity of genes and organisms. They study processes such as mutations, gene exchanges, and genome dynamics that occur at the DNA level and generate evolution. For biologists, *biodiversity* is the diversity of populations of organisms and species, but also the way these organisms function. Organisms appear and disappear; sites are colonized by organisms of the same species or by another. Some species develop social organisations to improve their reproduction goals or use neighbor species that live in communities.

Depending on their environment, organisms do not invariably use the same strategies of reproduction [19].

For ecologists, *biodiversity* is also the diversity of durable interactions among species. It not only applies to species, but also to their immediate environment (biotope) and the ecoregions the organisms live in. In each ecosystem, living organisms are part of a whole; they interact with one another, but also with the air, water, and soil that surround them. Biodiversity is not static: it is a system in constant evolution, from a species, as well as from an individual organism point of view. The average half-life of a species is estimated at between one and four million years, and 99% of the species that have ever lived on earth are today extinct. Biodiversity is not distributed evenly on earth. It is consistently richer in the tropics. As one approaches polar regions one finds larger and larger populations of fewer and fewer species. Flora and fauna vary depending on climate, altitude, soils and the presence of other species [19].

Endemic species

In biology and ecology endemic means exclusively native to a place or biota, in contrast to cosmopolitan or one of various ways of being not native (e.g., adventive, exotic, alien, introduced, naturalized). However, it is also differentiated from indigenous. A species that is endemic is unique to that place or region, found naturally nowhere else, whereas a species that is indigenous may be native to other locations as well. Usually the term is applied to a discrete geographical unit, most often an island or island group, but sometimes a country or other defined area [19]. Islands are especially likely to develop

endemic forms because of their geographical isolation; remote island groups, such as Hawai'i and the Galápagos Islands, have large numbers of endemic species. The restricted area and vulnerability to the depredations of man and introduced species mean that endemics all too easily can become extinct [19].

Endangered species

An endangered species is a species whose population is so small that it is in danger of becoming extinct. Many countries have laws offering special protection to these species (forbidding hunting, banning development, etc. of their habitats) to prevent their extinction. Only a few of the many truly endangered species actually make it to the lists and obtain legal protection. Many more species become extinct, or potentially will become extinct, without gaining public notice [19].

Many of these laws are controversial. Typical areas of controversy include: criteria for placing a species on the endangered species list, and criteria for removing a species from the list once its population has recovered; whether restrictions on land development constitute a "taking" of land by the government, and the related question of whether private landowners should be compensated for the loss of use of their land; and obtaining reasonable exceptions to protection laws [19].

A listing as an endangered species can backfire, as it makes a species more valuable and more desirable for collectors and poachers [19].

The conservation status of a species is an indicator of the likelihood of that endangered species continuing to survive. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.

The best-known worldwide conservation status listing is the IUCN Red List, but many more specialized lists exist.

The following conservation status categories are used in articles in this encyclopedia. They are loosely based on the IUCN categories [19].

- **Extinct**: the last remaining member of the species had died, or is presumed to have died beyond reasonable doubt. Examples: Thylacine, Dodo.
- **Extinct in the wild**: captive individuals survive, but there is no free-living, natural population. Examples: Dromedary, Przewalski's Horse.
- **Critical** or *critically endangered*: faces an extremely high risk of extinction in the immediate future. Examples: Ivory-billed Woodpecker, Arakan Forest Turtle
- **Endangered**: faces a very high risk of extinction in the near future. Examples: Kings holly, Pink fairy armadillo
- **Vulnerable**: faces a high risk of extinction in the medium-term. Examples: Cheetah, Bactrian Camel
- **Secure** or *lower risk*: no immediate threat to the survival of the species. Examples: Nootka Cypress, Llama

Species inventory

Systematics assesses biodiversity simply by distinguishing among species. At least 1.75 million species have been described; however, the estimates of the true number of current species range from 3.6 to more than 100 million. Some also say that the knowledge of the species and the families became insufficient and must be supplemented by a greater comprehension of the functions, interactions and communities. Moreover, exchanges of genes occurring between the species tend to add complexity to the inventory [19].

Biodiversity Hotspots

A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction [19].

Biodiversity Informatics

The term "Biodiversity Informatics" was coined to circumscribe the application of IT tools and technology to biodiversity information, principally at the organismic level. It thus deals with information capture, storage, provision, retrieval, and analysis, focused on individual organisms, populations, and taxa, and their interaction [14].

B. Mt Isarog

Mt. Isarog, an inactive volcano, rises in the heart of the province of Camarines Sur, the central part of the Bicol Peninsula about 450 kilometers south of Manila. It is the

highest forested peak in Southern Luzon. The Park, 10,112 hectares wide, has a rich diversity of flora and fauna. It is home to at least 143 kinds of birds, 15 of which are endemic to Luzon including a sub-species of the Velvet-fronted Nuthatch which is found only in Mt. Isarog. Other species endemic to the mountain are the Mt. Isarog Shrew Mouse, Isarog Striped Shrew Rat, the Isarog Shrew Rat and the Isolated Forest Frog. Rich in diversity, the park harbors 1,300 known species of plants including hardwood trees, mosses, ferns and orchids. Mammals found in the area include, among others, the Philippine deer, monkeys, bats, wildcat and wild pig [20].

C. Information System

A system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information [21]. Any telecommunications and/or computer related equipment or interconnected system or subsystems of equipment that is used in the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of voice and/or data, and includes software, firmware, and hardware. The entire infrastructure, organization, personnel, and components for the collection, processing, storage, transmission, display, dissemination, and disposition of information.

D. GIS (Geographic Information System)

A geographic information system (GIS) is a system for creating and managing spatial data and associated attributes. In the strictest sense, it is a computer system

capable of integrating, storing, editing, analyzing, and displaying geographically-referenced information. In a more generic sense, GIS is a "smart map" tool that allows users to create interactive queries (user created searches), analyze the spatial information, and edit data.

E. Databases

A database is an organized collection of data. The term originated within the computer industry, but its meaning has been broadened by popular use, to the extent that the European Database Directive includes non-electronic databases within its definition [22]. Traditional databases are organized by fields, records, and files. A field is a single piece of information; a record is one complete set of fields; and a file is a collection of records. For example, a telephone book is analogous to a file. It contains a list of records, each of which consists of three fields: name, address, and telephone number.

An alternative concept in database design is known as Hypertext. In a Hypertext database, any object, whether it be a piece of text, a picture, or a film, can be linked to any other object. Hypertext databases are particularly useful for organizing large amounts of disparate information, but they are not designed for numerical analysis. A [database](#) is a structured collection of data. The data stored in a database is managed by a [Data Base Management System \(DBMS\)](#). The DBMS is responsible for adding, modifying, and deleting data from the database. The DBMS is also responsible for providing access to the data for viewing and reporting [23]. DBMS is a collection of programs that enables you to enter, organize, and select data in a database

IV. Design and Implementation

A. Entity Relationship Diagram

Figure 1 represents the overall relationships between users, messages, regulations, gather session, gather data, population species and factors. The attributes of the entities are shown in figures 2-11.

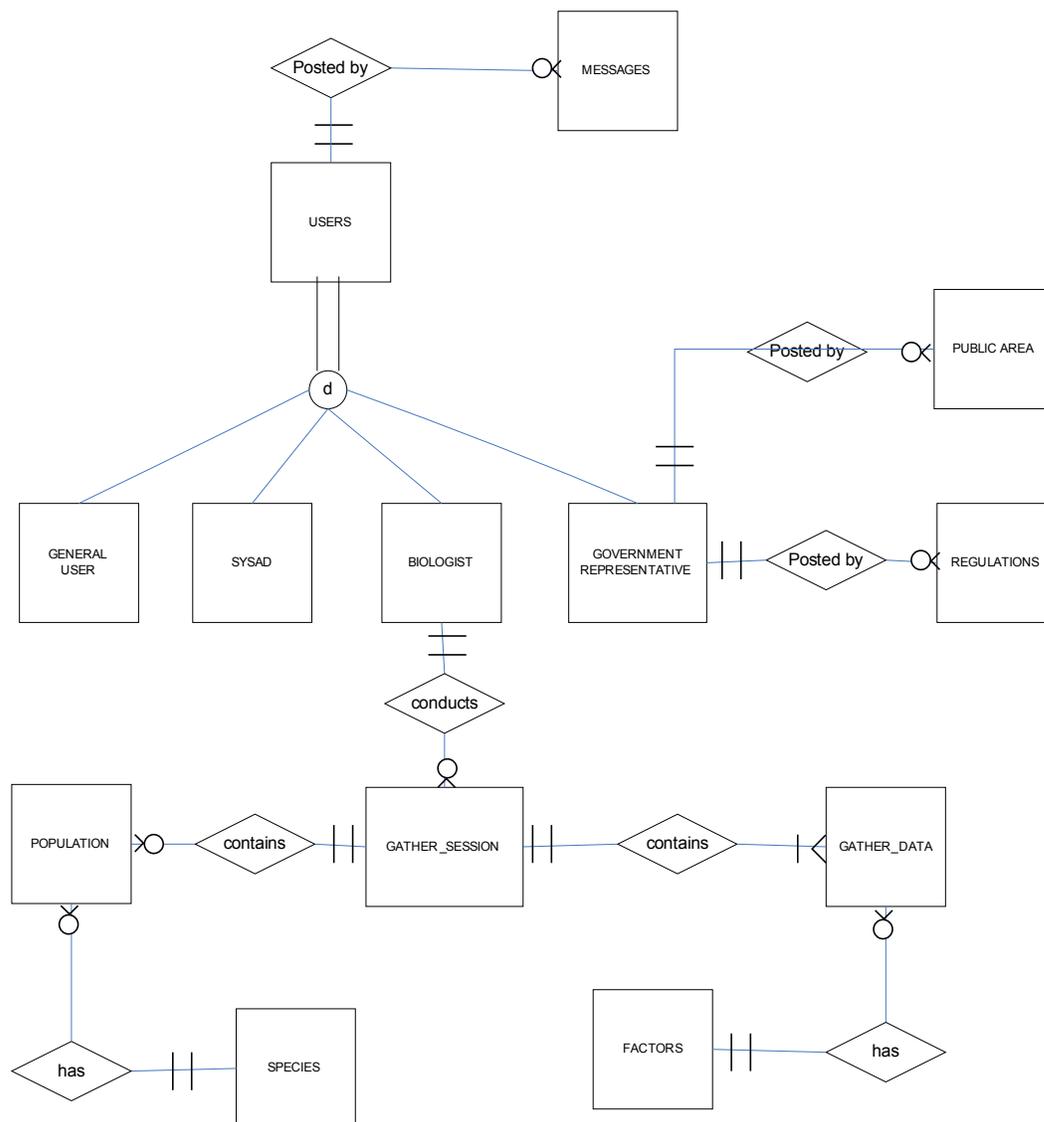


Figure 1. Entity Relationship Diagram, Mt Isarog Biodiversity Information System

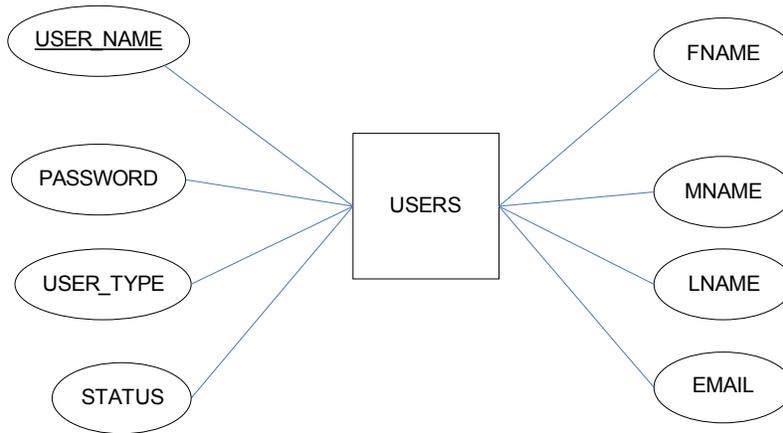


Figure 2. Users Entity with Attributes, Mt Isarog Biodiversity Information System

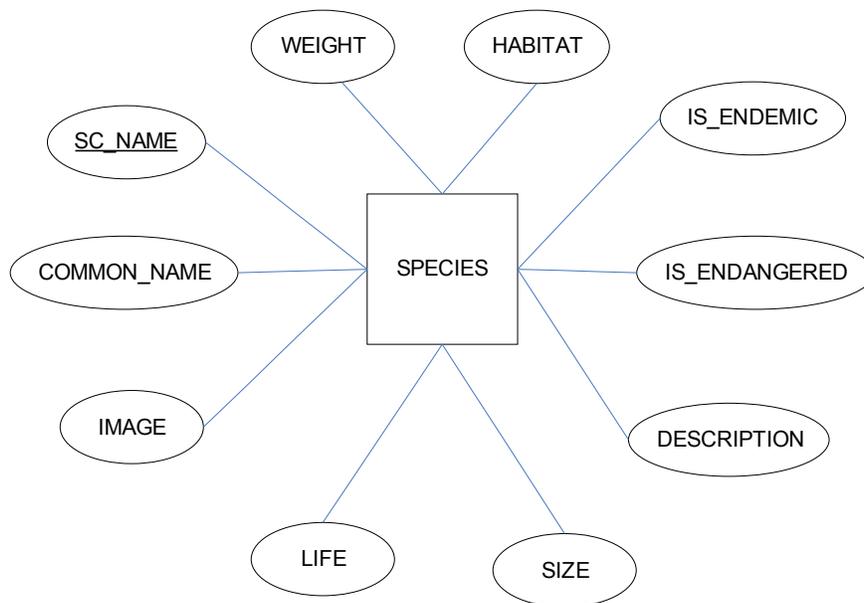


Figure 3. Species Entity with Attributes, Mt Isarog Biodiversity Information System

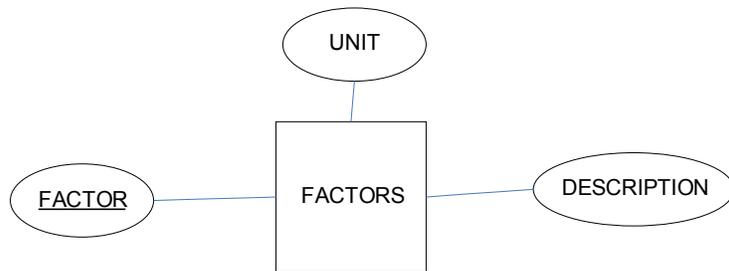


Figure 4. Factors Entity with Attributes, Mt Isarog Biodiversity Information System

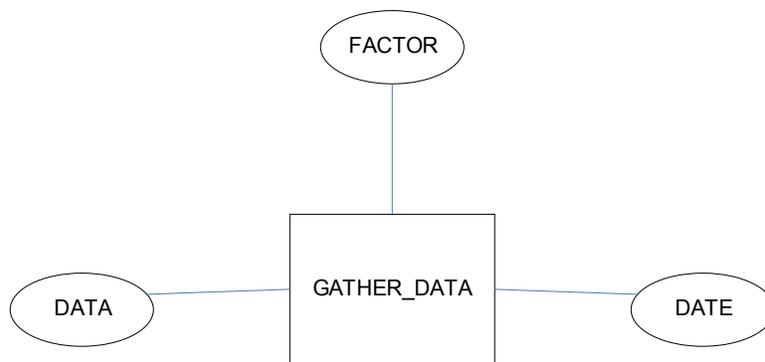


Figure 5. Gather_data Entity with Attributes, Mt Isarog Biodiversity Information System



Figure 6. Gather_session Entity with Attributes, Mt Isarog Biodiversity Information System

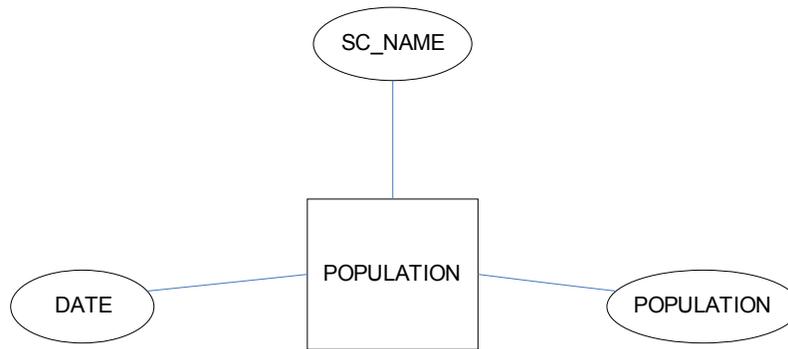


Figure 7. Population Entity with Attributes, Mt Isarog Biodiversity Information System

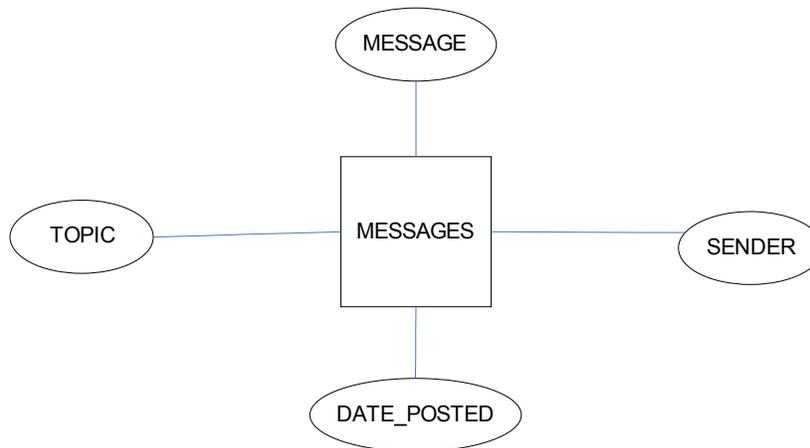


Figure 8. Messages Entity with Attributes, Mt Isarog Biodiversity Information System

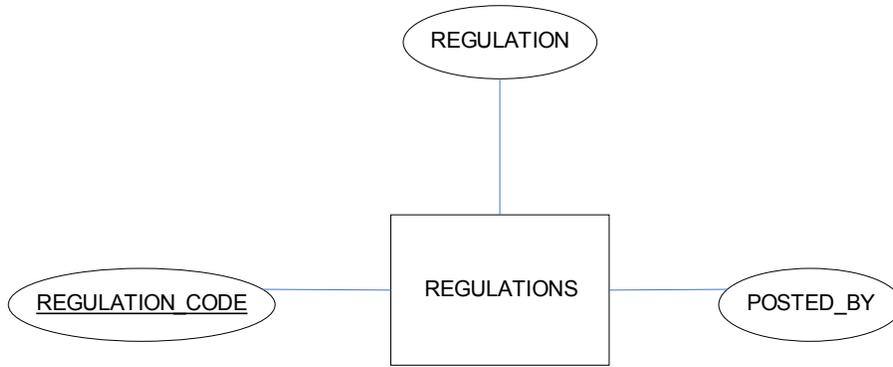


Figure 9. Regulations Entity with Attributes, Mt Isarog Biodiversity Information System

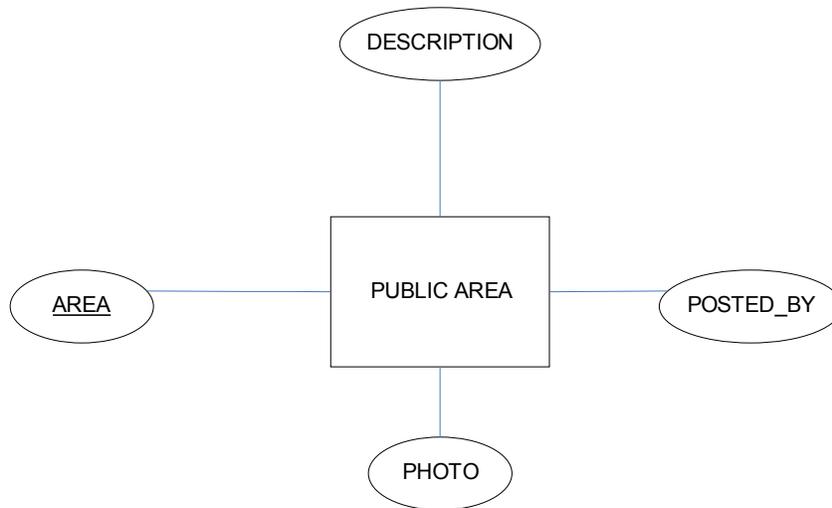


Figure 10. Public Area Entity with Attributes, Mt Isarog Biodiversity Information System

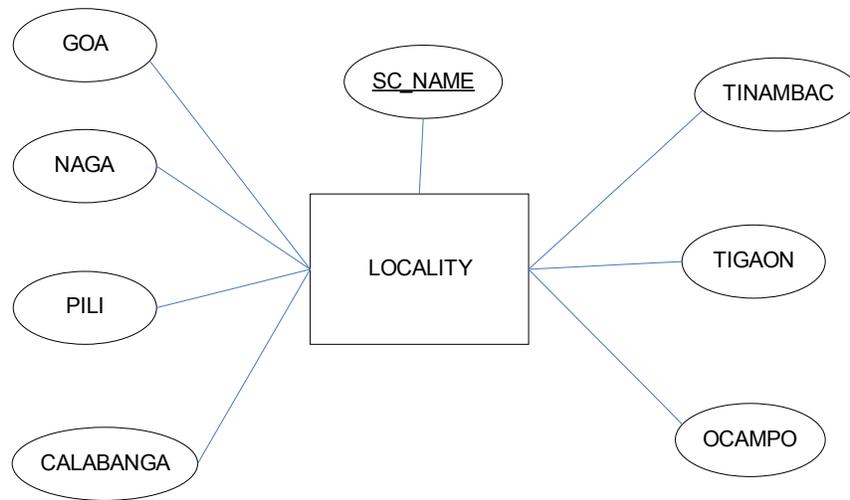


Figure 11. Locality Entity with Attributes, Mt Isarog Biodiversity Information System

B. Data Dictionary

TABLE USERS			
USER_NAME	User's username	Varchar (30)	Primary key
PASSWORD	User's password	Varchar (30)	
USER_TYPE	Type of user (biologist, general user, government representative, sysad)	Int	
STATUS	Disabled/enabled	Int	
FNAME	User's first name	Varchar (30)	
MNAME	User's middle name	Varchar (30)	
LNAME	User's last name	Varchar (30)	
EMAIL	User's email address	Varchar (30)	

TABLE SPECIES			
SC_NAME	Scientific name of species	Varchar(30)	Primary key
COMMON_NAME	Common name of species	Varchar(30)	
IMAGELINK	Filename of the species' picture	Varchar(30)	
DESCRIPTION	Brief description about the species	Blob	
IS_ENDANGERED	Tells if the species is endangered	Int	
LIFE	Life expectancy	Blob	
SIZE	Average adult size	Blob	
WEIGHT	Average adult weight	Blob	
HABITAT	Natural habitat of the species	Blob	
IS_ENDEMIC	Tells if the species is endemic to Mt Isarog	Int	

TABLE FACTORS			
FACTOR	Name of environmental factor	Varchar(30)	Primary key
DESCRIPTION	Brief description of the environmental factor	Blob	
UNITS	Unit of measurement	Varchar(30)	

TABLE GATHER DATA			
FACTOR	Environmental factor	Varchar(30)	Foreign key
DATA	Data regarding the factor	Float	
DATE	Date the data are gathered	Varchar(10)	Foreign key

TABLE GATHER SESSION			
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DATE	Date the data was gathered	int	
BIOLOGIST	Username of the biologist leading the gather session	Varchar(30)	Foreign key

TABLE POPULATION			
SC_NAME	Scientific name of the species	Varchar(30)	Foreign key
DATE	Date the population was gathered	Varchar(10)	Foreign key
POPULATION	Population of the species	Int	

TABLE MESSAGES			
MESSAGE	The message itself	Blob	
SENDER	Username of the sender	varchar(30)	
TOPIC	Topic of the message	Varchar(100)	
DATEPOSTED	Date message was posted	varchar(20)	
MNUM	Message number	int	

TABLE REGULATIONS			
REGULATION_CODE	Unique identifier for the regulations	Varchar(100)	Primary key
REGULATION	The link to the regulation/law	blob	
POSTED_BY	Username of the government representative that posted the regulation	Varchar(30)	Foreign key

TABLE PUBLICAREA			
AREA	Name of the area	Varchar(100)	Primary key
DESCRIPTION	Description of the area	blob	
PHOTO	Picture of the area	Varchar(100)	
POSTED_BY	Username of the government representative that posted the regulation	Varchar(30)	Foreign key

TABLE LOCALITY			
SC_NAME	Scientific name of the species	Varchar(100)	Primary key
GOA	Indicates presence in GOA	int	
CALABANGA	Indicates presence in CALABANGA	Int	
TIGAON	Indicates presence in TIGAON	Int	
TINAMBAC	Indicates presence in TINAMBAC	Int	
OCAMPO	Indicates presence in OCAMPO	Int	
PILI	Indicates presence in PILI	Int	
NAGA	Indicates presence in NAGA	Int	

C. Context Diagram

Figure 12 shows the interaction of the different users to the Mt Isarog Biodiversity Database. As illustrated in the Context Diagram, there are four main types of accounts: users, biologist, government representative and the sysad.

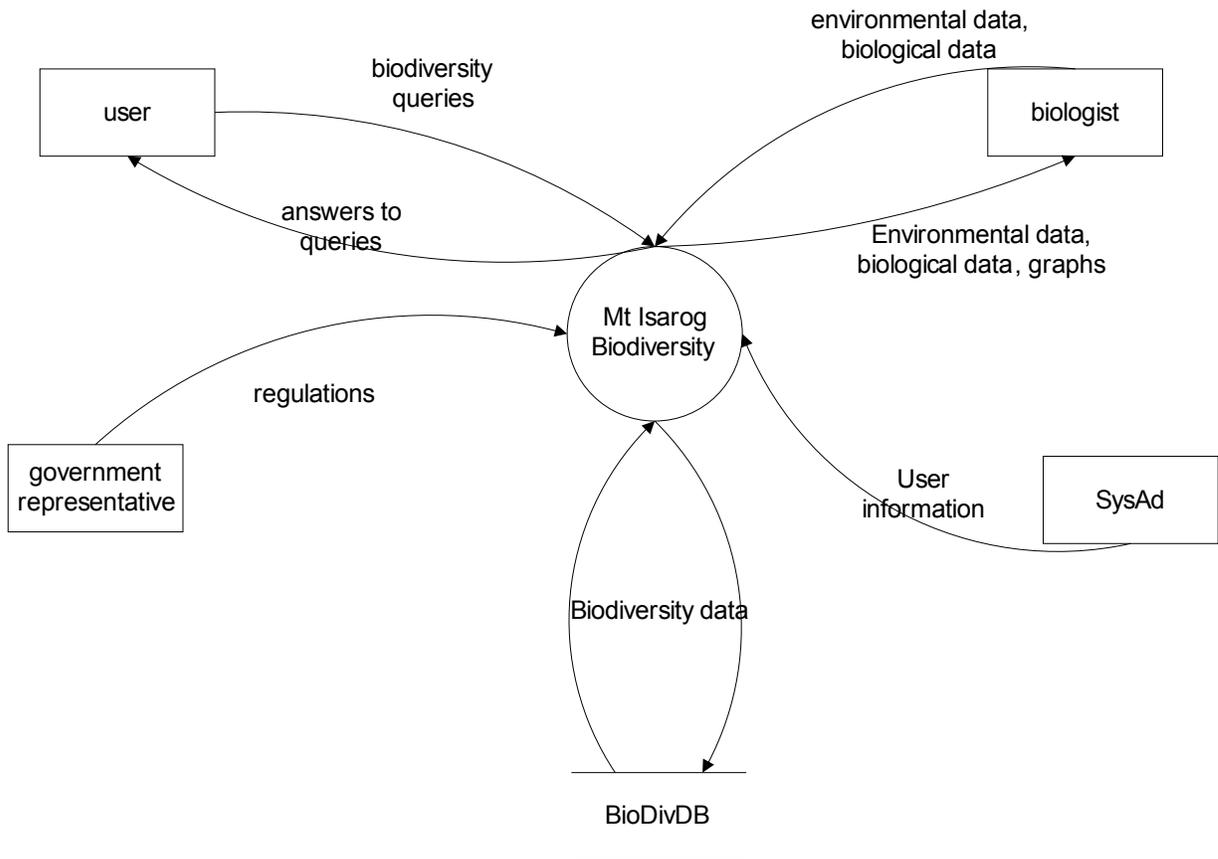


Figure 12. Context Diagram, Mt Isarog Biodiversity Information System

D. Data Flow Diagram

The top level Data Flow Diagram is seen in Figure 13. There are 7 main processes involved. These are Log-in, Update Biodiversity Record, View Biodiversity of Mt Isarog, View Graphs Generated By the System, Post/View Messages, Update Regulations and Update User Account.

The sub-explosion of process 2, Update Biodiversity Record, is shown in Figures 14-16. The main sub-processes are Update Species Table, Update Environmental Factor Table and Gather Environmental and Species Data.

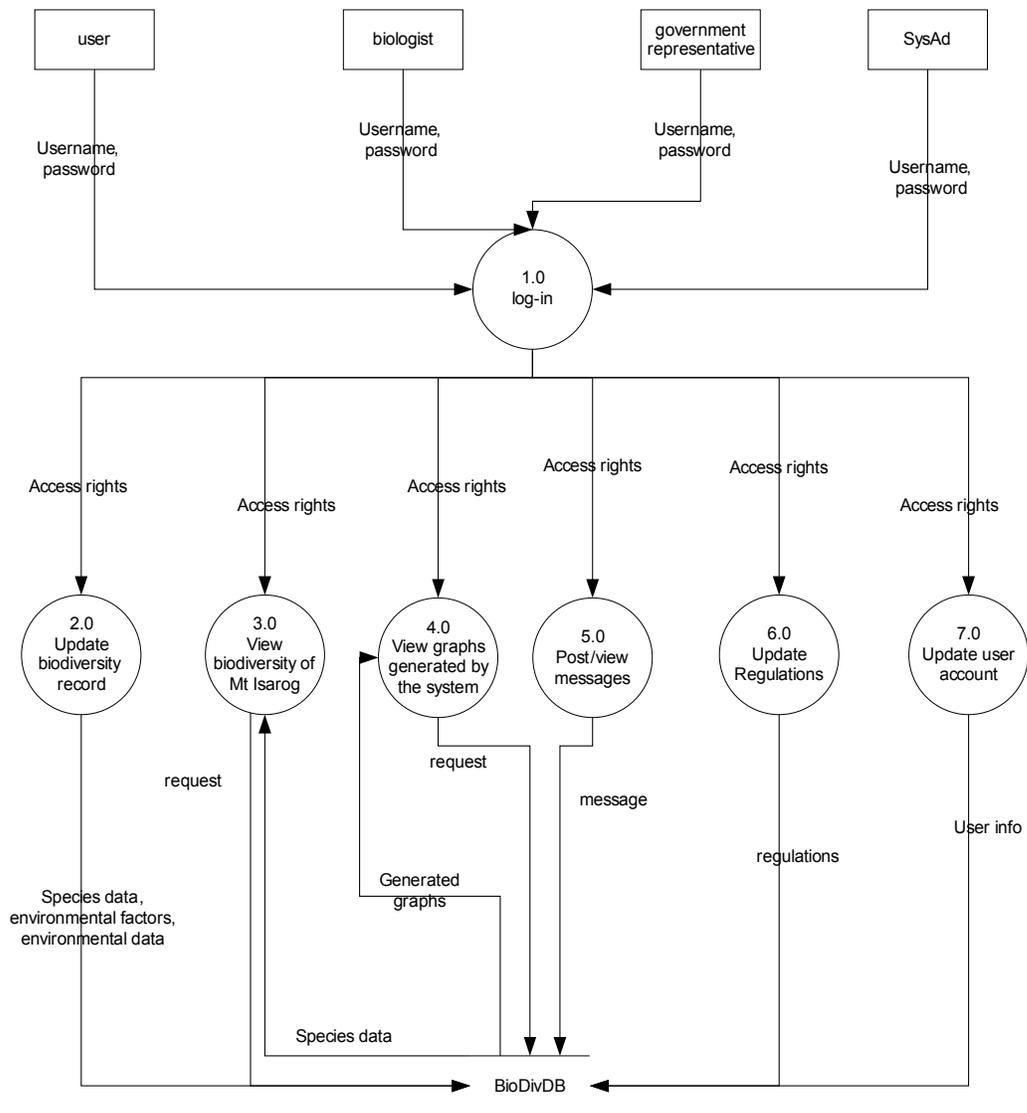


Figure 13. Top-level Data Flow Diagram, Mt Isarog Biodiversity Information System

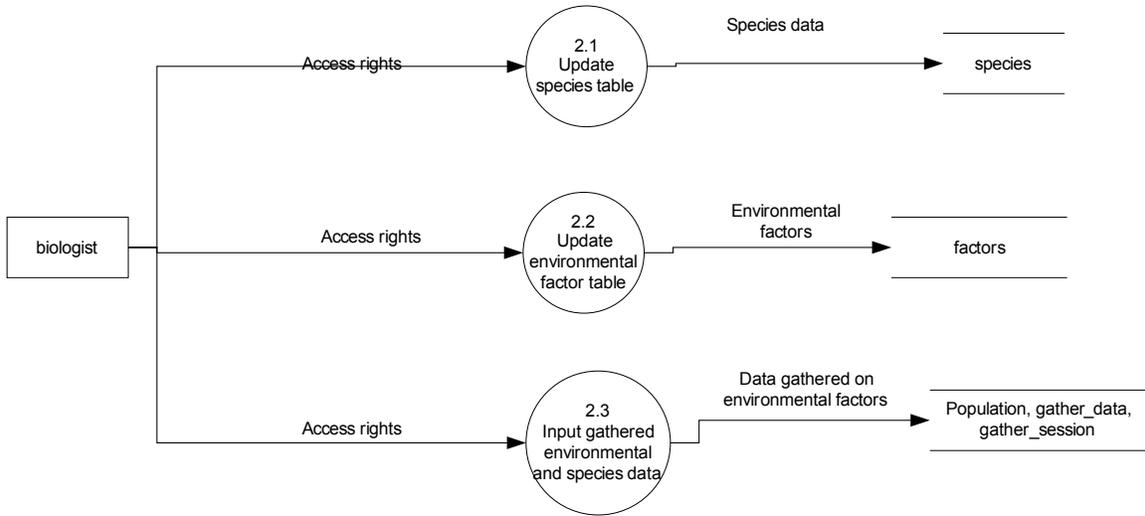


Figure 14. Sub-explosion of 2.0, Update Biodiversity Record, Mt Isarog Biodiversity Information System

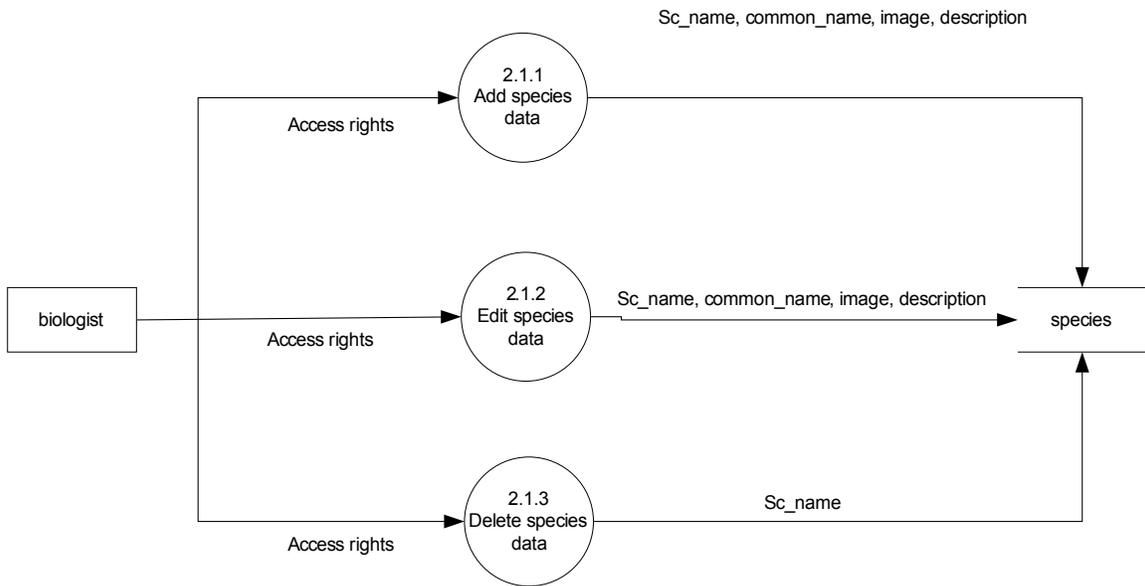


Figure 15. Sub-explosion of 2.1, Update Species Table, Mt Isarog Biodiversity Information System

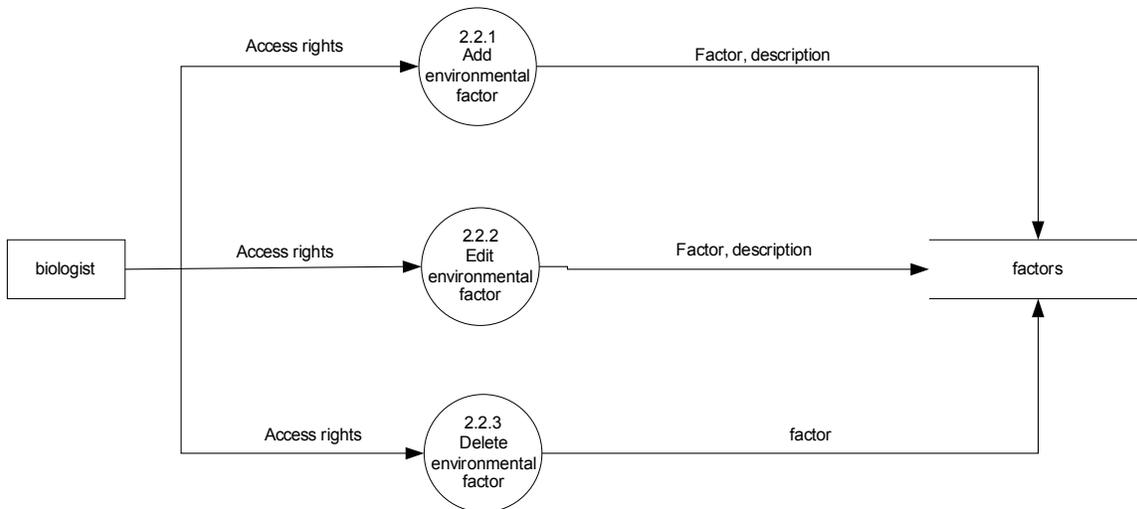


Figure 16. Sub-explosion of 2.2, Update Environmental Factor Table, Mt Isarog

Biodiversity Information System

Figure 17 shows the sub-explosion of the process View Graphs. It has only 2 processes namely: Specify Time Period and Generate Graph. On the other hand, the sub-explosion of process 5, Post/View Message is Illustrated on Figure 18.

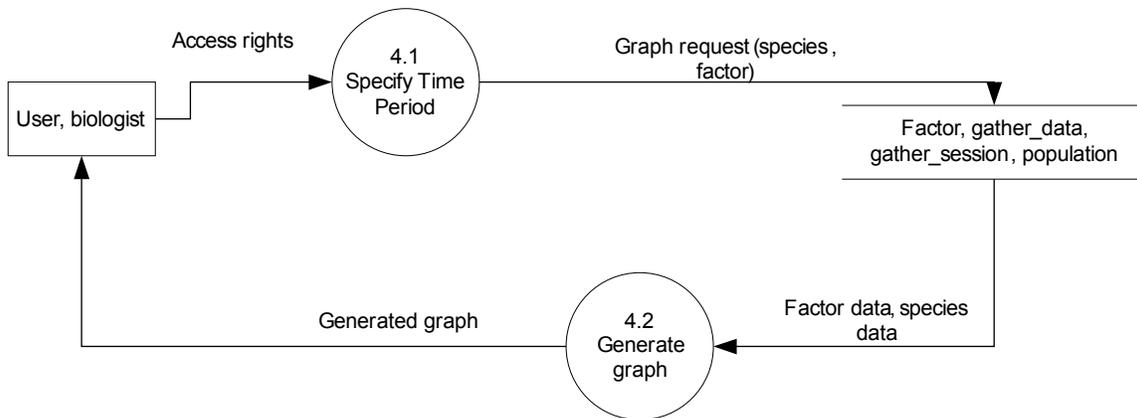


Figure 17. Sub-explosion of 4.0, View Graphs, Mt Isarog Biodiversity Information System

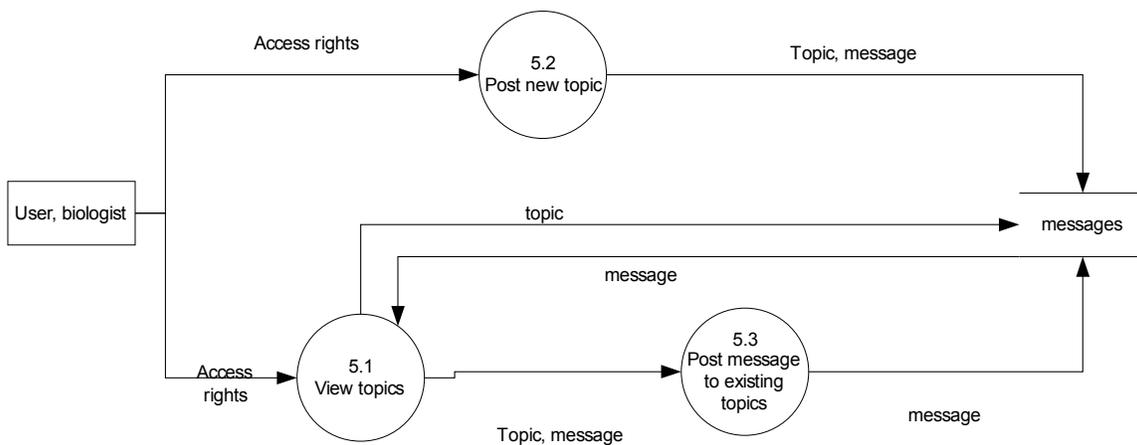


Figure 18. Sub-explosion of 5.0, Post/View Messages, Mt Isarog Biodiversity Information System

The sub-explosion of process 6, Update Regulations is seen on Figure 19. There are 3 sub-processes: Add, Edit and Delete Regulations. The System Administrator functionality of Update User Account is shown in Figure 20.

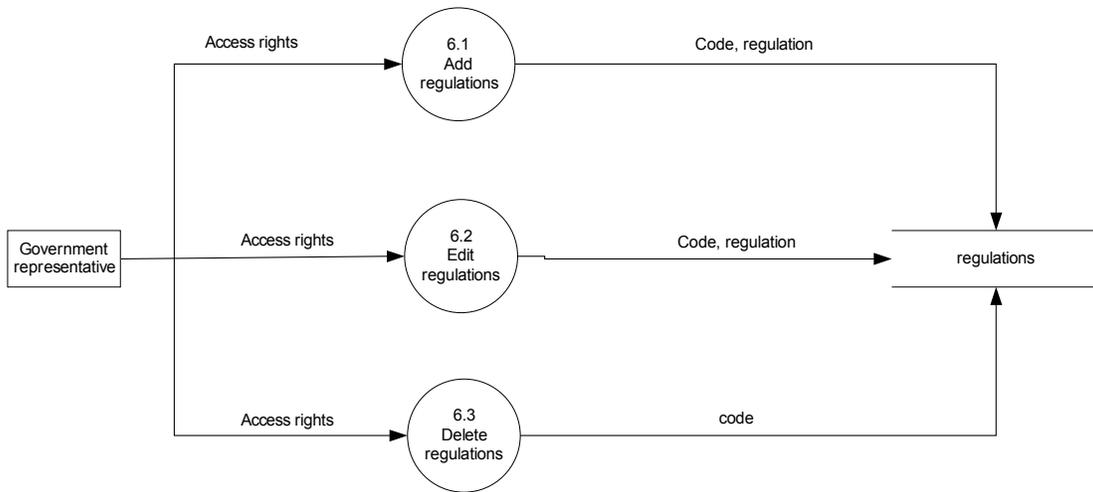


Figure 19, Sub-explosion of 6.0, Update regulations, Mt Isarog Biodiversity Information

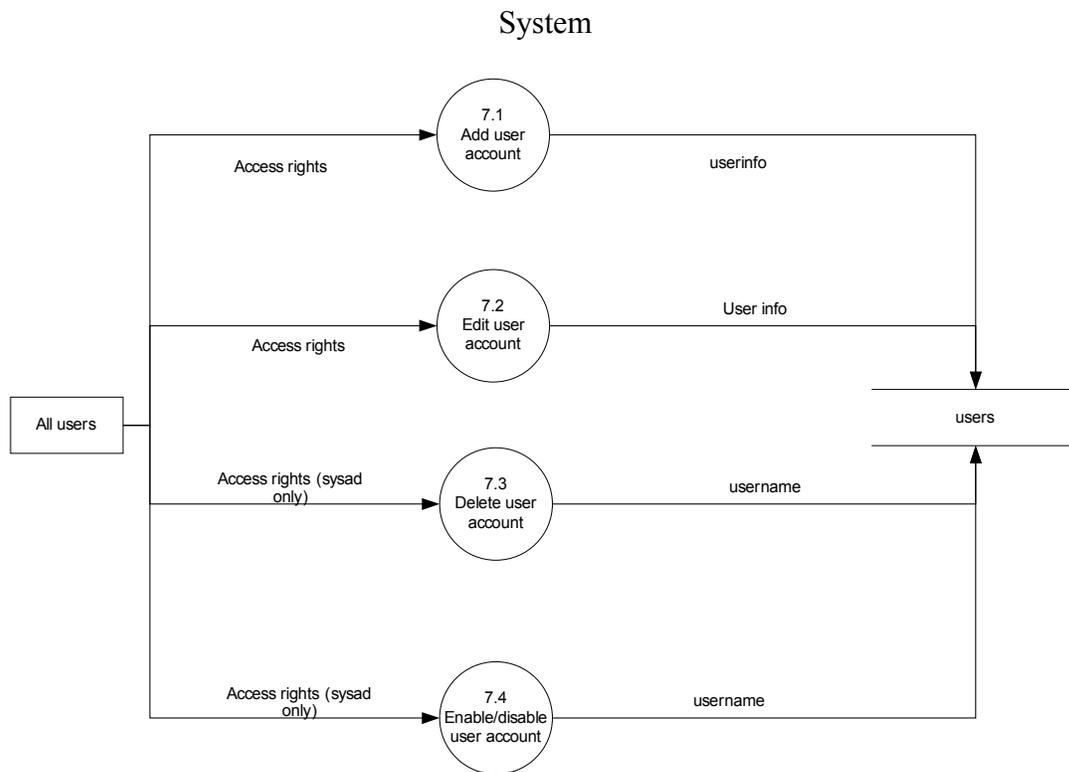


Figure 20, Sub-explosion of 7.0, Update user account, Mt Isarog Biodiversity

Information System

V. Results

The homepage of *Mt Isarog Biodiversity Information System* is shown in Figure 21. The top part of the home page shows the sign up and log in link. Anyone may sign up for an account but only registered users may log in. The top menu will vary depending on the type of user logged in. The left part of the page shows a menu of links. Anyone can access these links. The left menu is constant for all pages.

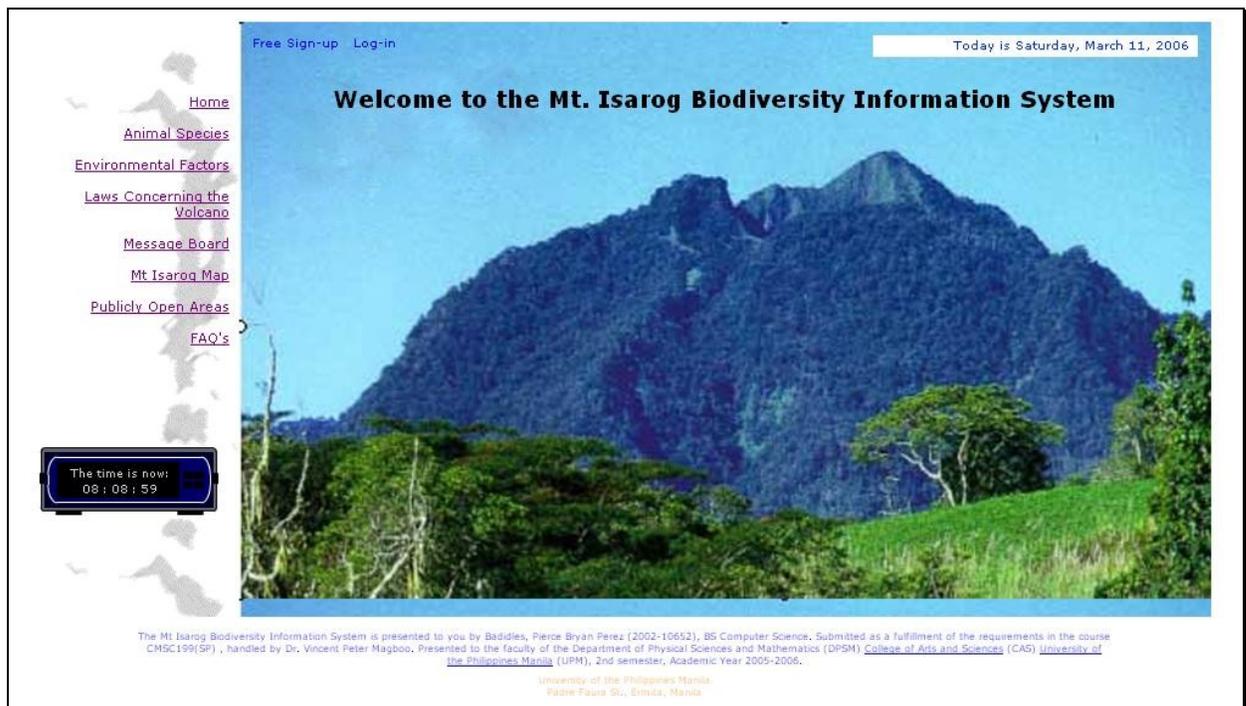
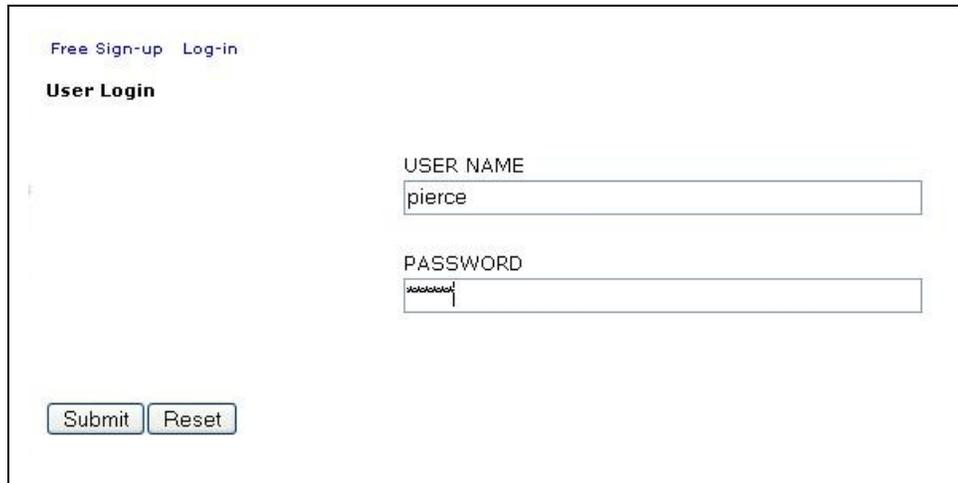


Figure 21. Home Page, Mt Isarog Biodiversity Information System

For all users, logging in is a must to access the functionalities of the system that is available to them. The log in page is shown in Figure 22



The screenshot shows a web interface for user login. At the top left, there are two links: "Free Sign-up" and "Log-in". Below these is a heading "User Login". The main form contains two input fields: "USER NAME" with the text "pierce" entered, and "PASSWORD" with masked characters "*****" entered. At the bottom left of the form area, there are two buttons: "Submit" and "Reset".

Figure 22. Log In Page, Mt Isarog Biodiversity Information System

The biologist is one of the four users of the system. Most of the functionalities of the system is made for the biologist. One functionality for the biologist is to add species records. The biologist fills out fields about the species' scientific name, common name etc. The biologist should also specify whether the species can be found in the different areas in Mt Isarog or not. The biologist may also upload a picture of the species. (see Figure 23)

Add Species Record

<p>SCIENTIFIC NAME collocalia troglodytes</p>	<p>COMMON NAME pygmy swiftlet</p>
<p>Kingdom: <input type="text" value="Animal"/></p> <p>Order: <input type="text" value="Apodiformes"/></p> <p>Family: <input type="text" value="apodidae"/></p>	<p>Phylum: <input type="text" value="chordata"/></p> <p>Class: <input type="text" value="aves"/></p>
<p>AVERAGE SIZE: <input type="text" value="1.5"/></p> <p>AVERAGE WEIGHT: <input type="text" value="175"/></p> <p>LIFE EXPECTANCY: <input type="text" value="10"/></p> <p>NATURAL HABITAT: <input type="text" value="Occupies forest clearing"/></p>	<p><input type="text" value="in"/></p> <p><input type="text" value="g"/></p> <p><input type="text" value="years"/></p>
<p>PRESENT IN</p> <p>Calabanga: <input type="text" value="YES"/></p> <p>Goa: <input type="text" value="YES"/></p> <p>..: <input type="text" value="YES"/></p>	<p>SPECIES DESCRIPTION</p> <p>Smallest swiftlet. Distinguish from Glossy Swiftlet by its size and white rump</p>

Figure 23. Add New Species, Mt Isarog Biodiversity Information System

Adding environmental factors with its corresponding fields is another function for the biologist as shown in Figure 24. When there are already environmental factors in the database, gathered data, together with a corresponding date and, optionally, the population of a species found on that date, regarding these factors may now be stored as illustrated in Figure 25.

Factor	<input type="text" value="Rainfall"/>	Units:	<input type="text" value="cm"/>
Description	<input type="text" value="Amount of rainfall during the record date"/>		
<input type="button" value="Submit"/> <input type="button" value="Reset"/>			

Figure 24. Add Environmental Factor, Mt Isarog Biodiversity Information System

Today is Tuesday, April 11, 2006
You're logged in as 'Bio'

[Add Species Data](#)
[Environmental Factors](#)
[Input Gathered Data](#)
[User Profile](#)
[Log-out](#)

Date:
mm dd yyyy

	Value	Units	Species	Population
Average temperature	<input type="text" value="299"/>	Kelvin	<input type="text" value="collocalia troglodytes"/>	<input type="text" value="500"/>
Rainfall	<input type="text" value="0"/>	cm	add more species	
Average humidity	<input type="text" value="4.5"/>	humidity unit		

Figure 25. Input Gathered Data, Mt Isarog Biodiversity Information System

The government representative is another user of the system. He is responsible for uploading laws concerning Mt Isarog (shown in Figure 26) and Uploading photos of areas that are open to the public (shown in Figure 27).

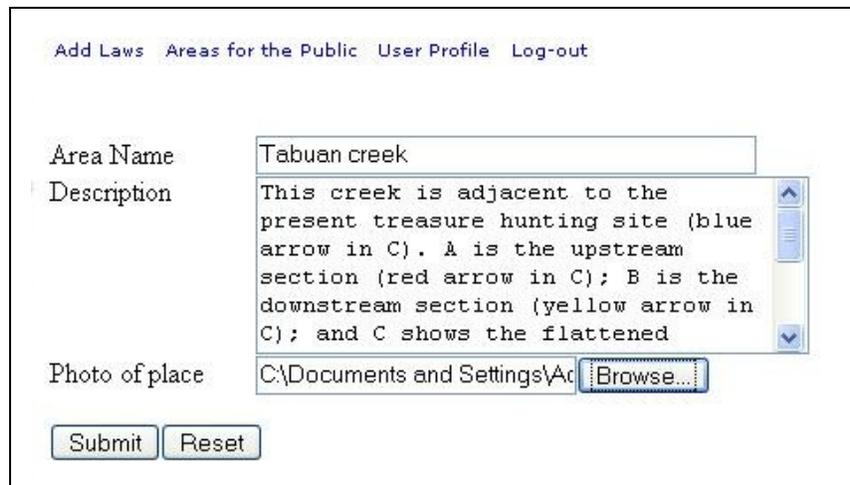


Add Laws Areas for the Public User Profile Log-out

Title

Filename

Figure 26. Upload Law, Mt Isarog Biodiversity Information System



Add Laws Areas for the Public User Profile Log-out

Area Name

Description

Photo of place

Figure 27. Add Area, Mt Isarog Biodiversity Information System

All users are allowed to change their user profile in the database. The page in editing these information is shown below in Figure 28.

The screenshot shows a web interface for editing a user profile. At the top right, it displays the date 'Today is Tuesday, April 11, 2006' and the user's login status 'You're logged in as 'pierce''. On the left, there are links for 'User Profile' and 'Log-out'. The main heading is 'Edit Profile for 'pierce''. Below this, there are several input fields: 'PASSWORD' and 'CONFIRM PASSWORD' (both masked with asterisks), 'FIRST NAME' (Pierce Bryan), 'MIDDLE NAME' (Perez), 'LAST NAME' (Badidles), and 'E-MAIL' (pbbadidles@yahoo.com). At the bottom left, there are two buttons: 'Submit' and 'Reset'.

Figure 28. User Profile, Mt Isarog Biodiversity Information System

All visitors of the system can view the different species information, environmental factors and data, laws, open areas, frequently asked questions and the message boards stored in the database. A list of all the species information about a particular species and the Mt Isarog map to show where the species can be found can be seen by anyone who visits the system. (see Figures 29-31).

There are a total of 11 species records

Image	Scientific Name	Common names	
	Anacardiaceae	Anacardiaceae	Delete
	Annonaceae	Annonaceae	Delete
	collocalia troglodytes	pygmy swiftlet	Delete
	Escalloniaceae	Escalloniaceae	Delete
	flying fox	flying fox	Delete

Figure 29. View Species, Mt Isarog Biodiversity Information System

User Profile Logout



Scientific name:
pitta erythrogaster

Common names:
red breasted pitta

Average size:
10-13cm

Average weight:
100-136 g

Life expectancy:
10 years

Natural Habitat:
trees and bushes

Species Description:
Small and red. Eats on insects and the like.

Latest Population :
no records yet

This species is endemic to Mt Isarog

[View locality map](#)
[Go Back](#)

Figure 30- View Species, Mt Isarog Biodiversity Information System

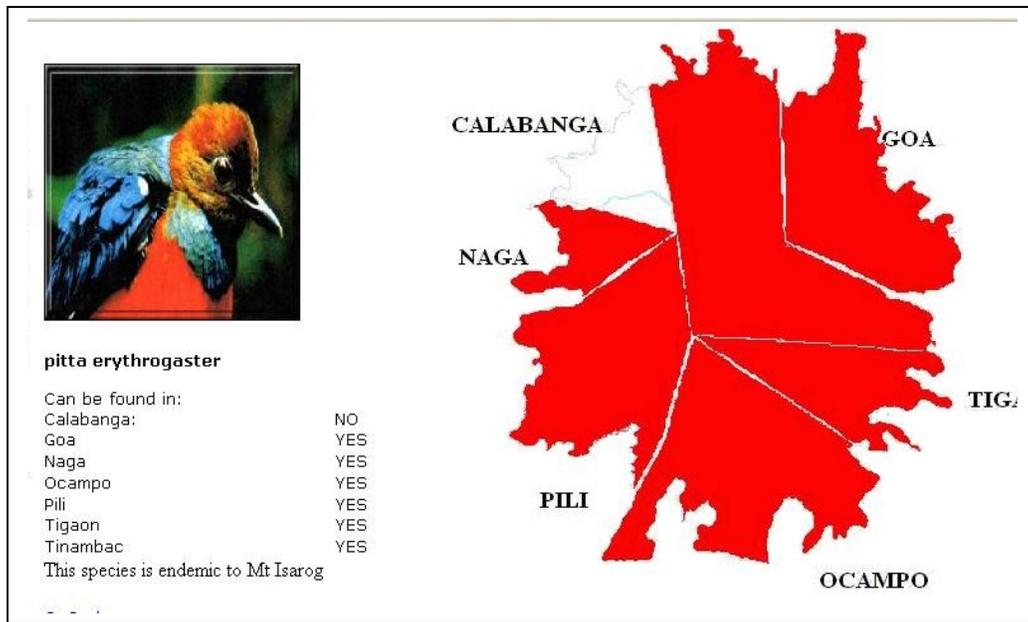


Figure 31. Locality Map, Mt Isarog Biodiversity Information System

Anyone can also view the list of different environmental factors the biologists are monitoring. They can also view the tabular and graphical representations of the gathered data about the factors. (see Figures 32-34)

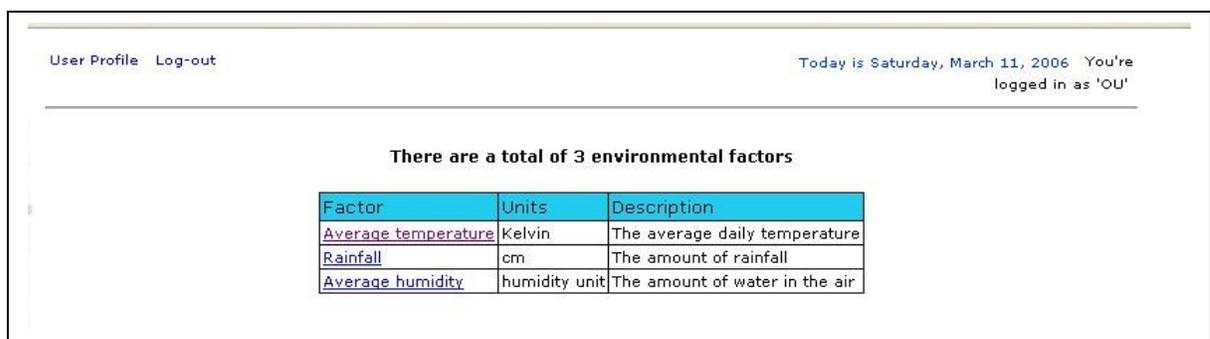


Figure 32. View Environmental Factors, Mt Isarog Biodiversity Information System

User Profile Log-out Today is Saturday, March 11, 2006
You're logged in as 'OU'

Findings for Rainfall [view graph](#)

Date	findings in cm
January 1, 2006	0
January 2, 2006	2
January 3, 2006	2
January 4, 2006	10
January 5, 2006	3
January 6, 2006	2
January 7, 2006	2
January 8, 2006	3
January 9, 2006	3
January 10, 2006	2
January 11, 2006	0
January 12, 2006	0
January 13, 2006	0
January 14, 2006	0.5
January 15, 2006	0
January 16, 2006	0.3
January 17, 2006	0
January 18, 2006	0
January 19, 2006	0

Figure 33. View Factor Data, Mt Isarog Biodiversity Information System

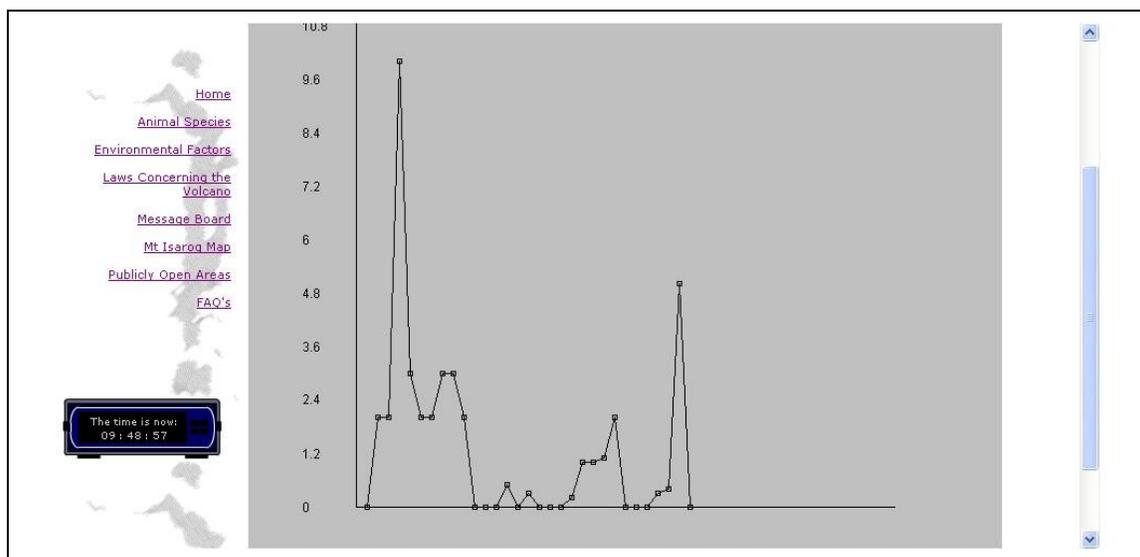


Figure 34. View Graph, Mt Isarog Biodiversity Information System

Visitors can also view the list of laws uploaded by the government representative and read them. (see Figures 35-36)

Today is Tuesday, April 11, 2006
You're logged in as 'Gov'

[Add Laws](#) [Areas for the Public](#) [User Profile](#) [Log-out](#)

There are a total of 3 rules and regulations

Regulation Code	Posted By	
29 - DENR strictly implement environmental laws in 2005	Gov	Delete
Tanggol Kalikasan	Gov	Delete
The Second Philippine National Report to the	Gov	Delete

Figure 35. View Laws, Mt Isarog Biodiversity Information System

- [Home](#)
- [Animal Species](#)
- [Environmental Factors](#)
- [Laws Concerning the Volcano](#)
- [Message Board](#)
- [Mt Isarog Map](#)
- [Publicly Open Areas](#)
- [FAQ's](#)

29 - DENR strictly implement environmental laws in 2005

Friday, December 30 2005 @ 12:27 AM GMT

For 2005, the Department of Environment and Natural Resources (DENR) has focused the strict enforcement of environmental laws.

"We sincerely believe investing in enforcement and compliance not only improves environmental quality and public health but also our competitiveness," said DENR Secretary Michael Defensor.

He said DENR adapted this strategy to help curb environmental degradation since laws protecting the country's land, water and air already exist.

"What good are these laws if not implemented?" he said.

DENR is optimistic the country's 14.77 million hectares of forest land in 2003 will further increase with sustained curbing of banned forestry practices which reduced such areas to 9.3 million hectares in 1978 from an estimated total forest cover of 21 million hectares in the early 1900s.

As of September 2005, government's crackdown on violators of its total log ban yielded about 30,000 cubic meters of forest products valued at approximately P155,347,970.

The time is now:
09:49:55

Figure 36. View Law, Mt Isarog Biodiversity Information System

All visitors can view the message board but only registered users may post new topics (figure 37) or post messages (figure 38) to existing topics.

Today is Tuesday, April 11, 2006
You're logged in as 'SysAd'

[System Users](#) [User Profile](#) [Log-out](#)

Topic	Topic creator	Date Posted	Posts
New Law uploaded	Gov	April 11, 2006	1
Account question	pierce	April 11, 2006	4
New species discovered!!!	Bio	March 11, 2006	4
Question...	OU	March 11, 2006	3

[Post new topic](#)

Figure 37. Message Board, Mt Isarog Biodiversity Information System

Today is Friday, April 14, 2006
You're logged in as 'pierce'

[User Profile](#) [Log-out](#)

From: pierce April 14, 2006
How do we protect endangered species?

From: Bio April 14, 2006
We can help protect them by not buying products made from endangered species. If the buying stops, the killing can too.

From: anna April 14, 2006
Are there other ways?

From: ryan April 14, 2006
We can also aid in the preservation of their habitat.

Post
How

[Go back](#)

Figure 38. Post Message, Mt Isarog Biodiversity Information System

Two maps are available for viewing. One is a clickable map s seen in Figure 39 where the user can click a certain area and find out which species are present there and the other is a topographic map shown in Figure 40.

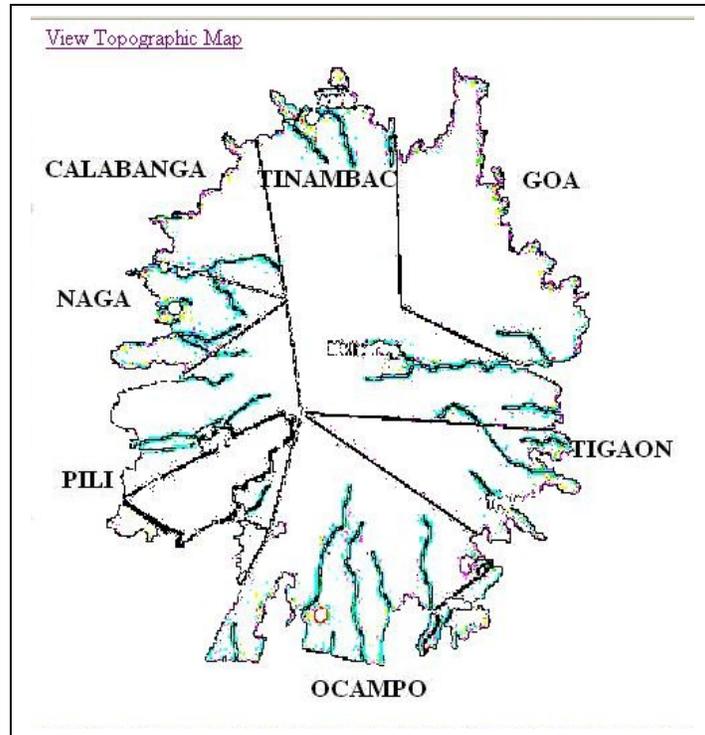


Figure 39. View Map, Mt Isarog Biodiversity Information System

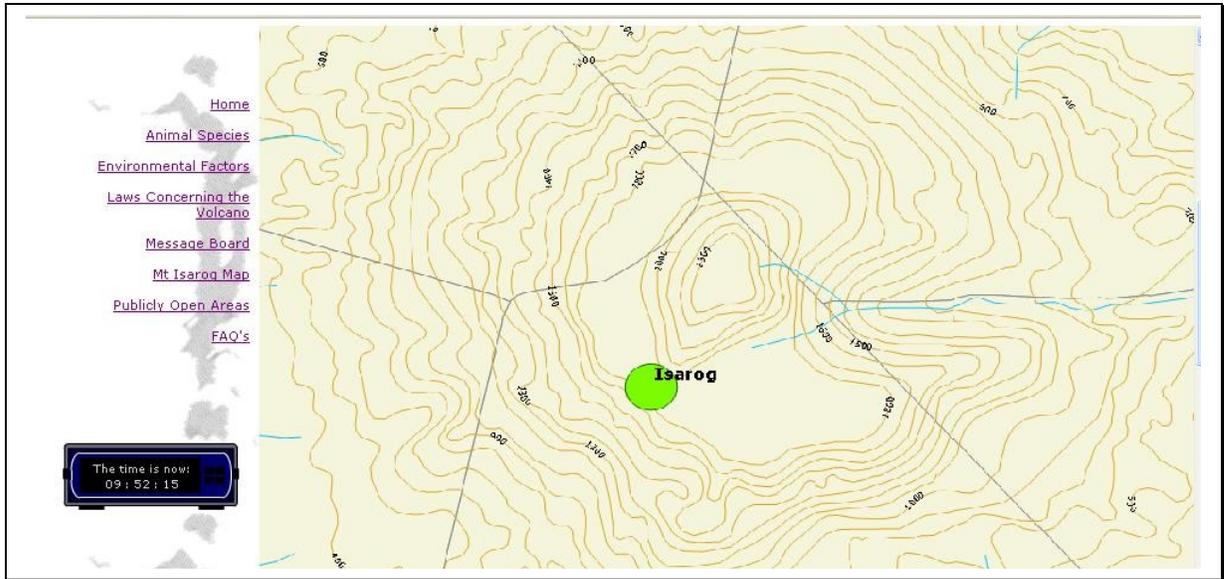


Figure 40. View Topographic Map, Mt Isarog Biodiversity Information System

A list of areas open to the public may also be viewed as well as the photos of these areas (see Figure 41-42). Some frequently asked questions regarding biodiversity can be seen on the FAQ Page shown in Figure 43.



Figure 41. View Areas Open to Public, Mt Isarog Biodiversity Information System

Add Laws Areas for the Public User Profile Log-out



Area Name Tabuan creek

Description This creek is adjacent to the present treasure hunting site (blue arrow in C). A is the upstream section (red arrow in C); B is the downstream section (yellow arrow in C); and C shows the flattened portion of the creek located between A (red arrow) and B (yellow arrow). This portion was created by a backhoe in order to facilitate its movement during digging and transport.

Figure 42. Photo of Area Open to Public, Mt Isarog Biodiversity Information System

User Profile Log-out Today is Saturday, March 11, 2006
You're logged in as 'OU'

Frequently Asked Questions

1) What is Mt Isarog?

Mt. Isarog, an inactive volcano, rises in the heart of the province of Camarines Sur, the central part of the Bicol Peninsula about 450 kilometers south of Manila. It is the highest forested peak in Southern Luzon. The Park, 10,112 hectares wide, has a rich diversity of flora and fauna. It is home to at least 143 kinds of birds, 15 of which are endemic to Luzon including a sub-species of the Velvet-fronted Nuthatch which is found only in Mt. Isarog. Rich in diversity, the park harbors 1,300 known species of plants including hardwood trees, mosses, ferns and orchids.

2) What is biodiversity?

Biological diversity has no single standard definition. One definition holds that biological diversity is a measure of the relative diversity among organisms present in different ecosystems. Diversity in this definition includes diversity within species and among species, and comparative diversity among ecosystems.

3) What does endangered species mean?

An endangered species is a species whose population is so small that it is in danger of becoming extinct. Many countries have laws offering special protection to these species (forbidding hunting, banning development, etc. of their habitats) to

Figure 43. View FAQ's, Mt Isarog Biodiversity Information System

The system administrator has the ability to view and add new users to the system. (see figures 44-45)

Today is Tuesday, April 11, 2006
You're logged in as 'SysAd'

System Users User Profile Log-out

Click on the Username for user account info.

[Add new user](#)

Username	User Type	Account Status
jmiraflo	System Administrator	Enabled
Bio	Biologist	Enabled
ryan	Biologist	Enabled
Gov	Government Representative	Enabled
OU	Ordinary User	Enabled
pierce	Ordinary User	Enabled
anna	Ordinary User	Enabled

Figure 44. View All Users, Mt Isarog Biodiversity Information System

Today is Tuesday, April 11, 2006
You're logged in as 'SysAd'

[System Users](#) [User Profile](#) [Log-out](#)

Add new user

USER NAME	<input type="text" value="pbbadidles"/>
PASSWORD	<input type="password" value="*****"/>
CONFIRM PASSWORD	<input type="password" value="*****"/>
FIRST NAME	<input type="text" value="Pierce Bryan"/>
MIDDLE NAME	<input type="text" value="Perez"/>
LAST NAME	<input type="text" value="Badidles"/>
E-MAIL	<input type="text" value="pbbadidles@yahoo.com"/>
USER TYPE	<input type="text" value="System Administrator"/> ▼

Figure 45. Add User, Mt Isarog Biodiversity Information System

VI. Discussion

The *Mt Isarog Biodiversity Information System* is an online biodiversity information system that records different information regarding the biodiversity in Mt Isarog. The primary information stored is information about the species in Mt Isarog. Different data such as their size, weight, etc. are stored in the database. A picture of the species may also be uploaded for viewing of other users. Information regarding the different environmental factors that the biologists think are affecting the population of at least one species in the mountain are also stored in the database. When the database already contains information about these factors, the biologists are then able to input their gathered data regarding these factors. These data are then stored in the database. Tabular and graphical representations of these data are available for viewing to all users of the system

The advantage of the system is that it stores data on the different environmental factors that could affect the species of the population. This can aid in the study of species declines and therefore can help in species preservation. Information regarding biodiversity in Mt Isarog becomes readily available for researchers, students and other people. The system also contains information on current laws, regulations and areas open to the public, hence, increasing public awareness and help in the conservation of biodiversity in Mt Isarog.

The systems records are not date stamped so it is impossible to tell when the data was inputted. Deleted data is forever lost because there are no records showing that it actually existed. The system is not capable of handling multiple images for a specific species. The error checking for the environmental factor data will be very difficult because the environmental factors are inputted by the user so the required data type is unknown.

A similar study was also conducted by a group of students from the University of Missouri-Rolla (and surrounding senior and junior high schools). Their main focus is the amphibian population while the *Mt Isarog Biodiversity Information System* has a broader scope because it focuses on plants and animals. The students were also focused on a smaller conservation site(Missouri Department of Conservation Bray Conservation Area; Rolla, MO) while the system has a larger conservation site(whole Mt Isarog). The students has more advanced technology and are using global positioning system(GPS) while the system does not.

A biodiversity information system may greatly satisfy the need to systemize the data in a format, which is usable by the decision-making individuals and institutions. The availability of some information online satisfies the need for larger publicity and access to information about the biological diversity with the aim to increase the public awareness about its preservation.

VII. Conclusion

The *Mt Isarog Biodiversity Information System* is an online biodiversity information system that primarily records different information regarding the biodiversity in Mt Isarog.

The primary function is the storage of information about the species in Mt Isarog. Different data such as their size, weight, etc. are stored in the database. Another important information stored in the tables is the information regarding the different environmental factors that the biologists think are affecting the population of at least one species in the mountain.

These information are editable by the biologists that have accounts in the system. Other users are able to view these information stored by the biologists. The government representatives are the ones who upload the laws concerning the volcano and tell the other users of the system which areas in the volcano are open to the public.

All users are able to view the species, environmental factors, faq's, laws, areas open to the public and the message board but only registered users are allowed to post

topics and messages to the message board. For a person to be a registered user, all he needs to do is sign up for an account. Signing up is free, quick and simple.

The system administrator is the one who manages the message boards and is able to add other users to the system. He may also disable/enable other users of the system.

VIII. Recommendations

The fields of the animal species may still be too limited and can only store a limited amount of information. More fields, particularly in the species table, is recommended so it can store a wider range of information and better queries can be performed.

Information on the distribution of the species in the mountain is limited. A GPS (Global Positioning System) made to track the species movement and the species distribution might be able to give more information about the species and its behavior.

The *Mt Isarog Biodiversity Information System* contains data on the environmental factors affecting species population and species population. Since these data are already present, it is a good idea to correlate these variables and be able to predict a certain species population given only the data on environmental variables.

Error checking is also a good feature to add to the existing system. There are instances that the system cannot check whether the input of the user is valid for the particular field because the field itself is user determined.

IX. Bibliography:

- 1) “Species habitats”, <<http://www.haribon.org.ph/index.php?q=node/view/38>>
- 2) “Biodiversity hotspot”,
<<http://www.biodiversityhotspots.org/xp/Hotspots/philippines/>>
- 3) “Biodiversity threats”,
<http://www.fieldmuseum.org/vanishing_treasures/Discover_1a.htm>
- 4) © 2003 Wake Forest University (from Volume 5, Number 2, of *The Interactive Multimedia Electronic Journal of Computer-Enhanced Learning*)
- 5) “Primary threat to biodiversity”,
<http://www.cepf.net/xp/cepf/where_we_work/philippines/philippines_info.xml>
- 6) “Biodiversity databases”, <<http://www.cs.umd.edu/hcil/biodiversity/#prototypes>>
- 7) “Information infrastructure”, <<http://bdi.cse.ogi.edu/>>
- 8) Suhay, pp 25-26. July-September 2000 issue
- 9) “Biodiversity Informatics”,
<<http://monitoring.biodiversity.bg/english/neobhodimost.htm>>
- 10) “Practical Training in Biodiversity Informatics”,
<<http://web.umr.edu/~bioinf/bray/description.htm>>
- 11) “Online vegetation map”, <<http://www.admin.ox.ac.uk/po/050504.shtml>>
- 12) “EMAN (ECOLOGICAL MONITORING AND ASSESSMENT NETWORK)”,
<<http://monitoring.biodiversity.bg/english/neobhodimost.htm>>
- 13) “Biodiversity Informatics in Germany”,
<www.groms.de/data/riede/GTIriede.pdf>

- 14) “SYNTHESYS”, <<http://www.bgbm.org/BioDivInf/projects-e.htm>>
- 15) “BioCASE”, <<http://www.biocase.org/>>
- 16) “World Biodiversity Database”, <<http://www.eti.uva.nl/tools/wbd.php>>
- 17) “Terrestrial and Freshwater Biodiversity Information System”,
<<http://www.biodiversity.govt.nz/land/nzbs/tfbis/tfbis/>>
- 18) “Natural Heritage Management System (NHMS)”,
<http://www.landcareresearch.co.nz/research/biodiversity/threatenedprog/biodiv_inventory.asp>
- 19) “Biodiversity”, <<http://en.wikipedia.org/>>
- 20) “Mt Isarog”, <http://www.iapad.org/pa/mt_isarog.htm>
- 21) “Information System”, <http://www.atis.org/tg2k/_information_system.html>
- 22) “Database”, <<http://www.webopedia.com/TERM/d/database.html>>
- 23) “Database management system”, <<http://www.tech-faq.com/database.shtml>>