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ROAN is a journal of conservation which provides a forum for the discussion and publication of empirical and articulate position papers problems and strategies of nature conservation and sustainable livelihood for rural peoples in Africa and Madagascar.

The journal also publishes original research findings on a variety of modalities for integrating conservation with rural development in order to achieve a long-term sustainable development of our natural resources for the benefit of all. It is published twice a year by the Technical Programmes Department, Nigerian Conservation Foundation.

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SPECPROF: A TOOL FOR BIOLOGICAL INDEXING

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Abstract

The development of a comprehensive information base is one of the most compelling needs in conservation as it can contribute to coordinated conservation efforts. In biodiversity conservation, indexing of organisms is of great importance because it sets the stage for investigating their relationships to other organisms. In view of recent trends in information and communication technology, electronic archiving of available data on the species is needed as a primary step to biodiversity conservation. A species profile (SPECPROF) database, an electronic data archiving, vouchering and retrieval system has been developed to support plant diversity indexing in a wide range of ecosystems. SPECPROF is an application database developed in the Microsoft Windows environment. The fields in SPECPROF are structured using the Microsoft Access 2000 database programme with Visual Basic providing the Graphical User Interface front end. It allows users to input, query and display information available on species. It is a fast and easy conservation tool for use in biological indexing.

Keywords: Biological indexing, conservation tool, electronic database, SPECPROF.

Introduction

Biological indexing is the process of unambiguously identifying biota, starting at the level of genotypes and mapping their distributions to understand the process of evolution and speciation, integrating this information into internationally accessible databases, and archiving and vouchering the characterised biota (Daniels 1995). Indexing of organisms is of great importance in biodiversity conservation because it sets the stage for investigating their relationships to other organisms (Daniels *et al.* 1996). Most conservation efforts have been targeted at species because they form the most basic level of organisation in the biological hierarchy and are readily apparent in the

field. However, existing information on biodiversity and ecosystems is neither readily available nor fully useful (Martin *et al.* 2002). For some species, the information simply does not exist but more commonly it is not retrievable due to lack of electronic databank. As such, local and regional scientists need to employ advances in information and communication technology to manage their resulting biodiversity inventory data. This would not only complement the efforts of international organisations like Global Taxonomy Initiative (GTI), 'All Species' foundation and Global Biodiversity Information Facility (GBIF) but also make such data readily available to a wide range of stakeholders.

Electronic archiving of available data on the species is therefore needed as the final step to biodiversity indexing. However, adaptability to biodiversity indexing at species level is not easy with the large, general-purpose databases available in the market. Subject-specific databases could provide basic guidelines and standard information for organisations building databases for conservation biology studies. Consequently, a subject-specific database that can easily be adapted and used to catalogue and retrieve basic information on the biology and ecology of plant and animal species becomes of great interest to conservation biologists. This paper therefore, reports the development and potential use of Species Profile (SPECPROF) Database as a conservation tool for use in biological indexing.

Conceptual Framework

Model Structure

SPECPROF Database (Specprof.db) is an electronic data archival and retrieval system developed to aid biodiversity indexing. The basic components of Specprof.db are the biological systems of interest, data fields, archival and retrieval systems (Fig. 1).

Species pool: The first generic issue considered in the development of the database was the biological systems or species pool for which the database is to address. The data fields were standardised to cater for the development of data system for a wide range of plant species. However, some of the attributes of the data fields may be modified when applying SPECPROF to a different pool of species. The current

version was developed to cater for plant diversity indexing in forestry and agricultural ecosystems.

Data Fields: The data fields were defined to include the biological attributes that were used in describing the species. The following data fields are available for each species, which are used for data input into the model.

Species Identity: Botanical name, synonyms, English or common names, local names and commercial names where necessary.

Species Description: Brief morphological description including vouchers.

Taxonomic Affinity: Family, documented abundance or range and varieties.

Ecological Affinity: Phytochorion/ria, vegetation types, localities and known natural enemies.

Known/Documented Uses: Other uses outside the immediate research area.

Ethnobotanical Information: Uses in the immediate research area (local uses).

Conservation Status: Whether the species is cultivated or not, propagation methods, threats and rarity.

Archival System: This is the software module that allows data input into the database.

Retrieval System: This module is the system that allows users to use queries to analyse, sort, view and print information available on each species available in the archive.

Operational Environment

Apart from the model structure, it was important to give consideration to the environment for hosting Specprof.db. Three considerations were considered, which include:

Individual Single User Systems: The single user version is a compact version meant to support the individual scientist who is interested in field data collection and archival for some range of species of interest. The computational resource requirement for these is not as much as for the other versions.

Local and Wide Area Networks: For agencies and institutions, hoping to undertake electronic archival and provide access to such data in-house or who hope to provide electronic data services to clients in research institutions and policy makers, larger version of the model is available for installation in local and wide area networks hosted by such agencies. Access to the database is thus possible from any terminal within the network.

Internet-Based System: Some agencies providing data services may wish to host the database directly on the Internet to provide wider access. Clients seeking to make use of such services are expected to register with the data providers by filling

data request forms, which contain clients' information and the range of data needed, on-line. Once registered, clients will be able to directly access the database from any location, query and download available data based on terms provided by the data provider.

Model Development Environment

SPECPROF was developed using the Microsoft Access 2000 Database programming environment as a template. Microsoft Access is easy to use and enables management of all information from a single file. Species information was integrated and compressed to fit into the database. The database is an application programme written in Microsoft Visual Basic 6.0. Currently, version 1.0 (SPECPROF 1.0) stores data in only one table called 'Specprofmain' since all data bear a one to one relationship with the botanical name. The data are being stored using the Access Database format with Visual Basic providing the Graphical User Interface (GUI) front end.

Usage

A detailed user's manual has been developed for Specprof.db. However, the database, being Microsoft Windows based, is menu-driven and user friendly. By clicking on any field of interest, a sub-menu will be opened to the user to carry out whatever action (like input, edit, view or print available data) the user wants by equally clicking on subsequent sub-fields.

The Menu

The main menu is termed 'Specprofmain'. It contains the following three sub-menus: species information, queries and print. The "species information" module is used to input, store and view available data. It consists of the following sub-fields: species identity, species description, taxonomic affinity, ecological affinity, documented uses, indigenous information, and conservation status. The "queries" and "print" modules on the Specprofmain are used for querying and printing respectively. The print module on Specprofmain prints the entire data available in the database.

The Query System

The query system was conceived and developed based on the documented uses of the species. It contains the *search* and *print* utilities. Its *search* utility is akin to the file *search* utility on Microsoft Windows using wild cards (? and *). Outputs can be viewed by clicking on the *search* utility while clicking on the *print* utility prints the query output results. Note that the sub-*print* utility functions only if the *search* utility has been previously activated so that the output results are based on current selection. There are three querying approaches, namely:

Global Querying: Retrieves and displays all the information available on all species archived in the database.

Species Querying: Retrieves and displays information on selected species. When any botanical name is selected, the query retrieves all the available data for that

species.

Utility Querying: Selects information on species based on three groups of documented uses: food, medicine, drinks and beverages. If any of the check boxes before a utility text box is checked, the query retrieves all species with data in that field even if the text boxes are empty.

Potential Applications of Specprof.db in Biodiversity Conservation.

The range of potential applications of Specprof.db is extensive, depending on the end users' interests. The database could be adapted and used to catalogue basic information on the biology and ecology of plant species in any identified ecosystem as well as data and information centres. It is a fast and easy conservation tool for use in biological indexing. Some of the areas where applications could enhance biodiversity conservation are highlighted in the sub-sections below.

Field Inventories

Field studies are a major central composition of biodiversity and conservation programmes. Specprof.db could be easily installed in portable computers (laptops), which are now becoming handy tools for field works. Thus, the database could serve as a good companion to researchers and conservationists during field inventories, thereby saving time and potential loss of data.

Harmonization of Records by Data, Information and Research Centres
Museums, Herbaria and Forestry Research

Centres are some of the data and information centres that have roles to play in conservation of biodiversity. These centres archive and make information on biota available to a wide range of stakeholders. The application of Specprof.db therefore, would enable such centres to harmonize available information on the species. When information becomes easier to obtain, it increases the potential for further research and their adaptation to policy.

Community-Based Initiatives to Biodiversity Conservation

Specprof.db is a database that encourages community-based researches. For instance, the data field on indigenous knowledge in Specprof.db is a text and as such, could be very detailed and extensive. It therefore may imply that many local people could be involved in the collection and sorting of input data. This could rekindle the interest of the people in the plants around them, promote rural economy and conserve the species better since the local people would be at the centre of such data collection.

Multidisciplinary Schemes to Biodiversity Conservation

Conservation Biology is a multidisciplinary science. As such, there can only be a breakthrough in biodiversity conservation if the tools, models and programmes available can support multidisciplinary research. Specprof.db has and encourages such attribute as the archival and retrieval systems of the database could be applied to various academic disciplines and utilised by many end users. It therefore, ensures a

better approach to biodiversity conservation.

Illustrative Application

Specprof.db has been tested and applied to the indexing of some indigenous, edible, wild, woody species in Omo Biosphere Reserve, Nigeria, using data collected by Ahuama (2004). Specific Query: "Give a list of species that are used for medicine, food and in drinks and beverages making." This query thus generated species by species information for all species so far archived in the database, which have the above attributes. The results are presented in Appendix S1 (see Supplementary material) and show that *Dioscoreophyllum cumminsii* (Stapf) Diels, *Irvingia gabonensis* (Aubry-Lecomte) Baill, *Myrianthus arboreus* P. Beauv., and *Spondias mombin* L. match the above query. Any information archived for the species is additionally displayed.

Summary and Conclusions

Most conservation efforts have been targeted at species because they form the basic level of organisation in the biological hierarchy and are readily apparent in the field. Electronic archiving of available data on the species in the form of operational database is thus, the final step in biodiversity indexing. In order to support data archiving and retrieval in the long-term, a Species Profile (SPECPROF) database was developed in-house to aid indexing of plant species in the forestry and agricultural ecosystems. The database, being Microsoft Windows based, is menu-driven and user friendly. Researchers, conservationists and

other stakeholders could use the database to archive and retrieve basic information on the species.

The potential applications of Specprof.db to biodiversity conservation are extensive, depending on the end users and the specific or group interests. The database could be adapted and used to catalogue basic information on the biology and ecology of plant species in any identified ecosystem as well as data and information centres. As an electronic indexing tool,

some potential end users include field and laboratory scientists, Herbaria, Museums, data, information and research centres. Community-based and multidisciplinary initiatives to biodiversity conservation will equally find SPECPROF very useful in meeting their aims and objectives.

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Supplementary Material

Appendix S1. Specprof.db typical query output.

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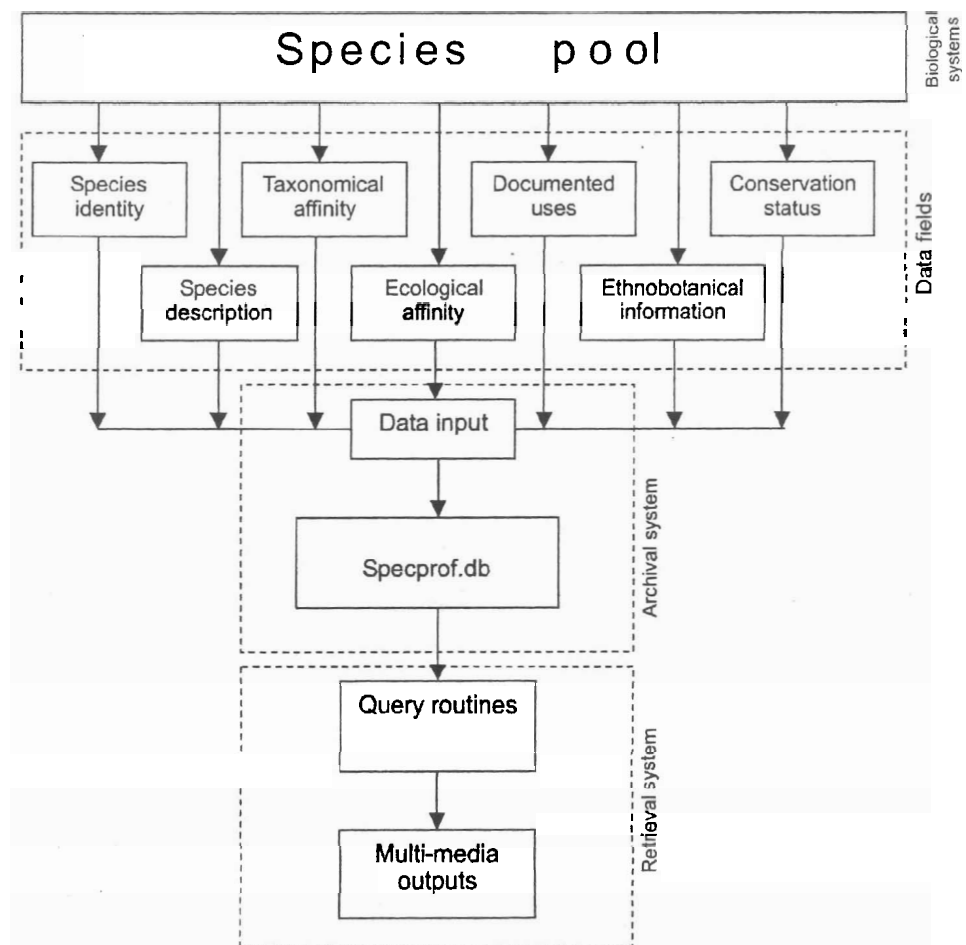


Fig. 1. Model structure of Specprof Database

Appendix S1. Results Generated from Specprof database in Response to the Query: "give a list of species that are used for medicine, food and in drinks and beverages making".

Botanical Name: *Dioscoreophyllum cumminsii* (Stapf) Diels

Synonyms: *D. lobatum*

Common names: Serendipity berry

Local names: Omu-aja

Size: c10 m

Stem/bole: Slender & pubescent

Leaves: Simple, digitately lobed/entire

Flowers: Jun-Aug. Green & unisexual

Fruits/seeds: Jul-Oct. Green but red when ripe.

Habit: *Strepanolianas*

Family: Menispermaceae

Abundance/range: 65

Phytochorion/ria: G-Cong.

Vegetation zone: LRF.

Localities: Gambari F.R., Ibadan, Ife, Ipoti-Ekiti, Sapoba.

Known natural enemies: Birds, lizards

Food: Fruit pulp & root tubers edible

Medicines: Leaves & fruits.

Drink/beverages: Fruit & tuber used to sweeten drinks

Cultivated: No

Threats: Habitat loss & fragmentation.

Rarity: Rare

Propagation methods: Stem cutting, tuber & seed

Cultural/nursery: Seeds need shade to germinate

Ethnobotanical information:

The red fruits are very sweet and edible. The tubers are eaten like yam tubers. The leaves and stems are used in the treatment of diabetics.

Botanical Name: *Irvingia gabonensis* (Aubry-Lecomte) Baill

Synonyms: *I. barteri*

Common names: Wild/bush mango, Dike nut

Local names: Oro

Size: c35 m, girth c2 m

Stem/bole: Bark greyish & smooth

Slash: Yellowish brown & brittle

Leaves: Alternate & glossy

Flowers: July-August, Oct-Feb. Yellow

Fruits/seeds:	May-July, Nov-Feb. Yellow or Greenish Yellow
Habit:	<i>Mesophanerophyte scapose</i>
Phytochorion/ria:	G-Cong, G-C/SRT
Vegetation zones:	LRF, DV & SG savanna
Localities:Abeokuta,	Agaaie, Akure, Awka, Benin, Calabar, Eket, Enugu, Ibadan, Ife, Ijebu-Ode, Ilaro, Ilesha, Lagos, Nsukka, Oban, Ondo, Onitsha, Owo, port Harcourt.
Known natural enemies:	Bats, birds & termite
Food:	Fruit pulp & dry seeds edible
Medicines:	Leaves, stem & root bark as well as sap
Drink/beverages:	Sap added to palm-wine to increase the potency
Cultivated:	In Edo state of Nigeria.
Threats:	Habitat loss, timber extraction and over-exploitation
Rarity:	Endangered
Propagation methods:	Stem cutting & seed
Cultural/nursery:	Germination better with fermented seeds

Ethnobotanical Information

The fruit pulp of *var. gabonensis* (Mildbr.) Okafor is sweet and eaten like mango. The seeds (stones) are slimy and used as local soup thickener. The other variety, *excelsa* (Mildbr.) Okafor has very slimy and tasty seeds that are in high demand for thickening soup in the locality. The decoction of the leaves of both varieties is given as treatment for liver problems and that of the stem bark is used as febrifuge. The wood is very hard and used in constructing canoes and many household implements like mortar and pestle. The branches are used as firewood and the shells are used in divination.

Appendix S1 Cont'd:

Botanical Name:	<i>Myrianthus arboreus</i> P. Beauv.
Local names:	Ogunseere, Ibisere
Size:	c15 m
Stem/bole:	Bark grey, thin. Bole short with stilt roots.
Slash:	White
Leaves:	Alternate, digitately compound
Flowers:	Jan-Apr, July-August. Ml. yellow, Fl. Green and compact.
Fruits/seeds:	Apr-June, Nov-Dec. Yellow
Habit:	<i>Mesophanerophyte scapose</i>
Family:	Moraceae
Abundance/range:	53
Phytochorion/ria:	G-Cong, G-C/SRT

Vegetation zones:	LRF, DV & SG savanna
Localities:	Abeokuta, Ahoada, Ajilite, Akure, Benin, Calabar, Eket, Ibadan, Ife, Ijebu-Ode, Ilaro, Lapai, Oban, Obubra, Onitsha, Owo.
Known Natural Enemies:	Bats, birds & termites
Food:	Fruit pulp & young leaves edible
Medicines:	Dry leaves, stem & root bark
Drink/beverages:	Fruit juice can be used to make wine
Cultivated:	No
Threats:	Habitat loss & neglect
Rarity:	Indeterminate
Appendix S1 Cont'd:	
Botanical Name:	<i>Myrianthus arboreus</i> P. Beauv.
Propagation methods:	Stem cutting & seed
Cultural/nursery:	Seedlings need light to establish

Ethnobotanical Information

The fruit pulp is sweet and edible. Fresh young leaves are ground and used as vegetables for local melon soup. Fresh leaves plus those of *Megaphrynium macrostachyum* (Benth) Milne-Redh. and *Corchorus olitorius* L. are squeezed with little cold water and given to women in labour for save delivery. A decoction of the dry leaves and the stem bark of *Prósopis africana* (Guill. & Perr.) Taub. is used to threat malaria and yellow fever. A poultice of the dry leaves is taken for elimination of small pox in the family. Ground powder of roasted root bark plus other materials is rubbed into incisions around the 2 ankles to prevent witchcraft.

Botanical Name:	<i>Spondias mombin</i> L.
Common names:	Hug plum, mombin
Local Names:	Iyeye
Size:	c24 m, girth c1.5 m
Stem/bole:	Bark thick, corky & fissured
Slash:	Pale pink, darkens quickly
Leaves:	Pinnate, leaflets opposite.
Flowers:	Mar-Apr, Greenish white
Fruits/seeds:	Apr-May, Jul-Aug, Yellow
Habit:	<i>Mesophanerophyte scapose</i>
Family:	Anacardiaceae
Abundance/range:	60

Appendix S1 Cont'd:

Botanical Name:	<i>Spondias mombin</i> L.
Phytochorion/ria:	G-Cong, G-C/SRT
Vegetation zones:	LRF, DV , SG & NG Savanna
Localities:	Abakaliki, Abeokuta, Abinsi, Benini, Calabar, Ibadan, Ife, Ijebu-Ode, Ilorin, Katagum, Lagos, Lokoja, Oban, Ogbomosho, Ondo, Onitsha, oyo.
Known natural enemies:	Bats, birds
Food:	Fruit pulp edible
Medicines:	Leaves, stem and root bark as well as fruit juice.
Drink/beverages:	Fruit juice can be used to make wine
Cultivated:	Widely cultivated.
Threats:	Habitat loss & neglect
Rarity:	Rare
Propagation methods:	Stem cutting
Cultural/Nursery:	Seedlings need light to establish

Appendix S1 Cont'd:

Botanical Name:	<i>Spondias mombin</i> L.
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Ethnobotanical Information

Fresh fruit pulp is tasty and edible. Fresh leaves are chewed as a remedy for dizziness. Infusion of the fresh leaves is used to treat gonorrhoea. Fresh leaves extract is applied to wounds to stop bleeding and used as eye ointment. A decoction of the fresh leaves is used to treat heart disease and cough. Decoction of the leaves and stem bark is given as remedy for fever. The stem bark is ground with the seeds of *Capsicum annuum* L. and added to soup, which is then taken as a vermifuge. A decoction of the root bark and the leaves of *Capsicum annuum* is given to a pregnant woman (in the 7th month) first thing in the morning till term for easy delivery. An aqueous extract of the fresh leaves is put into a big basin. The puerperal mother sits inside the basin. This is a therapy for arresting excess bleeding after birth.