

BROWSE INFORMATION AT YOUR FINGERTIPS – THE FORAGERS SOURCE

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Abstract

The use of browse to manage dietary requirements of many animal species is becoming more important within zoological institutions. Browse can include shrubs, trees, woody vines and stems, including various plant parts like berries and flowers. Browse is important as a dietary constituent for many captive wild animals, but critical for others. It has also become essential for enrichment purposes and animal health. For zoological institutions that utilize browse, it is common practice to maintain a list of the types of browse that can be safely fed to target species. Some institutions actively trade browse lists with other institutions. Due to fluctuations in the nutritional properties of browse harvested at different locations at different times of the year, this system is less than optimal. The Foragers Source website (<http://www.foragerssource.org>) is a proposed solution.

Introduction

The use of browse to manage dietary requirements of many animal species is becoming more important within zoological institutions. Browse can include shrubs, trees, woody vines and stems, including various plant parts like berries and flowers. Browse is not only important as a dietary constituent, but becomes more essential for enrichment purposes and animal health, and for some animal species, it is life. Feeding the wrong browse can also result in the death of an animal.

Correct management of browse is thus critical to the health of captive wild animals. When feeding or utilizing browse, most zoological institutions refer to their “in-house” lists to ensure what browse species can safely be fed to target species. Some institutions trade lists of approved browses and some publish their information via paper and electronic modalities. Other zoo personnel pour through the lay and scientific literature in an attempt to capitalize on the browse feeding experience of others. Unfortunately, the basis for much of that literature is the loss of animal life or health. And much of the experience of feeding browse has never been published.

In 1991 there was a joint effort between the Denver Zoological Gardens and Colorado State University to examine the specifics of safe browse management. The resounding conclusion from that effort, lead to a browse survey being sent out as a collaborative effort between the Association of Zoological Horticulture (AZH) and Colorado State University (CSU). This survey was specifically sent to determine what browse species

were being fed to specific animal species. Minimal and inconsistent data from that survey resulted in a more intensive survey being sent out in 1996. The results of that 1996 survey were the basis for the initiation of a browse database. A database that would initially collect browse samples for nutritive analyses in hopes to expand beyond nutritive analyses in the years to come.

In 1997, Lehr et al. presented a paper at the Nutritive Advisory Group bi-annual symposium. The proceedings from that paper outlined the techniques used at Colorado State University in collecting browse samples from five regions of the United States for nutritive analyses. In 1998 Kirschner et al. presented a paper at the Comparative Nutrition Society bi-annual symposium at Banff, Canada. The proceedings from that paper discussed those initial steps of compiling the nutritive analyses data into an actual database. From those initial stages the database has continued to evolve into what it is today. The database is entitled the Foragers Source and provides nutritive analyses of those original browse samples. It also provides a forum or template for others working with browse within the zoological community. Other collections of browse nutritive analyses, scientific literature and feeding suggestions will be uploaded and shared with all of those having a vested interest of knowing about browse. The main objective of the Foragers Source project is to provide a central point of reference for the international zoological community concerned with the nutritional care of captive wild animals. The Foragers Source website (<http://www.foragerssource.org>) will host a variety of resources aimed at helping nutritional zoologists in their day-to-day tasks. Additionally, it is hoped that the project will raise awareness of the importance of proper nutrition for wild animals.

Methods

Currently the project is defined in two phases. The goal of phase one is to provide a proof of concept website that sets the stage for involvement of the wider international zoological community. The goal of phase two is to further improve the functionality of the site based upon input from the zoological community.

Foragers Source Phase One

The first phase of the project will consist of the development of three main resources to be made available on the Foragers Source website: 1) A plant nutritional sample database (Sample DB); 2) a plant specimen identification reference database (Plant DB); and 3) an article archive featuring research articles and other information contributed by the zoological community pertaining to animal nutrition. Additionally, the site will provide a discussion forum where zoologists can discuss a range of topics. A user account must be created in order for individuals to evaluate and utilize the three resources.

Site Features

User Accounts

In the hopes of building a network of like-minded zoologists, the current project plan calls for the placement of certain site features and resources behind the need to create a

free user account. Users would be required to supply their first and last names, the name of the organization they are affiliated with and a valid e-mail address.

Benefits of user accounts include:

- 1) Creation of a site user unique identity will be necessary for the nutritional sample submission system planned for phase two.
- 2) User ID necessary to participate in the discussion forums.
- 3) Creation of a mailing list allowing the ability to send an e-mail newsletter keeping the community abreast of important news, issues and events.

Nutritional Analyses (Sample DB) and Species Identification (Species DB)

Databases

The Foragers Source project currently consists of two main databases. The **Sample DB** (Table One) contains all of the nutritional data collected during the 1996-2003 study. The current data fields represented in the database reflect that study. All nutritional analyses are presented as leaf or twig values, based on the original study (Lehr et al., 1997 and Kirscher et al., 1998).

The second database provides an extensive species identification (Species DB) collection. The **Species DB** serves as a reference point for the Samples DB (all of the species present in the sample data are represented in the Samples DB) and as an identification reference guide, featuring general characteristics, photos, illustrations, etc.

Table One – Key to the Nutritional Analyses Database found within The Foragers Source (Sample DB) based on browse samples collected from 1996 to 2003.

| | |
|----------------|---|
| sample_id | unique identifier for the sample |
| plant_id | identifier reference for the sampled plant |
| institution_id | identifier for the submitting zoological institution |
| year | the year the sample was harvested |
| season_id | the season the sample was harvested in |
| l_serial_num | leaf serial number (reference to old collection system) |
| l_ave_ash | leaf average ash content |
| l_cp | leaf crude protein percentage |
| l_dm | leaf dry matter percentage (as fed) |
| l_ndf | leaf neutral detergent fibers percentage |
| l_adf | leaf acid detergent fiber percentage |
| l_adl | leaf acid detergent lignin percentage |
| perc_leaf | percentage of whole plant that is "leaf" |
| t_serial_num | twig serial number (reference to old collection system) |
| t_ave_ash | twig average ash content |
| t_cp | twig crude protein |
| t_dm | twig dry matter percentage (as fed) |
| t_ndf | twig neutral detergent fibers percentage |
| t_adf | twig acid detergent fiber percentage |
| t_adl | twig acid detergent lignin percentage |
| perc_twig | percentage of whole plant that is "twig" |

In addition to the values presented in Table One for nutritional analyses of the original browse samples, the Sample DB calculates whole-plant values dynamically based on the static values listed in Table One. Thus, calculated percentage ash, crude protein, dry matter, and fiber analyses (NDF, ADF and ADL) for the whole plant values will be available in the database.

Utilizing Sample DB Features

Database users can search Sample DB for nutritive analyses using any combination of plant species, harvest year, harvest season or submitting institution. The search results are presented in two view formats. The "Note Card View" facilitates easier reading of single samples while "Spreadsheet View" facilitates easier comparison of different samples. The results of an individual search may be printed directly from the website or saved to the user's local computer as an Excel spreadsheet file. If a user clicks on the name of any plant species returned in the search, they will be linked to the species identification (Species DB) record for that plant species (Table Two). Within this database, the user can view specimen photos, illustrations and general characteristics about the plant.

Table Two – Key to the Species Identification Database found within The Forages Source (Species DB) based on browse samples collected in 1996 to 2003.

| | |
|-----------------|--|
| plant_id | unique id number for plant species |
| plant_sci_name | plant species' scientific name |
| plant_comm_name | plant species' common name |
| type | plant species' type (tree, shrub, perennial grass, etc.) |
| height | plant species' average height |
| allelopathy | Is the species known to exhibit allelopathy or suppression of growth of one plant species? |
| usda_zone | plant species' USDA hard zone |
| fr_sd_c | fruit or seed color |
| bloom_c | bloom color |
| fol_ct | foliage color and texture |
| blm_p | bloom period |
| pal_bg | palatability for browsers/grazers |
| soil_ph | best soil condition of soil pH need for the plant |
| best_area | best area for plant growth |
| hoof_stock | potential food source for hoofstock (yes/no) |
| mammals | potential food source for mammals (generalized) (yes/no) |
| s_m_primates | potential food source for small to medium primates (yes/no) |
| primates | potential food source for large primates (yes/no) |
| marsupial | potential food source for marsupial (yes/no) |
| reptilia | potential food source for reptilia (yes/no) |
| lagomorpha | potential food source for lagomorpha (yes/no) |
| rodentia | potential food source for rodentia (yes/no) |
| large_rodentia | potential food source for large rodentia (yes/no) |
| ursidae | potential food source for ursidae (yes/no) |
| xenartha | potential food source for xenartha (yes/no) |

| | |
|------------|--|
| carnivora | potential food source for carnivora (yes/no) |
| pachyderms | potential food source for perissodactyla/pachyderms (yes/no) |
| fish | potential food source for fish (yes/no) |
| birds | potential food source for birds (yes/no) |
| insects | potential food source for insects (yes/no) |
| chiroptera | potential food source for chiroptera (yes/no) |
| harm | harmful or toxic effects (listed or none) |
| enrich | enrichment properties (listed or none) |

Results and Discussion

Forages Source Phase Two

Phase two of the Foragers Source project will focus on improving the site features based on feedback from individuals using the database, or from those that work with browse within zoological institutions. While the site features developed for phase one were designed to be "proof of concept" implementations, they were done so with an open and modular approach, so that phase two improvements can be easily added to complete the system. Many of the improvements and changes to the system during phase two will be the result of feedback from members of the zoological community, the following is a list of suggested tasks/modules:

Ratify a standard data format for all Databases

Currently, the data fields defined in the databases are based on the 1996-2003 browse study (Lehr et al., 1997 and Kirschner et al., 1998) conducted at Colorado State University. It may be useful to expand those definitions to include other information. Additional data fields may include nutritive analyses on fruit, berries, bark, seeds, pods and other browse components. Global position sensor (GPS) data of the location where the sample was harvested may be included in addition to location factors such as yearly rainfall averages, temperatures and altitude.

Administration Requirement Sub-System of Sample DB and Species DB

Phase one of the Forager's Source was developed within the confines of a basic prototype. There is currently no means of editing the information contained within the databases except by direct interaction with the database server. The development of a web-based administration system would allow for easy editing and publishing of the sample data, species information, photos etc. that are contained in the databases.

Sample Data Submission System

Similar to the administrative sub-system, a nutrition sample data submission system would involve the creation of a web-based tool that would allow project members who conduct their own nutritional analysis to submit sample data that would then be published and searchable in the main database. That data could then be searched and utilized by the rest of the community.

Creation of Animal Database

To provide a complete perspective of the nutritional care of captive wild animals, it

would be beneficial to create a third database that contained detailed information about the nutritional needs of specific animal species. A single species data record could contain dietary requirements, common ailments, toxicity concerns and symptoms etc. Along with textual information, photos and illustrations of the animal's symptoms resulting from ingestion of toxic plants could be included to help care-givers identify problem cases.

Active research article solicitation

Literature concerning browse and the nutritional care of captive wild animals is scarce and what literature that exists can be hard to find. With the goal of making the archive as rich and as useful as it can be, it would be beneficial to actively solicit research papers and other information sources. Research authors benefit by having another outlet for publication, and the zoological community benefits by having better access to the information.

Conclusion

From the beginning, the intention behind The Foragers Source has been to give the zoological community more than a simple static source of browse information. Rather, the intention was to create a “living entity” that will allow concerned zoologists access to the most current nutritional information and to share knowledge and experience.

From a research perspective, having all of the published information concerning browse and captive wild animal nutrition in one location will be an invaluable resource. On a practical level, for those involved in the day-to-day care of wild animals, The Foragers Source will provide a useful reference to help them give the animals under their charge the best care possible.

The Forages Source

<http://www.foragerssource.org>

LITERATURE CITED

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