EthoTrak, Lessons Learned from Electronic Behavioral Data Monitoring

By: Sylvia Atsalis, Carrie Kasnicka, Sue Margulis, Jennifer McGee, Melinda Pruett-Jones

In Memory of Allison Walsh whose commitment to animal well-being made EthoTrak possible.

Introduction to EthoTrak

Zoological institutions constitute valuable resources for the study of animal behavior. Data collected can be used not only to improve the husbandry and management of captive animals but also to benefit the conservation of wild populations. Within the captive setting, data are collected with relative ease, and the sex and age of subjects are known. A significant drawback, however, is the limited number of animal subjects per species hosted at single institutions. The scope of resultant data sets is limited as statistical analyses are not robust with small data sets, and gleaned information is biased toward the behavior of only a few individuals. The key to establishing strong datasets lies in increasing sample sizes. Pooling data from across institutions can help to increase sample sizes resulting in databases that are more informative and representative of species behavior.

In 2003, Brookfield Zoo began a long-term effort to develop an easy-to-use, flexible, digital (PDA-based) system for collecting basic behavioral data within zoological institutions, a system that we termed EthoTrak. The software is particularly notable in that it is designed specifically for multi-institutional use by compiling data from across participating institutions into a single functional database. With EthoTrak, zoological and other institutions where that care for animals are able to maximize their potential as sources from which invaluable information on animal behavior can be drawn.

To achieve the goal, participating institutions must use standardized behavioral terminology (established ethograms) in order to maintain consistency across institutions in how behaviors are named, categorized, and quantified. Only with uniform behavioral data collection methods can information from multiple participants be analyzed, compared and shared. By quantifying information that has been collected historically in subjective and less rigorous ways, we can more readily use behavioral information to understand animal behavior and to inform management decisions.

Given EthoTrak's basic premise of uniformity and collaboration, we developed the technological component of the tool to facilitate use by creating a remarkably user-friendly interface, and by ensuring that the tool can be used across a broad range of computer configurations with minimum system requirements. For this reason, EthoTrak was developed to operate equally well from a stand-alone PC as well as from a network. To implement EthoTrak the following are needed: minimally Windows 98, Access 2000, an updated Microsoft Data Access Components, a USB port, internet connection, and palm pilot devices. Because of EthoTrak's modest requirements, implementing and using the system is inexpensive because uses software that most computers already have and it maintains unlimited licensing on the handheld application. The most significant expense when using EthoTrak is the cost of the handheld palm pilot devices.

Equally important to the development of the technological aspects of EthoTrak is the formulation of a sound behavioral component, i.e. easy to understand, variably complex ethograms. EthoTrak is equipped with ethograms that use standardized terminology and are based on a pre-designed two-tiered structure. The structure is composed of a set of Higher Order Behaviors (HOBs) within each of which are found species-specific behaviors (SSBs). Higher Order Behaviors are broad categories of state behaviors that are applicable to a taxon (birds, primates, ungulates etc.), while

species-specific behaviors are detailed state or event behaviors that apply expressly to the targeted species. All SSB behaviors map onto a Higher Order Behavior. Through the tiered hierarchy a broad range of taxa are accommodated. In addition to HOB and SSB behaviors, institutions are able to add “institutional” behaviors to the standard ethogram, which allows them to accommodate the ethogram to their specific data collection needs. Ultimately, EthoTrak is designed so that institutions may select the level of complexity that is most useful for them and with which users feel more comfortable. They can choose to collect behavior only on the HOB level, or they can choose to collect data at the SSB level—ethogram detail can increase as observers become more comfortable with PDA’s and methodology over time.

Although the desktop program is where the EthoTrak system is set up, and records are maintained, edited and transmitted to the shared datebase, it is through the hand-held component that the data are collected. With the hand-held palm devices EthoTrak allows users to collect the “Who, What, When, Where, and With Whom” information basic to any behavioral data collection protocol. For additional convenience, the observer is able to enter comments and flag specific records for later perusal. While recording data the observer is able to check ethogram definitions through an internal dictionary. Practice observation sessions can be distinguished from “real” ones permitting users to learn the system prior to recording data that will be counted as valid.

The desktop application of EthoTrak is used to customize the supplied ethogram to the specific needs of the institution and to enter the information that will be needed to collect data in the field, e.g. identity of animals and description of habitat. The palm pilot is connected to the desktop computer and loaded with the information during a synchronization process called a "HotSync". With palms in hand, observers collect data either through focal animal observations for a predefined period of time, or through point sampling throughout the day. Following data collection the handheld is re-synchronized with the PC. During synchronization, data collected on the handheld device are transferred to the desktop, and recent changes to the PC EthoTrak application are transferred to the palm. The “HotSync” process moves the data from the handheld device through the pc to the institution’s network database, or simply to the standalone database. Data are now available to generate automatic reports, on time budgets, frequency of behaviors, location of animals in the habitats, and the interactants and neighbors of subject animals. Users are able to export their data sets to a different application for additional analyses as needed. This is also when data are available for export to the host institution, Brookfield Zoo, where cross-institutional data are compiled and can be analyzed.

Exportation of data to Brookfield Zoo takes place through a process called ETP, or EthoTrak Transfer Protocol, which accumulates the data, through internet connection, into a master database at the host institution from which data can be shared across institutions. Currently, individual institutions have access only to their own data and can generate reports based only on their own animals. Only the host institution, BZ, where all data are compiled, has access to the complete database and can generate graphs based on this dataset. A future aim is to determine secure ways to make data accessible to all participants. In addition, at this juncture in program development, only HOB-level data for each species are used for the instantaneous reporting when data from multiple institutions are used.

With EthoTrak, the time-intensive efforts typically required to collect and enter data are eliminated since paper is not required to collect and analyze data. By developing a system that is inexpensive to use, flexible, and shareable, we envisioned a tool that is useable across a wide range of institutions. Our initial testing involved five institutions collecting data on four varied taxa: white-cheeked gibbon, Micronesian kingfisher, okapi, and Atlantic bottlenose dolphin. Our aim was to identify the challenges

posed by data collection and sharing, and to determine how these challenges related to the species under observation, the size of the institutions, and the variations in use. In these proceedings, we (users of EthoTrak and EthoTrak's key programmer) report on the lessons learned from our efforts to pilot-test the EthoTrak system during the past year.

Data Collection, Fostering Participation and Collaboration

The idea that zoo staff can and should be involved in asking questions about the animals they care for is foundational to EthoTrak. Although multiple staff are not required to collect data, a principle goal of EthoTrak is to involve keepers in the data collection and analysis process. Toward this purpose, we provide extensive training, part of which focuses on the importance of collecting behavioral data. When keepers are experienced with collecting data through other means, such as on paper, it is relatively easy to transition into using EthoTrak. At most institutions, our experience has been that multiple staff members participate despite the occasional initial hesitation. Staff are eager to become part of a larger, multi-institutional objective. Moreover, using EthoTrak becomes an opportunity to take the time to observe animals, an opportunity which may not have been routinely used without the impetus of EthoTrak. The chance to record systematic observations on animal behavior can be a powerful incentive for staff participation. Staff find that collecting data with EthoTrak easily integrates into their daily schedules and that occasionally missing an observation session has little serious affect on the overall protocol of data collection.

Another incentive for staff involvement in collecting data is that at crucial times of an animal's life the instantaneous behavioral reports may help to reveal significant behavioral patterns. Are there relational problems between animals in a group? Is stereotypy on the rise? These questions and so many more can be answered with EthoTrak because the system allows the user to graph results instantly so that casual observations can be supported, or not, based on actual quantitative data. However, EthoTrak's use is not limited to the critical times in an animal's life. Daily use results in the compilation of basic behavioral data that can be used as a way to conduct comparisons among animals, or to monitor the behavior across life stages of an animal's life. By participating in the process of recording data, the staff feels that their actions are important in making decisions about the animals they care for, and, generally, we find that staff are inclined to participate eagerly when data collection objectives are stated clearly.

The Importance of Baseline Data

Compilation of baseline data is essential to understanding animal behavior because these data sets are needed to establish behavioral patterns, to monitor behavioral changes, and for comparative purposes. Changes in the behavior of an animal can best be distinguished if comparative data are available. Quantitative data to back up the perception of change in an animal's behavior are necessary to make relevant decisions on animal husbandry and management. As an example, in Atlantic bottlenose dolphins, where males form pair bonds, placing compatible males together is crucial to their well-being and the way they exhibit normal behavior. Establishing a database on specific male-male interactions can form a basis for knowing what is typical behavior and what is not, and even knowing which males have shown, through quantitative data, that they are compatible.

Monitoring calf development is another area where EthoTrak can be useful. Keepers are highly invested in seeing a calf develop normally. Databases on nursing behavior constitute sources to which new data can be compared. Nursing frequency of a

new calf can be compared to available data to check for typical species-specific patterns. When needed appropriate management decisions can be taken.

The Importance of Ethograms

EthoTrak's backbone is the Ethogram: the behavioral repertoire of the target species. Forage, Locomote, Affiliation, Aggression etc. are basic or Higher Order Behaviors that are standard, to some degree, across species. In contrast, formulation of species-specific behaviors requires intimate knowledge of each species for precise definitions of particular behaviors. Exact definitions are important because when multiple people are involved in data collection the subjective component when interpreting behavior must be minimized. At Brookfield Zoo, we have found that keepers are excellent sources of information for describing behaviors, such as the many sexual behaviors of dolphins, or the multiple threat positions of birds. Thus, among the most valuable components of participation is the way that keepers, SSP members and other staff can help to develop minutely precise ethograms. When staff are relied upon for their expertise they become even more diligent observers of animal behavior. Keepers may provide sketches or photos of specific behaviors to help in illustrating definitions appropriately. Our experience has been that staff involvement has been critical to developing accurate ethograms that represent the diverse array of behaviors of each species included thusfar in EthoTrak.

Challenges with Data Collection

Data collection can be especially challenging when animals live in highly complex social groups, as in the case of the bottlenose dolphin. With this species it was particularly important to have clear definitions of complex behaviors, to set appropriate guidelines regarding assumptions about behaviors and to coach staff on how to make appropriate judgments when recording behaviors. A recurrent question concerned the manner by which concurrent behaviors should be recorded. To maintain consistency, data collectors must be instructed as to which type of behavior is recorded over another during point sampling. A social behavior may over-ride other behaviors such as feeding or locomoting, but that should be determined by a set of standards applicable to all.

Flexibility is an essential trait of EthoTrak. Establishing a system of observation, a schedule, that works with keeper time budgets is key to using EthoTrak because observers will be more inclined to enjoy taking data if they know that the observation period is within their own time limitations. The data collection protocol varies depending on the institution's needs and abilities. EthoTrak works under variable schedules. One participating institution may be able to collect as much as 30 minutes of data daily, while another divides the time into two or three shorter sessions over the week. Either way, the data continue to accumulate consistently from across institutions.

The target species, too, will pose its own challenges and impose its own scheduling needs. For example, the challenge may be to continue with regular data collection even in the case of a species that is not so active. In this situation the underlying philosophy is that if routine observations are not conducted the infrequent occurrence of important behaviors will be missed. In sum, the challenge for time management is dual: the time limitations of the keepers and the time needed depending on typical species behavior. The essential point is that EthoTrak itself poses little challenge in terms of time because time commitment is so modest. EthoTrak can easily become part of any time challenged schedule.

Interinstitutional Collaboration

EthoTrak provides and fosters opportunities for close collegial collaboration. EthoTrak is already being applied to several collaborative research efforts. It is in the

development of strong interinstitutional partnerships where EthoTrak's potential is highest, because by its very nature EthoTrak is collaborative. Taking the opportunity of recent gorilla births at two Chicago zoos, Brookfield Zoo and Lincoln Park Zoo, the EthoTrak team has developed an application to collect data on infant development. This occasion is a wonderful example of inter-institutional collaboration, one that will document the process of growth and development in young gorillas, and monitor mother-infant interactions throughout the critical period of infancy. Similar projects can be applied to other species. We are also pleased to be helping other researchers in an interinstitutional project on polar bear, which is specifically designed to evaluate husbandry practices. In this project, EthoTrak will be used to monitor and compare polar bear behavior before and after enrichment.

EthoTrak's Future

EthoTrak is a tool that acts as a unifying force among people who have animal interests at heart. EthoTrak is dependent on open channels of communication among keepers, management staff and EthoTrak staff. Specifically, the EthoTrak team relies on users to develop ethograms, to alert us to nonintuitive aspects of the system so that we can make appropriate adjustments, and for comments that improve analytical capabilities in order to create widely useful and meaningful behavioral reports. We also rely on participants to suggest improvements based on their particular needs.

Finally, Ethotrak's success is crucially dependent on open channels of communication among participating institutions. Only through their continued involvement can EthoTrak improve and expand. With this in mind, we conducted an online survey of all participants to evaluate ease of use of EthoTrak. Of all users 77% specified that EthoTrak was "quite easy" or "very easy" to use. Based on survey results the EthoTrak team is seeking to make further adjustments particularly in the ease of use of the automated reporting tool, and by increasing the number of available standardized reports. Ethograms already in use continue to be perfected, while newer ones are being developed. The need for gender, age, and life stage-based ethograms is being investigated, as is the addition of more species.

Other advances, too, wider in scope, are envisioned, particularly with regards to making the tool broadly accessible, and to making interinstitutional data available to more participants and researchers. Therefore, we plan to improve the web reporting tool, develop security features for sharing databases, and create flattened data sets to ensure data confidentiality. These features along with improved user interface and the extension of EthoTrak for use with pocket PCs will enhance EthoTrak's utility. Finally, to realize EthoTrak's main idea of increasing sample sizes through wide interinstituional participation, we are seeking to identify additional participants with an interest in multi-institutional research and collaboration.

As we expand EthoTrak to meet the broader needs of the zoological community we are also positioning the system to inform the development process of the behavioral module of the Zoological Information Management System (ZIMS). ZIMS is being developed currently by ISIS (International Species Information Systems) together with IADISC (International Animal Data Information System Committee) to create an advanced database technology to support high quality, globally comprehensive data for endangered species management programs.

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