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Zoo Research Guidelines

Project Planning and Behavioural Observations

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Zoo Research Guidelines:
Project Planning and Behavioural Observations

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Scientific investigations are the basis for understanding the animals in a zoo, assessing the way they are cared for and how they interact with their zoo environment. Through careful research, we can improve animal management, husbandry, welfare, breeding, diets etc. Research conducted in zoos can also contribute to the conservation of animals *in situ*. In zoos it is possible to study animals closely, which can be an excellent training for observations in the field. Zoos also provide a valuable opportunity to train young scientists and other interested parties in scientific research techniques.

These guidelines are designed to clarify the series of steps that are usually involved in developing and conducting a research project in a zoo environment. They discuss those challenges that are characteristic for zoo research projects and that may differ from those encountered in laboratory or field studies. The guidelines are intended to assist those relatively new to zoo research in carrying out sound, well-designed projects that have scientific validity.

The first volume of this series of Zoo Research Guidelines is organised into sections identifying the steps in the research process: 1. Formulating the research question, 2. Developing the research design, 3. Data analysis and interpretation,
4. Compiling the project report. Please note that these steps may be cyclical and interdependent, e.g. experimental design and analysis should be considered together. It is advisable to read all sections before starting and consider carefully any cross-references between sections. The final section 5. presents a wide range of useful references and identifies key texts for each stage of the project.

1. Formulating The Research Question & Initial Practicalities

- Identify the question(s) and the species upon which you wish to focus. Consult your supervisor to make sure that these are appropriate for a zoo project using perhaps preliminary reference to other studies. A thorough literature search on both the species and the question is then the next step. Electronic databases such as 'Web of Science' are the easiest way to search for scientific papers on a particular topic. The Internet and reports on previous zoo projects, which can be obtained by contacting Zoo Libraries or Zoo Research Coordinators, can be useful. However, the source and accuracy of Internet material should be carefully considered. Also previous project reports may be unreliable and inaccurate due to the restricted input from zoo personnel or poor supervision. Read unpublished projects critically and decide if the information is valid. Avoid following on from a scientifically unsound project unless you can make changes and improve on it. Do not base your project too closely on a previous study as this may be classed as plagiarism. If in doubt consult your project supervisor.

  Example: If you were interested in studying the effect of visitor numbers on the behaviour of a group of macaques, your literature search should cover 'macaque behaviour' both 'in the wild' and 'in zoos' plus 'visitor effects on zoo animals/primates'. You could specify your research and measure noise levels or note down age structure of the visitor crowd.

- Discuss the project with your supervisor before contacting the zoo or animal collection. A list of suggested projects may be available from your supervisor, the Zoo Library or the Zoo Research Coordinator. Check carefully what your course requires with regards to the execution and write-up of the project and whether these requirements can be fully met by the intended zoo project. For example, are descriptive statistics adequate or is statistical hypothesis testing a requirement?

- If you are planning to investigate physiological parameters to back-up your behavioural observations, make sure you are familiar with the legislation and zoo-specific regulations for invasive sampling procedures. The Zoo Federation Research Group has produced *Sampling Guidelines* that provide information on what samples can be taken from animals without incurring a Home Office 'regulated procedure' license (see section 5.). Most zoos do not hold a Home Office Licence. You can find further information on ethical aspects of animal research procedures in the reference section 5. If in doubt, consult the Research Coordinator at the zoo.

- Find out the registration procedure for conducting a project at the zoo you have chosen. Start by contacting your supervisor who might have zoo registration forms or information leaflets. If there is no information available, contact the Zoo

Research Coordinator. It is helpful, and often a requirement, to have a short, typed project proposal to submit to your supervisor and the zoo.

- Identify your study animals and determine any group structure. Ask the zoo for identification sheets or a copy of the taxon report for the species of your interest. The taxon report gives individual information on age, sex, parents, etc. Check through any previous project reports that are available on these animals (ask the Research Coordinator or the Zoo Librarian). Previous reports may not only hold information on the individuals but often also contain enclosure maps. Determine whether identification of individuals is possible within your time constraints. It might be sufficient for your particular research question to subdivide the population by sex or age group.

- Define the specific question(s) you wish to address before you start any data collection. Do your literature searches direct you towards specific hypotheses? You should be able to justify your project aims from the literature.

2. Developing The Research Design

2.1 Practicalities and Responsibilities

- Consider what types of projects are appropriate for a zoo environment. For example invasive studies that require a Home Office Licence may be possible in a laboratory but will not be accepted in a zoo. For ethical reasons it is unlikely that you will be able to collect data that would require separating individual animals from a group (e.g. for individual feeding trials) or catching or anaesthetising the study animals.

- Discuss with your supervisor and if necessary with the Zoo Research Coordinator how feasible your initial design will be to implement. The project needs to work around zoo regimes (e.g. animal feeding times, keepers rota) and avoid disrupting the animals or the keepers. Check the husbandry regime for your study animals and bear in mind that you may not be able to observe them at certain times (e.g. outside of zoo opening times or when they cannot be seen from public viewing areas). By handing in a preliminary proposal well before the start of your project, the zoo will have the opportunity to inform you about any possible problems.

- Always keep to the arrangements that you made with zoo staff (e.g. for putting enrichment devices into enclosures) and ensure that you turn up on the days and at the times agreed. Be sure to inform the keepers and/or the Research Coordinator if you make changes to your research plans.

2.2 Experimental Design

Please note that any statistical tests you may do depend closely on the design of your experiment and the way in which you collect your data. You should read sections 2. and 3. in conjunction with each other. If you are in any doubt you should consult detailed literature (see section 5.) and/or your supervisor.

- Identify independent and dependent variables in your experiment. The independent variable is the factor that you, as the researcher, will manipulate. The dependant variable is what you will measure. The independent variable can be manipulated either directly or indirectly.
  Example: Independent variables might include the addition of enrichment devices (directly controlled by you) or visitor numbers (indirect measure since you cannot control it). The dependent variable might be position of the animal(s) in the enclosure or behaviour frequencies or durations.

- If your project requires observation of detailed behaviour you will need to construct an ethogram. This is a detailed list of objectively described, mutually exclusive behaviours that you will focus on to answer your research question(s).

These behaviours provide you with measurable units for which you can record frequencies and durations or latencies. Literature research (e.g. see section 5.), previous studies on the same animals and preliminary observations can help to identify and define these behaviours.

- Think carefully about the context of your data collection – what else might be going on at the same time and possibly affecting it? Eliminate as many confounding variables as possible so that the only factor that affects your dependent variable is/are your independent variable/s. Those that cannot be eliminated should be controlled for as far as possible and acknowledged and discussed in your project report (see section 3.).

  Example: Animals may reduce their activity when visitor numbers increase but does this also coincide with higher temperatures due to better weather?

2.3 Choosing Sampling Methods

- Exactly what data you collect depends on your hypothesis. The variables you measure should be chosen to best describe what is of interest to answer the research question. Avoid taking unnecessary data by remaining focused on your hypothesis.

  Example: Instead of collecting general data on, for example, everything that each individual of a group does, you might focus specifically on where individuals are found in the enclosure and behaviour shown there. If you are looking at the effect of enrichment devices, you might focus on behavioural elements relevant to the device (e.g. foraging and feeding) or focus more broadly on changes in time budgets, but it would not be necessary to collect data on details of e.g. social behaviours.

- Decide when to collect the data. You need to consider time of day, visitor numbers, temperature, weather conditions, animal breeding season etc (also see section on confounding variables in 2.2.). Make sure you plan your data collection so that you have enough time to answer your questions within such constraints and allow extra time for unexpected problems. Please note when interpreting the results of a short-term project that the outcome cannot be seen as being representative for the animals' behaviour all year round! – see section 3.

- Consider how/when/how often etc. to record the data and ensure you are using the most appropriate sampling method to answer your question. This is important in determining whether your data are suitable for statistical analysis, so do check if you intend such analysis. (See section 5.0 for helpful references on sampling and its relationship to statistical tests.)

Example: You might study one focal animal at a time, select individuals out of sub-groups or scan the behaviour of the whole group at the same time point. Sampling methods include; *ad lib*, focal and scan behaviour sampling. Recording can be continuous, instantaneous, frequency, etc.

- The number of observations you take will depend on how many animals you have available, how many different experimental conditions you are planning to compare, the probability tests you have decided to use (if any) and how strong the effect of your independent variable is. Decide how long you will leave between sampling periods (among other factors, this will depend on the duration of the behaviours observed) and how you will avoid bias when choosing a subject to sample. It is important that these issues are carefully considered to avoid generating errors in interpreting results and/or any statistical analyses. If certain individuals are more active/visible, their behaviour maybe recorded repeatedly (and so be over-represented in the results) instead of obtaining data from all individuals evenly.

  Example: To avoid bias, pick subjects at random or in a set order rather than focusing on the animal displaying the most interesting behaviour at that time. This might result in lots of, e.g. 'inactive' or 'out of sight' behaviour being recorded but, even if this seems less interesting to you, the observer, it is still valid data.

- Once you have planned your data collection it is very valuable to carry out preliminary observations (a pilot study) to iron out any unforeseen problems with your research design or sampling strategies. It also enables you to judge realistically how long the data collection for the whole project will take and to plan a timetable accordingly (with extra time added for further unforeseen problems!).

3. Data Analysis And Interpretation

- If you are intending to carry out probability testing, you should have decided on the tests that you will use before starting to collect your data (as discussed in section 2.). This will ensure that you collect data in the right form and are not left wondering what test you can use on your results!

- To consider which statistical tests to use, try consulting general statistics books and texts, particularly those that are especially directed at zoo or field researchers (see section 5.). You will need to consider (and test) whether the data you have collected are normally distributed as this will determine whether parametric or non-parametric tests can be used. Generally parametric tests are more powerful but depend closely upon having normally distributed data (among other constraints). Where data are not normally distributed and transformations are not recommended or helpful, similar non-parametric tests are available. Bear in mind that it may not always be appropriate or necessary to use hypothesis testing with statistics. Descriptive statistics and graphical representations of data may be more appropriate than trying to force data into an inappropriate test that may provide invalid or unrepresentative results and lead to erroneous conclusions.

- As with the previous stage in the process, preliminary analyses after some data have been collected are extremely useful to check whether any further refinements to the data collection are needed. Therefore allow time for preliminary observations and analyses when planning your observation timetable.

- Some statistical problems can be typical for zoo projects (e.g. pseudoreplication and pooling errors) usually because of small sample sizes, inappropriate repeated measures etc (see also section 2.3). Statistics books and previous research that address these issues (see section 5.) can help to prevent the occurrence of these errors. There are, for example, different correction methods available but a major way of avoiding these problems is through carefully planned experimental design.

- Take care when interpreting your results to reconsider the planning and design part of the process and think back over any confounding or extraneous variables. Did any others arise during the course of your data collection (e.g. new animal arrived in collection, new feeding method, strong weather change)? How might these, individually and together, have affected your results? You need to discuss these thoroughly; in some studies they have a larger effect than the independent variable. Consider the value of your results for the observed animals (in study zoo) and also, if appropriate, how applicable these results are for the subject species in other zoos/wild.

4. THE PROJECT REPORT

- The style of the project report will obviously depend on the requirements of your course and academic institution but it is essential that you produce at least one copy for the Zoo. Check whether you should pass it to the zoo personally and to whom it should be addressed (usually to the Research Coordinator) or whether your academic institution collects it to pass on. Without a written report the knowledge gained from the research will not be available for zoo staff, which means your work does not benefit the animals. Be sure to agree on the ownership of any data collected with the Zoo Research Coordinator before you start your project. Some zoos set as a requirement that they are provided with an electronic copy of your data at the end of your project. *Be sure to comply with any such requests* to ensure valuable links and good relations between zoos and academic institutions are maintained.

- The most useful reports include information that would allow another person to follow the same study on different animals or in other situations. The report should state the background of the study and why it was carried out. It must include details of the methods used, particularly when exactly the data was collected, how many hours of observations were collected and details of behavioural sampling methods and experimental design. State exactly what the results were (including any statistical details) and include a discussion of how the results can be interpreted, using knowledge of the theoretical background. It is often useful for the zoo if you add recommendations for husbandry procedures that result from your research.

5. USEFUL REFERENCES

5.1 Zoo Research – Background and Contexts

Key references:

- Crockett, CM (1996) Data collection in the zoo setting emphasising behavior. In: *Mammals in Captivity; Principles and Techniques*, Kleiman, DG, Allen, ME, Thompson, KV and Lumpkin, S (eds). University of Chicago Press, Chicago, pp.545-565.
- Federation Research Group (2002) *Research Sampling Guidelines for Zoos.* The Federation of Zoological Gardens of Great Britain and Ireland, London.

Other useful texts and key papers dealing with general zoo research issues:

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Benirschke, K (1996) The need for multidisciplinary research units in zoos. In: *Mammals in Captivity; Principles and Techniques*, Kleiman, DG, Allen, ME, Thompson, KV and Lumpkin, S (eds). University of Chicago Press, Chicago, pp.537-544.

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Burghardt, GM (1996) Introduction: Research and welfare in animal exhibit facilities. In *The Well-being of Animals in Zoo and Aquarium Sponsored Research*, Burghardt, GM, Bielitski, JT, Boyce, JR and Schaeffer, DO (eds), Scientists Center for Animal Welfare, Greenbelt, pp. 1-3.

Feistner, ATC and Price, EC (2000) Working together for conservation: A win-win strategy for zoos and universities. In *Proceedings of the 2nd Annual Symposium on Zoo Research*, Plowman, AB (ed.), Federation of Zoological Gardens of Great Britain and Ireland, London, pp. 23-30.

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Thompson, SD (1993) Zoo research and conservation: Beyond sperm and eggs toward the science of animal management. *Zoo Biology* 12: 155-159.

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5.2 Developing the Research Design

Key references: These provide a good starting point for developing your research design; the first two cover what their titles suggest, the others give valuable information on how to plan behavioural observations, devise ethograms, determine sampling strategies etc (see also the separate specialist reference sections 5.3 and 5.4).

- Adams, DC and Anthony, CD (1996) Using randomisation techniques to analyse behavioural data. *Animal Behaviour* 51: 733-738.
- Bart, J, Fligner, MA and Notz, WI (1998) *Sampling and Statistical Methods for Behavioural Ecologists*. Cambridge University Press. Cambridge.
- Dytham, C (1999) *Choosing and Using Statistics – A Biologists Guide*. Blackwell Science Ltd. Oxford.
- Martin, P and Bateson, P (1993) *Measuring Behaviour. An Introductory Guide, Second Edition*. Cambridge University Press, Cambridge.
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- Still, AW (1982) On the number of subjects used in animal behaviour experiments. *Animal Behaviour* 30: 873-880.

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Hurlbert, SH (1984) Pseudoreplication and the design of ecological field experiments. *Ecological monographs* 54(2): 87-211.

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Sutherland, WJ (ed.) (2000) *Ecological Census Techniques, a Handbook*. Cambridge University Press, Cambridge.

5.3 Principles of Behavioural Observation

This section focuses specifically on the *principles underlying behavioural observation* and how it can be used to answer particular questions. (See also section 5.4.)

Key references:

- Altmann, J (1974) Observational study of behavior: sampling methods. *Behaviour* 49: 227-267.
- Dunbar, RIM (1976) Some aspects of research design and their implications in the observational study of behaviour. *Behaviour* 58: 78-98.
- Federation Research Group (2002) *Research Sampling Guidelines for Zoos.* The Federation of Zoological Gardens of Great Britain and Ireland, London.
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- Saudargas, RA and Drummer, LC (1996) Single subject (small N) research designs and zoo research. *Zoo Biology* 15: 173-181.

Other useful texts dealing with principles of behavioural observations:

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Tinbergen, N (1963) On aims and methods of ethology. *Zeitschrift für Tierpsychologie* 20: 410-433.

5.4 Observing behaviour

This section addresses *techniques and problems* of behavioural observation as a large number of zoo research projects rely on reliable and accurate behavioural observations. (See also section 5.3.)

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