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HOW LABORATORIES CAN CONTRIBUTE TO STUDIES OF NATURAL POPULATIONS: WITH SPECIAL REFERENCE TO CALLITRICHIDS

P. F. Neyman

University of California, Berkeley

The possible relevance of field studies to laboratory investigations has been suggested by various workers (Rothe, 1975; Epple, 1974; Dienhardt, 1970). That profitable application could also occur in the reverse direction has been less often discussed (Corbin & Vande Populierre, 1976). This contention forms the focus of the present paper. Some types of data or specimens that may seem useless in the laboratory context, and therefore be ignored despite the ease in collecting them, can be invaluable to the field or museum worker. Even animals that are to be "sacrificed" for experimental purposes can provide data such as is outlined below.

When the objective of field study is to characterize a population with regard to age structure and reproductive pattern, two major questions immediately arise: What is this animal's reproductive state? and How do I estimate its age? The typical field study affords neither sufficient time nor adequate sample size to establish satisfactory age and reproductive-state criteria. This could by contrast be relatively easily accomplished in the laboratory. Recent publications on palpation of embryos *in utero* (Phillips & Grist, 1975; Hearn, in press) and on tooth eruption sequences in callitrichids (Chase & Cooper, 1969; Tappen & Severson, 1971; Johnston, Dreizen, & Levy, 1970) are examples of valuable laboratory-derived tools which could not have been efficiently developed in the field.

These comments are particularly applicable to certain callitrichids which are maintained in some numbers in captivity. Field studies of this little-known family are certain to increase in the future. They are amenable to capture methods used for other small mammals and to "in the hand" aging techniques. It is here that laboratory data could be particularly useful. For example, data relevant to estimating the age of juveniles is badly needed. Not only age *per se* is of interest but, ultimately, date of birth. Since births are rarely observed in the field, it is almost always necessary to estimate birth date. If observations on a group are being made daily, the possibility for error is negligible; but since only one group can be observed at a time, the sample so obtained is only a minor part of the total sample. This is particularly true if the investigator can be present at the study site for only part of the year, but still wishes to characterize reproductive patterns over a number

~~Author's address: Department of Zoology, University of California, Berkeley, CA 94720.~~ ~~The author asks those desiring reprints who have grant support to enclose a self-addressed, stamped envelope with their request.~~

of years. Types of data useful in aging can be divided into two types: Those applicable to captured animals, and those useful for individuals seen only at a distance. Obviously the latter will have less precision, but, providing its error can be estimated, such a measure is preferable to none at all.

I will outline some types of data I would have found useful during my study of wild *Saguinus oedipus* (Neyman, 1977). Perhaps future workers who undertake field studies of callitrichids can benefit from having available at the initiation of their work baseline data such as these. In addition I will point out some behavioral indices and some anatomical parts easily obtainable in the laboratory, which may be applicable to studies of natural populations.

Indices Relevant to Age Estimation

Weight Measurements of Growth

Needed especially during the early ages where the weight-gain curve shows the least variability and the steepest slope (Chase & Cooper, 1969). This measure has two disadvantages: Possible negative change with age and high variability which increases with age. On the other hand, it is very easy to measure and potentially useful for a longer period of life than length measures, since it levels off later (Chase & Cooper, 1969). Its usefulness in constructing age-estimation curves depends on large samples. Individuals used should be from different litters, as littermate weight tends to be highly correlated (Neyman, personal observations). A weight drop in old animals might be looked for. Data collected by the writer on wild *S. oedipus* suggested this, where age was judged by tooth condition.

Length Measurements of Growth

Body length. Crown-rump length was used by Chase and Cooper (1969) for *Saguinus nigricollis*. For live animals this is probably the most easily taken overall length measure. Its disadvantage is that it differs from the standard method for measuring mammalian body length (DeBlase & Martin, 1974). The latter is calculated by subtracting tail length (tip of first moveable vertebra to fleshy tip, measured dorsally) from total length (nose to fleshy tip of tail, measured dorsally).[1] The method used should be stated.

Knee-heel length. Hearn (1977) found this the most easily taken, most repeatable, and least variable of several length measures attempted on *Callithrix jacchus*, perhaps because it involves basically only one bone.

[1]The American system (described here) differs somewhat from the European (see DeBlase & Martin, 1974).

Dental Development

The dental complement of a captured animal is a potential check and supplement to an age estimate based on weight or length measures. At present the only species for which tooth eruption sequences are available are *Saguinus nigricollis* (Chase & Cooper, 1969; Tappen & Severson, 1971) and *Callithrix jacchus* (Johnston, Dreizen, & Levy, 1970). Any laboratory regularly examining infants can easily collect these data. A distinction between just erupting, partly grown, and fully grown-in teeth might be made.

Tooth Wear

Canine or molar wear have been used with varying success for age estimation in field studies of many mammalian species (Morris, 1972). A standardized laboratory diet would allow assessment of individual variation and would constitute a valuable contrast and control for wild animal observations. Quantification of the aging process of teeth could be potentially useful.

External Appearance

Details of appearance with age in marmosets are practically undescribed in the literature (and unillustrated). Yet, the collective knowledge from laboratory colonies is potentially considerable. Easily visible characters that are only present during certain stages of development need to be described, and individual variability in their timing assessed.

Characteristics of newborn infants. A medial stripe or patch is present in newborns at the front center of the head in at least several species of callitrichids. This is a potential character by which very young infants could be differentiated from older ones with certainty at a distance, since it apparently disappears at an early age. It would be useful to know in what species it occurs, whether it is consistently present and visible at a distance, and how variable the age of disappearance is. Other distinctive patterns may occur in other species.

Facial and head hair patterns of juveniles. In many callitrichids facial and head hair patterns are markedly different in the infant and juvenile compared to the adult. For example, in *Saguinus oedipus* areas of the cheeks, temples and forehead lateral to the topknot, which are bare in the adult, are in the juvenile covered with black and white hairs that disappear in a predictable sequence (Hampton & Hampton, 1967). The individual variation in age of disappearance, and the duration of the period it subsumes have not been documented. Series of photographs (front and side) of individuals at standard ages could be used by field workers to test or increase their accuracy of age-determination based on appearance. Such a series could even be carried in the field for reference.

Indices of Reproductive State

Nipple Development and Changes

Nipple length, width, and color are standard characters used in mammalian population studies, and will probably prove useful for marmoset studies in differentiating parous from non-parous individuals. Nipples enlarge and elongate in nursing females (R. W. Cooper, personal communication, 1976). The degree of variability of this phenomenon, its post-lactation persistence, and whether it occurs in case of abortion or miscarriage has not been investigated. Such data will have obvious applicability to investigations of social organization, if there is any relationship between dominance and parity in the wild such as that demonstrated in captivity.

Cycle of Mammary Gland Changes During Pregnancy and Lactation

There are practically no data available on lactation, its duration, or the morphological changes that accompany it. The relationship between differential development of the two sides (R. W. Cooper, personal communication, 1976) and litter number or use of them is likewise unknown. Also lacking are data on the duration of lactation and the variables influencing it.

Indicators of Puberty and Reproductive Maturity

Externally visible characters indicating puberty need to be correlated with physiological changes. The onset of pigmentation in the suprapubic gland has been suggested as a criterion for puberty in *Saguinus geoffroyi* of both sexes (Dawson, 1976). Dawson found that presence of pigmentation correlated very well with weight in wild *S. geoffroyi*: Only 3 of 38 individuals in his sample with unpigmented suprapubic glands exceeded 425 gm; no individuals with pigmented glands weighed less than this. Additional criteria for differentiating reproductive from non-reproductive adults would be very useful in field investigations of population and social structure.

Behavioral Indices

In laboratories where behavioral observations are accompanied by routine physical examinations, a look might be taken at correlations between grossly observable skin gland parameters (length, width, discoloration of surrounding hair)[2] and marking frequency. Individual variation in degree of yellowing in the chest, abdominal, and anal areas

[2]Reliable judgements about color are exceedingly difficult to make. Comparisons may be facilitated through the preservation of hair samples, which can be stored in glasine envelopes. They should be kept in a closed container with paradichlorobenzene to prevent insect damage.

is striking in wild *S. oedipus*. With the data available, it is impossible to judge how much variation is ascribable to age, reproductive state, or individual behavior. If this were known, it might be possible to make limited inferences regarding social structure in wild groups based on skin gland condition. Also, age-specific changes in vocalizations and behaviors of infants could be observed. Of interest here are variability between individuals, effects of litter number, arrival of new litters, etc.

Data Collection

Reasonable sample size and regularity of notation is essential to assessment of the degree of reliability with which data described above can be used for age estimation. Thus the preferable way to collect them is routinely, on standardized forms, and at specific ages. This need involve only a small amount of time. Since only a few births can be expected to occur in a colony on any one day, by scheduling individuals for examination at weekly or 28-day ("standard month") intervals from the date of birth, it would be possible to weigh and examine only a few individuals daily and still obtain standardized data. For characters that cannot be measured, categorization of even a crude nature is always far preferable to *ad lib* verbal descriptions. Until reliable categories can be established, early data might be supplemented with photographs which can later be reclassified if necessary. Lastly, to be most flexible for later users, all published data should include not only mean and range (of character expression or age of occurrence), but, most importantly, a specified measure of dispersion from which error estimates could be made.

Anatomical Material

Bodies of sacrificed animals, especially the less common species, may provide useful material for taxonomic and anatomical studies. Skulls and skeletons, as well as skins, could constitute useful comparative material for the study of wild populations. It cannot replace wild-caught specimens of known origin, but may aid in assessing species variation, particularly since the number of wild-caught specimens available in museums is limited in the majority of marmoset species. In order to document variation, the aim should be to preserve a series of skins, skulls, and skeletons, rather than representative types.

Under the direction of Dr. Richard Thorington, the Smithsonian Institute Division of Mammals recently established a whole-body preservation program for primates, intended chiefly as a source of anatomical material for comparative studies. Uncommon species are particularly needed for this collection. The Smithsonian also maintains a collection of preserved internal organs of mammals.

All specimens should be provided with permanent labels, written in indelible India ink, containing standard data used in mammalian

studies. These are: Origin, date, sex, and certain measurements taken on the unpreserved body--nose-tail length, tail length (as described above), hind foot length, ear length, and weight (for details see DeBlase & Martin, 1974). The inclusion of age, reproductive state, and history would greatly enhance the specimen's value. It is preferable to label the specimen itself, as well as the container in which it is placed, with the data described.

Conclusion

The application of some of the types of data described to natural populations must of course be made with great care. There is already some indication, for example, that rate of growth may differ between captive and wild callitrichids (Epple, 1970). Laboratory-derived data on parameters varying with age would have to be checked with data from known-aged wild animals. Also laboratory animals may be exposed to as much or more variability as are natural populations, albeit from different sources, and to stresses and physiological demands not present in wild environments. Nevertheless the captive situation offers the possibility of controllability, reduction of variability, large sample sizes, and repeated measures on the same individuals. A detailed knowledge of the diet, social exposure, and environmental changes that an individual has experienced is possible. Thus, even where not directly utilizable by field workers in their investigations, laboratory-derived data could potentially increase our understanding through a greater knowledge of species baselines and limits (see, for example, Baldwin & Baldwin, 1976).

References

Baldwin, J. D., & Baldwin, J. I. Effects of food ecology on social play: A laboratory simulation. *Zeitschrift für Tierpsychologie*, 1976, *40*, 1-14.

Chase, J. E., & Cooper, R. W. *Saguinus nigricollis*--physical growth and dental eruption in a small population of captive-born individuals. *American Journal of Physical Anthropology*, 1969, *30*, 111-116.

Corbin, J. E., & Van de Populierre, J. M. Use of laboratory animals as models for wild animals in captivity. In P. J. S. Olney (Ed.), *International zoo yearbook*, 1976, *16*, 20-22.

Dawson, G. A. Some aspects of the population ecology of the Panamanian marmoset, *Saguinus oedipus geoffroyi*. Michigan State University: Ph.D. Thesis, 1976.

DeBlase, A. F., & Martin, R. E. *A manual of mammalogy*. Dubuque: Wm. C. Brown Co., 1974.

Dienhardt, F. Nutritional requirements of marmosets. In R. S. Harris (Ed.), *Feeding and nutrition of nonhuman primates*. New York: Academic Press, 1970, 175-182.

Epple, G. Maintenance, breeding, and development of marmoset monkeys (Callithricidae) in captivity. *Folia primatologica*, 1976, *12*, 56-76.

Epple, G. The behavior of marmoset monkeys (Callithricidae). In L. A. Rosenblum (Ed.), *Primate behavior: Developments in field and laboratory research* (Vol. 4). New York: Academic Press, 1974.

Hampton, S. H., & Hampton, J. K., Jr. Rearing marmosets from birth by artificial laboratory techniques. *Laboratory Animal Care*, 1967, *17*, 1-10.

Hearn, J. P. The endocrinology of reproduction in the common marmoset, *Callithrix jacchus*. In D. Kleiman (Ed.), *Biology and conservation of the Callitrichidae*. Washington, D. C.: Smithsonian Institution Press, 1977.

Johnston, G. W., Dreizen, S., & Levy, B. M. Dental development in the cotton ear marmoset (*Callithrix jacchus*). *American Journal of Physical Anthropology*, 1970, *33*, 41-48.

Morris, P. A review of mammalian age determination methods. *Mammal Review*, 1974, *2*, 69-104.

Neyman, P. E. Aspects of the ecology and social organization of free-ranging cotton-top tamarins (*Saguinus oedipus*) and the conservation status of the species. In D. Kleiman (Ed.), *Biology and conservation of the Callitrichidae*. Washington, D. C.: Smithsonian Institution Press, 1977.

Phillips, I. R., & Grist, S. M. The use of transabdominal palpation to determine the course of pregnancy in the marmoset (*Callithrix jacchus*). *Journal of Reproduction and Fertility*, 1975, *43*, 103-108.

Rothe, H. Some aspects of sexuality and reproduction in groups of captive marmosets (*Callithrix jacchus*). *Zeitschrift für Tierpsychologie*, 1975, *37*, 255-273.

Tappen, N. C., & Severson, A. Sequence of eruption of permanent teeth and epiphyseal union in New World monkeys. *Folia primatologica*, 1971, *15*, 293-312.

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