

COMMENTARY

Publication Trends in Zoo Biology: A Brief Analysis of the First 15 Years

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Zoo Biology has completed 15 years as a professional journal dedicated to ex-situ wildlife research. To assess the journal's representation of zoo and aquarium research, we examined some aspects of its publication record, based on analyses of 395 research articles. The taxonomic representation of *Zoo Biology* is heavily skewed toward research articles on mammals (73%), with articles on birds, reptiles, and invertebrates contributing only 10%, 7%, and 7%, respectively. Behavior and reproduction (sensu lato) are the predominating disciplinary themes of research, with heavy reliance on non-invasive endocrine methodology using RIA and EIA. The relatively small number of articles dealing with demography and genetics is surprising when one considers the eminent role such analyses have played in Species Survival Plans. Most contributions are multi-authored and arise from U.S. institutions, with collaborative ventures between zoos and universities accounting for 26% of all articles. The academic community, however, contributed nearly one third of *Zoo Biology's* articles as non-collaborative contributions. University and aquarium affiliations are known to exist, but the products of such cooperation are not appearing in the pages of *Zoo Biology*. We conclude the taxonomic trends reflect a shortage of research-oriented staff in the zoo and aquarium profession, and a tendency for a significant number of zoo biologists to publish in taxon-oriented journals. *Zoo Biol* 16:3–8, 1997. © 1997 Wiley-Liss, Inc.

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INTRODUCTION

Many changes have transpired in zoos and aquariums during the one and a half decades since the appearance of *Zoo Biology's* inaugural issue. Some claim that a virtual reformation of zoo and aquarium priorities took place, while others remind us that similar changes had been shaping the zoo and aquarium profession all along. When the first issue of *Zoo Biology* appeared in 1982, captive breeding had become

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the rallying cry of the profession, and as a result a significant amount of scientific, organizational, and technical talent was mobilized from its rank and file. Whether one views it as a revolution or reformation, efforts to coordinate breeding programs and research were apparent in zoological institutions through much of the developed world. Various aspects of the process have been chronicled in this journal, the *International Zoo Yearbook*, *Der Zoologische Garten*, and *International Zoo News*.

The earlier development of zoos and aquariums was also reported in a wide variety of publications, from popular books to scholarly publications (Dee, 1995). Hediger's book, *Zoo Biology*, however, was the first volume to enunciate a scientific philosophy of zoological institutions, and as a result of its influence the journal *Zoo Biology* emerged. If not unique among scientific journals, *Zoo Biology* is certainly special in applying scientific methods to the biological issues of managing wildlife ex-situ. Much zoo and aquarium research, being applied, does not easily find publication in journals of taxonomic or disciplinary orientation.

Zoo Biology has been publishing research articles now for 15 years; in the following paragraphs we document some of the trends that can be ciphered from its pages.

METHODS

This analysis is based on a compilation of information gleaned from 395 articles that were published in the first 15 volumes of *Zoo Biology*. Our initial objective, to examine trends in the taxonomic representation and institutional affiliation of *Zoo Biology* contributors was undertaken five years ago for the benefit of curriculum development in zoo biology training. The task of compiling the information on 231 articles was undertaken by C.P. The more detailed analysis of the last 5 years was undertaken upon the suggestion of the Editor, Don Lindburg. Many multidisciplinary articles proved difficult to place into the disciplinary pigeonholes we selected for analysis and therefore, liberal interpretations of topical category were sometimes required. Only one category was used per publication. When we analyzed the last five years of data, we added a separate category for environmental enrichment, and examined the breakdown of vertebrate classes into orders. We also surveyed the affiliations and countries of origin of senior authors. Lastly, we examined certain aspects of study design: methodology (i.e., experimental or description), sample size, use of statistics, and reliance on RIA/EIA for physiological studies.

RESULTS

The taxonomic representation of *Zoo Biology* is heavily skewed toward research articles on mammals (73%), while articles on birds and reptiles contribute only 10% and 7%, respectively. The small number of remaining taxa are a mixture of species, representing fish, amphibians and different invertebrate phyla and classes, and account for about 9.4% of the remaining articles (Fig. 1). During the last 5 years, 66% of mammal contributions have been on primates and carnivores, a trend which is also evident in the previous decade (Fig. 2). Among birds, eight orders encompass all of the 19 papers.

From the standpoint of biological discipline, reproduction (*sensu lato*) and behavior are the predominating themes of research, with each discipline contributing

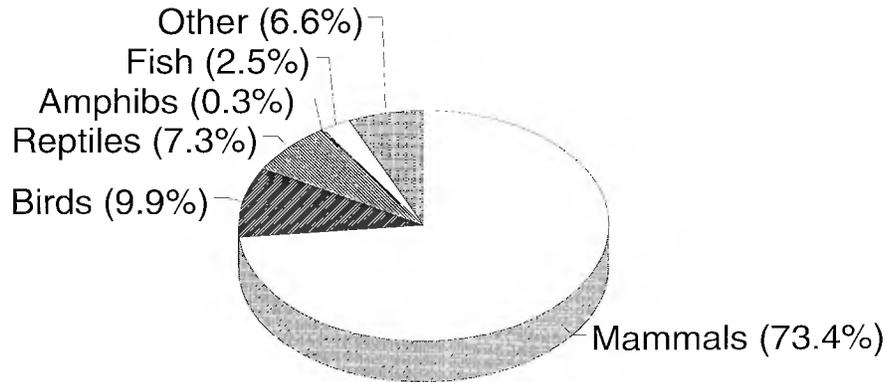


Fig. 1. Taxonomic representation of 395 research articles published in *Zoo Biology* (volumes 1-15).

about 32% of all articles (Fig. 3). Reproduction was further broken down into physiological (e.g., hormone cycles, germ plasms, growth) and descriptive studies (e.g., studbook analyses, life history characteristics), with 17% and 15% of the papers falling into each respective category. Genetics and demography, the two disciplines central to small population biology, represent 9% of the research articles in the journal. Environmental enrichment accounts for 7% of the articles published in the last 5 years.

The number of authors per article during the past 5 years ranged from one to 14, with a mean of three authors (N = 163). Considering only senior author affiliations, zoos accounted for 43%, aquariums for 5.5%, and universities for 36% of the articles. In considering the collaboration of authors, 26% of all articles were collabo-

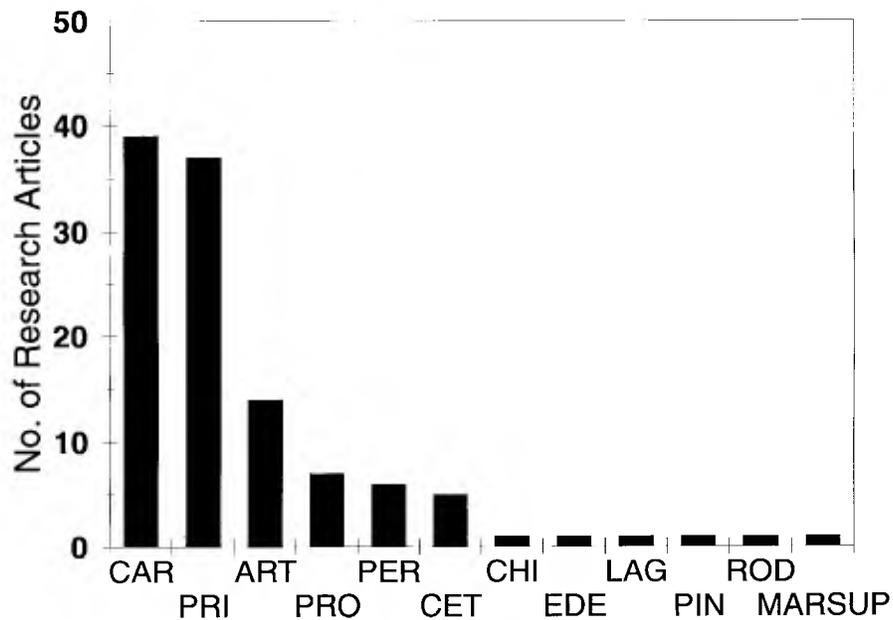


Fig. 2. Distribution by taxonomic order of 114 mammals in research articles published in *Zoo Biology* (volumes 11-15).

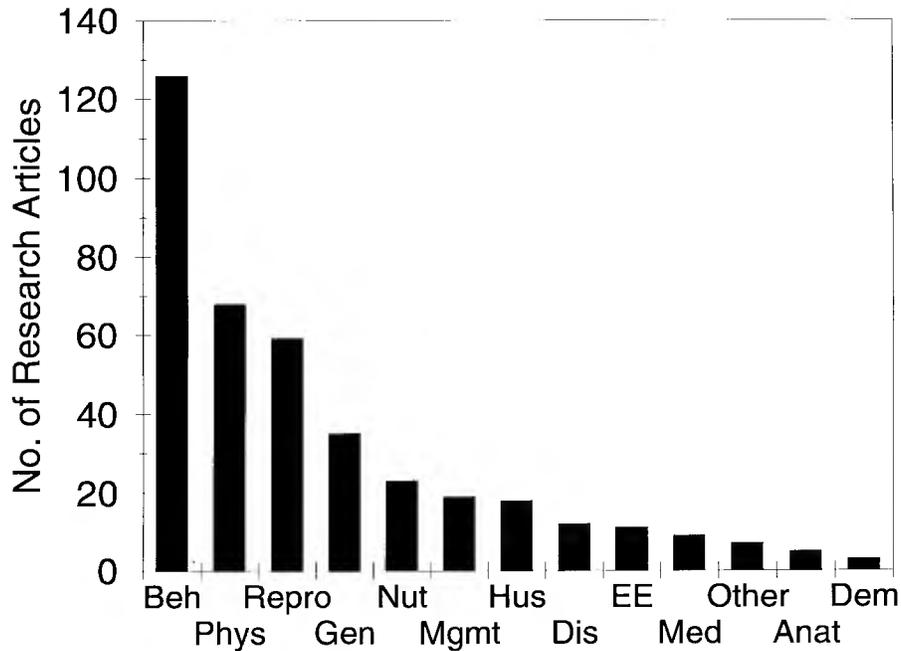


Fig. 3. Disciplinary assortment of 395 research articles published in *Zoo Biology* (volumes 1–15). Beh=behavior, Phys=physiology, Repro=reproduction, Gen=genetics, Nut=nutrition, Mgmt=management, Hus=husbandry, Dis=disease, EE=environmental enrichment, Med=medicine, Anat=anatomy, Dem=demography.

rations between zoo and university personnel/students, while 31% emanated solely from university and 30% solely from zoo-affiliated staff. During the past 5 years, 42% of all research articles (N = 164) were senior-authored by personnel of AZA institutions. These 24 institutions (16 zoos and 8 aquariums) represent about 14% of the current listing of 176 member institutions. However, 58% of the 69 articles senior-authored by AZA institutions came from the Wildlife Conservation Society (5), Zoo Atlanta (7), San Diego Zoo and Wild Animal Park (13), and the National Zoological Park (15).

When one considers country of origin, 76% of all articles during the past 5 years arose from authors of U.S. institutions. An additional 16% of the articles were contributed by authors from English-speaking countries (England, Canada, Australia, South Africa). Only 8% of the contributions therefore came from non-English speaking countries.

During the past five years, 74% of the articles were descriptive rather than experimental. However, nearly 74% of all articles employed statistics in analyses of quantitative data. Quantitative methods such as radio- and enzyme-immunoassay (RIA and EIA) were employed in nearly 20% of the studies reported (Figure 4). Sample size ranged from one to 635, with a mean of 33.6 (SD = 78.5).

DISCUSSION

The taxonomic distribution of research articles in *Zoo Biology* reflects neither the relative abundance of taxa nor their abundance in zoos and aquariums.

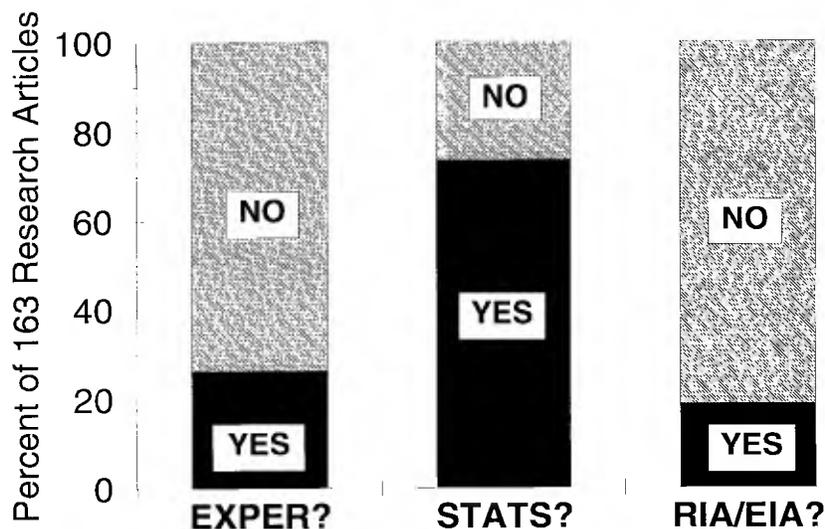


Fig. 4. Some attributes of 163 research articles published in *Zoo Biology* (volumes 11–15). Exper=Was experimental method used?, Stats=Were statistical methods used to treat quantitative data?, RIA/EIA=Were radio- or enzyme-immunoassay used for physiological analyses?

What explains the bias favoring mammal papers? One possible reason for the bias is the central focus that mammals, and particularly large mammals, have historically enjoyed in zoos. The public partiality to large mammals also seems to apply to researchers. Primates and carnivores, both highly popular with the public, have also been central in the emergence of the Species Survival Programs (SSP). Large mammals clearly accounted for the majority of effort in the early days of SSP development, and taxonomically, they remain in center stage. Among 54 SSPs existing in 1996, 65.7% account for these two orders. When research committees became an important component of SSPs in the 1980s, they also stimulated the formulation of projects which generated articles for the journal. It can also be concluded that *Zoo Biology* has offered an appropriate outlet to research on these taxa.

The paucity of articles on vertebrate classes other than mammals, however, is surprising. Research articles on birds (10%) are fewer than expected on the basis of SSP representation (24% of all SSPs), while reptiles represent about 79% of all SSPs and 7% of all *Zoo Biology* research articles. Have other taxon-oriented journals been siphoning off publications that rightly belong in *Zoo Biology*? Are herpetologists under-achievers in the realm of research? The opposite has been argued elsewhere (Wemmer 1989), but it appears that zoo herpetologists are more likely to publish in journals other than *Zoo Biology* (A. Odum and J. Murphy, pers. comm.). Birds represent a significant number of SSPs, but account for a relatively small number of publications. Articles on invertebrate taxa are more frequent contributions to *Zoo Biology* (7%) than expected on the basis of SSP representation (1.890%). We conclude the taxonomic trends reflect a shortage of research-oriented staff in the zoo and aquarium profession, and a tendency for a significant number of zoo biologists to publish in taxonomic journals.

Zoo Biology has remained a journal devoted primarily to behavior and physiology. Since ethology was central to Hediger's (1964, 1968, 1969) perspective, the continued emphasis on behavior is natural, and has also given rise to studies of environmental enrichment. The importance of reproductive biology as a recurrent topic of *Zoo Biology* articles is clearly related to the emergence of non-invasive methods of endocrine monitoring that have developed primarily in zoos.

The relatively small number of articles dealing with demography and genetics is surprising when one considers the eminent role such analyses have played in the SSPs. No doubt this reflects the fact that many such analyses are intended as a means of improving management, rather than definitive pieces of scientific work.

Articles in *Zoo Biology* seem to reflect a healthy degree of collaboration within the zoo community and between zoos and universities, but it is also apparent that universities conduct a significant amount of research in zoos that does not involve scientific partners. University and aquarium affiliations certainly exist, but the products of such cooperation are not appearing in the pages of *Zoo Biology*. The predominance of four zoos as contributors of over half the scientific articles in the journal is a poignant commentary on Finley and Maple's (1986, p. 261) statement that "most zoos encourage research and have engaged in recent research activities of some type." If true, most zoos are not publishing their research findings in *Zoo Biology*. An alternative explanation is that most zoos are not seriously engaged in research.

Small sample size has always been a major stumbling block to conducting research in zoos, but it seems to be a lesser shortcoming in aquariums, where experiments can be conducted with more modest demands of space. The result has been a greater dependence on detailed quantitative studies that are descriptive rather than experimental. This does not detract from the value of the science for zoo and aquarium management, and it will likely continue to be a trend in the future.

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REFERENCES

- Dee, M. The popularization of nature: zoo literature and literati. Pp. 25-31 in *THE ARK EVOLVING, ZOOS AND AQUARIUMS IN TRANSITION*. Conservation and Research Center, National Zoological Park, Front Royal, Va., 1995.
- Hediger, H. *WILD ANIMALS IN CAPTIVITY, AN OUTLINE OF THE BIOLOGY OF ZOOLOGICAL GARDENS*. New York, New York: Dover Publications, Inc., 1964.
- Hediger, H. *THE PSYCHOLOGY AND BEHAVIOUR OF ANIMALS IN ZOOS AND CIRCUSES*. New York: Dover Publications, Inc., 1968.
- Hediger, H. *MAN AND ANIMAL IN THE ZOO: ZOO BIOLOGY*. New York: Seymour Lawrence/Delacorte Press, 1969.
- Schmidt, C.R. The European Breeding Programme (EEP). *INTERNATIONAL ZOO NEWS*. 34(6):4-7.