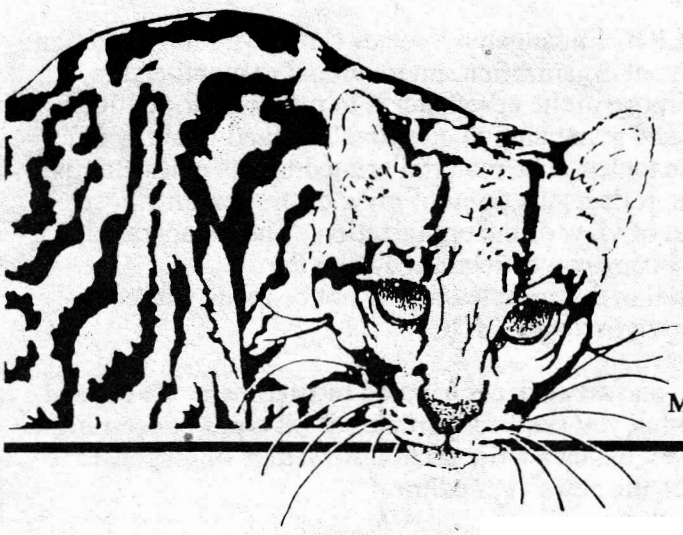
L.I.O.C. Endangered Species Conservation Federation Incorporated.



Newsletter
4101 Penn Ave., Pittsburgh PA 15224
Mar./Apr. 1989 , Volume 33, Number 4

5TH WORLD CONFERENCE ON BREEDING ENDANGERED SPECIES IN CAPTIVITY

OCTOBER 9-12, 1988

CINCINNATI, OHIO

SPONSORED BY:

CINCINNATI ZOO AND BOTANICAL GARDEN
KINGS ISLAND WILD ANIMAL HABITAT
THE FAUNA AND FLORA PRESERVATION SOCIETY

IUCN CAPTIVE BREEDING SPECIALIST
GROUP MEETING—OCTOBER 8, 1988

Special Issue!

The transcripts of the Small Felid Workshop held at the 5th World Conference on Breeding Endangered Species in Captivity, Cincinnati OH, USA, 9-12 October 1988.

Information about LIOC ESCF Inc. and this Newsletter.

This newsletter is published bi-monthly by the LIOC Endangered Species Conservation Federation Incorporated. We are a non-profit, non-commercial organization, international in membership, devoted to the welfare of exotic felines. The purpose of the newsletter is to present information about exotic-feline conservation, management, and ownership to our members, and to allow our members to publish their points of view on these topics. The material printed in this newsletter is contributed by our members and, in many cases, reflects the point of view of the person whose name appears on the article, rather than the point of view of the organization. The organization's statement of intent is contained in our by-laws; a copy can be requested from the Secretary/Treasurer.

Since the newsletter consists of articles, photos, and artwork contributed by members, we depend on you for our material. We can only publish what you send us. Articles of all types concerning exotic felines are gladly accepted. We also have a reader's write section for letters or responses to articles. Please send materials for contribution to the newsletter editor.

Newsletter Editor: Wendie Wulff, 4101 Penn Ave. #6, Pittsburgh PA 15224

LIOC ESCF Officers, Directors, Branches and Affiliates.

Founder

Catherine Cisin, Amangasett NY 11930, (516) 267-3852

Officers

President: Dr. John Perry, 6684 Central Ave., N.Fridley MN 55432, (612) 571-7918, (612) 481-2763
Vice President: Suzi Mutascio, 6 E. Lake Circle Dr., Medford NJ 08055, (609) 983-6671
Secy/Treas: Connie Hatfield c/o McKinnon Airport, Sandy OR 97055, (503) 668-8628

Life Directors

Ken Hatfield, c/o McKinnon Airport, Sandy OR 97055, (503) 668-8628
Ethel Hauser, 14622 N.E. 99th St., Vancouver WA 98622, (206) 892-9994
Dr. John Perry, 6684 Central Ave., N.Fridley MN 55432, (612) 571-7918, (612) 481-2763
Shirley Wagner, 3730 Belle Isle Lane, Mobile AL 36619, (205) 661-1342

Term Directors

Member Services: Barbara Wilton, PO Box 66040, Portland OR 97266 (503) 774-1657
Education and Conservation: Al Porges, 6 West View Dr., Stoughton MA 02702 (617) 344-4943
Legal Affairs: Mary Parker, PO Box 27334, Seattle WA 27334 (206) 363-0617
Advertising and Publicity: Jeff Bellingham, PO Box 722 Niverville, Manitoba, Canada ROA 1EO (204) 388-4845

Branches

Florida: Danny Treanor, 1898 Twin Lakes Dr., Winter Garden FL 32787, (407) 887-6336
New England: Al Porges, 6 Westview Dr. Stoughton MA 02072, (617) 344-4943

Affiliates

World Pet Society: Jan Giacinto, Box 343 Tarzana CA 91356, (818) 345-5140
Animal Finder's Guide: Pat Hoctor, Box 99, Prarie Creek IN 47969, (812) 898 2678

Editor's Notes

The 5th World Conference on Breeding Endangered Species in Captivity was held in Cincinnati Ohio last October 9th through 12th. I drove to Cincinnati and attended the sessions for a two days -- this is a short report of what I saw.

The Conference was about the propagation of all kinds of endangered captive wildlife. There were sessions on everything from rhinos to salamanders. Felids were represented in four sessions (two on tigers, one on far eastern leopards and one on black footed cats) and in the Small Felid Workshop. Only one of the sessions on tigers was scheduled for the days I attended -- and then that session was canceled. But I did make it to the Workshop. The entire Workshop was tape recorded, and the Moderator of the Workshop, Dr. Gail Foreman, took responsibility for getting the recording transcribed. She sent copies to everyone who attended, and I'm reproducing what she sent in the following pages (with thanks and appropriate credits to Gail and all the Panelists).

There were about 60 people at the Felid Workshop -- the attendees seemed to be primarily felid research specialists and zoologists, rather than breeders or owners from the commercial or private sectors. I did see Pat Quillen and Penny Andrews, who some of you may know though LIOC connections, and I also saw John Becker from the International Society for Endangered Cats (a group whose goals are similar to ours -- ISEC, 4638 Winterset Drive, Columbus OH, 43220). The content of the Workshop is reproduced in the transcript -- the only thing we're missing are copies of the slides. Pat Quillen and Gail Foreman, in particular, had some wonderful slides of cats. Finally, I'd like to draw some attention to Jill Mellen's article at the end of the transcript. Jill's Appendix on Instructions for Making Behavioral Observations on Captive Pairs of Small Cats might be a good starting point for those LIOC members who are interested in doing some informal investigative work with their own animals. And Jill's reference lists are good starting points for some additional reading.

We spent one afternoon of the Conference at the Cincinnati Zoo, which has a fantastic collection of small cats including a marbled cat, two pallas cats and an entire family of fishing cats. We were given behind-the-scenes tours of the cat facilities at the zoo and we spoke with a number of curators about the diets and habits of the individual animals. The zoo cats were fed commercial diets (for example, Zupreem or Nebraska brand) with commercial vitamin and mineral supplements (for example, Chapparal or Fauve). There was some discussion of the high vitamin E level of commercial diet mixes. Apparently the zoo had been able to convince one of the manufacturers to produce a special mix with a lower vitamin E content. One of the men I spoke with said that the animals seemed to be doing better on the new mix. Interestingly enough, the zoo also had a 15 year-old pair of ocelots who had been on a diet of horsemeat and supplement all their lives. (Apparently they had been brought up on meat and refused to switch.) Those animals looked terrific and the curator agreed that they were in good health. The zoo tour included a cat show conducted by Katharine Hilker, who some of you may also know through LIOC connections. She gave the same show to an audience of zoologists that she gives as a regular zoo activity. She had cats demonstrating natural behaviors (for example, a serval leaping for food) and her accompanying commentary on feline conservation was interesting and educational. She also talked about the feline breeding research that was being done at the Cincinnati Zoo -- particularly about the program which recently resulted in a domestic feline host mother giving birth to exotic kittens through embryo transplant techniques. The Cincinnati Zoo is well worth visiting if you're in the area -- the cats are spectacular and the curators and keepers are willing to talk to you about them.

SMALL FELID WORKSHOP TRANSCRIPTS

5th World Conference on Breeding Endangered Species in Captivity
Cincinnati, Ohio, USA
9-12 October 1988

Moderator: Gail E. Foreman, Ph.D., Director of Research, The International Society for Endangered Cats, Columbus, Ohio

Panalists: Ulrich Schurer, Ph.D., Director, Wuppertal Zoo, West Germany
Alan Shoemaker, Zoologist, Riverbanks Zoo, Columbia, South Carolina
Ellen Dierenfeld, Ph.D., Nutritionist, New York Zoological Society
Earle Pope, Ph.D., Section Head, Reproductive Physiology Division, Center for Reproduction of Endangered Wildlife, Cincinnati Zoo, Cincinnati, Ohio
Jill Mellen, Ph.D., Research Coordinator, Washington Park Zoo, Portland, Oregon
Pat Quillen, Executive Director, Society of Scientific Care, San Diego, California

MODERATOR:

I want to thank the Cincinnati Zoo and the Flora and Fauna Preservation Society for allowing the Felid Research and Conservation Interest Group to hold this symposium. I also especially want to thank Jill Mellen who actually did all the legwork for me.

For those of you whom I haven't met yet, my name is Gail Foreman. I'm the Research Director for the International Society for Endangered Cats. I am currently completing my dissertation work on captive breeding and parenting behavior in Geoffroy's cat.

The themes of the workshop tonight are the aspects of preservation and management in exotic small felids, both in the recent past and in the near future. Each panel member has been asked to discuss a particular aspect of felid management and to give a summary of the significant developments in their particular field during the past five to ten years, or since the last cat conference was held. They have then been asked to identify the most important areas which need to be addressed in the next five years. We would like to hold the questions until the end please, and then after the questions, the panel members will briefly present their final remarks.

The areas we will be covering tonight are field research, the European captive population situation, the North American captive population situation, advances in felid nutrition, reproductive physiology, behavioral research and the world of the private sector in the field of research.

FIELD RESEARCH- FOREMAN

Although the theme of this workshop is the management of captive small felids, base line field research is extremely important in the overall survival of these species. The good news is, there has been a significant amount of field research on small felids in the last five years, and currently there are many projects in the works. Until recently, if we had been holding this conference ten years ago, I would have had to say that there was none or very little field research in progress. In the past, the majority of field research on small felids has concentrated on harvested species in game management-oriented research in North America, primarily bobcats, Canada lynx and puma, and in Europe, on the European wildcat and the northern lynx. This situation appears to be changing now and small felids in the developing nations have recently become the foci for a significant amount of field research.

I am going to present to you a brief, and hopefully illuminating, summary of some of the research that is currently in progress and some of the proposed research for the future. There are 21 small cat species that are part of field research projects which have just been completed, are in progress right now, or are going to be the focus of future research.

Forty-four studies are currently underway or have recently been completed on the North American bobcat. The majority of these studies are still Fish and Wildlife management related studies. I am not going to dwell on these type of studies because we are all familiar with this type of population and status research. Twenty-nine puma studies are underway or have been completed

and one of the most significant of these has been the study by Warren, Pence and Waid (1983-1985) on the ecology of the puma in Texas. They addressed movement patterns, activity patterns and the cats' prey base. Franklin and Johnson have been investigating puma in Chile, along with Geoffroy's cat and pampas cat. This is an ongoing study that is concerned with the status and conservation requirements of these cats in Chile and the study will continue until 1990. Dr. Roelke and the Florida Fish and Game Commission are continuing with the Florida panther research. They have been analyzing semen and blood for infection and parasites and evidence of inbreeding in the population. Ackerman just completed a study on cougar predation, ecological energetics, population and food habits in Utah.

The Northern lynx has been the subject of twenty studies and the majority of these studies involved reintroduction efforts. Breitenmoser and Haller studied the reintroduction of lynx in Switzerland. Other studies addressed the reintroduction of lynx in Italy, social organization, feeding habits and other ecological aspects. This is also an ongoing project and I understand that there have been some problems. Some of the animals have been taken by hunters.

One of the most exciting developments is the explosion of studies that have been recently completed or are currently underway on ocelot. The ocelot has been a part of 17 studies. In 1982-84, Sunquist and Ludlow studied ocelots intensively in Venezuela. This study included seasonal home ranges, movement patterns, habitat selection and feeding habits. Tewes and Navarro have completed a very extensive study on the southern Texas ocelot including space use patterns, status and distribution, reproduction, dispersal, mortality patterns and den ecology. Mondolfi researched ocelots in Venezuela in a study which looked at ecology, habits and space use patterns. Schaller, Quigley and Crawshaw (1982) studied the ocelots in the Mato Grosso, Brazil. Their study included range size and activity patterns and also included movements of the puma in that area. Emmons also just completed a study (1982-85) on ocelots in Peru on their diet, habitat use and looked at the prey population base. Puma was also included in this study. She also looked at the relationship among the felid and their prey in that area.

The caracal has been the focus of ten studies, the most notable of which was the study by Norton and Lawson who carried out radio-tracking to determine movement patterns of the cats in Cape Province, South Africa. Wilson, who is in the Central African Republic and various other areas of west Africa conducting duiker research, has also been reporting on caracal and African golden cats for the IUCN Cat Specialist Group. Stuart has been looking at surplus killing by caracal in Cape Province, SA, and Grobler has reported on feeding behavior and kitten growth in South African caracals.

The Canada lynx has been the subject of mostly Fish and Wildlife management studies that we have seen in the past. Eight studies have been completed recently.

Another focus of fairly intensive research right now is the clouded leopard. Santiapillai and Ashby carried out an anectodotal population survey in Sumatra and Rabinowitz is now in Thailand working on cloudeds. Rabinowitz completed a preliminary survey of clouded in Taiwan and Malaysian Borneo and is currently studying the population in Thailand. I just got a report from

Howard Quigley the other day that Alan met with a mishap and stepped in a tiger trap, suffering a broken leg. The status of the research is that the cats have proved very difficult to trap because of the high natural prey base. They are just not going to the bait.

The Spanish lynx has been the focus of seven studies. Delibes, Rau and Beltran completed a study on the relationship of the lynx and fox and the role of competition between the two species. Gala studied feeding ecology and energy requirements. Two other studies involved Ph.D. dissertation work, one on space use, time rythyms, dispersion and mortality, and the other on social organization. Aymerich did a comparative study on the diet of the Spanish lynx and the European wildcat.

Six studies have been carried out on the serval, most notably, a landmark study by Geertsema on serval ecology in Tanzania. This was a four-year study on home range, activity patterns, behavior and feeding habits. Stuart did research on the status of servals and their distribution in Cape Province and VanAarde and Skinner are looking at the pattern of space use by relocated servals.

European wildcats have been the subject of six recent studies. Stahl is studying the European wildcat in France. He is looking into links between social structure and the nature of available resources, ranges, activity and hunting techniques.

Geoffroy's cat in South America is represented by four studies. Rabinovich is working on status and distribution of this cat and the pampas cat in Argentina. Tello is carrying out the same kind of study in Bolivia and is also looking at puma, margay, ocelot and jaguarundi. Sunquist, Koneckni and Ludlow are also conducting a survey in Belize concerning margay, ocelot, jaguarundi and also possibly oncilla.

The leopard cat is the focus of two studies, the most notable of which is the study on the lesser cats being carried out by the Indian Zoological Survey. Biswas is carrying out a study on the leopard cat in eastern India which also includes jungle cat, marbled cat, fishing cat and Asian golden cat.

The black-footed cat is only represented by one study. The Stuarts are conducting a long-term survey on all the carnivores of Africa. Their short-term goals are to study the status, distribution and ecology of the black-footed cat, but they will also be studying the sand cat and caracal.

One benefit of the ocelot research to come out of Texas (Tewes and Schmidly) has been the publication of information concerning capturing techniques for field research. These techniques have worked very well in field research for sexing, aging, censusing and estimating population numbers in small felid research.

Future research- what is coming up? In Ragni, Italy, a national group is being formed for the study and conservation of Felidae in Italy, through a University of Perugia gift. The main scope will be the biology of the wildcat and lynx and the areas of genetic and taxonomic research, the population situation, behavior, ecology, reproduction and breeding in captivity. There

will also be projects for conservation, reintroduction and the dissemination of information.

Rylander, at Texas Tech University, is planning a future study on activity and habitat selection comparing captive and free ranging bobcats. This is a very interesting study, because he is using radio-collared cats in both studies. Rylander will be looking at the estimated population sizes in west Texas, home ranges and daily activities, and he will compare captive and free-ranging behavior both visually and telemetrically so that there can be visual confirmation of the information from the radio collars.

Also, the Caesar Kleberg Institute in Texas with Tewes and Miller have quite a few studies planned for the future concerning Texas ocelots. They will be looking at habitat islands and corridors, highway mortality, translocation, habitat and prey base improvement, interspecific competition, status and distribution and genetic variability. They are also looking at a habitat restoration study for ocelots and jaguarundis and are attempting to transform agricultural fields into wildlife habitats. Caeser Kleberg will also be carrying out bobcat status and management studies in a harvested population.

Well, that's it. There are still more studies being carried out, but I have presented some of the most notable. Just one thing I want to sum up with here. We have to look at why there has been such a problem with stimulating and carrying out field research on small felids. There are three things that have bothered me in the past, and I think we can point to some of these as part of the reason behind the lack of research. One of them is the educational institutions where recently, the quantity of contributions have been valued more than the quality. Long-term studies are becoming very rare as researchers must 'publish, or die' and this leads to a proliferation of 'quick and dirty' projects. Another area of concern is the researchers themselves. I call this the 'chain letter' approach to publications. You add your name to the bottom of the long list of authors and move up with each paper. One day, with nothing better to do, some grad students counted numbers of authors on papers. The most found was 34 authors on one paper. This problem, of course, relates back to the educational institutions where quantity is more important than quality. The third area of concern and an area where most of the responsibility must lie is with the funding agencies. It is extremely difficult to acquire funds while a species still has a chance of survival. Only when the situation is beyond repair, are funds granted for basic field research. My only suggestion is that perhaps if we attached missles to the cats instead of radio transmittors, we might have a better chance of being funded. Thank you, that is the end of my remarks.

MODERATOR: I now want to introduce you to our next speaker, Dr. Ulrich Schurer, who is the Director of the Wuppertal Zoo and has been at Wuppertal for 15 years and in felid conservation for 20 years. He is extremely familiar with the situation in Europe and especially the black-footed cat. He is going to talk to us about the European situation in the past, present and the future.

EUROPEAN SITUATION- SHURER

I gather there is much more interest in exotic cats in the United States than in Europe right now. I really want to sum up, as far as I know, the situation in research institutes, in the private sector and in the zoological gardens, because the situation and status of small exotic cats in Europe may not be well known in North America. I can offer some information about small captive cats in Continental Europe, but there are people here from England who have first-hand experience from their own collections and maybe they can contribute more.

First, the situation in research institutions. You all know the name of Professor Paul Leyhausen. I got to know him personally. He had his institute, which was financed by the Max Planc Institute, on the grounds of the Wuppertal Zoo. Unfortunately, he was only a neighbor. After his retirement, his research institute was abandoned by the Max Planc Society and Wuppertal Zoo took over the building, but not the cats. Professor Leyhausen sent some to England, for example, the African Golden cats and sent the sand cats to the United States. Some of his own cats, about which he had been publishing for years, he took to his new home, which is near Bonn. Nothing was left of the institute except empty cages, which I soon filled with a fast-growing pool of black-footed cats and clouded leopards. That means the black-footed cats have been growing, but the clouded leopards have not. The building is now a behind-the-scenes institution for breeding endangered species. So Paul Leyhausen's Institute is currently gone.

Some significant research on cat and other carnivore vocalization is still being done by Dr Gustav Peters, a former student of Dr. Leyhausen, who works now at the Museum Alexander Koenig in Bonn. He is a mammal curator there and I am sure that some of you know him. Apart from that, I wish to emphasize that the taxonomic implications of Professor Leyhausen's work, not his ethological work, are not generally accepted by the general mammalogists or zoo people. We do not call tigers Neofelis tigris. It might be of interest that Professor Hemmer, who did a lot of work on cats in the last 20 years, and who tried to do the sand cat studbook, isn't very active in this field any more.

Right now in our zoo there is an ongoing study on European lynx. This is a very interesting study and the first publication for a Ph.D. was recently published. It combines research in a zoo cage with field work and was quite a lot of new information. It was just published this year. At the zoo we are trying to find out more about the reproductive biology of the black-footed cats.

Let me get to the private sector. I gather there is a lot of private interest in exotic cats in the United States. It is not so in Germany; I don't know a lot about the rest of Europe. But some private people have lots of Geoffroy's cats and Bengal cats. Few are bred, and this part of the European population of these cats doesn't seem very significant. There was a big and very interesting cat collection, particulary small cats, which belonged to Scheffel after whom Felis margarita scheffeli was named. Unfortunately, this collection no longer exists. Some of his cats went to our place, some to Leyhausen's, and some are maybe in the United States now.

The zoo situation. In European zoos, only caracal, serval, Geoffroy's cat and Bengal cat are really well established. Former, very extensive collections of smaller cats at Rotterdam and Wassernaar Zoos no longer exist or have been much reduced in the number of species and specimens. What is there now in European zoos? You have a certain number of Temminick's cats which are breeding so-so, not very well, but there is reproduction. There are some jungle cats, mainly in smaller collections, some in bad conditions, and interest in these cats is low. There is only one group of rusty-spotted cats in Frankfort, jaguarundi hardly exists anymore in Europe, and there are clouded leopards in Europe, but there is not much breeding.

Now let me say something about European wildcats. I heard that there are some in the United States. I think you shouldn't worry about these Felis sylvestris from western Europe very much because there are breeding programs and reintroduction programs underway in western Europe and this cat is really well represented in European collections.

Regarding the priorities of breeding small exotic cats under captive conditions, there are relatively a large number of cats. Those who followed the paper of Jean-Marc Lernould this morning say that there is a huge number of primates, that it is very difficult to decide on which ones you have to concentrate. It is not so bad in the cats, but we must still decide which ones we want to breed. But the ones we keep should have a reasonable number of founders and possibly should be represented in some numbers both in Europe and in North America. And they should be the most endangered ones, but who knows, there is still not enough information available. A species I propose is the Temminick's cat. Another for me certainly is the black-footed cat for which I have established an international studbook. This studbook has been done by Dr. Rudi Dmoch. Data has been compiled during the last three years, and actually the studbook has been in existence for about 2 years. It has been recognized by the IUDZG and approved in Stuttgart. We are waiting for final approval by IUCN and that will not be a problem.

But another species which causes much concern to me is all Felis lybica and Felis sylvestris subspecies except those in western Europe. We have done something together with Al Ain Zoo in the United Arab Emirates. There the situation is as it is in most parts of the distribution of Felis lybica. There is the danger of hybridization with domestic cats and maybe only a very few of Felis lybica gordoni, which are from the northeastern part of the Arabian penninsula, are left which are pure wildcats. Unfortunately, there is only one pair in captivity now which produces kittens. These kittens have been distributed between at least three European Zoos including Wuppertal. We got the first pair here. If more founders should become available, we are ready to take them. We had to overcome some severe problems with the CITES authorities, not the German authorities, they were supportive of our plans, but the international ones. I want to tell you that I would hate to say in 20 years that we had lost the ancestor of the domestic cat. You know how few Felis lybica there are in captivity, and maybe the international community who are interested in breeding exotic cats should make a decision on if they want to concentrate on one of the subspecies. If they want to take founder stock from that subspecies, it could be the one from South Africa. It would be the easiest to get stock from, but we shouldn't forget the ancestor of the domestic cat.

MODERATOR: Our next speaker is Dr. Ellen Dierenfeld, a nutritionist at the New York Zoological Society. Dr Dierenfeld has worked in the area of nutrition with a wide variety of animals and has a continuing interest in felid nutrition.

NUTRITION-DIERENFELD

Nutritional requirements of domestic cats are well documented for most of the macronutrients, but somewhat less studied for many of the micronutrients, particularly minerals. Limited enzyme activity and digestibility studies comparing domestic cats with exotic species have revealed no significant differences between the two groups. Thus it appears that domestic cats should be considered an appropriate model for other felids.

Rather than repeat information more comprehensively reviewed elsewhere, I would like to concentrate on three unique aspects of felid nutrition with particular emphasis on application of recent research findings to captive management and breeding of exotic species.

Cats lack enzyme systems for endogenous synthesis of arachadonic acid, vitamin A, and taurine. These nutrients can be synthesized by other mammals, but must be supplied in the diet for the cat. Each of these nutrients can be found in (apparently) ample supply in fresh, unprocessed, meat-based diets. Commercial diets, however, must be formulated to supply necessary levels.

Arachidonic Acid. This essential fatty acid is converted from linoleic acid to meet nutritional requirements in most species. However, conversion ability is limited for the cat, and arachidonic acid should be supplied at a minimum of 0.1% of dietary dry matter to meet felid requirements. Arachidonic acid is a precursor of prostagladins, which are utilized in the synthesis of steroid hormones. A direct influence of arachidonic acid upon reproduction, therefore, is certainly possible through existing biochemical pathways. Gosselin and her colleagues here in Cincinnati are currently examining fatty acid metabolism in exotic felids, an area which has not, in my opinion, been thoroughly investigated. Results could prove to be some of the most significant advances in current felid nutrition research, and I look forward to their findings.

Vitamin A. Precursors (B-carotene) of vitamin A cannot be converted to the active form in the cat, thus retinol must be supplied in the diet at approximately 10,000 IU/kg (dry matter basis). Both deficiency and excesses of this vitamin can be detrimental to health and reproduction in the cat. Recently, Grosselin reported hypervitaminosis A as a possible cause of liver lesions observed in captive cheetah. Liver vitamin A levels measured in these animals at necropsy (2000 to 58,000 ug/g dry) were substantially higher than liver values from normal domestic cats (2000-4000 ug/g). In examining the diets fed to the cheetahs, these researchers measured vitamin A levels up to 10-fold the NRC requirement in commercial products, with a maximum of 545,000 IU/kg in beef liver. Recommendations for lowering the vitamin A content in the commercial products to values more closely approximating NRC requirements, as well as not feeding liver as a major dietary item (at least to cheetahs), have resulted from this study.

Taurine. This sulfur amino acid is relatively inert, but is conjugated with the bile acids during fat digestion. Other mammals synthesize adequate quantities of taurine from cysteine, but the cat needs a dietary supply of approximately 500 mg/kg dry diet. Deficiency of taurine results in retinal degeneration, poor reproduction and, it has been recently discovered, cardiac disease. Pregnant queens with taurine deficiency resorb or abort fetuses, or give birth to stillborns; kittens that do survive grow poorly and display neurological abnormalities.

Plasma taurine concentrations in domestic cats range from 80-120 nmols/ml. Cats consuming a number of commercial diets have shown low plasma taurine levels associated with deficiency signs. Analyses of the taurine content of diets indicated levels up to 4X NRC recommendations. Although it has not been identified, a water-soluble fraction present in cooked, but not uncooked, samples of certain commercial diets inhibits uptake and/or utilization of dietary taurine by the cat. Deficiency can be corrected easily by the supplementation of 250-1000 mg/day crystalline taurine to the cat, addition of extra taurine to diets (which most commercial manufacturers use routinely), and/or supplementation with diet items high in taurine; shellfish > meat > plants. Reproductive and cardiac problems can be reversed; retinal damage, however, is permanent.

Dietary taurine levels high enough to prevent eye defects in cats still may not be adequate for successful reproduction. With support from the Nixon Griffis Fund for Zoological Research, Czekala (San Diego Zoo) and Lasley (University of California, Davis) are examining circulating levels of taurine in zoo felids to correlate with reproductive success and diets fed. Twenty-two species, from 14 zoological parks, fed six commercial diets were investigated. Ninety-five percent of plasma taurine levels from zoo felids were above the normal range for domestic cats; however, taurine levels in domestic cats associated with successful reproduction have not yet been established.

One very interesting observation from these studies was the measurement of taurine in zoo cheetahs (145 nmol/ml) versus animals captured from the wild in Namibia (289 nmol/ml) and held less than two years in captivity. Reasons for this discrepancy remain to be elucidated, as do ramifications for improved health and reproduction in the captive population. The African samples will also be examined for other nutritional parameters including vitamins A, E, cholesterol and minerals to determine if differences exist, and provide an important source of baseline comparative information for evaluating dietary utilization between animals fed whole carcasses as opposed to commercially processed diets.

One final area that should be addressed in nutrition of exotic felids is that of feeding behavior. It has been suggested that although single meal feeding with fast periods is suitable for large cats, small species may benefit from several small meals daily. These effects of meal pattern manipulation on health and reproduction should be evaluated in a systematic manner.

First and foremost, however, we should be sure we are feeding our cats like cats. A wealth of literature exists to provide guidelines on nutrition composition of diets appropriate for felids as a whole: we must ensure we are

meeting at least those minimal guidelines before we can hope to make significant strides in evaluating diet suitability of individual cat species.

MODERATOR: Our next speaker will talk about the captive population situation in North America. Alan Shoemaker is the zoologist at Riverbanks Zoo in Columbia South Carolina. He is the holder of the rare leopard studbook, a member of the IUCN Cat Specialist Group and a studbook advisor for the AAZPA.

NORTH AMERICAN CAPTIVE POPULATION-SHOEMAKER

Felids have been associated with man since the time of the pharaohs. Some were valued as pets, and in at least one case, domesticated. Cheetahs were valued as hunters.

Cats are extremely popular as subjects for exhibit in zoological gardens. In the most recent Species Distribution Report from ISIS, at least 4323 cats of 31 species were reported. The majority of these animals were only reported by North American institution, and doubtless similar numbers of felids are kept by zoos in other regions and by private owners.

Most felids have suffered in the wild from loss of habitat, the fur trade, the pet trade, and trophy hunting. At least one small felid subspecies, the Pakistan sand cat, owes its extinction almost entirely to the pet trade although a few highly inbred specimens are still found in captivity. Also, three races of tigers are extinct because of habitat loss and uncontrolled hunting. And these are just the recorded losses.

Under CITES, all cats are at least regulated as APPENDIX II species and may not enter international commerce unless legally exported from the country of origin. Twenty-six species, subspecies or geographical populations are listed as APPENDIX I, a listing roughly equal to that of an endangered species as defined by the U.S. Fish and Wildlife Service. Finally, 29 species, subspecies, or populations of felids are listed as endangered by the U.S. Fish and Wildlife Service, and one more as threatened.

Although a number of international studbooks have been initiated for felids, most involve the larger species. There are studbooks for the tigers (Siberian and Sumatran only), rare subspecies of the spotted leopard, clouded leopard, snow leopard, cheetah and Asian lion. Small cats have been largely ignored. Aside from a studbook intiated in 1974 by Helmut Hemmer for the Pakistan sand cat, no other management program involving smaller species existed until 1988 when Dr, Rudiger Dmoch of the Frankfort Zoo began compiling an international studbook for black-footed cats.

Small cats (Felis or Lynx) are reported by ISIS to number over 1100 individuals within participating institutions. That´s the good news. The bad news is that of the 1100+ animals, only 233 (25%) are classified as endangered; the other 898 cats are common, non-endangered species. And from a conservation point of view, the picture gets worse.

Most species of small cats kept in zoos arrived in an unplanned manner unrelated to the species´ legal status. Some species, lynx, bobcat, and puma are continually being offered to zoos by wildlife agencies. Servals and

caracals are also relatively common in nature and easily kept making them almost as common in captivity as the northern felids. Seven hundred twenty-one of these five easily-bred species represent 80% of the non-endangered forms kept by zoos that report to ISIS. Many females are now prevented from reproducing because of the difficulty owners have in locating good homes for offspring.

The other nine less regulated species usually represent felids that were casually imported in the past but are no longer available from countries within their natural range. Today, many of these nine species are only represented by older non-breeding specimens which have little to offer propagation efforts.

Regardless of the species and its legal status, many small cats arrived at zoos by accident, particularly as former pets. Often these animals were neutered or were otherwise unsuited for pairing and reproduction. A few species, such as the flat-headed and marbled cat were imported as odd individuals whose founder size was never large enough to support a long-term breeding program.

Today, geriatric, solitary, or non-breeding specimens of both endangered and common species are still found in a number of collections, and are taking up valuable space that could be used for better planned propagation efforts. Typical of species with little or no future in zoos under present conditions are northern races of jaguarundi, Temminck's golden cat, marbled cat, Mexican bobcat, flat-headed cat, Pallas' cat and European wild cat among others. Other species such as ocelot, margay and Geoffroy's cat breed in a few institutions but are more common in the private sector.

One more problem in small cats involves their origin. Most can rarely be attributed to a particular subspecies. Argentina, for example, possesses all subspecies of Geoffroy's cat within its political boundries, but there is no way to reliably determine a cat's subspecific identity if the origin is listed as only Buenos Aires.

Finally, many species are highly variable across their range and subspecies were named long ago using techniques no longer acceptable by modern taxonomists. Given all the above, most small cats in collections can only be identified to the species level. This uncertainty in purity of geographic races may complicate later reintroduction programs, if captive stocks are used as founders for release animals.

Where does this leave zoos? For one thing, it leaves many collections with old, non-breeding animals. Others have common animals that should be replaced later by more endangered taxa once suitable specimens are available. Regardless of legal status, it is time owners realize that most of their endangered felids are unidentifiable as to origin and of little value to professional propagation or release efforts.

MODERATOR: Our next speaker is Dr. Earl Pope, Section Head of the reproductive physiology division of the Center for the Reproduction of Endangered Wildlife at the Cincinnati Zoo. He has a very extensive academic and zoological background in in-vitro fertilization, embryo transfer and other areas of reproductive

physiology. Dr. Pope has dealt with a wide variety of both domestic and exotic species, and he will be talking to us about the reproductive physiology of small cats.

REPRODUCTIVE PHYSIOLOGY- POPE

What I want to do is give a brief update of what has been done in the area of reproductive physiology over the last 4-5 years. I have included some information on large cats as well as domestic cats, as they make an excellent model for some of the work that we hope to apply soon to some of the small exotic cats. I've broken it down into the area of endoctrinology and I have also included some behavioral information, sperm physiology and the assisted reproductive technique. I will start off with a slide from Seal and his group, from a couple of papers in the last year or so on Siberian tigers. This slide just shows that the Siberian tiger is definitely a seasonal breeder with a peak of births in the springtime. They also did a study in which they correlated physiological data with the behavioral patterns. The behavioral information is not shown on this slide, this is just a representative endocrine profile of one female from their study which shows that the estrus activity occurs over a 3-4 month period in the springtime of the year, and that the tiger goes into an approximately 8 month period of anestrus, and that the tiger is an induced ovulator. In their series of five females, however, they did find that one of the five tigers was a spontaneous ovulator in at least three concurrent cycles.

This slide represents a study from Smith and others at the Portland Zoo on leopards, in which they compared the endocrine profiles to the behavior patterns. What they are showing is that the leopard is, of course, not a seasonal breeder, but that the females which were housed together did exhibit some spontaneous ovulation. They also found that the isolated females did not show any spontaneous ovulations. The slide shows that the progesterone peaks indicating ovulation did occur at least on occasions when these animals were housed together.

Here are a couple of slides from Yamada and Durrant's work in San Diego. They were not looking at endocrine profiles but they were correlating estrous behavior in the clouded leopard to a long term study of vaginal smears from a tractable female with which they were able to work. This slide shows that the peak of estrual activity was in December, and this tied very nicely with the vaginal smear results from that female in which the increase of superficial cell types was also in December. This is indicative of an estrous smear, and a drop-off in parabasal cell types.

Moving on to sperm physiology. This slide shows that the study of Wildt and his group in 1983, in which they first reported a high incidence of telomorphic sperm in the cheetah, and then compared this sperm to the sperm parameters of the domestic cat. You see that the concentration was lower in the cheetah, the percent motility was about 20% lower, and the incidence of abnormal sperm was also about 50% higher than the domestic cat's. They followed that up with their study in which they surveyed 28 non-domestic felids and looked at the sperm morphology percentages of these cats. This slide is just a ranking of that, and you can see that in addition to the cheetah, which in this case does not even fall into the lowest category as they have them grouped there. If you look in the middle, you see the percent

normal sperm which goes from a high of approximately 80% down to 15% at the bottom of the table.

This is a slide from the latest study from this group. It just shows the ranking for the tiger, cheetah, leopard and puma. The tiger had the highest incidence of normal sperm. To generalize, it had the best sperm sample, and the cheetah, leopard and puma were down at the lower end as far as the percentage of normal sperm and some of the other sperm characteristics. This slide is from the same study in which they were taking blood samples during the period of normalization for the electro-ejaculation. It shows that in all cases, the lowest blood levels for testosterone, LH and cortisole were for the cheetah. Although they did not objectively take measurements of the aggressive natures of the animals at the time of immobilization, they did state that in general, the cortisole levels reflected the degree of aggressiveness of each of the species. This slide is showing the clouded leopard's sperm samples, and the main point that I want to make, is that there are no seasonal differences in the sperm characteristics from the snow leopard. There were individual animal differences, but in none of the parameters which you see on the slide were there any seasonal effects on sperm in the clouded leopard male.

Now I will switch to the application of the enhanced oral site penetration test as the Minnesota group has published over that last year or so, and their results on applying that. As you know, it has been a most useful test in human infertility clinics and it is probably the best test that there currently is available for studying the actual fuctionality of the sperm. What they found in their initial study was that at zero hours preincubation, there was no penetration, at two hours they got their maximal penetration, and it dropped off after that. If you are in the middle at percent motility, you'll see that motility at this incubation temperature of 37 C was also dropping off very rapidly. That would account, at least in part, for the drop-off in percent penetration. Here we see a slide of the percent penetration of sperm that had been incubated at 23 C compared to 37 C. It did indicate that body temperature was absolutely necessary for penetration to occur, and that capacitation did not take place when held at room temperature.

Along these same lines, Wildt and his group studied effective temperature and undiluted versus diluted semen on motility characteristics of tiger sperm. It shows the same sort of pattern in that it was important to dilute the sperm. The undiluted sperm survived a much shorter period of time, and if you held it at 23 C it survived for a shorter period of time that it did at 37 C. Howard and coworkers used the enhanced oral site penetration test in domestic cat sperm. They were looking at two types of sperm, males that produced ejaculates that had a high percent of abnormal sperm versus those in which the high and low were normal. As expected, it showed that the samples that had the higher percent abnormal sperm did have a lower penetration rate. The other factor that they studied was the type of medium and they did show a medium effect on the percent penetration rate, with the modified Krebs Ringer being higher than the DWW medium.

With regard to assisted reproductive techniques, I will start out with artificial insemination. This is an endocrine profile from the female puma from the London Zoo that gave birth in 1980 to the first cubs to result from artificial insemination in exotic felids. The slide just shows that she was

given 1250 PMSG, 72 hours later HCG, and then 90 some odd days later she gave birth to the cub. Although that was the first birth, there was subsequently reported from the Cincinnati Zoo the following year, a pregnancy for the Persian leopard. This was a non-surgical insemination as compared to the surgical insemination in the puma. I show this slide to illustrate, that from the large group of cheetah that were hormonally stimulated, in this case for artificial insemination, they did successfully induce ovulation in a high percentage of the cases. But there was not a single pregnancy resulting from this group of cheetahs that were A.I.'d. On the other hand, the group at Texas A & M, reported in 1982, that in their work with one African lioness, they followed her cycle by behavioral patterns and at the appropriate times ovulation was induced by either HCG in the first two attempts, or GnRH in the final three, and the female was artificially inseminated. Then approximately 5-6 days later, they surgically performed an embryo recovery. In the last three attempts, in which they used GnRH, they were successful in recovering a morula in each of the three attempts. So, it does show that ovulation can be induced and that fertilization, at least early in the development, can proceed in at least the lions.

From the study from Wildt's group on domestic cats in which they were comparing gonadotrophin-induced groups of cats versus naturally-induced estrus, they found that in natural estrus, practically all of the embryos that they recovered were morphologically normal with a high percentage of fertilization. But in the gonadotrophin induced cats, they got more abnormal embryos and a lower fertility rate, but for whatever reason, their pregnancy rate and the number of recipients that gave birth to offspring was low in each case. I want to compare that work with the domestic cat work done in Cincinnati within the last few years. This slide shows a series of gonadotrophin treated cats. They were given from about 3mg of FSH up to about 8mg FSH over a period of 5-6 days followed with HCG, and then approximately a week later, the embryos were surgically recovered. This shows the results of that study. The highest number of transferable embryos were recovered from group four, they were able to recover 15 embryos, and the overall recovery rate of that group was 81.5%. Now these are the results of the transfer of these embryos that were recovered from the gonadotrophin treated females. In this series of eleven recipients, there were five of the females that did give birth to live kittens. So, it was an improved percent pregnancy rate in this study compared to the earlier ones.

In a follow-up study in which they transferred embryos following freezing and thawing, they got a similar pregnancy rate, five out of eleven females, although the number of offspring per litter was greatly reduced. They have also been attempting to do some embryo splitting work, and they have transferred several hundred domestic cat embryos and have not obtained a pregnancy to date. The results of these cat embryo studies seems to be that cats are a different breed than some of the other species in which split-embryo transfers have been successful.

Cincinnati has also been attempting to take some of this information which has been learned from the domestic cats and to apply it to the small exotics. This slide shows a group of degenerate fragmenting embryos that were recovered from our first attempt with a serval from which we recovered 36 embryos. Unfortunately, the female was not compatible with the male, and she did not mate. At that point, we decided to switch to IVF and I have shown here a

slide from Wildt's group that they just published on their series of IVF in domestic cats. The chief point is that the highest fertilization rate was attained at 80 hours between PMSG and HCG and keeping the HCG reduced to 100 rather than the 200 unit level. This slide is just an outline of our current methodology for our procedures that we are using for our procedure in IVF in domestic cats. In domestic cats, we are collecting sperm primarily by artificial vagina. We do a swim up on it and collect, hopefully, mature oocytes. The eggs and sperm are put together after approximately 5-6 hours, we then remove the oocytes, put them in fresh media, let them grow for approximately 4 days, and then take the cleaving embryos and transfer them back to suitable recipients. This slide shows some of our gonadotrophin treatment data showing follicular development in various dose levels. Unfortunately, many of our donor cats would give only good oocytes or bad oocytes, and up through the first 6 months of the study, more of our females were giving us immature oocytes than mature. The point I was making with this slide is that the concentration of the semen in the insemination dish shows that 25,000 per ml was perhaps a bit too low. We raised the concentration in this case by using 50,000 per ml. Also, we did obtain a 44% fertilization rate when we used a frozen sperm sample, but that was an extraordinarily good sample that was frozen about 4 years ago.

This slide shows our initiation into the IVF of the exotic cats. This is an Indian desert cat that we have been working with on two trials this year. The FSH-HCG dose we gave her, the intervals, the follicles aspriated, and in the first case, we recovered a nice batch of 18 mature oocytes. Unfortunately, my sperm prep methods were not what they should have been at that time, and you can see that although the initial sample had about 50% motility, by the time I had finished processing it, it had dropped down to about 10%. Therefore, I got a low percent fertilization. The last time we did her, we didn't get as many good, mature oocytes, but fortunately.I had improved my sperm processing methods, and we got a higher percent fertilization rate. We did transfer those back into the same female, the five embryos, but she did not maintain pregnancy. This slide shows a mature Indian desert cat oocyte that we recovered. This slide is a group of fertilized embryos from the last batch that we just transferred. The embryo on the right is probably a fragmenting one, the one in the middle may be about an 8-cell, and the others are morulas. At that time, I transferred the embryos at about 96 hours post recovery. This slide shows one of those embryos at a higher magnification. The ones that did not cleave, we tried an air dried staining technique. This slide shows that they were at Metaphase II, you can see the chromosome, and at the top is the second polar body.

I will end with stating that we just had our first IVF kittens born in August and this slide shows what they look like.

MODERATOR: I now want to introduce Mrs. Pat Quillen, a private conservationist and breeder of leopard cats, oncilla, Geoffroy's cats and margay for over twenty years. She is Executive Director of the Society of Scientific Care, a non-profit conservation-oriented private breeding facility in California. In my opinion, and in the opinion of many, Pat represents what can and what could exist in the private sector if we would simply open communication channels. So, I would like to introduce my good friend, Pat Quillen.

.HE PRIVATE SECTOR- QUILLEN

Originally, the first page of this material addressed concerns over communication gaps among the zoos, the researchers, and the non-professional, or private sector. But my own views coincide with those so eloquently expressed by Dr. Ulysses Seal yesterday morning, and in consideration of the late hour, I'll make this as short as possible.

When first asked to participate in this workshop, it was suggested that reference might be made to the number of private breeders which existed prior to ten years ago versus the number of private breeders still active today. Although seriously diminished, there is a worldwide communication network in the private sector. The problem, however, in attempting to list the participants within this network, past and present, is that not only are some of these individuals averse to having attention brought to the activities which they deem to be a very personal dedication, but also a few are acting outside of the legal permit systems. Nearly all are financially supporting a facility which houses several animals without any outside assistance. Out of mutual respect, the network has commonly been used on a "need to know" basis. A breeder having a specific problem requiring input from someone having experienced the same or similar problems, would plug into the network by contacting other private breeders and explaining the species, the nature of the problem, and the degree of urgency. The word is passed from contact to contact until one or more reliable sources of needed information is located. The number of incoming calls with questions generally increases with the number of years a breeder has been actively working with the animals and is related to the success and reputation of that breeder over the past years. In seeking solutions to a specific problem, it is interesting to note that not even a 20-year veteran breeder has encountered every possible problem. And you may find that an individual who has only one or two years of experience, may have dealt with a similar problem and may provide the information needed.

This network of communication has been a constant source of amazement to me. As one of the twenty-year veterans receiving calls and letters from nearly every continent, I began asking the callers which person had given him or her my name, only to find that the person who had given my name was unknown to me, and sometimes previously unknown to the caller as well. Over the past five years, the number of calls from breeders requesting information on animal care and husbandry problems has declined. As though it were the end of an era, fewer and fewer of the dedicated breeders continue their efforts to maintain gene pools of endangered or threatened species of cats.

How many private breeders existed ten, or even five years ago? I don't know. How many private breeders exist today? I only know that they are very few by comparison. On the positive side of the scale, there is a much higher incidence of calls from zoo staff and researchers wishing to become involved in conservation breeding programs for some of the vanishing species. Facilities such as the Society of Scientific Care in California came into existence as a home for abused and/or rejected cats. Most of these animals were either unresponsive to human interaction, or responsive in an extremely undesirable manner. The founding animals proved to be a most interesting study group, but daily record keeping was not an issue, to say the least. I would like to show you an example of those daily recordings. This is an old record sheet that I pulled from back in 1974. One of these forms were on the

front of each enclosure. You can see that it noted which animal was in the left adjacent enclosure and which animal was in right adjacent enclosure. This proved to be important information which we found affecting the behavior of many of the animals.

[Pat then showed a series of slides of oncillas, margay and leopard cats]. I'm going to run through a number of various slides of the lesser (Columbian) oncilla because it is very seldom seen. Please notice as we move into the Brazilian subspecies that a vast difference exists between the two subspecies. The difference you are seeing relates to the body conformation and color pattern. They can and have often been mistaken for margays. Now we are in the margay slides. This animal is a natural hybridization. As near as I can tell, this is a cross between a margay and an ocelot and it was a wild-caught infant. This animal is now about 12 years old and is in Guatemala. Another animal which we are looking forward to doing some genetic work with is this animal. Its owner, who is also a breeder, is sure that it is not a margay, but a cross between a margay and an oncilla. We will follow up with a genetic study. Her coat pattern does lend itself more to the margay. This leopard cat mother was only able to nurse three infants so we had to pull and hand-rear the last one.

MODERATOR: Our next speaker is Dr. Jill Mellen who is the head of research at the Washington Park Zoo in Portland, Oregon. She is currently completing her doctoral study at the University of California, Davis on small felid behavior and factors influencing reproductive failure in captive small felids. She will speak to us on felid behavioral research in zoos.

BEHAVIORAL RESEARCH-MELLEN

[See attached]

QUESTIONS:

PAUL JOSLIN: Perhaps I should first introduce myself to the group. I am Deputy Chairman of the IUCN Cat Specialist Group and essentially, we are very anxious to determine the status and the reason for the status, causes for decline, and what needs to be done to reverse that decline for practically all of the species which have been touched upon. When it comes to Asia, that is an area which we have come to recognize as an area in which we know very little about the lesser cats in particular. There has been a considerable amount of work on tiger, there has been a lot of work on the Asian lion, and there has been some amount of work on the snow leopard. I want say some amount of work, there have been a few intensive studies in a few major areas, but we are just beginning to recognize that in the case of that one species, that they vary enormously over their entire range. George Schaller recently reported on finding that roughly a third of the diet of a snow leopard in a protected reserve in China consisted of marmot for example. This now opens up a whole new world of possibilities pertaining to what we can do to help the status of that animal.

When you get into the lesser cats, especially the fishing cat, marbled cat, golden cat, caracal lynx, there have been no radio telemetry studies, and hardly anything on food habit studies. It is just wide open in terms of

beginning to get a grip on these cats either in terms of depth or in terms of the general status. So we are very anxious to push forward in encouraging that research be undertaken as soon as possible. We are trying very hard to get many of the indiginous biologists in some of these countries to be the ones to lead that kind of activity. Perhaps for the whole of Asia, the most endangered cat of all, the one we know the least about at this time is the Asiatic cheetah, which there are perhaps about 30 left, at least there were in a protected Iranian region just prior to the downfall of the Shah. They just got through a war and conditions are beginning to change. IUCN recently began to do work with reference to developing liasons with Iran. maybe we can start to find out what the status of the cat is. We know from the Russians that it is no longer in Afghanistan, the cheetah is now, in effect, gone. A slant on it that we may be able to work towards in achieving improvement in their status, or at least be able to give us assurance that things may not be too bad, the Conservation Monitoring Center in Cambridge, England, their protected areas and reserve systems, they have over 11,000 protected reserves on computer. In a majority of those, they have at least a page or two on each of those reserves. Those reserves list the major species, down to size of staff, budget and all other important information. However, they do not list any of these lesser cats. They look at it in terms of their staff, as being kind of unimportant. If we can get these cats into those lists, if we can get whatever, if we can get some of those censuses done, so we can find out what those parks and reserves have, we may be in a whole lot better shape than we feel that we are at the present time.

MODERATOR: Yes, I agree with you completely, Paul. How do you see the funding situation for studies of this sort?

JOSLIN: Desperate.

MODERATOR: Desperate in the sense that we are not going to get funds, or in the sense that we desperately need them?

JOSLIN: The need for funding is very great. There are people in many of these countries that I would consider very competent, people who need perhaps a little extra training in how to go about censusing small carnivores, but essentially they are pretty darn good biologists. A lot of them come over for training at Front Royal, Virginia (Smithsonian) for example, in this country alone. They have then set up in their own countries. India is a fine example with a wildlife institute. But we need some additional help. There are places with funds, you just have to work. It is regarded by their countries as kind of important, but it is a pretty minor interest compared to some of the major problems that they have to deal with. One more thing before I sit down. If one talked to John Eisenberg, what he would regard as the cat that we know the least about, that we are most in need of information, is the Andean wildcat of South America. There is almost nothing known other than what has appeared in the context of the fur trade. And we desperately need information to find out if this cat is actually ok in its limited habitat, or if it is being pushed to its limit. We have no idea at the present time.

[Each panelist gave a statement at the end of the questions pertaining to what they would like to see accomplished in the next five years. Unfortunately, these statements were not on microphone and the recorder was unable to pick them up clearly]

Behavioral Research on Captive Felids - A Review

Jill D. Mellen, Conservation/Research Coordinator
Washington Park Zoo, Portland OR

Within the Family Felidae, the larger cats (*Panthera* and *Acinonyx*) have been the object of intensive research. Numerous field studies have provided much insight into their behavior and ecology. The larger cats are also well represented in zoological institutions. Further, with the exception of the cheetah, all of the larger cats reproduce well in captivity. With few exceptions, the smaller cats (*Felis* and *Neofelis*) have not been studied extensively in the wild nor do they breed consistently in zoos.

Behavioral Studies: Basic Research

Prior to a discussion of behavioral research on captive felids, it is important to review some of the theoretical work that has served as a basis for subsequent work on exotic felids in captivity. Paul Leyhausen, in 1965, wrote an article about solitary behavior of animals and in many respects changed the way "solitary" animals were perceived. Prior to Leyhausen's article, a general perception was that "solitary" animals exhibited few social behaviors. Leyhausen's work was one of the first to point out that although "solitary" animals do not live in groups, they do indeed possess a rich repertoire of social behaviors. His work served to spark a interest in the "social" life of solitary animals, including felids. In 1973, Kleiman and Eisenberg produced an eloquent review that compared canid and felid social behavior. This work also served as a basis for much of the current work today.

A number of general articles provided a comparative perspective on felids: Fox (1974), Hemmer (1976, 1978), and Leyhausen (1979). These papers contained little quantification of behavior, but have provided perspectives on

behavior from zoologists whose insight was gleaned from many years of observation.

Wemmer and Scow (1977) presented some of the first quantitative assessments of communication in small cats. Works by Kleiman and Eisenberg (1973), Leyhausen (1979), and Ewer (1973), also present information on visual communication modes in cats. With regard to olfactory communication in captive felids, Verberne and de Boer (1976), Verberne (1976), de Boer (1977) published some excellent research on domestic cats that is applicable to exotic cats. Additional work by Brahmachary (1979) and Brahmachary and Dutta (1981) on tigers and King (1986) on cheetahs has added to our knowledge about scent marking patterns in captive felids. Wemmer and Scow (1977) described and discussed some aspects of vocalizations. Gustov Peters (1981, 1983) and Movchan and Opahova (1981) have produced sonograms of the vocalization patterns of several species of felids.

Behavioral Studies - Application to Captive Management

As Gail Foreman stated in her dissertation proposal, most articles on the behavior of captive small felids have dealt with a single pair of animals at one location and describe events rather than trying to identify parameters involved in successful species propagation (e.g., in *International Zoo Yearbook, The World's Cats, Carnivores*). These articles typically present "notes on the breeding/maternal behavior/development of . . . " particular individuals at a zoo. The *Felid Bibliography* (Foreman, 1988) lists these references. These case studies provide some useful information, but it is difficult and sometimes unfruitful to generalize to a broader base.

In 1974, Kleiman published results of a study on the estrous behavior of captive tigers. This study represents one of the first in which behavior of captive felids was systematically examined and estrus behavior quantified. These data

were used to improve breeding success of captive tigers. Another excellent example of the use of systematic examination of the behavior of a cat species to facilitate captive propagation is a study by Freeman on snow leopards. Freeman (1983) compared the behavior of reproductively successful and unsuccessful pairs of snow leopards at five different zoos. The results of her study provide a non-invasive, diagnostic tool for predicting reproductive success and represents a good model for inter-zoo studies. King (1986) conducted a long-term, intensive study of a group of cheetahs at the Sacramento Zoo, examining among other things, behavioral signs of estrus and males' response to an estrous female. Lanier and Dewsbury (1976) presented some quantitative information on copulatory patterns of large felids.

There are very few studies which quantify the behavior of smaller cats. Bennett and Mellen (1983) presented some information on the breeding behavior of a pair of sand cats. Other studies have been conducted on small cats at both the Woodland Park Zoo in Seattle and the Washington Park Zoo in Portland as part of undergraduate research methodology courses taught at these respective institutions, but most are unpublished manuscripts.

Current Behavioral Research

A number of studies have correlated physiological parameters with behavioral measures. Recent studies include those by Seal et al. (1987) on tigers, Schmidt et al. (1988) leopards and Yamada and Durrant's work (1987) on clouded leopards. A more complete review of physiological work was just presented by Dr. Pope.

One of the most important areas where behavioral research can facilitate the management and propagation of small felids is the systematic observation of several pairs of cats. These data allowed for the establishment of quantifiable behavioral norms. Foreman (1989) and I (Mellen, 1989) have both made

systematic behavioral observations on pairs of small cats in work that followed the lead of Freeman's inter-zoo study (1983) on snow leopards. Foreman (1989) examined reproductive and maternal behavior in Geoffroy's cats at four different zoos and I (Mellen,1989) studied reproductive parameters of 16 species of small cats at seven different zoological institutions.

In my observations of over 60 individuals representing 16 species of small cats at 7 zoological institutions (Mellen, 1989), it has become quite apparent to me that reproductive activity and reproductive potential can be accurately assessed through systematic behavioral observations. In other words, such observations are very likely to provide information on whether or not a female is cycling, whether there is any breeding activity, and if a pair fails to breed, provide insight into wether one or both individuals is "responsible" for reproductive failure. Schmidt et al.'s work (1988) on leopards is supportive of my suggestion. Schmidt et al. monitored serum concentrations of estradiol and sexual behavior of leopards during normal estrous cycles. They found that hormonal estrus was not always accompanied by observable behavioral estrus, but during those times where behavioral estrus was observed, there was always a concurrent increase in serum estradiol concentrations. Thus, I think it is fair to assume that if one sees behavioral signs of estrus, it is highly likely that a female is indeed cycling.

Using a simple checklist, this assessment can be made via a small investment in time (30 minutes per observation, daily or every other day). Resultant data can be graphed over time. Sample checklists, definitions of behaviors, and instructions on how to collect such data are in an Appendix at the end of this article.

In addition to recording behavioral data, other methods allow one to measure and assess basic life history and husbandry management information. Factor analysis (a.k.a voodoo statistics) is being used in this area. Factor analysis allows one to determine which complex of variables most closely correlates with a factor of interest, e.g., successful production of kittens. Foreman (in prep.) and Mellen (in prep.) have applied this method to the management of cats in captivity in an attempt to determine which variables most closely correlate with reproductive success/failure. In my study, I am using data collected from a total of 8 different zoos. Some of the variables measured include: size of the enclosure, number of den sites available, distance small cats are from large cats, husbandry style, inbreeding, origin (i.e., captive-born or wild-caught), early rearing experience (i.e., maternally-reared or nursery-reared), diet, and health of the animal. These variables will be measured and assessed as to which one(s) most closely correlate with reproductive success, i.e., number of surviving kittens. It is, I hope, apparent from the above example that we have begun to expand beyond specifically looking at behavioral parameters to a more complex way of looking at the captive environment of these animals.

One aspect of zoo research that is difficult to accomplish is the use of an experimental design to investigate a problem. The experimental method involves an experimenter manipulating one variable while controlling or making constant all other variables. With regard to research on captive felids, I used the experimental method to look at the effects of early rearing experience, i.e., maternal rearing versus nursery rearing, on reproductive success in small captive felids. Instead of conducting this experiment on exotic species of cats, I used female domestic cats as a model. The effects of nursery rearing have long

been debated among zoo personnel. It is a pervasive feeling among zoo professionals that maternal rearing is preferred over nursery or hand-rearing, because it is presumed that maternally-reared cats are more likely to breed and maternally-reared females are better mothers. However, there are numerous exceptions in both zoo populations and among cats belonging to private breeders where hand-raised cats have bred readily and cared for their offspring. It was my intention to raise three groups of domestic cats to mimic the typical rearing conditions of exotic felids: one group was human-reared alone, a second group was human-reared with a sibling, and a third group was raised by mother with a sibling. The first two groups were meant to mimic typical nursery situations; the third group represented the preferred zoo condition where a female raises her own offspring. The results of this study strongly suggest that human-raised cats are less likely to breed than are maternally-reared cats (see Mellen, 1988, 1989 for details). This example of an experimental study is a rare luxury in a zoo setting because zoos typically have neither large numbers of single species nor the facilities to house the necessarily large numbers of animals.

Future of Behavior Research

As with many field researchers, it has become apparent that a genuine interest in the behavior of cats has been replaced by an immediate concern for their survival. As Alan Shoemaker pointed out, the captive populations of small cats are in peril. Unless new genetic material is introduced into these very small populations, these captive groups are destined for extinction.

Management practices, e.g., housing, diet, husbandry, are quite disparate among zoos. I would suggest a systematic examination of these practices as has been done in the Cheetah Species Survival Plan and being

addressed by the Clouded Leopard Interest Group of the American Association of Zoological Parks and Aquariums.

The current trend in zoo research appears to be focusing primarily on two areas: at the tissue level (i.e., reproductive physiology) and at the population level (i.e., genetics/demography). While these areas play a very important role in captive propagation of endangered species, attention still needs to be focused at the level of the individual animal. Regardless of the expertise in the areas of reproductive physiology and population genetics/demography, reproductively sound, genetically outbred animals still fail to breed. This reproductive failure may be due to incompatibility of a pair, inadequate environmental considerations, and/or incorrect husbandry procedures. It is my opinion that equal attention must be paid to the individual animals, i.e., the whole organism. It is at this level (the individual) that we care for the animal, it is the behavior of the animal that we respond to, and it is at the level of the individual animal where we may someday reintroduce the species back into its original habitat. I would hope that we continue to look at the behavior of cats in the context of their captive environment.

References

Bennett, S. & Mellen, J. (1983). Social interactions and solitary behaviors in a pair of captive sand cats (*Felis margarita*). *Zoo Biol., 2,* 39-46.

Brahmachary, R. (1979).The scent marking of tigers. *Tigerpaper, 6* (2-3), 19-20.

Brahmachary, R. & Dutta, J. (1981). On the pheromones of tigers: experiments and theory. *Am. Nat., 118* (4), 561-567.

de Boer, J. (1977). The age of olfactory cues functioning in chemocommunication among male domestic cats. *Behav. Proc., 2,* 209-225.

Ewer, R. (1973). *The carnivores.* Ithaca, New York: Cornell Univ. Press.

Foreman, G. (unpublished manuscript). Captive propagation of the smaller felids: Courtship and parenting in Geoffroy's Cat (*Felis geoffroyi*). Doctoral Dissertation Proposal, Ohio State University, Department of Zoology.

Foreman, G., (ed.) (1988). Felid bibliography. Felids Research and Conservation Interest Group and the International Society for Endangered Cats, Inc., Columbus, Ohio.

Foreman, G. (1989). Captive propagation of the smaller felids: Courtship and parenting in Geoffroy's Cat (*Felis geoffroyi*). Ph.D. Dissertation, Ohio State University, Department of Zoology.

Fox, M. (1974). *Understanding your cat.* New York: Coward, McCann & Geoghegan, Inc.

Freeman, H. (1983). Behavior in adult pairs of captive snow leopards (*Panthera uncia*). *Zoo Biol., 2*, 1-22.

Hemmer, H. (1976). Gestation period and postnatal development in felids. In R.L. Eaton (ed.), *The world's cats (Vol. 3(2))*. Seattle: University of Washington.

Hemmer, H. (1978). The evolutionary systematics of living Felidae: Present and current problems. *Carnivore, 1*, 71-79.

King, N. (1986). The behavior of a group of cheetahs (*Acinonyx jubatus*). Ph.D. Dissertation, University of California at Davis, Department of Psychology.

Kleiman, D. (1974). The estrous cycle of the tiger. In R. Eaton (ed.), *The world's cats (Vol. 2)*. Seattle: Woodland Park Zoo.

Kleiman, D. & Eisenberg, J. (1973). Comparisons of canid and felid social systems from an evolutionary perspective. *Anim. Behav., 21*, 637-659.

Lanier, D. & Dewsbury, D. (1976). A quantitative study of copulatory behaviour of large Felidae. *Behav. Processes 1*, 327-333.

Leyhausen, P. (1965). The communal organization of solitary mammals. *Symp. Zool. Soc., Lond., 14*, 249-263.

Leyhausen, P. (1979). *Cat behavior.* New York: Garland STMP Press.

Mellen, J. (1988). The effects of hand-raising on sexual behavior of captive small felids using domestic cats as a model. American Association of Zoological Parks and Aquariums Annual Proceedings. pp. 253-259.

Mellen, J. (1989). Reproductive behavior of small captive exotic cats (*Felis* spp.). Ph.D. Dissertation, University of California at Davis, Department of Psychology.

Movchan, V. & Opahova, M. (1981). [Acoustical signals of cats living in the zoo.] *Zool. Z.H., 60*, 601-609.

Peters, G. (1981). [Purring in the Felidae.] *Saugetierkd. Mit.*, 29, 30-37.

Peters, G. (1983). [A preliminary report on the vocal repertoire of th caracal, *Caracal caracal* (Schreber, 1776)]. Bonn. zool. Beirtr., 34, 107-127.

Schmidt, A., Hess, D., Schmidt, M., Smith, R., & Lewis, C. (1988). Serum concentrations of oestradiol and progesterone during the normal oestrous cycle in the leopard (*Panthera pardus*). *J. Reprod. Fert., 82*, 43-49.

Seal, U., Tilson, R., Plotka, E., Reindl, N., & Seal, M. (1987). Behavioral indicators and endocrine correlates of estrus and anestrus in Siberian tigers. In R. Tilson & U. Seal (eds.), *Tigers of the world: The biology, biopolitics, management, and conservation of an endangered species.* Park Ridge, NJ: Noyes Publ.

Verberne, G. (1976). Chemocommunication among domestic cats, mediated by the olfactory and vomeronasal senses. II. The relation between the function of Jacobson's organ (vomeronasal organ) and flehmen behaviour. *Z. Tierpsychol., 42*, 113-128.

Verberne, G. & de Boer, J.(1976). Chemocommunication among domestic cats, mediated by the olfactory and vomeronasal senses. I. Chemocommunication. *Z. Tierpsychol., 42*, 86-109.

Wemmer, C. & Scow, K. (1977). Communication in the Felidae with emphasis on scent marking and contact patterns. In T. Sebeok (ed.), *How animals communicate.* Bloomington, Indiana: Indiana University Press.

Yamada, J. & Durrant, B. (1987). Vaginal cytology and behavior in the clouded leopard (*Neofelis nebulosa*).

Appendix I. Instructions for Making Behavioral Observations on Captive Pairs of Small Cats

I. When to Observe

The cats should be observed at approximately the same time each day. Because the interest here is in detecting reproductive activity, time of day when the cats are likely to be active is the best choice. If the cats are moved off exhibit for cleaning and/or feeding, the best time to observe is likely to be immediately after they are returned to their enclosure.

II. What to Observe

Below is a listing of behaviors found to be indicative of reproductive behavior. These behaviors are defined and reference is made to other sources where these behaviors are illustrated by line drawings and/or photographs:

Table 1. Ethogram for Observing Reproductive Behavior in Captive Pairs of *Felis*

Behavior	Description
Solitary Behaviors - Record for both the male and the female	
Cheek rubbing	cheek of cat rubbed against an inanimate object [Wright & Walters, 1980, p. 124; Hart & Hart, 1985, p. 135; Freeman, 1983, p. 19]
"Sharpening" claws	claws of front paws are used to scratch some surface (usually wood) [Wright & Walters, 1980, p. 124; Hart & Hart, 1985, p. 135]
Flehmen	open mouth grimace following the sniffing of an object or another cat [Wright & Walters, 1980, p. 112; Hart & Hart, 1985, p. 167; Freeman, 1983, p. 20]

Urine marking	urinating on vertical surface, tail is usually held straight up and sometimes the distal one-third of the tail is vibrated or appears to quiver; behavior sometimes includes scraping substrate with hind feet [Wright & Walters, 1980, p. 124; Hart & Hart, 1985, p. 135; Freeman, 1983, p. 18]
Vocalization	vocalization which appears to be a non-directed "calling"

Social Behaviors - Record for both the male and the female

Hiss/Growl	cat orients to another cat and emits a hissing/growling noise
Strike with paw	cat strikes another with its paw
Anogenital sniffing	cat sniffs the anogenital region of another [Freeman, 1983, p. 15]
Following	cat follows within two body lengths other cat for a distance of at least two body lengths
Approaching	cat directly approaches another cat (within one body length) and the cat approached does not move away

Reproductive Behavior - Record for the male

Mounting	male dorso-ventral mounts female, straddling her with both front feet and hind feet, and sometimes stepping with hind feet [Wright & Walters, 1980, p. 130-131; Hart & Hart, 1985, p. 167-168]
Nape Bite	male grasps back of female's neck (nape) with his teeth; the male may or may not be simultaneously mounting the female [Wright & Walters, 1980, p. 130; Hart & Hart, 1985, p. 167-168]
"Pelvic" thrusting	while mounting, the male repeatedly thrusts his genital region in the vicinity of the female's genital region [Wright & Walters, 1980, p. 130-131; Hart & Hart, 1985, p. 167-168]
Anogenital (A/G) grooming after a mount	self-grooming of the anogenital region - scored <u>only</u> if it occurs within three minutes after a mount [Wright & Walters, 1980, p.131; Hart & Hart, 1985, p.168]

Reproductive Behavior - Record for the female	
Lordosis	female lowers her forequarters while elevating her hindquarters; this posture can occur in conjunction with mounting or the female may simply exhibit this behavior without any direct contact by the male [Wright & Walters, 1980, p. 130-131; Hart & Hart, 1985, p. 167-169]
Tail to one side	while the female is exhibiting a lordosis posture, her tail is moved laterally, exposing her anogenital region [Wright & Walters, 1980, p. 130; Hart & Hart, 1985, p. 167]
Threaten after mount	the female threatens the male (hisses, growls, strikes at with her paw, strikes male with her paw) within 30 seconds of being mounted [Wright & Walters, 1980, p.131]
Rolls on back after mount	the female rolls on her back within 30 seconds of being mounted [Hart & Hart, 1985, p. 169]
Anogenital (A/G) grooming after mount	self-grooming of the anogenital region - scored only if it occurs within three minutes after a mount [Wright & Walters, 1980, p.131; Hart & Hart, 1985, p.168]

In addition to the behaviors listed and defined in Table 1, notes can be made describing the general activities of the pair.

III. How to Observe

There are many sampling methods that can be utilized to systematically record the behavior of animals. These various methods are described elsewhere (e.g., Altmann, 1974; Lehner, 1979; Mellen, Hage, Carlson, and Pfeiffer, 1982; Martin and Bateson, 1986; Crockett, in press). The specific sampling method described here for the study of small cats is termed **one/zero** or **checklist** . It is one of the simplest sampling methods to use and affords a high level of inter-observer reliability.

Figure 1 is a data sheet that can be used for collecting behavioral data for pairs of small cats. Below are instructions on how to use this data sheet. Using an audible timer set for a 30-second interval, the observer simply scores whether or not the male and the female were observed to exhibit any of the listed behaviors within that 30-second interval. Each behavior exhibited by the male and the female during that 30-second interval is checked off. At the end of each 30-second interval (signalled by the audible timer), the observer moves to the next column on the checksheet and again checks off those behaviors exhibited by the male and female, if they occur. In any given 30-second interval all of the behaviors could be exhibited by a cat, some of the behaviors could be exhibited by a cat, or none of the behaviors could be exhibited (and thus none of the cells representing that interval would be checked). Regardless of how many times a behavior occurs within each 30-second interval, that behavior is simply checked off as having occurred. For example, a male may cheek rub 13 times within a particular 30-second interval; for that interval, cheek rubbing is simply checked, indicating that at some point within the interval the male was observed to have cheek rubbed. This sampling method is termed "one/zero" for that reason. Regardless of the true frequency, i.e., how many times the cat actually cheek rubbed within the interval, the behavior is given a score of "one" (or checked off) if it occurred, or given a score of "zero" (or not checked off) if it did not occur. At the end of the observation period (usually 60 minutes), the total number of check marks are totalled for both the male and the female. These totals represent the total number of intervals in which the various behaviors occurred. Figure 2 is a sample data sheet and illustrates how data are collected. Note that instead of a check mark, an "M" for male and an "F" for female were used. These symbols were used instead of check marks to make tallying the data easier.

			7				8				9				10		Total	Total
M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F		Male	Female
																Cheek Rub		
																Sharpen Claws		
																Flehmen		
																Urine Mark		
																Vocalize		
																Hiss/Growl		
																Strike with Paw		
																Anogenital Sniff		
																Follows		
																Approaches		
																Mounts		----------
																nape bite		----------
																"pelvic" thrust		----------
																A/G groom after mount		----------
																lordosis	----------	
																tail to one side	----------	
																threaten after mount	----------	
																roll on back after mount	----------	
																A/G groom after mount	----------	

Figure 1. (cont) Blank data sheet to be used for observations on small cats in captivity

NAME _____ DATE _____ TIME _____ PAGE ____

1/0 Data Collection Method				1				2				3				4				5				6	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Cheek Rub																										
Sharpen Claws																										
Flehmen																										
Urine Mark																										
Vocalize																										
Hiss/Growl																										
Strike with Paw																										
Anogenital Sniff																										
Follows																										
Approaches																										
Mounts																										
nape bite																										
"pelvic" thrust																										
A/G groom after mount																										
lordosis																										
tail to one side																										
threaten after mount																										
roll on back after mount																										
A/G groom after mount																										

Figure 1. Blank data sheet to be used for observations on small cats in captivity

NAME Mellen DATE 10 Oct 88 TIME 9:45 AM PAGE 1

1/0 Data Collection Method				1				2			3				4					5				6	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Cheek Rub										F				F											
Sharpen Claws								F																	
Flehmen																									
Urine Mark																									
Vocalize																									
Hiss/Growl																									
Strike with Paw																									
Anogenital Sniff																									
Follows																									
Approaches																									
Mounts																									
nape bite																									
"pelvic" thrust																									
A/G groom after mount																									
lordosis										F				F						F					
tail to one side																									
threaten after mount																									
roll on back after mount																									
A/G groom after mount																									

Notes: F head rubs log F head rubs M

Figure 2. Completed data sheet illustrating how data are collected, tallied, and converted to proportions

Mellen, WPZ

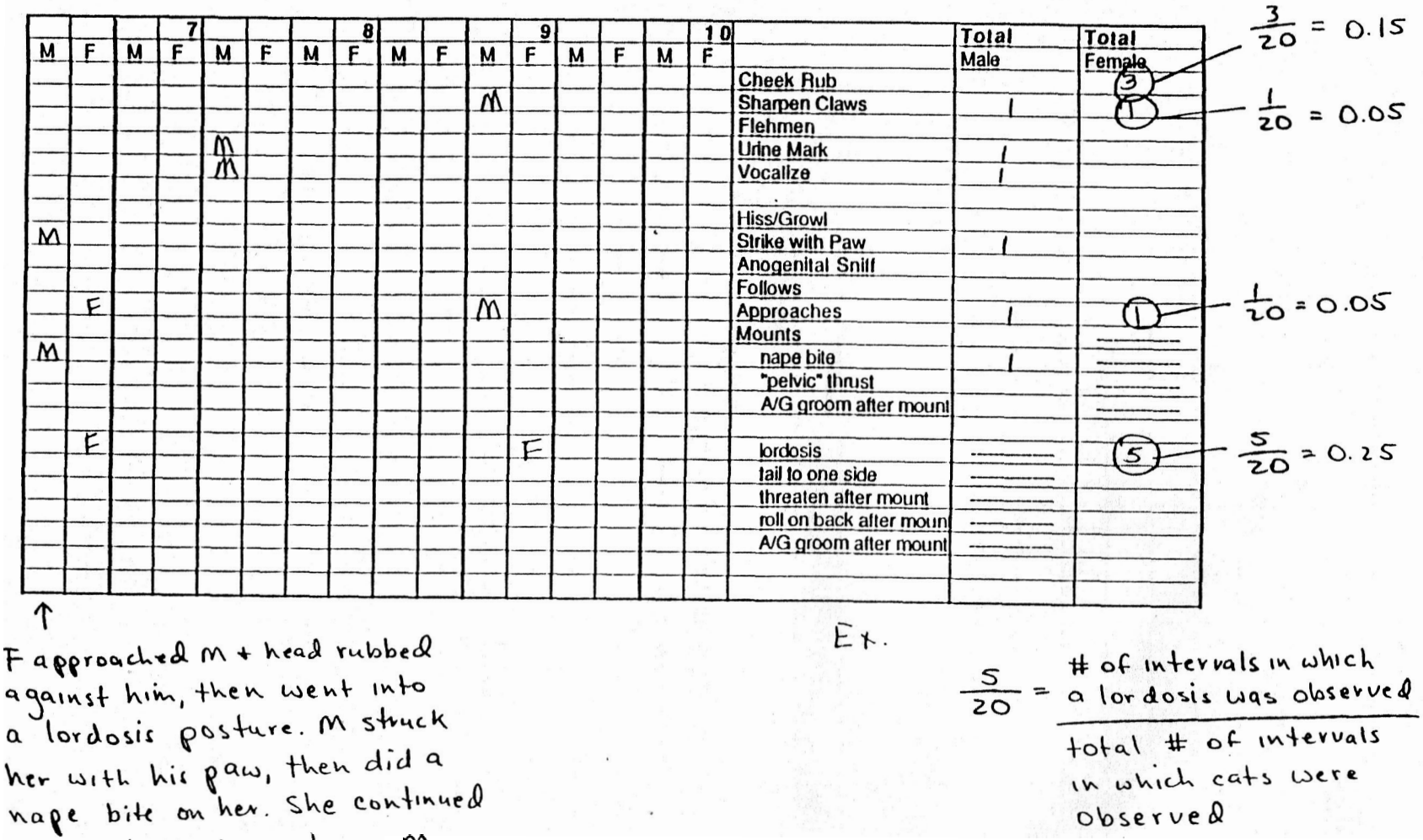


Figure 2. (cont) Completed data sheet illustrating how data are collected, tallied, and converted to proportions

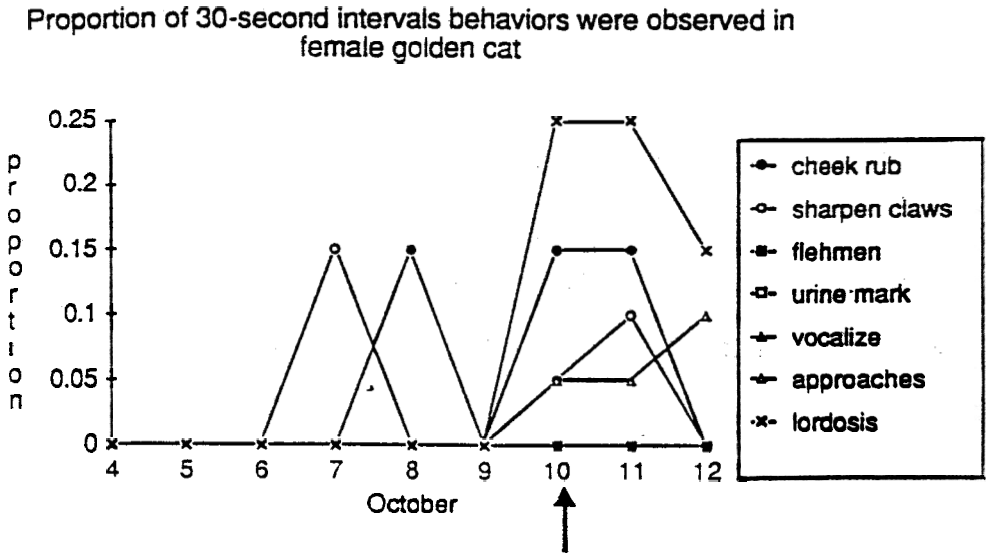


Figure 3. Hypothetical data set for golden cats. Data were collected using a one/zero sampling method, converted to proportions, and graphed over time. Arrow indicated October 10th and represents those sample data presented in Figure 2.

IV. Graphing the data

The data collected can be graphed daily or weekly. In the examples presented below, data are graphed daily. The first step in graphing data is to convert the raw scores, i.e., the tallies on the data sheet representing the number of intervals in which each behavior was observed, to proportions. The simple math used to convert raw data to proportions is illustrated in Figure 2 next to the **Total** columns.

The total number of intervals in which a particular behavior was observed is divided by the total number of intervals in which the cats were observed. In the sample data sheet (Figure 2), a lordosis posture was scored 5 times for the female, i.e., during 5 intervals the female was observed to exhibit a lordosis; the cats were observed for a total of 10 minutes or 20 30-second intervals. Thus, the proportion of intervals in which the female exhibited a lordosis is 5/20 or 0.25. These same calculations are done for each behaviors exhibited by the male and the female. These proportions are then graphed over time. Figure 3 illustrates how these data might be graphed. Typically, data for the male and the female are graphed separately for ease of interpretation.

V. Interpreting the data

Once observations have been made over several months and then graphed, patterns should emerge if the female is cycling, i.e., coming into estrus. Estrus is suggested whenever there is a substantial change in behavior. Typically, the occurrence of scent marking in the female increases dramatically as does the occurrence of all social behaviors initiated by both the male and the female.

References

Altmann, J. (1974). Observational study of behaior. *Behaviour, 49*, 227-267.

Crockett, C. Data collection in the zoo setting. In S. Lumpkin (Ed.), *Wild mammals in captivity.* In press.

Freeman, H. (1983). Behavior in adult pairs of captive snow leopards (*Panthera uncia*) *Zoo Biology, 2*, 1-22.

Hart, B. & Hart, L. (1985). *Canine and feline behavioral therapy.* Philadelphia: Lea & Febiger.

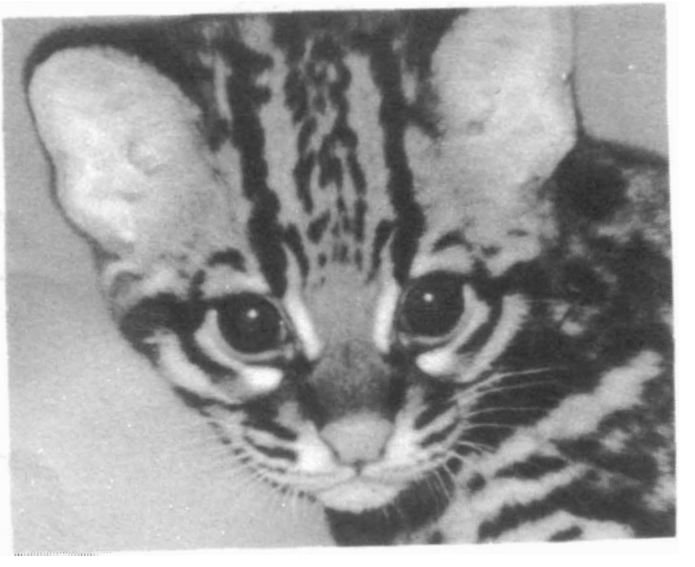
Lehner, P. (1979). *Handbook of ethological methods.* New York: Garland STPM Press.

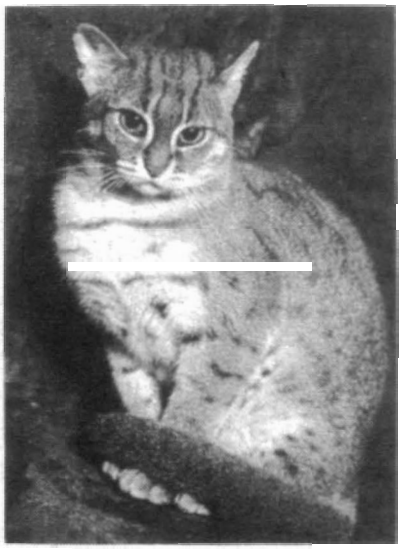
Martin, P. & Bateson, P. (1986). *Measuring behaviour: An introductory guide.* Cambridge: Cambridge University Press.

Mellen, J., Hage, S., Carlson, D., & Pfeiffer, S. (1982). Research methods for studying animal behavior in a zoo setting. Videotape jointing produced by Minnesota Zoo, Apple Valley, MN and Washington Park Zoo, Portland OR.

Wright, M. & Walters,S. (Eds.). (1980). *The book of the cat.* New York: Summit Books.

The cat photos on the following pages are reprinted from the Cincinnati Zoo's 1986 members' scrapbook, which was handed out at the Conference.





MISS JANE BAETJER

1739 N.E. Biddle Street

Palm Bay, Florida 32907

Dear Members,

I am writing this letter with the hopes that we can make a genuine effort to revitalize and re organize the Florida Chapter,and encourage all members new and old,even you that have been out of touch for a while. We need to encourage members to become actively involved again.Our endeavors will once again give the chapter strength and solidarity,that is so desperately needed at this time. The Florida Chapter was once strong and when we spoke,people listened,and we could live with the new legislation.We didnt change the world,but we did make a difference and were heard. I myself,being an old timer of 18 years with the club remember Florida members fighting for what they beleived in,and were very involved,and we did accomplish a great deal. We are now the endangered species,and will soon become EXTINCT----consumed and devoured by the laws,if we dont stand up and come together. We need to pull together and reorganize our ideas and efforts and be heard once again. I have spoken to many local and national members and have their support,and now we need your support.I have proposed we have another Florida Chapter Convention as we did in 1972.I feel this would give us a chance to become inspired with guidelines,projects,etc. to save our cats and ourselves.I remember one thing about the old club meetings in Florida,I made a lot of lasting and cherished friendships,and we all had the same purpose.Somehow the the purpose has been lost in the shuffle of red tape and trying to live in a steroid society that tries to suppress our every emotion and belief. I do feel that in all reality,the Florida Chapter can be strong again,if we can all become involved.We will need spokesmen,attorney,projects,and lots of members with drive and ambition to make this dream a reality.I am confident we can do it -----SO LISTEN UP and let us know if you will try to attend the Florida Chapter(tenative date Feb.1990) We need your support and to attend the convention would be a start in the right direction.

Sincerely,

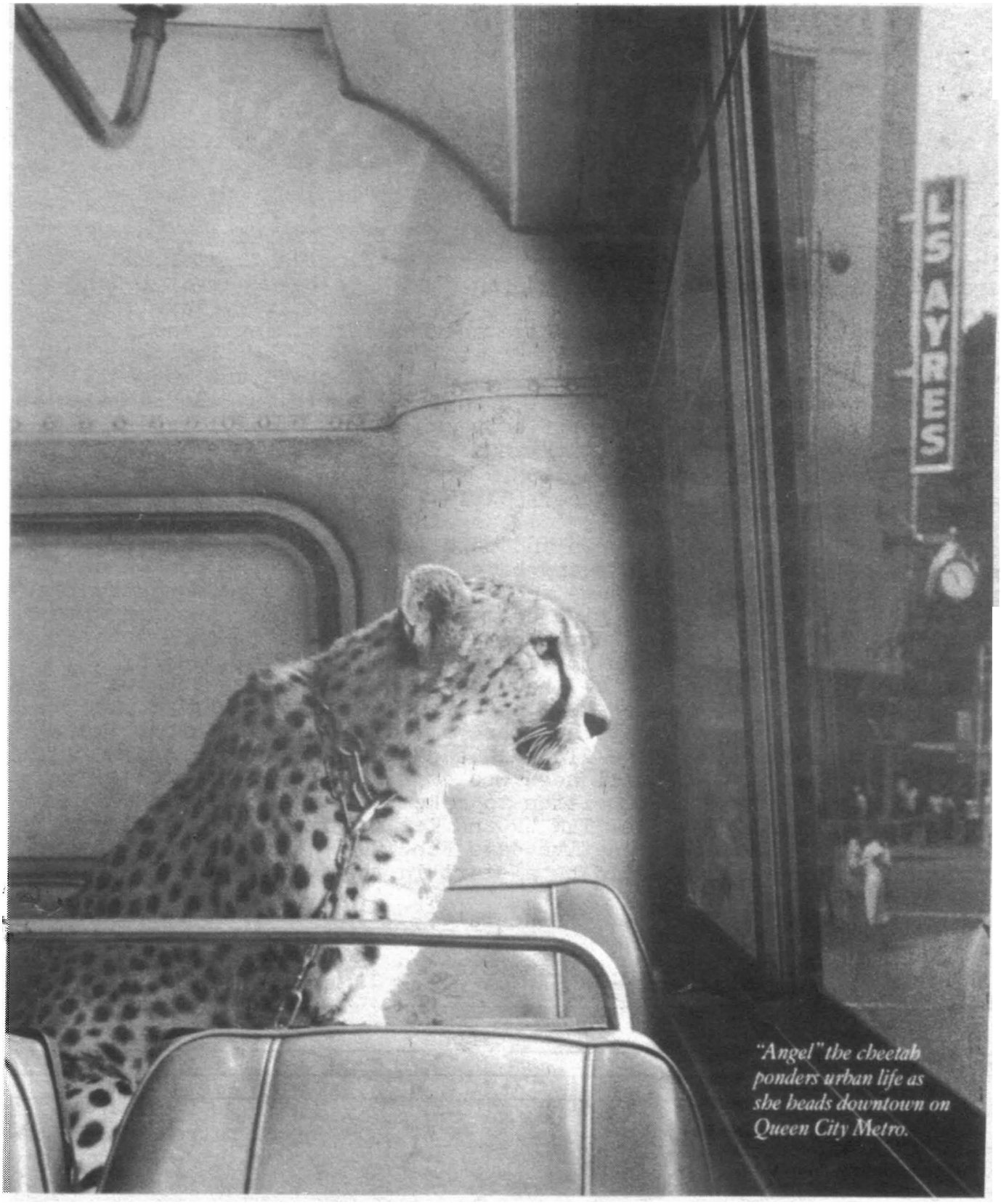
Jane Baetjer

Name_____ Phone_____

Address _____

_____YES I will try to attend ____NO please state reason.

ALL LIOC MEMBERS ARE INVITED AND WELCOME. WE NEED YOUR SUPPORT.



"Angel" the cheetah ponders urban life as she heads downtown on Queen City Metro.