

Thailand Clouded Leopard and Fishing Cat Conservation Project

Collaboration between:

Khao Kheow Open Zoo, The Zoological Parks Organization of Thailand,
Nashville Zoo and Smithsonian National Zoological Park

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Clouded leopards and fishing cats are among the most charismatic and least understood of Thailand's many beautiful cat species. Little is known about the behavior or status of these shy and elusive cats *in situ*. Only three clouded leopards ever have been radiocollared and no systematic survey has ever been attempted for the *in situ* population of clouded leopards. However, there has been rampant habitat loss throughout Southeast Asia over the past 20 years and clouded leopards are considered Appendix 1 under CITES and is listed as vulnerable under the IUCN red data book. Unfortunately, the *ex situ* populations are in no better condition. Breeding clouded leopards in captivity has been a challenge the world over, primarily due to male aggression, decreased breeding activity between paired animals and high cub mortality. Compared to clouded leopards, fishing cats are not as difficult to breed in captivity, however, behavioral incompatibility and male aggression can compromise reproductive efficiency.

Clouded Leopard and Fishing Cat Breeding Program in Thailand

Ex situ efforts must focus on improving clouded leopard breeding success in Thailand zoos where a large population of wild caught animals are being held in zoological institutions. Of the 27 clouded leopards currently in captivity in Thailand only 4 are captive bred animals, and they were produced at either Khao Kheow Open Zoo and Chiang Mai Zoo. Recent research in captive clouded leopards in both Thailand and in North America have revealed that two important factors are involved in poor reproductive performance in this species: 1) imbalanced diet; and 2) stress associated with inappropriate housing facilities. First, many traditional feline diets are high in fat content and provide imbalanced levels of protein, vitamins and minerals. These diets have been associated with health and reproductive problems including metabolic bone disease, poor sperm quality, depressed reproductive cycling and high cub mortality. The recent conversion of the North American's clouded leopard population to commercially available diets (Milliken Meats, Toronto; and Dallas Crown Meats, Texas), which are specially formulated for use in wild cat species, has eliminated health and reproductive deficits in this population. Second, recent research conducted at North American zoological institutions has determined that exposure to human traffic and proximity to other species, particularly potential large predators (such as tigers), correlate strongly with high stress hormone levels in the clouded leopard. Chronic increases in stress hormone levels, in turn, are associated with poor reproductive

performance in a number of species and have been associated with aggressive and lethal attacks by male clouded leopards. Ideal housing for the clouded leopard, therefore, is isolated from both human exposure and from visual contact with other carnivore species (such as large felids, bears, etc.). In light of this new information on clouded leopard management, the Khao Kheow Open Zoo in Thailand and the Nashville Zoo, in collaboration with the Smithsonian National Zoological Park and the Clouded leopard Species Survival Plan (SSP), plan to initiate an improved clouded leopard and fishing cat breeding project at the Khao Kheow Open Zoo that will serve as a model for all future cat breeding projects in the Thailand Zoological Park Organization (ZPO).

Specific objectives for this three-year project include:

Renovate or build enclosures to provide isolated breeding areas and dens for clouded leopards and fishing cats. Develop items for enrichment.

Provide an on-site American animal manager (current employees of the Smithsonian National Zoological Park and the Nashville Zoo) with extensive experience in clouded leopard breeding, nutrition and management.

Provide salary for a Thai animal keeper.

Provide training to Thai animal staff in basic clouded leopard and fishing cat husbandry and breeding techniques.

Provide a nutritionally balanced diet consisting of whole prey items (such as quail, rats) and chicken with nutritional (vitamin/mineral) supplementation. Final diet will be formulated using computerized analyses of nutritional composition of specific items.

Assess changes in stress (measured as fecal cortisol) before and after the improvements in diet.

Assess changes in reproductive status (measured as fecal estrogen and progesterone in females; fecal testosterone in males) before and after the improvements in diet.

Assess changes in stress (fecal cortisol) before and after the move to improved isolated enclosures.

Assess changes in reproductive status (fecal estrogen, progesterone, testosterone) before and after the move to improved isolated enclosures.

Monitor female reproductive cyclicity and seasonality (fecal estrogen and progesterone).

Monitor male reproductive status and seasonality using semen analysis and fecal hormones (fecal testosterone).

Determine time of puberty (using fecal estrogen, progesterone, testosterone) in young male and female clouded leopards and fishing cats.

Develop a record keeping system for animal husbandry, nutrition, breeding, pregnancy and cub survival data.

Begin introductions and breeding encounters with selected animals.

Conduct behavioral observations using an ethogram developed for felids. Ethogram and a list of definitions will be translated into Thai.

Assess changes in stress (measured as fecal cortisol) and behavior before, during and after introductions and pairing.

Monitor pregnancy/gestation/parturition using fecal hormones.

Provide training in hand-rearing protocols used successfully in felids.

Role of the Smithsonian National Zoological Park and the Nashville Zoo

There is a critical need to develop a successful long-term captive breeding program for Thailand's valuable wildlife species. Participation and oversight of the clouded leopard and fishing cat project by an onsite manager from the United States zoo community is fundamental to the ongoing development and future success of the program. One of the most important tasks of the project is to provide an experienced clouded leopard manager on-site at the Khao Kheow Open Zoo during the entire duration of the project to oversee daily animal care and for training and assistance to the staff. The proposed position calls for an individual with extensive clouded leopard and small cat husbandry and breeding experience to develop and supervise the breeding program, and to directly assist and train the zoo staff. Without a qualified person present full-time, the chances for success are questionable. The members of the Clouded Leopard SSP and Rick Schwartz, Director of the Nashville Zoo, have unanimously selected Kenneth Lang for this position. Lang is the Senior Mammal Keeper at the Smithsonian National Zoological Park's Conservation & Research Center and has worked with felids throughout his career. Lang also has successfully paired and bred clouded leopards for more than 20 years. His excellent clouded leopard management skills, particularly in the area of husbandry and species behavior make him an ideal candidate. In addition, his interpersonal skills are well suited for interacting with the animal care staff at zoos in Thailand. While Lang is stationed in Thailand, a temporary keeper will be hired at CRC to replace Lang. Rob Santymire has been selected as the replacement animal keeper at CRC.

Due to responsibilities related to his job at CRC, Lang is unable to live in Thailand all year round. Therefore, the project will require that Lang be in Thailand during key transition points in the development of the breeding program. This will mean working in Thailand for two periods of ~4 months each in 2002-2003. During the first period, he will supervise and oversee enclosure modifications, nestbox construction, gradual diet changes, and animal transfers to the newly renovated breeding facility. In the second 4-month period, he will initiate breeding encounters in the new breeding facility including pairing and developing a reliable record keeping system and studbooks. In the interim 4 month period, Nashville Zoo will provide an animal husbandry manager with extensive expertise in felid management. The Nashville Zoo has selected Peter Riger for this position, who will travel to Thailand with Ken Lang for the first 2 weeks to meet Thai colleagues and assist in initial enclosure renovation and nestbox design. Funding will be necessary for air travel and per diem for Ken Lang and Peter Riger. The Khao Kheow Open Zoo will provide free housing for Lang or Riger during their time in Thailand. The purchase of a small truck is required.

Animal Collections at Thailand Zoological Institutions

Before initiating the formal project, it was necessary to conduct a 'prospecting expedition'. Specifically, Ken Lang and Rick Schwartz traveled to Thailand for two weeks in February 2002 to assess priorities and explicit needs to make the formal project successful. Funding for air travel within Thailand, lodging and per diem was

provided by the Nashville Zoo, and international air travel for Lang was provided by British Airways. This trip allowed Lang and Schwartz to: 1) assess existing and potential breeding facilities at the Khao Kheow Open Zoo and begin to determine necessary modifications and renovations; 2) evaluate general appearance and health of all clouded leopards maintained in the five participating zoos of the Zoological Parks Organization (Korat, Songkala, Khao Kheow, Chiang Mai and Dusit Zoos) to determine best candidates for breeding program; 3) discuss diet options (commercial frozen meat versus live rodent/bird colony) for cats housed at the Khao Kheow Open Zoo based on available funds, storage and space; and 4) formulate a budget and timeline for the project with the Zoological Parks Organization Director General, Pisit na Patalung and Deputy Director General, Sophon Dumnuai.

A summary report of the February 2002 Thailand trip entitled 'Clouded Leopard Collection and Facility Evaluation of Thailand Zoological Parks Organization' (prepared by Rick Schwartz) is available. This includes assessment of the clouded leopard collections and facilities at the five ZPO zoos (Korat, Songkala, Khao Kheow, Chiang Mai and Dusit Zoos). A list of the 27 clouded leopards maintained and evaluated at the five ZPO's zoos also is available. This list includes a brief description and ranking of each animal (rank based on animal condition and health appearance; scale of 0 to 5; 5 being the best candidate for inclusion in the breeding program). It was concluded that the breeding program for clouded leopards be developed at the Khao Kheow Open Zoo. A Memorandum of Understanding (MOU) was prepared and has been signed by the four collaborators (Khao Kheow Open Zoo, Nashville Zoo, Smithsonian National Zoological Park and the Clouded Leopard SSP). Fishing cats later were included in the project since the addition of this small cat required minimal additional funding primarily for proper diets and research supplies for hormonal analyses. Overall, this project will serve as a model for future breeding programs in rare felids in Thailand and Southeast Asia.

Training Workshop in Feline Husbandry and Breeding

All workshops previously conducted in Thailand have focused on information and technology transfer for senior staff, curators and veterinarians. No training workshops have been provided for animal keepers. Therefore, training for the animal care staff at the five Thailand Zoological Parks Organization (ZPO) institutions is an important aspect to the utilization of appropriate husbandry protocols. Training during this project will be conducted in two ways: On-site Program Managers will actively train staff in daily routines and basic animal husbandry procedures at the Khao Kheow Open Zoo and through visits to the other ZPO facilities. Also, a workshop entitled 'Thailand Feline Husbandry, Enrichment and Breeding' for regional animal care staff is scheduled for January 2003 at the Khao Kheow Open Zoo. This workshop will cover animal husbandry and care, enrichment, nutrition, reproduction, record-keeping, preventative health measures, and exhibit design and maintenance procedures. Other topics will include animal handling and shipping, the mission of zoos and pest control. This will be the first workshop in what could become a yearly program.

Research Studies Using Non-Invasive Fecal Hormone Monitoring at the Khao Kheow Zoo

Numerous research studies are proposed and will be required to optimize efforts to breed clouded leopards and fishing cats at the Khao Kheow Zoo. A three year research plan is proposed to investigate a number of basic questions about male and female clouded leopard and fishing cat biology and to assess the progress of the collaborative breeding project. This research will depend upon non-invasive assessment of stress and reproductive activity of male and female cats using analyses of hormone metabolites excreted in feces. The collection and freezing of daily fecal samples will be required for this research. The following is a brief summary of the proposed studies.

Assess the impact of housing and imbalanced diets on stress and reproduction in male and female clouded leopards and fishing cats.

Rationale: Both stress and nutritional deficiency have profound effects on feline reproductive success. Known causes of stress in captivity include lack of hiding places (nest boxes), small enclosure size, and close proximity to large carnivores such as tigers, leopards and bears. All of these conditions are known to decrease reproductive success in clouded leopards and all of these conditions currently exist for clouded leopards and fishing cats in the Zoological Parks Organization in Thailand. In addition, inadequate or unbalanced intake of vitamins and mineral in the diet also results in poor fertility in cats. During the collaborative Thailand breeding project, the clouded leopards and fishing cats included in this project will be placed in improved housing situations and will be started on an improved balanced diet. This affords an excellent opportunity to document the impact of these improvements on reproductive and stress parameters in these cats. Fecal samples will allow documentation of female reproductive cycling activity and male testosterone levels over time as each improvement is made. These hormones assays will be conducted by Dr. JoGayle Howard and Dr. Katey Pelican of the Smithsonian National Zoological Park. On the same fecal sample, stress levels can be quantified through analysis of fecal stress hormone (cortisol) levels. These endocrine assays will be analyzed by Dr. Nadja Wielebnowski at the Brookfield Zoo.

Research Plan:

Collect daily fecal samples from males for at least 2 months before and 4 months after move and/or diet change to determine changes (if any) in fecal testosterone and cortisol metabolites. Ideally, the move to the new enclosure and the change in diet should occur at different times so that the effect of each change could be documented.

Collect daily fecal samples from females for at least 2 months before and 4 months after move/diet change to assess changes, if any, in progesterone, estrogen and cortisol levels. Ideally, the move to the new enclosure and the change in diet should occur in steps so that the effect of each change could be documented.

Collect at least 3 months of fecals from adult males and females exposed to: a) nutritious diet but stressful housing (proximity to large carnivores, lack of hiding capabilities, small enclosure size, exposure to human contact); b) good housing-and unbalanced diet; and c) poor housing and unbalanced diet.

Develop a behavioral ethogram to assess animal behavior to the changes in housing conditions. Correlate cortisol and testosterone (males) or progesterone and estrogen (females) with stress and nutritional parameters.

Assess normal reproductive function in males and females moved to the Khao Kheow Zoo breeding center.

After the animals have been moved and given the opportunity to settle in, 6 months of fecal hormones will be collected to assess normal reproductive traits in female and male clouded leopards in Thailand Zoos. Data will provide the first comprehensive assessment of normal reproductive function in the Thai population as compared to previous studies focusing on the North American zoo population.

Monitor breeding pair progress throughout the move, pair introductions, breeding activity, pregnancy, parturition and lactation through correlation of behavioral observations with fecal hormone parameters.

Behavior in the animals included in the breeding program will be monitored daily using an ethogram developed by Dr. Nadja Weilebnowski. In conjunction with daily observations and video documentation of cats, daily fecal samples will be collected to correlate behavior with reproductive and stress hormone levels. These data also will be used to monitor parameters of the breeding program including suitability of enclosure design, pair introduction techniques, compatibility of pairs and breeding success. To determine normal pregnancy parameters, fecals should be collected during pregnancy, parturition and throughout lactation and then for 2 months following weaning of the cubs.

Determine onset of puberty and age at sexual maturity.

Data also will be collected opportunistically on pre-pubertal animals during the course of the proposed project. In order to determine time of puberty (sexual maturity), daily fecal samples should be collected on fishing cats and clouded leopards at the Khao Kheow Zoo from the age of 6 months (fishing cats) or 12 months (clouded leopard) until 36 months of age.

End Result: In the first year, analysis of fecal hormone parameters will provide a wealth of information on the health and reproductive status of the clouded leopards and fishing cats in the Thailand breeding center project. We will be able to: 1) monitor the effect of improved nutrition and housing on the animals included in the project; 2) determine the normal reproductive activity of male and female clouded leopards and fishing cats in Thailand; 3) determine the level of stress in individuals and make improvements to diet and housing when necessary; 4) determine optimal living conditions for clouded leopards and fishing cats including nest box location and number, height of enclosure and proximity to other cats; 5) determine normal timing of puberty for fishing cats and clouded leopards in Thailand; 6) monitor progress and problems associated with introductions and pairings; 7) identify normal pregnancy parameters including

duration of pregnancy and lactational anestrus; and 8) diagnose reproductive problems in specific individuals in the project.

Protocol for Clouded Leopard and Fishing Cat Fecal Collection: Collect entire fecal sample from each female in the study each day (or as often as they defecate, which is often not daily). This will require daily cleaning of each animal enclosure to ensure that the proper date is affixed to each sample and to ensure that samples do not remain under suboptimal conditions for more than 24 hours. The samples should be placed in zip-lock plastic bags (provided) and labeled with the cat's name, studbook number and the date of collection in permanent ink or ballpoint pen. If the animals are paired with another cat, one of the animals should be given food coloring dye (provided) daily to distinguish between the fecal samples. The dye provided is very concentrated so only a drop is needed mixed into a meatball or specific food item. Any changes in the location, enclosure, diet, pair status, lighting, weight, health status, behavior etc. should be noted daily for each animal in the research program. This is very important so that we can correlate animal changes with alterations in the hormone levels. Samples should be frozen within 1 hour of collection and stored frozen until shipped to the Conservation & Research Center. Fecal samples are considered wildlife 'by-products' (rather than parts) and are not regulated under CITES/Endangered Species Act in the USA. Therefore, the United States does not require CITES documents for the international movement of feces. Although subject to inspection at port of arrival, feces also are not regulated by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS).

Thailand *In Situ* Felid Conservation Project

Thailand has many charismatic cat species in the world, including the tiger, clouded leopard, golden cat, fishing cat, flat-headed cat and marbled cat. Habitat loss has been rampant throughout Southeast Asia over the past 20 years, and these felid species are vulnerable to population pressures and habitat fragmentation. Conservation plans for saving these endangered cats *in situ* are hampered by a lack of information on their status and distribution across remaining habitats. Programs are needed *in situ* to identify critical habitat and species distribution so that specific management actions for these felids can be implemented.

The development of an *in situ* conservation field activity is a critical and necessary component of this project. To begin identifying needs and strategies, JoGayle Howard conducted a meeting in April 2002 at the National Zoological Park's Conservation and Research Center (CRC) with field biologists from CRC (Bill McShea, Peter Leimgruber, Melissa Songer, Chris Wemmer) and also Conservation International (Jim Sanderson; currently working on field projects in Thailand). Numerous field studies and sites within Thailand were discussed and considered for this project. It was decided that a major area of focus should include the Khao Yai National Park and a wildlife habitat adjacent to Khao Yai National Park that is managed by Wildlife Fund Thailand (a conservation organization established in 1983 involved with anti-poaching activities and re-forestation of wildlife habitats). Khao Yai National Park was the first park to be established in

Thailand in 1962, and it remains the largest of all national parks in Thailand (2,176 sq km). One major advantage of this *in situ* survey project is that, although clouded leopards and fishing cats are the primary areas of focus, information will be obtained on multiple species in the nature reserve. Numerous cat species (including tigers, clouded leopards, fishing cats) and also elephants have been observed in Khao Yai National Park. Also, the CRC has numerous GIS (Geographic Information System) and satellite imagery tools that will be useful for assessing all habitats in Thailand in addition to specific ‘*in situ*’ sites.

In June 2002, Peter Leimgruber visited Khao Yai National Park and a Khao Yai Conservation Project (a re-forestation project located adjacent to Khao Yai) run by WildAid in Thailand. During the visit, Peter met with Steve Galster (Wild Aid), Alongkot Chukaew (Project Leader), and Dr. Chumphon Sukasem (Park Superintendent) to discuss potential collaborations. The CRC was invited by the Thailand Royal Forestry Department and WildAid to collaborate on *in situ* projects in Thailand. WildAid is interested in a collaborative project for elephant population monitoring at Khao Yai National Park, and a joint research proposal has been submitted to the U.S. Fish and Wildlife Service. Felid conservation projects now are being developed and will be coordinated through the Thailand Royal Forestry Department and WildAid. CRC ecologists Dr. Peter Leimgruber and Dr. Bill McShea will work with the Thailand Royal Forestry Department to monitor habitat and species density of wild felids (including tigers, clouded leopards, fishing cats) in Khao Yai National Park.

There will be three main components to the work in the wild:

1. A regional habitat analysis of Thailand using satellite imagery and GIS (Geographic Information System) will be conducted to identify areas with the greatest potential for felid conservation. CRC staff, Dr. Peter Leimgruber, will coordinate these activities at the Conservation & Research Center GIS Laboratory. Similar to the recently completed regional habitat analysis for Asian elephants in Myanmar (Burma), CRC scientists will use existing digital data/satellite imagery on human activities (fires, roads, logging) and forest cover information to identify critical remaining habitats and assess their degree of legal protection. This will allow us to identify: a) which areas are critical for tiger, clouded leopard and small cat conservation; b) which areas are imminently threatened; c) how much habitat has been lost already; d) what is the protection status of the remaining habitats; and e) where are other groups working (i.e. where are the gaps in conservation activities). These are country-wide assessments that can inform detailed local conservation research and activities. At the local scale, GIS/remote sensing can be useful for long-term monitoring of populations and habitats.

2. A field survey of cat populations will be conducted and, if possible, ecological studies to identify habitat selection in the species. CRC field staff, Bill McShea, will conduct the field monitoring project and assist staff in the Thailand Royal Forestry Department’s Khao Yai National Park in species identification and animal densities using motion detection cameras. These cameras will be positioned in grids using a systematic scientific protocol. GPS (global positioning system) units will be used to identify exact location of each camera. Khao Yai National Park will be surveyed through extensive use of infra-red trip cameras. This Park is 2,176 sq km and will be divided into 136

blocks (each 16 sq km). Each block will be monitored for one week with 3 cameras placed at likely locations within the block. Each site will be baited with lure to attract predators and the cameras positioned to obtain a side view of the animals. With 21 cameras active, we will need 20 weeks of monitoring (plus 10 weeks for moving and restoration of cameras) to cover the reserve. The pictures of felids will be examined for unique coat pattern and markings, and this will be used to identify felid species in the park and also estimate the number of felids within species in the park based on a capture/recapture modeling of the number of new and "repeat" individuals photographed. Ideally, this also would include radio-telemetry, depending on whether this is feasible and acceptable for Royal Forestry Department.

3. A training component for capacity building during which field staff in the Thailand Royal Forestry Department will be trained in field techniques for monitoring habitat and animal density. A graduate student (Masters or PhD degree) from a Thailand university will serve as Project Coordinator and be responsible for directing the field team (four forestry staff stationed at Khao Yai National Park) and camera monitoring. If approved by the Royal Forestry Department, monitoring techniques also could include radio-telemetry of individual animals. A GIS intern will be needed for one year at the Smithsonian National Zoological Park's Conservation & Research Center GIS Laboratory to develop the GIS maps of Thailand and Khao Yai National Park.