American Association of Zoological Parks and Aquariums

EXECUTIVE OFFICE AT OGLEBAY PARK, WHEELING, WV 26003-1698 (304) 242-2160

DATE: 16 December 1982

REPLY TO: Thomas J. Foose, Ph.D.
AAZPA Conservation Coordinator
ISIS Office
Minnesota Zoological Garden
Apple Valley, MN 55124
(612) 432-9010, Ext. 255

Dr. Nico J. Van Strien
P.O. Box 109
Bogor
Indonesia

Dear Dr. Van Strien:

Thank you for your letter of 10 December and the copies of the two very informative reports. Your latest estimates of the rhino populations in Gunung Leuser are most encouraging. I also appreciate the lead about the possible translocation of rhino in West Malaysia.

I'm glad Rodney Flynn has advised you of the AAZPA interest in a captive propagation program for Sumatran rhino to reinforce efforts to preserve this species in its natural habitat. We have been exploring such a possibility through various contacts, particularly in Sabah where some of the most appropriate opportunities appear to exist to collect animals that are not in viable situations ecologically, genetically, or politically.

Currently, I am attempting to prepare a proposal for the AAZPA to proceed with attempts to develop a Sumatran rhino project. Enclosed is a very preliminary draft for your review. The proposal is merely a working document prepared before I received your latest report. Furture versions of the proposal would incorporate your new figures.

It must be emphasized the plans proposed are very tentative and could be implemented only if the AAZPA Board approves. Indeed, the proposal has been prepared primarily to persuade the AAZPA to commit to a Sumatran rhino project. In the meantime, I am attempting to collect as much information and advice as possible before submitting the proposal officially to the Board. However, a preliminary review by the AAZPA President and Executive Director has been very positive. I am optimistic we can proceed if appropriate plans can be developed.

Admittedly, I am something of a novice with this species and its situation biologically and politically. Hence, I would appreciate if you would treat the proposal confidentially for now until it can be improved based upon input from persons like yourself, Rodney Flynn, etc.

Thus, your comments on the proposal would be greatly appreciated. Specifically, I solicit your counsel on:

(1) the basic proposition of a captive propagation program as part of a global strategy to preserve this species;

(2) the general plan of action delineated in my proposal, i.e., commencing and concentrating in Sabah and perhaps West Malaysia;

(3) your interest and availability to participate in such a project, perhaps as a field manager or adviser for some of the capture operations;

(4) the exploratory trip early next year, and in particular whether you might be able to assist in arrangements for visits to Gunung Leuser and perhaps Udjung Kulon;

(5) the position of Dr. Schenkel and the Asian Rhino Specialist Group on captive propagation for this species.

Please forgive whatever naivete or insensitivity may reside in the proposal as presently prepared. The AAZPA is greatly concerned about the Sumatran rhino, indeed all rhinos. To provide you with a better perspective on our conservation programs and plans, enclosed also is a copy of a paper I presented at the Rhino Symposium sponsored by the London Zoo last August.

In conclusion, we believe that the resources, facilities, and experience that the AAZPA could provide might be able to assist the efforts to preserve the Sumatran rhino. But we want to become involved only as part of a global strategy for this species as established and/or endorsed by the IUCN SSC Asian Rhino Specialist Group. Therefore, we need guidance from persons such as yourself.

Best regards,

tom

Thomas J. Foose, Ph.D.
AAZPA Conservation Coordinator

Enclosure

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REPLY TO: Thomas J. Foose, Ph.D.
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ISIS Office
Minnesota Zoological Garden
Apple Valley, MN 55124
(612) 432-9010, Ext. 255

John Payne, Ph.D.
Wildlife Section
Forest Department
P.O. Box 311
Sandakan, Sabah
Malaysia

Dear Dr. Payne:

Thank you for your letter of 23 November 1982 concerning the possibility of a propagation project for Dicerorhinus sumatrensis in Sabah. The AAZPA is indeed interested in participating in a global campaign to preserve this species through a strategy that will involve both captive and wild populations. An overview of the AAZPA programs and plans for the entire family Rhinocerotidae is provided by the enclosed copy of a paper I presented at the International Rhino Symposium at the London Zoo last August.

Currently, I am in the process of developing a proposal for an AAZPA project on Sumatran rhino. A first step in the proposed plan would be an exploratory trip to Malaysia and Indonesia from mid-March through mid-May 1983. The purpose of the trip would be to visit as many sites, scientists, and officials as possible to evaluate the potentials and problems of a captive propagation project involving the AAZPA. Therefore, your invitation to visit Sabah to assist in possible development of a captive propagation program has been received with great interest and appreciation.

Consequently, if the proposed trip is possible, Sabah would be the first and probably most important of the rhino areas to be visited. West Malaysia and perhaps Sumatra would also be included (the latter region mostly for comparison and perspective as the situation for collecting rhinos there seems less appropriate). Presently, I am contemplating two weeks in Sabah, longer if necessary and desirable, commencing about the third week in March. Would such a schedule be agreeable to you and others in Sabah?

It must be emphasized that these plans are still tentative. Approval by the AAZPA Board will be required before the plans can be finalized. But AAZPA interest is high to assist with efforts to preserve this unique creature so close to extinction. I am hopeful I will know by late January if the AAZPA Board will approve the trip. In the meantime, any further information or advice you could provide would be greatly appreciated.

Sincerely,

Thomas J. Foose

Thomas J. Foose, Ph.D.
AAZPA Conservation Coordinator

TJF/slp

Enclosure

cc: R. Wagner, AAZPA Executive Director
P. Karsten, AAZPA President
W. Conway, Chairman, AAZPA Species Survival Plan Committee

IN PURSUIT OF THE SUMATRAN RHINO

A Proposal

Thomas J. Foose, Ph.D.
AAZPA Conservation Coordinator
7 December 1982

INTRODUCTION

This is a preliminary proposal to the AAZPA Board and Sumatran Rhino Interest Group to proceed with explorations toward establishing a captive population and program to assist with preservation of this species. More specifically, this proposal is an application for approval from the AAZPA for an exploratory trip to be conducted by Tom Foose or another SSP representative in the first half of 1983 to Malaysia and Indonesia to advance this project. Other steps to develop this program are also proposed.

BACKGROUND

The Asian two-horned rhino (Dicerorhinus sumatrensis) may be the most gravely endangered of the 5 surviving species of this family (Table 1). Although the total population estimated for the Javan rhino is lower, its situation seems more sanguine because of an active program of protection by conservationists (WWF 1981-82). Moreover, the Javan is not the only representative of its genus. The Indian rhino is at least superficially similar despite ecological differences from the Javan (Groves 1967). In contrast, the Sumatran rhino is the sole survivor of a formerly more successful genus and is considered representative of a primitive type from which other extant rhinos may have evolved (Groves and Kurt 1972).

Information available from recent and reliable reports on the distribution of surviving Sumatran rhinos is summarized in Tables 2 and 3 and Figures 1 and 2. Numbers are precariously low and the decline continues inexorably. Both Borner (1979) and Flynn & Abdullah (1982) document the disappearance of rhinos from areas of former occurrence, even of moderate abundance, during the last ten years. One by one, the last remnants are being lost.

Moreover, even where rhinos do and will survive in natural habitats, populations may be so small and fragmented as to be genetically unviable. Population biologists have advised that a genetically effective population of 500 may be necessary for long term survival of a species (Franklin 1980, Soule 1980). A number of population biologists believe even this number may be too few. Extinction due to loss of genetic diversity and vitality is not the only problem.

Small populations are vulnerable to extinction from other types of perturbations such as natural disasters, demographic stochasticity, etc. (Shaffer 1981).

In the case of the rhinos, there is yet another, probably greater threat. Poachers may be the final executioner. Unless sanctuaries can be secured against poachers, there is no hope for this species in the wild.

Field conservationists have contended that there are several sanctuaries and populations that might be preservable in the wild (Borner 1979; WWF 1981; Andau and Payne 1982; Flynn and Abdullah 1982; Clive Marsh, personal communication). The five most probable places are designated by asterisks in Table 2: Gunung Leuser and perhaps Kerinci/Seblat in Sumatra; Endau Rompin and Taman Negara in Western Malaysia (Peninsular Malaysia); and the Silabukan/Lumerau and South/South East Forest Reserves in Sabah. not an official name; just a region.

The other surviving rhinos are fragmentally distributed over the range of the species in remnants of one to five animals usually in areas with poor protection. These remnants have little or no prospect for survival biologically or politically in their present location. A viable alternative would be to collect some of these animals for a captive population. Collectively, these remnants represent an appreciable number of animals (Table 3).

An alternative to captivity for the remnants might be to translocate them into the possibly protectable reserves and preservable populations. However, as Andau and Payne (1982) in part observe, there are formidable risks and problems with such an enterprise.

(1) Not enough is known about the ecology of rhinos to assure the success of translocation.
(2) Security of the possibly preservable sanctuaries and populations is far from certain.
(3) Genetic management could be maximized in a captive situation.

Even if a few populations of Sumatran rhino can be preserved in the wild, it may still not be possible to maintain large enough numbers (i.e. the N_E) for long term survival. Successful protection of the major sanctuaries and populations designated in Table 2, an objective of a great uncertainty, would probably only

produce a total of 550 rhinos. These estimates are predicated on the area of the sanctuaries that can probably be protected and a maximal density of one rhino/40 km^2 suggested by the ecological studies of Flynn and Abdullah (1982). Certainly, none of the separate populations enumerated in Table 2 could constitute a genetically effective number, N_E, sufficient for long term survival of the species. If interactively managed to constitute a single population biologically through carefully regulated exchanges of animals periodically, these demes might be viable genetically. An N_E of 550 would be just at the threshold for long term viability prescribed by the population biologists. However, in the wild N_E's are usually well below the actual population. The subdivision of the population into several demes might compensate somewhat but the number of the different populations would still be low. Moreover, it cannot be overemphasized that protection of these populations and sanctuaries in the wild is a very uncertain prospect. For example, the June 1982 issue of the Malayan Nature Journal is devoted to articles about encroachment into Taman Negara National Park.

The potential of a captive population of several hundreds managed to maximize its genetically effective size could be a vital reservoir to reinforce and replenish the wild stock until or unless larger reserves could be secured in the wild. Survival of the Sumatran rhino (and many other species) may well depend upon an interactive system of both wild and captive populations.

The possible importance of a captive population is not a new idea. At least as early as 1959, the potential of a captive population to preserve the species was recognized (Anderson 1961). In that year, an expedition was sponsored by the Copenhagen, Basel and Boger Zoos to collect rhino along the Siak River in Sumatran. Ryhiner and Skafte conducted the operation.

Ten rhinos were collected in an unprotected area. Estimates of the local population at that time was 40-60 rhinos. Unfortunately, only one male was among the ten collected and he escaped. A female was consigned to each of the three zoos, the other six were released. Of the three placed in zoos, the animals at Bogor and Basel both died in 1961. The female at Copenhagen survived until 1972 when it succumbed to vandalism. Perhaps even sadder than the abortive results of this well intentioned endeavor is the fact that a survey by

Borner in 1975 discovered no evidence of rhino in the same Siak River area where in 1959 the species was described as plentiful and the 10 were actually collected. Borner concluded the Sumatran rhino had been exterminated in this region.

In 1976, Borner, who had conducted an extended study of the rhino all over Sumatra for IUCN/WWF and the Indonesian Government (Borner 1979), prepared a proposal for establishment of a captive population founded by remnant individuals and groups of Sumatran rhino with virtually no hope of surviving in their habitat and hence of contributing to perpetuation of the species. Naturally, this proposal was very knowlegeably and thoroughly prepared. Implicitly, the Borner proposal had the moral support of WWF and IUCN. The proposal was circulated to several zoos. Unfortunately, none of the individual institutions could provide the commitment of resources and leadership to implement this project. So the proposal expired and Borner moved onto other assignments in Africa where he still is located.

The current AAZPA initiative on Sumatran rhino commenced with the formal inception of the Species Survival Plan and the appointment of an AAZPA Conservation Coordinator. Because of its desperate situation, the Sumatran rhino was one of the four species designated by the SSP in 1981 as part of its strategic program for the entire family Rhinocerotidae. Preliminary explorations were initiated for this ambitious enterprise.

The first really productive lead and contact were established through the New York Zoological Society in the autumn of 1981 with Dr. Clive Marsh. Dr. Marsh has considerable field experience in South East Asia and is currently employed as the Conservation Officer for the Sabah Foundation which is one of the main forest development companies in that country. Through Clive much information has been obtained on the rhino situation in Sabah, and promising contacts have been established with wildlife officials there, principally ~~Phillip~~ Patrick Andau, Assistant Chief Game Warden.

Basically, a few rhinos survive in Sabah. The largest concentration seems to be in the Silabukan/Lumerau Forest Reserves under concession to the Sabah Foundation. This company is, of course, engaged in development of the forests

for human needs. However, they are also committed to conservation and in particular are concerned about survival of the rhinos. It is now believed there may be some hope to preserve the rhinos and habitat in the Silabukan/Lumerau Reserve (Figure 2).

However, there are a number of rhinos evidently inhabiting areas around the Silabukan Reserve that are going to be converted to agriculture (Area 2 on Figure 2). Wildlife officials in Sabah (Andau and Payne 1982) have strongly recommended these animals be collected for a captive population and have tentatively invited the AAZPA to organize this effort. The Sabah Foundation has also indicated they would provide logistical and perhaps other support for a project to collect rhinos for a captive program.

Additional rhinos probably occur elsewhere in Sabah. There is another population in the ~~South/South East Forest Reserve~~ Forest Reserves of South and South East Sabah that may also be protectable in the wild.

Extensive discussion of the proposal to establish a captive population and program occurred at the IUDZG Rhino Symposium in London, August 1982. In attendance were representatives of major zoos around the world as well as many field conservationists including members of both the SSC Asian and African Rhino Groups and SSC Chairman Gren Lucas. Indeed, the Symposium provided Foose, Rabb, and Maruska the opportunity to confer directly with Clive Marsh and also with Andrew Laurie, a member of the Asian Rhino Group with much experience on rhinos in Asia. There was general agreement that a captive program would be a constructive, if not crucial, contribution to preservation of the Sumatran rhino. The sole qualification placed on the proposition was that only animals outside the main sanctuaries and populations be considered candidates for the captive programs.

Possibilities in Sabah were explored further by Dr. Archie Carr, Assistant Director of the N.Y.Z.S. Animal Conservation and Research Center, during his recent attendance at the World National Parks Congress in Bali, Indonesia. Clive Marsh and Sabah officials were also there. They were most encouraging about an AAZPA project, assuring Carr that it would be politically feasible. Indeed, they stated the Wildlife ~~Department~~ Section of Sabah would ~~extend an official invitation to~~ welcome the AAZPA to conduct an exploratory expedition to assess logistical and bio-

logical feasibility of the project. They propose the trip occur in the first half of 1982. ~~The invitation is expected in the near future. It~~ appears important that the AAZPA decide if they will pursue this project as soon as possible so the exceptional interest and momentum of the Sabah officials are not lost.

Good opportunities appear also to exist to extend this kind of project into Western Malaysia (Peninsular Malaya). As in Sabah, there appear to be an appreciable number of animals distributed as invaluable remnants in the country (Table 3). Another important contact that has been established is with Dr. Rodney Flynn who has recently completed a 5 year study of Sumatran rhino in Peninsular Malaya. He has provided invaluable information on the ~~biological and political~~ situation there. Moreover, he too has acknowledged the inviability of the rhino remnants, especially in genetic terms (Flynn and Abdullah 1982).

Politically, ~~Peninsular Malaya~~ and Sabah are ~~states~~ in the Federation of Malaysia. ~~All~~ Indications are that a project to collect animals in both Sabah and West Malaysia would be feasible politically. Mohd. Khan bin Momin Khan who is the Director-General of the Malaysian Department of Wildlife and National Parks has been cited in a recent article on rhinos in ~~Asia Week~~ (June 1982) as being supportive of a captive program to reinforce wild populations.

Any attempt to develop a captive program for Sumatran rhino should be a part of a global strategy for preservation of the species. The IUCN SSC Asian Rhino Specialist Group should be the coordinator of such a strategy. Sanction from the Asian Rhino Group for an SSP project would be highly desirable, perhaps essential. Unfortunately, the Asian Rhino Group has not yet endorsed AAZPA SSP endeavors. Conway and Foose apprised Asian Rhino Group Prof. Dr. Rudolf Schenkel of AAZPA interest in a letter of 17 February 1982. The objective was to establish a dialogue with Dr. Schenkel and the Group. Schenkel responded to the letter on 29 April 1982. His position was noncommittal but he stated he would present the AAZPA overtures at the next meeting of the Asian Rhino Group in Kuala Lumpur in June 1982 and advise us of their position. Another partial session of the Asian Rhino Group was also convened at the general SSC Meeting in Kuala Lumpur in October. Schenkel has not responded since his April letter.

Some other members of the Asian Rhino Group have been quoted in print (e.g., Asia Week 1982) or have personally communicated that they are supportive of a captive program as vital to survival of the species. The IUCN SSC Action Plan has advocated a captive propagation program. But Schenkel evidently has reservations although they have not been explicated to the AAZPA. It seems critical that whatever differences may exist between the Asian Rhino Group position and the AAZPA interests be resolved.

In conclusion, an appreciation of the need for a captive propagation program for Sumatran rhino has existed and has been expanding over the last 25 years. What has been lacking has been the commitment of sufficient resources, sustained initiative, and perhaps scientific perspective to pursue this project to fruition. The AAZPA seems in an almost unique position to provide this kind of leadership and resources.

THE SPECIES SURVIVAL PLAN OF ACTION

The objective of the SSP project would be to establish a captive population and program for propagation of Asian two-horned rhino to reinforce the efforts to preserve this species in the wild. Animals collected for the captive program would derive from the population remnants with no hope of survival in the wild because:

(1) the groups are too small and fragmented to be genetically viable and

(2) their habitat is destined for destruction and they seem inevitable victims of the poachers.

Because of political receptiveness as well as the biological situation (Table 3), it is proposed the collecting project would commence and concentrate in Sabah. Subsequently, or perhaps almost concurrently (depending on resources and feasibility), the operation could be extended to Peninsular Malaya where even more rhino remnants might be available. If interest, opportunity, and resources exist the project might eventually include Sumatra or even Indonesian Borneo.

It will be important to pursue as many sources of founder stock as possible. The species has been so decimated in the wild that no one area is likely to pro-

vide the genetic diversity or simple numbers advisable to found a captive population. Of course, even one pair of rhinos in captivity would provide more hope than exists now. However, 5 to 10 pairs would be optimal. The upper limit might be realistic if Western Malaysia and eventually Sumatra can be included.

One possible complication that must be considered is reproductive barriers between members of the disjunct Mainland and Island populations. Three extant subspecies are normally recognized (Groves and Kurt 1972). The northern most D. s. lasiotis probably would not be involved in the project being presently proposed. However, D. s. sumatrensis (Sumatra and West Malaysia) and D. s. harrisoni (Borneo) would be. If no reproductive isolation exists, it is recommended there be no further concern with maintaining subspecific distinction in a captive population.

Depending on the number that ~~could be collected~~ become available, it is proposed that rhinos be brought to U.S.A. be placed in 2 to 4 zoos with rhino experience and expertise. San Diego, St. Catherines, Miami, and Los Angeles seem likely candidates.

There should be no misconception that capture of Sumatran rhinos will be anything but formidable, perhaps the most ambitious project the AAZPA has ever attempted. It will be costly! Almost certainly $1,000,000 or more will be required to produce results. But preliminary explorations have been encouraging on the possibility of substantial support from outside donors. It will be slow. The field conservationists consulted so far suggest that a collection team will have to be in the field for perhaps 3 years or more. It will be difficult. The rhinos are rare and they are elusive. If they weren't they would already be extinct. However, 10 rhinos were collected in 1959. Borner delineated a rather precise and plausible protocol in his 1976 proposal. The likely key to success would seem to be orientation of the traps (most likely some kind of stockade to minimize trauma) around the wallows or saltlicks which are the center of a rhino's activity. By utilizing and perhaps supplementing natural saltlicks, it is believed rhinos could be attracted to areas where traps would be placed. Key Comments.

Critical to the success of this project will be the selection of a field manager of the collecting operation. Capture of the Sumatran rhinos will be an

arduous, protracted, and probably frustrating enterprise. It will be vital to secure the services of someone who not only is an expert in modern technology of large animal capture but also is acquainted with the environmental and political conditions of operating in the tropical forests of South East Asia.

Several candidates have been identified for this function. One is Tony Parkinson, a veteran trapper formerly in the employ of John Seago but now resident in South East Asia. In recent years, he has been employed by President Marcos of the Phillipines to direct the project on captive propagation of tamarou (Bubalus mindorensis). If available, he may be an excellent choice. I support wholeheartedly — definitely for 1st appraisal, & hopefully the Catch

However, consideration is probably also due to three other persons with extensive field experience with Sumatran rhinos. Markus Borner is one. He conducted a 3 year study of the species in Sumatra and prepared in 1976 a rather elaborate proposal delineating a viable protocol for collecting rhinos. A major problem with Borner may be availability. He has moved to Africa where he is engaged in conservation projects.

Nico Van Strien is another researcher who has studied rhino in Sumatra for years (Van Strien 1974, 1978). Reportedly, he has critically analyzed the problems with the abortive capture project of 1959 and so could be a prudent selection. Again, availability may be a problem.

Yet a fourth person that might be recruited is Rodney Flynn. In addition to his extended research experience with rhinos in Malaysia, he did initiate an attempt to capture some to attach radio-telemetry devices. Unfortunately, his permit was revoked for political reasons before there was any opportunity for success. But at least he has acquired relevant experience.

The exploratory trip by Foose or another representative of the SSP could determine much about political and biological feasibility and requirements. However, logistical and operational feasibility should be assessed by one of the persons who might manage the collecting project.

Therefore, in the "Recommendations and Proposals Section" it is suggested that one or another of these candidates accompany the SSP representative on the exploratory trip. If the AAZPA decides to proceed, contact should occur immedi-

ately with each of these persons to assess further their appropriateness and availability, and to arrange for their possible participation. At the least, the SSP representative should try to visit with Parkinson, Van Strien, and perhaps Flynn during the trip. Mohd. Khan?

Bill Conway had also suggested previously that the exploratory trip would be enhanced if an international representative for IUCN could participate. Preliminary investigation of this suggestion has indicated that such involvement might be premature or even counterproductive until the AAZPA is sure the project is reasonably feasible as determined by the exploratory trip herein proposed. Nevertheless, this suggestion can be explored further.

Finally, it should be reiterated that an SSP project to establish a captive program should be an integral part of a global strategy involving both captive and wild populations. Hence, it would be optimal if any SSP project would be conducted in conjunction with efforts to preserve the major populations and sanctuaries in the wild. Excellent opportunities would seem to exist for this kind of cooperation in both Sabah and West Malaysia. World Wildlife Fund might be a possible collaborator. However, as an alternative or addition, there is at least one other possibility in this area. The Animal Conservation and Research Center of the New York Zoological Society has indicated an interest in such a collaborative effort. Assuming familiarity does not breed contempt or other unwanted progeny, the advantages of such an association seem obvious.

IMPLICATIONS FOR THE AAZPA

The attempt to establish a captive program and population for the Sumatran rhino will be a formidable and novel undertaking for the AAZPA. But the species and the situation are unique. The magnitude of this project financially, politically, and biologically seems to require the kind of collective approval that perhaps only the AAZPA can presently provide.

Is this then the first of an endless series of similar projects? Certainly other species are in need of rescue efforts. Already the IUCN Pig and Peccary Group have approached the SSP to assist with a captive program for the Giant or Chacoen peccary (Catagonus wagneri). It seems inevitable that as the importance of the SSP grows, there will need to be increasing interactions be-

tween the captive and wild populations and programs.

Despite these prospects, it should and can be argued cogently that the Sumatran rhino venture will not necessarily establish a precedent for other initiatives of this scope by the AAZPA or its Conservation Coordinator. While there are other projects for which AAZPA involvement could be solicited, none has been suggested or anticipated where such a unique species seems to depend so exclusively on SSP leadership and resources for success. The Sumatran rhino project could easily be one of a kind.

One immediate concern that has been expressed is the impact of a prolonged absence by the Conservation Coordinator on the SSP programs. Undeniably, there would be some disruption to the program and burden on other persons involved in the SSP. However, it is believed these problems could be minimized. Since the priority this year for the SSP is for consolidation of existing programs, much of the activity could and should devolve on Species Coordinators. Moreover, efforts can be intensified to anticipate, and organize better, work that might normally occur during this period. Ed Schmitt believes that he could realistically provide requisite coverage. Surely, everyone would be very appreciative of a respite from the deluge of paper that normally emanates from the Conservation Coordinator's Office.

In conclusion, although the risks and commitments for the project are great, the benefits are perhaps even greater. Beyond the gratification and significance of perhaps preserving one of the planet's most interesting creatures, the stature that would accrue to the AAZPA could be incalculable.

RECOMMENDATIONS AND PROPOSALS

1. Formalize the Sumatran Rhino Interest Group into an SSP Propagation Group that would be composed of:

   Bill Conway - New York - Species Coordinator
   Chuck Bieler - San Diego
   Ed Maruska - Cincinnati
   Bill Zeigler - Miami
   Mike Dee - Los Angeles
   Wilbur Amand - Philadelphia

Elvie Turner - Fort Worth
George Rabb - Brookfield
Peter Karsten - AAZPA President
Bob Wagner - AAZPA Executive Director
Tom Foose - AAZPA Conservation Coordinator
Ed Schmitt - WCMC Chairman, ex officio
Alan Shoemaker - Studbook Adviser, ex officio
John Seidensticker - National, Special Adviser

2. Conduct an exploratory trip by a representative of the SSP to Malaysia and Indonesia from mid March to early May 1983.
The purpose of the trip would be to visit as many sites, scientists, and officials as possible to assess logistical, political and biological feasibility of collecting rhino for a captive population. The suggested itinerary is U.S.→ Manila → Sabah → Peninsular Malaya → Singapore → Java → Sumatra → U.S. Tom Foose, AAZPA Conservation Coordinator, is proposed as the SSP representative. Additionally, it may be important to recruit as other participants in this expedition persons who might be employed as the actual field managers of the collecting operation. Highly attractive candidates for this function are Tony Parkinson, Markus Borner, Niko Van Strien, and Rodney Flynn.

3. If the trip is approved, immediately notify persons in Sabah of our intentions and arrange for the visits to Western Malaysia, Sumatra, and Java.
Letters should be directed to:

(6) Clive Marsh - ~~Primary~~ Initial contact for AAZPA in Sabah.
(2) ~~Phillip~~ Patrick Andau - Assistant Chief Game Warden for Sabah.
(1) Mohd. Khan bin Momin Khan - Director-General of the Malaysian Department of Wildlife & National Parks.
(4) Nico Van Strien - Probably most knowledgeable person on Sumatran rhino in area.
(3) Markus Borner - Former field researcher on Sumatran rhino.
(5) John Payne - Conservation Officer, WWF-Malaysia

(4) Tony Parkinson - Tropical trapper.

(5) Rudolf Schenkel - Chairman, IUCN Asian Rhino Specialist Group

Foose can prepare these letters.

4. Intensify efforts to secure official sanction from the IUCN SSC Asian Rhino Group for the project.

Attempts to establish a dialogue with Chairman Dr. Schenkel have not been entirely successful. It does seem a direct discussion with Schenkel would be constructive, perhaps critical. Therefore, it is further suggested that Schenkel be invited to the U.S. (New York or Brookfield seem logical places) in January or February 1983 for consultations. The trip could perhaps be further justified and supported by arranging for Dr. Schenkel to present a seminar on his work with the Javan and other Asian rhinos.

5. It would also be advantageous for the SSP representative to confer directly with Dr. Rodney Flynn who recently completed a 5 year study of Sumatran rhino in West Malaysia. Flynn is currently at the University of Alaska. The SSP representative could conceivably consult with him en route to Asia. But again, there should be great interest in arranging for Flynn to present a seminar on his work at N.Y.Z.S. or Brookfield. A detailed description via slides of his experience could significantly enhance SSP endeavors.

6. Confirm financial contributions toward the trip from zoos interested and involved in the project.

Five zoos indicated, at Phoenix, they would contribute. Two others not represented by their executive officers believed their institutions would. Knowing how much money could be amassed from these sources, any additional funds needed would then be solicited from other donors.

7. Explore possibilities that the AAZPA SSP effort to establish a captive population could be coordinated with a program of field research and management on the species in the wild in Sabah and perhaps West Malaysia.

The New York Zoological Society Animal Conservation and Research Center has indicated an interest in such a cooperative project. WWF-Malaysia already has a project in progress in Sabah.

ITINERARY FOR PROPOSED TRIP

- Depart U.S. for Far East about 15 March.
- First stop 3 days in Manila to consult and perhaps entrain Parkinson. invite Khan to Sabah during dry time
- Proceed onto Sabah to explore situation. Propose 14 days in this country.
- From Sabah to Kuala Lumpur and Peninsular Malaya for 14 days to confer with Mohd. Khan bin Momin Khan and to visit as many other officials as necessary and sites as possible.
- Next to Singapore for 3 days to visit with Bernard Harrison about Singapore Zoo's possible participation in the project.
- From Singapore to Java to consult with Nico Van Strien (probably most knowledgeable person in area on Sumatran rhino) and other Indonesian scientists and officials. Van Strien is in Bogor where it will also be necessary to obtain permit to visit Sumatra. A visit to Udjung Kulon, sanctuary for the last Javan rhinos would also be highly informative. Propose 7 days in Java.
- Then onto Sumatra to visit the main sanctuary in the world for Sumatran rhino at Gunung Leuser. Flight would be initially to Medan, then onto the Dutch Orang Station at Ketambe. Propose 7 days in Sumatra.
- Home through ~~Singapore~~ maybe K.L., to confer with Khan
- Total expedition would require 50 days.

REFERENCES

Andau, P.m. and Payne, J.
1982. The Plight of the Sumatran Rhinoceros in Sabah. Unpublished Manuscript.

Asiaweek
1982. Extinction is forever. Article in AsiaWeek of 9 July 1982.

Anderson, S.
1961. Sumatran rhinoceros at Copenhagen Zoo. International Zoo Yearbook. 3:56-57.

Borner, M.
1976. Sumatran Rhinoceros: Establishment of a captive breeding unit: Proposal. Unpublished manuscript.

Borner, M.
1979. A field study of the Sumatran rhinoceros. Ph.D. Thesis. University of Basel, Switzerland.

Flynn, R.W. and Abdullah, M.T.
1982. Distribution and Status of the Sumatran Rhinoceros in Peninsular Malaysia. Submitted to Biological Conservation.

Franklin, I.R.
1980. Evolutionary change in small populations. In Conservation Biology, edited by M. Soule and B. Wilcox. Sinauer Associates; Sunderland, MA.

Groves, C.P.
1967. On the rhinoceros of Southeast Asia. Säugetierk Mitt. 15:221-237.

Groves, C.P. and Kurt, F.
1972. Dicerorhinus sumatrensis. Mammalian Species. American Society of Mammologists.

McNeely, J. and Cronin, F.W.
1972. Rhinos in Thailand. Oryx. 11:457-460.

McNeely, J. and Laurie, A.
1977. Rhinos in Thailand. Oryx. 13:486-487.

Shaffer, M.L.
1981. Minimum population sizes for species conservation. Bioscience. 31:131-134.

Skafte, H.
1961. A contribution to the preservation of the Sumatran rhinoceros. Acta Tropica. 18:167-176.

Skafte, H.
1964. Rhino Country. Robert Hale, Ltd.; London, U.K.

Soule, M.E.
1980. Thresholds for survival, maintaining fitness and evolutionary potential. In Conservation Biology, edited by M. Soule and B. Wilcox. Sinauer Associates; Sunderland, MA.

Soule, M. and Wilcox, B.
1980. Conservation Biology. Sinauer Associates; Sunderland, MA.

Van Strien, N.J.
1974. The Sumatran or Two-Horned Rhinoceros - A Study of Literature. Mededelinger Landbouwhogeschool Wageningen. (Nederland). 74-16.

World Wildlife Fund
1981. World Wildlife Fund Yearbook 1981-82. WWF; Gland, Switzerland.

TABLE 1

RHINOS IN THE WILD

	SPECIES	ESTIMATED NUMBERS	DISTRIBUTION	POPULATION TRENDS
AFRICAN	BLACK	14,000-24,000	Many Populations in Subsaharan Africa	Declining Precipitously
	WHITE:			
	NORTHERN	1,000	Two Main Populations	Decreasing Rapidly
	SOUTHERN	2,600-2,800	Several Populations; More Being Established	Increasing
ASIAN	INDIAN	~ 2,000	Several Populations in India and Nepal	Increasing or Stable Temporarily
	JAVAN	< 57-66	One Population	Increasing
	SUMATRAN	118-254	Small and Fragmented Populations Over a Wide Range in S.E. ASia	Decreasing

TABLE 2

SURVEY OF SURVIVING ASIAN TWO-HORNED RHINOS

AREA OR COUNTRY	LOCATION	ESTIMATE OF RHINOS	HABITAT AVAILABILITY PRESENTLY (Km^2)	HABITAT AVAILABILITY POTENTIALLY (Km^2)	HABITAT STATUS	REFERENCE	POTENTIAL CARRYING CAPACITY*
Sabah	Silabukan/Lumerau**	~~7-12~~ 20<	250-1000	1000	Perhaps protectable.	Andau & Payne 1982	25
	Around Silabukan	5+	~1000	None	Being converted to agriculture.	Andau & Payne 1982	None
	S./SE. Forest Reserve**	Some	~2000	2000	Perhaps protectable.	Andau & Payne 1982	50
	TOTAL	15-30					
West Malaysia (Peninsular Malaya)	Endau Rompin**	20-25	1600	1000-1600	1000 km^2 Reserve;Park proposed.	Flynn & Abdullah 1982	25-40
	Taman Negara**	8-12	4400	4400	National Park, but under pressure.	Flynn & Abdullah 1982	110
	Sungai Dusun	4-6	40+	140+	State Wildlife Reserve	Flynn & Abdullah 1982	10
	Gunung Belumut	2-3	230	230	Wildlife Reserve proposed.	Flynn & Abdullah 1982	8
	Mersing Coast	0-1	N.A.	Prob. None	Being deforested.	Flynn & Abdullah 1982	0
	Ulu Lepar	3-5	1000	1000	Unprotected and being deforested.	Flynn & Abdullah 1982	0
	Sungai Depak	3-5	N.A.	Prob. None	Being deforested.	Flynn & Abdullah 1982	0
	Kuala Balah	3-4	N.A.	Prob. None	Being deforested.	Flynn & Abdullah 1982	0
	Bukit Gebok	1-2	N.A.	None	Being deforested.	Flynn & Abdullah 1982	0
	Krau Reserve	0-1	500	500	Unstable.	Flynn & Abdullah 1982	12
	Ulu Selama	3-5	N.A.	N.A.	Unprotected.	Flynn & Abdullah 1982	?
	Ulu Belum	3-5	N.A.	N.A.	Unsecure area.	Flynn & Abdullah 1982	?
	Thai Border	0-1	N.A.	N.A.	Unsecure.	Flynn & Abdullah 1982	?
	TOTAL	50-75					
Sumatra	Gunung Leuser**	25-100	1400	8000	National Park but disturbance.	Borner 1979; WWF 81-82	200
	Kerinci/Seblat**	15-20	2000	4000	Protection meager.	Borner 1979	100
	Torgamba	1-5	?	?	Being deforested.	Borner 1979	0
	Sumatera Selatan	2-5	500	?	Deforestation occurring.	Borner 1979	10
	Siak River Region	None	?	None	Being heavily developed.	Borner 1979	0
	TOTAL	43-130					
Kalimantan	Banumuda	0	N.A.	N.A.	Being deforested.	WWF Yearbook 81-82	0
Thailand	Phu Khio Reserve Tenasserim Range Khao Soi Dao Reserve	6-15	N.A.	N.A.	Unstable.	McNeely & Cronin 1972 McNeely & Laurie 1977 Asia Week 1982	0
Burma	Schwe U Daung Reserve	4	N.A.	N.A.	No information.	Borner 1979	?
	Elsewhere	?	N.A.	N.A.	No information.	None recent and reliable.	?
Indochina		?	N.A.	N.A.	Very unstable.	None recent and reliable.	0
TOTAL		118-254	~15000	~22000	None totally secure.		~550

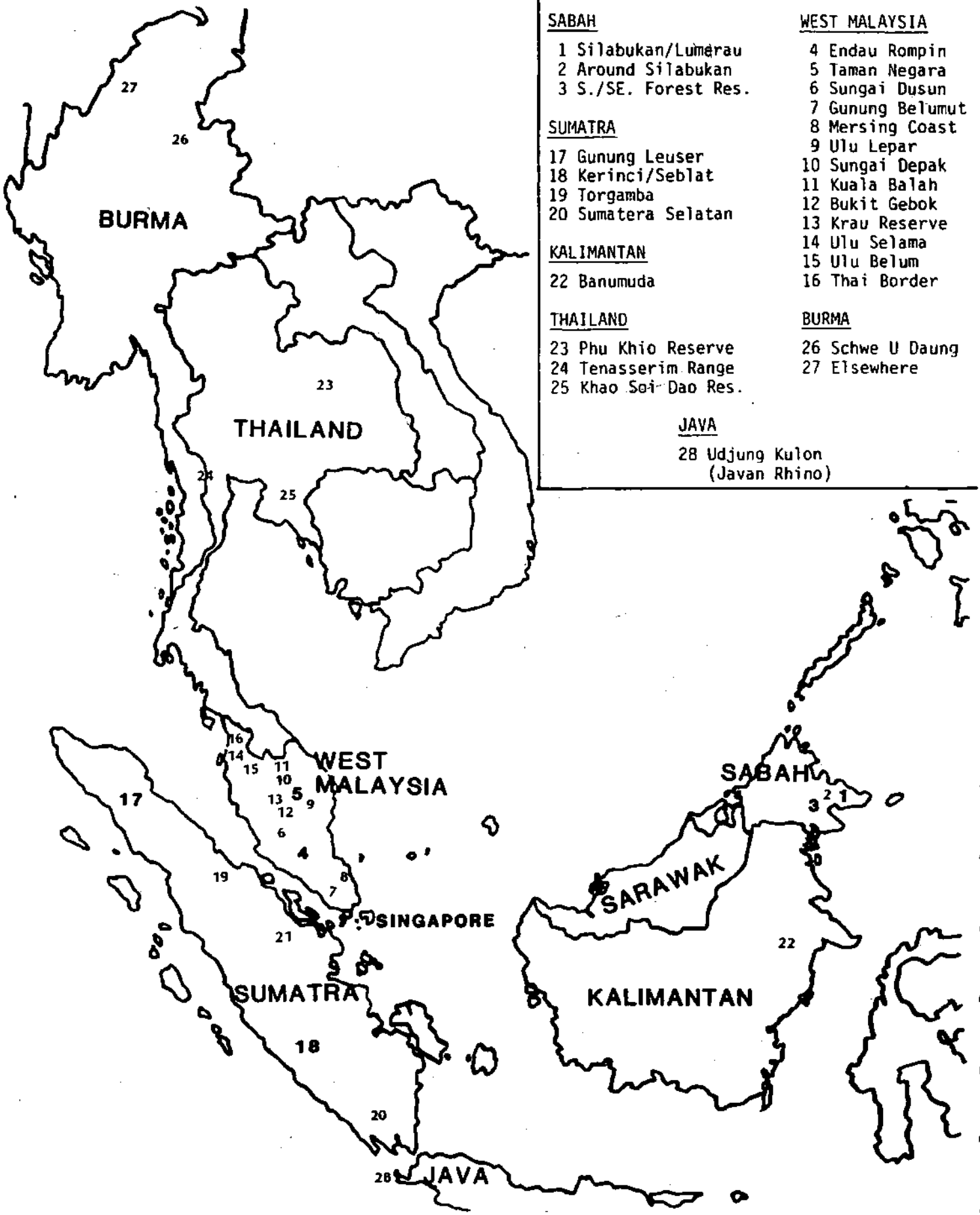
* Predicated on maximum density 1 rhino/40 km^2 suggested by Flynn (1982).
** Populations possibly preservable in wild if interactively managed.

TABLE 3

SUMMARY OF ASIAN TWO-HORNED RHINO POPULATIONS

AREA	TOTAL ESTIMATED POPULATION	TOTAL WITHIN PROBABLY PRESERVABLE POPULATIONS	TOTAL OUTSIDE PROBABLY PRESERVABLE POPULATIONS
Sabah	~~15-30~~ 28-38	~~7-12~~ 20+	8-18
West Malaysia (Peninsular Malaysia)	50-75	28-37	12-38
Sumatra	43-130	25-100	18-30
Kalimantan (Indonesian Borneo)	0	0	0
Thailand	6-15	?	?
Burma	4+	?	?
Indochina	?	?	?
TOTAL	118-254	75-169	43-85

FIGURE 1



SABAH

1 Silabukan/Lumerau
2 Around Silabukan
3 S./SE. Forest Res.

SUMATRA

17 Gunung Leuser
18 Kerinci/Seblat
19 Torgamba
20 Sumatera Selatan

KALIMANTAN

22 Banumuda

THAILAND

23 Phu Khio Reserve
24 Tenasserim Range
25 Khao Soi Dao Res.

WEST MALAYSIA

4 Endau Rompin
5 Taman Negara
6 Sungai Dusun
7 Gunung Belumut
8 Mersing Coast
9 Ulu Lepar
10 Sungai Depak
11 Kuala Balah
12 Bukit Gebok
13 Krau Reserve
14 Ulu Selama
15 Ulu Belum
16 Thai Border

BURMA

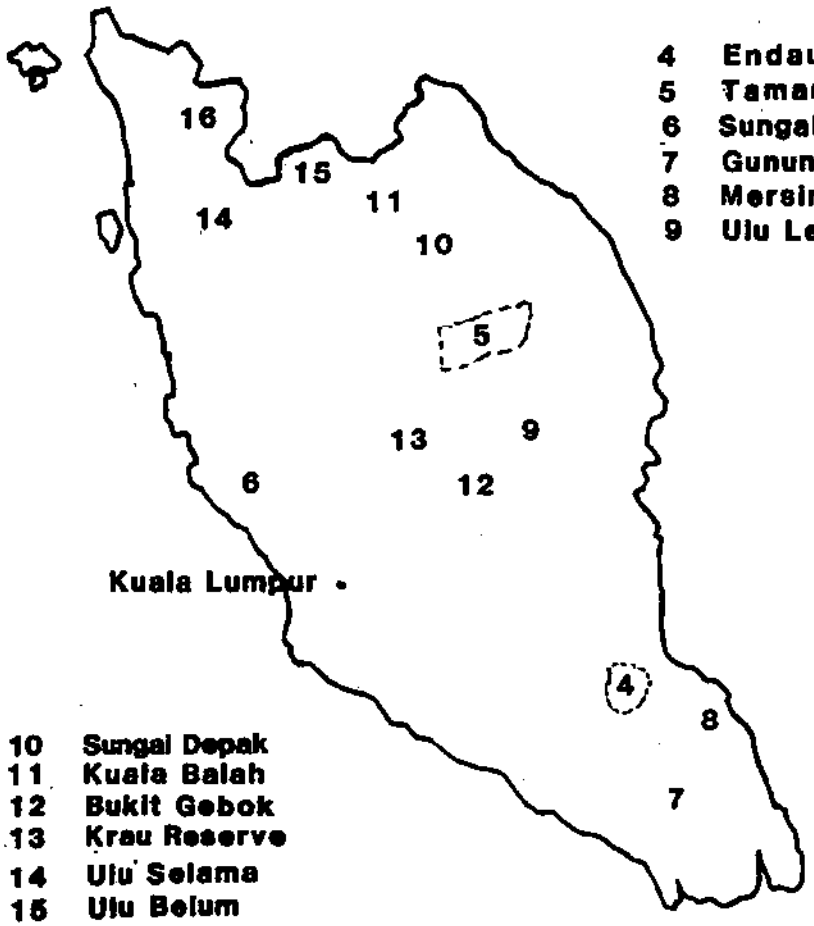
26 Schwe U Daung
27 Elsewhere

JAVA

28 Udjung Kulon
(Javan Rhino)

FIGURE 2

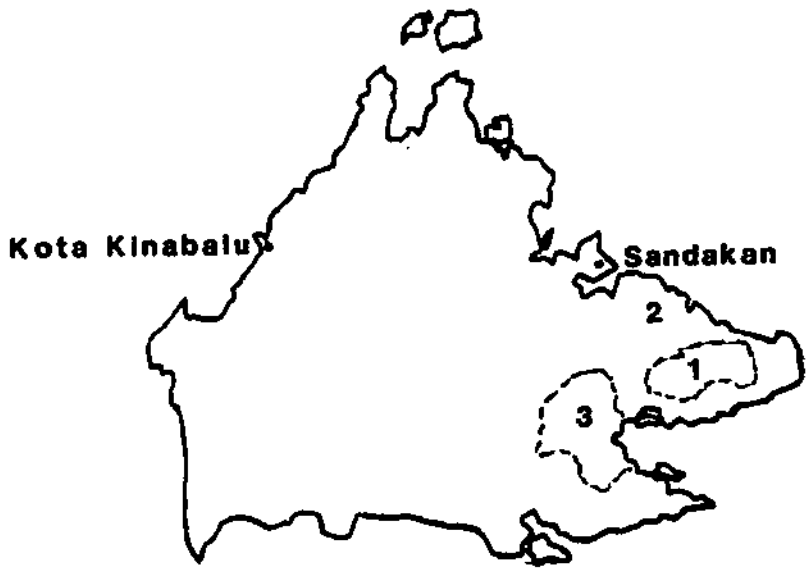
WEST MALAYSIA



4 Endau Rompin
5 Taman Negara
6 Sungai Dusun
7 Gunung Belmut
8 Mersing Coast
9 Ulu Lepar

10 Sungai Depak
11 Kuala Balah
12 Bukit Gebok
13 Krau Reserve
14 Ulu Selama
15 Ulu Belum
16 Thai Border

SABAH



1 Silabukan/Lumerau Forest Reserves

2 Areas being converted to agriculture

3 South/Southeast Forest Reserves

IN PRESS: Proceedings of IUDZG Rhino Symposium, Zoo Berlin, West Berlin

AAZPA SPECIES SURVIVAL PLANS FOR RHINOS

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SSP General

As affirmed in the World Conservation Strategy of IUCN, captive popula- and propagation can and must be an integral part of the global programs to protect and preserve endangered and rare species of wildlife. Zoos and aquariums are "an ark" that can provide sanctuary for species until or unless their natural habitats can be secured or restored. Indeed, we appear to be moving toward a world where the survival of many taxa will depend upon the interactive management of both wild and captive populations (Figure 1). Moreover, as wild populations are reduced and fragmented, while captive collections and facilities become larger, more naturalistic, and better coordinated, the two types of places are converging in terms of the kinds of management that must be employed for their survival.

To better contribute to this objective, the American Association of Zoological Parks and Aquariums (AAZPA) has committed to a Species Survival Plan (SSP). The SSP is an attempt to provide a strategic and supportive framework for programs to propagate and preserve rare and endangered species in AAZPA institutions. Although the SSP has been initiated primarily as a North American program, there is no desire or need to be provincial. It has merely seemed more feasible to organize programs of the scope proposed by the SSP on a continental basis before there is the more ambitious attempt to develop a fully international effort. Hopefully, the SSP can serve as a component of and as a model for more international programs by zoos and aquariums. Eventually, there might be a system of regional programs, like the SSP, coordinated by the International Studbook Keepers and through them by the IUDZG and Captive Breeding Specialist Group (CBSG) of the IUCN.

A collective strategy by zoos and aquariums is absolutely vital if captive institutions are really to contribute to conservation of wildlife. Preservation

of viable levels of genetic diversity and demographic security necessitates maintenance of large and stable populations (Figure 2). No matter how dedicated or resourceful, individual institutions cannot maintain large enough populations for many or most species to preserve these levels of diversity and degrees of stability over long periods of time. Nor should a species be dependent on a single or a few institutions for its survival. Such limited distribution is very vulnerable to various kinds of disaster.

There are two general functions of the AAZPA SSP. One is to assist with development of scientific and cooperative programs to manage species as biological populations in captivity. Just as importantly, the SSP will also attempt to provide direction and coordination for strategic selection of taxa that will be treated by the captive programs.

Strategic selection of taxa is necessary because the capacity of our captive facilities is currently so limited in relation (1) to the number of species and subspecies in need of sanctuary and (2) to the size of populations that will have to be maintained for genetic viability. Thus selection of species becomes a process of allocating the space and resources available in zoos. For genetic reasons, captive populations should be as large as possible. But there are many species competing for this space. So it seems necessary to establish a carrying capacity for every species. This carrying capacity must be a compromise between (1) maintaining large populations for genetic diversity and demographic stability and (2) providing sanctuary for as many species as possible. Strategic selection of species would, therefore, seem to require: assessment of how much habitat is available in zoos; ascertainmnet of what species are in need of captive sanctuary; allocation of the space and resources as optimally as possible. This kind of analysis is presently being performed on many groups such as the rhinos discussed later. A major conclusion of all such analyses is that there currently aren't enough captive facilities to accommodate all extant or even endangered species and subspecies in viable numbers.

Realizing the need for more captive habitat, actual expansion of the carrying capacity of SSP facilities is being explored in two areas. Territorial expansion may be possible through cooperative relationships with private facilities possessing large tracts of land and sincere commitment to conservation.

Some of the exotic game ranches in the western United States seem likely prospects for such programs. Two pilot projects are already in progress in Texas: one on Grevy's zebra at the Waterfall Ranch of Tom Mantzel; the other on scimitar-horned oryx at the David Bamberger Ranch. There is also considerable interest and activity toward developing a ranch project on African rhinos, both white and black, as discussed by Harry Tennison (Game Conservation International) and others at this Symposium.

Technological expansion of the captive facilities is also possible through the employment of cryogenic methods for preservation of germplasm. Cryogenic storage of germplasm will, of course, greatly augment the actual populations of animals maintained in zoos and aquariums. Potentially, this technology may permit systematic and comprehensive preservation of much of the planet's biota. Zoos and aquariums are very appropriate bases of operation for such cell banks. Consequently, cryogenics will be a very important part of the SSP programs.

Taxa are being selected for the SSP programs by a comprehensive and coordinated system according to criteria that reflect the guidelines of the the World Conservation Strategy and objectives of the IUCN/WWF. Thus the selection process is: responsive to status in the wild; representative of taxonomic, zoogeographic, and other kinds of biological diversity; but realistic about the feasibility of propagating particular species captivity. Evaluations of potential candidates are depending greatly upon information provided by the IUCN/WWF through the Red Data Books, the SSC, the CBSG, the ICBP, and other related agencies. Indeed, the SSP is being developed in very close consultation with the Captive Breeding Specialist Group (CBSG) as well as other components of the Species Survival Commission of IUCN.

Initial selections have concentrated on taxa that can be employed as models for the entire program and hence represent both a diversity of organisms and a variety of problems. To date, about 30 taxa have been designated, including: Siberian tiger; Asian lion; snow leopard; black rhino; Indian rhino; white rhino; Asian two-horned (Sumatran) rhino; Asian wild (Przewalski) horse; Grevy zebra; barasingha; okapi; gaur; Scimitar-horned oryx; Arabian oryx; Asian small-clawed otter; ruffed lemur; black lemur; golden lion tamarin; lion-tailed

macaque; gorilla; orangutan; Rothschild's (Bali) mynah; white-naped crane; Humbolt's penguin; Andean condor; Chinese alligator.

Each SSP program is organized around a Species Coordinator who is assisted by a management committee known as a Propagation Group elected from and by participating institutions. Further, to facilitate development and operation of these programs, the AAZPA has created a position of Conservation Coordinator, who is located in the ISIS Offices. Each Propagation Group includes a Regional Studbook Keeper. In many cases, the Regional Studbook Keeper and Species Coordinator will be the same person. Where there is an International Studbook Keeper outside the AAZPA, he/she is being invited and encouraged to serve on the Group. Regional Studbook Keepers can greatly facilitate the efforts of the International Studbooks by assisting with compilation of data. Indeed, if programs like the SSP develop on other continents, the Regional Coordinators from each area might form an advisory committee, analogous to the SSP Propagation Group, around the International Studbook Keeper.

A "Memorandum of Participation" documents the commitment of an institution to participate in an SSP program. The Memorandum of Participation commits each participant to manage their animals in accordance with the guidelines of a Populational Masterplan and the recommendations of the Species Coordinator and the Propagation Group. This document emphasizes that the commitment is to cooperation in the program, not to transfer of ownership or relinquishment of control of animals. Transactions deriving from recommendations of the Propagation Group to relocate animals will be between the institutions involved and may entail sales, exchanges, donations, or loans at their discretion. An example of a Memorandum of Participation appears at the end of this article.

Whatever taxa are selected, they can be viably propagated and preserved in a captive situation only if they are managed intensively as biological populations. Many endangered taxa reproduce well in captivity. However, reproduction or simply breeding, even if it is prolific, is a prerequisite for but is not equivalent to long-term propagation and preservation. Taxa must be managed genetically and demographically as biological populations. Such management is the paramount purpose of the Species Survival Plan.

Thus, the real substance of an SSP program is the Populational Masterplan. These masterplans present demographic and genetic analyses and provide recommendations for both general strategies and specific tactics for management, i.e.:

(1) what the size and structure of the population is presently, potentially, and optimally, in terms of numbers, ages, and sexes;
(2) how many institutions should be accommodating the taxon;
(3) which animals should reproduce, how often and with whom;
(4) which animals should be maintained in or removed from the population;
(5) what basic standards of husbandry and considerations of sociobiology should be emphasized.

More technically, the populational masterplans must:

(1) determine an optimal carrying capacity for the captive population so as to maximize its genetically effective size under the constraint that many other taxa must be provided sanctuary by the limited space and resources of zoos and aquariums. (Normally, there would have to be very cogent arguments and exceptional circumstances for this carrying capacity size for AAZPA institutions to be more than 250 animals.) Also recommended, should be the number of habitats or institutions over which the taxon should be distributed;
(2) analyze each taxon demographically to determine patterns and potentials of survivorships and fertilities, and hence, of change;
(3) provide for the population's rapid expansion to and stabilization at the carrying capacity with an age and sex structure that will optimize genetically effective size and demographic stability; this will normally entail both removal of animals from certain age and sex classes as well as regulation of reproduction.
(4) analyze each species genetically through geneological as well as electrophoretic and karyotypic studies to assess the diversity and distribution of the gene pool.

(5) maximize preservation of genetic diversity in the taxa by:
   a. insuring that there are an adequate number of founders, where available, for the captive population.
   b. attempting to perpetuate equal representation of these founders in the population through time.
   c. retarding genetic drift by optimizing effective population size through regulation of family sizes, sex ratios, and age structure.
   d. minimizing or at least managing consanguineous reproduction by rearrangements of animals to separate related specimens.
   e. avoiding most artificial selection.
   f. optimizing the number of demes (subpopulations or groups) into which the population is divided.

(6) in addition to maintenance of populations of animals, direct collection and preservation as much germplasm as possible.

A general strategy is emerging for genetic management of populations in captivity. The primary objective of this management strategy for captive populations must be to preserve as much as possible of the genetic diversity that has evolved and exists in the wild gene pools. The basic components of the strategy recommended to achieve this objective are:

1. Acquire an adequate number of founders. Since no more diversity can be preserved in captive populations than has been obtained from the wild, more founders are probably better in most cases. But, usually a relatively few founders will be available, especially for rare taxa. Moreover, with such forms, there must be care not to decimate the natural populations. However, if prudently selected, a few founders can provide an astonishingly significant sample of the average diversity of the pertinent gene pool (Figure 3). Prudent selection is more or less accomplished by obtaining founders that are unrelated and noninbred. In most cases, two founders

(i.e., a single pair) are not satisfactory. However, 10 to 20 founders, expecially if the sex ratio is even, should be adequate. Actually, more important than the number of founders is how they are subsequently managed. This prescription leads to the next component of the strategy.

2. Expand the population as rapidly as possible from these founders to the carrying capacity, with attention to other components of the strategy, e.g. equalization of founder representation or bloodlines. If 10 or more founders can be rapidly expanded (i.e. at approximately 10% or more per annum) to a population of several hundreds, not much genetic diversity will be lost. This phenomenon probably explains the successful passage of the southern white rhino through the bottleneck of approximately 20 animals earlier in this century (Anderson, page).

3. Perhaps, divide the population into several demes. The number and size of these subdivisions is not a point of general agreement and indeed may vary with the circumstances of the taxa being managed. However, it does seem as if there might at least be continental populations, an arrangement that would conform well with the realities of zoodom. Whatever the subdivisions, there should be periodic exchange of animals between them.

4. Within the significant subdivisions recommended in (3):
   A. Maximize effective population size (N_e). Genetic drift depends both on the effective population size and the generation time. Effective populations of 250 to 500 will preserve a high fraction of the original genetic diversity for 100+ generations, a period of time that will, for most of the megavertebrates, be centuries or even millenia. However, N_e is not merely a total count of the animals maintained but is a function of how they are managed. In general, disperate sex ratios and unequal lifetime family sizes will depress N_e below N_{total}.

Thus, in wild populations, N_e is usually significantly smaller than the total number of animals. However, with the intensive genetic management that seems feasible in zoos, N_e can be enlarged to be approximately equal to or perhaps even greater than the total number of animals in the poupulation.

B. Equalize founder representation. Bloodlines are usually very unequally represented in captive populations. (Figure 4). To maximize preservation of genetic diversity, representation of the various bloodlines or founders should be as equal as possible. Indeed, zoos are becoming increasingly aware that equalizing founder representation is a more important criterion for managing captive populations than merely minimizing inbreeding coefficients.

C. Manage inbreeding coefficients. How to manage inbreeding coefficients is another area where the geneticists diverge. Many believe that minimization, within the constraints of equalizing founder representation, is the best course. Others believe inbreeding coefficients of offspring should be determined as a result of other selection schemes for parents. None of the "zoo geneticists" however advocate high degrees of inbreeding.

Demographic management is also critical for captive populations. Populations must be stabilized around analytically established carrying capacities. Stability is particularly important for genetic reasons. If populations fluctuate significantly in numbers, the genetically effective size will be closer to the minimum than to the maximum and genes will be lost (Figure 5).

Captive populations whose reproductive husbandry has been mastered can possess an explosive potential for growth. Anderson (page) has already discussed that a 10% per annum rate of increase is quite feasible for rhinos. The doubling time for a population increasing at 10% per annum is 7 years! There

must be captive management to maintain populations with the carrying capacity of captive facilities.

SSP for Rhinos

Rhinos represent one of the most endangered families of vertebrates on our planet and hence are receiving the highest priority for the SSP Program. All five of the extant species are in some degree of endangerment (Table 1).

Of the three Asian species (Laurie, page) the two-horned or Sumatran rhino (Dicerorhinus sumatrensis) seems to be in the most precarious position with perhaps fewer than 200 surviving in small and fragmented groups dispersed across a very wide range in Southeast Asia. The Javan rhino (Rhinoceros sondaicus) is known to exist only in the Udjung Kulon Reserve in western Java. Although the population has appreciably expanded over the last two decades through the efforts of conservationists from IUCN and Indonesia, numbers are still estimated at only 57-66 animals. The situation for the Indian rhino (Rhinoceros unicornis) is considerably better with wild populations estimated at 1500-2000 in several sanctuaries in India and Nepal. However, the human pressure on wildlife continues to intensify in these regions and the future of the species can in no sense be considered safe.

Among the African species, only the southern species (Ceratotherium simum simum) seems secure and reports at this Symposium on its status in the wild (Anderson, page) and in captivity (Lindemann, page) clearly indicate there is no justification for complacency about even this form. The northern subspecies (C. s. cottoni) is gravely endangered. Indeed, the IUCN African Rhino Specialist Group has accorded this subspecies highest priority for action at its meeting in Wankie Park in July of 1982. However, the most precipitous decline in recent times has occurred for the black rhino (Diceros bicornis) (Hillman, page). While the latest estimates available indicate that black rhinos are still the most abundant species in the family, the rate of decline is phenomenal with reductions of up to 90% of present levels projected for some, even "protected", populations in the near future. Because of rampant poaching and habitat destruction, only scores now exist where only a decade ago there were thousands.

Part of the problem for the rhinos is depicted in Figure 6. Even where rhinos do and will survive in natural habitats, populations may be so small and fragmented as to be genetically unviable. Survival of the rhinos (and many other groups) is almost certainly going to be dependent upon an interactive system of both wild and captive populations (Figure 1). Consequently, the SSP is attempting to develop a strategic approach to the entire family Rhinocerotidae.

What then is the capacity of captive facilities in North America for rhinos? Predicating estimates of capacity on numbers currently maintained (Table 2), there appears to be captive habitat for approximately 250 rhinos in North America. With expected enlargement of capacity by expansion of facilities in existing zoos and development of cooperative programs with ranches, this number could be increased to 400 or perhaps more. It seems essential that North American zoos should maintain a minimum population of 100 animals for each type of rhino that is designated for an SSP program (Figure 2). By itself, a population of this size will not be sufficient to preserve a taxa of rhino in captivity indefinitely. However, it is presumed that other regional programs like the SSP will develop in Europe and elsewhere to maintain populations of similar size. These captive populations together with the wild remnants can then be managed interactively for preservation of the rhinos.

Within these constraints, the SSP has designated four taxa of rhinos for programs: Indian (Rhinoceros unicornis); black (Diceros bicornis); white (Ceratotherium simum); and Sumatran (Dicerorhinus sumatrensis). An important consideration in these selections has been to include a representative of each of the four genera of rhinos in an endeavor to preserve some of the ecological and phylogenetic diversity of the family.

The programs for Indian and black rhino seem well justified by all SSP criteria and are well under way. Masterplans are now being formulated and implemented for both species.

Even though more secure than other species, the white rhino has been designated for an SSP program for several reasons:

1. Because it is presently the most populous rhino in captivity, a coordinated strategy cannot be developed without considering this species.
2. The species does represent a unique form of rhino.

3. Its status, even as represented by the southern subspecies, is not secure in either the wild or captivity.
4. There is desperate need for captive efforts to assist in an attempt to preserve the northern subspecies which, according to research by Ollie Ryder and colleagues at the San Diego Zoo, may be more different from the southern than formerly believed.

The southern subspecies of the white rhino is the most populous form of rhino in captivity, largely because zoos have been serving as repositories for surplus removed to stabilize the wild population. However, as Mrs. Lindemann has discussed (page), the captive population has not been managed as well as it could or should be. One problem is that many zoos maintain the southern white rhino as simple pairs, a social situation in which they do not reproduce well. In contrast, both the Indian and black rhinos (and presumably Sumatran) do reproduce well in such situations. Thus, it seems sensible to try to reorient this kind of captive habitat from the white to the Indian and/or black rhino.

Consequently, there will be an attempt to relocate many of the southern white rhinos in zoos to new repositories (e.g. private ranches) that can accommodate relatively large herds of this species. Such a program will achieve several objectives:

(1) It will expand the capacity of captive facilities in North America for rhinos and thereby enable a program to be developed for the fourth and final genus of the family.
(2) It will place the white rhino in a more conducive situation for propagation.
(3) It will create more habitat in zoos for species that are more immediately in need of close management and can evidently propagate well in such circumstances.
(4) It will provide the ranches with rhino experience, using a relatively tractable species.

Another complication for the SSP programs for white rhino, and indeed rhinos in general, is the subspecies problem. There are two subspecies of white rhino. While the southern (simum) is considered temporarily "safe" by the IUCN, the northern (cottoni) is one of the most endangered forms. Until

recently, the prevalent opinion in the AAZPA has seemed to be that the two subspecies were not that different and so the southern subspecies would adequately preserve the uniqueness of the species and the genus. The situation has now changed somewhat. Recent research by Dr. Oliver Ryder and colleagues at the San Diego Zoo (page) reveals (although the sample size is very small) a more significant distinction between these two taxa.

In response to this apparent predicament, should the SSP zoos attempt a massive effort with the northern white rhino? Such an endeavor would seem to require (1) appreciable expansion of facilities, (2) massive elimination of the southern white rhino, and/or (3) abandonment of one of the other species already designated.

Thus, it is not certain, at this time, if the limited space and resources in relation to strategic priorities for the entire family Rhinocerotidae will enable the SSP to maintain a captive population of cottoni large enough (i.e., 100 or more) to be genetically viable for long-term preservation of this subspecies. However, it seems prudent and possible to propose establishment of a nucleus in North America as a temporary reserve to preserve options for the immediate future. At least this will purchase some time to determine how various rhino situations are going to change.

Consequently, the SSP has advised the SSC African Rhino Specialist Group it would be interested in acquiring and accommodating a nucleus of 10 to 20 animals with a six ratio of 3/7 to 6/14. Depending on the number of animals available, one or two herds would be developed. If there are enough animals for two herds, it may be best to try one on a ranch and one in a larger zoo such as San Diego or the St. Catherine's Survival Center of New York Zoological Society. Oral commitments have been obtained from several exotic animal ranch owners stating their willingness to establish breeding herds of white rhino on their land.

The SSP program for the Sumatran or more properly Asian two-horned rhino is more ambitious. Presently, there are no specimens of this form in captivity. In the wild, there are three modest populations (one each in Sumatra, Sabah, and West Malaysia) that perhaps can be preserved in situ (Andrew Laurie, page ;

Clive Marsh, personal communication). However, there are an equal number of animals fragmentally distributed over the rest of the species range in remnants of one to five animals. Because of the small size of these groups and the almost certain destruction of their habitat, these animals most probably cannot be preserved as viable populations in the wild. A viable and desirable alternative seems to be to assemble them for a captive propagation program. Consequently, the SSP has designated this species in order to explore formally the possibility that these remnants could be collected for a captive population and program. The AAZPA SSP will be actively attempting to pursue this objective in cooperation with IUDZG, and the IUCN SSC.

Finally, research will be a vital component of all SSP programs. Particularly important will be research on reproductive biology that can be applied to enhance propagation of various species: i.e., characterization of estrous cycles via both hormonal analysis and behavioral observation; development of techniques for artificial insemination and embryo transfer; establishment of successful and systematic collections of gametes. Consequently, as part of the strategic program being developed by the SSP for the family Rhinocerotidae, the Propagation Groups for the various species designated, in concert with the SSP Subcommittee, have organized a Rhino Research Task Force. The purpose of this Group will be to provide coordination, direction, facilitation and auspices for basic research on rhinos.

TABLE 1

RHINOS IN THE WILD

	SPECIES	ESTIMATED NUMBERS	DISTRIBUTION	POPULATION TRENDS
AFRICAN	BLACK	14,000-24,000	Many Populations in Subsaharan Africa	Declining Precipitously
	WHITE:			
	NORTHERN	1,000	Two Main Populations	Decreasing Rapidly
	SOUTHERN	2,600-2,800	Several Populations; More Being Established	Increasing
ASIAN	INDIAN	~ 2,000	Several Populations in India and Nepal	Increasing or Stable Temporarily
	JAVAN	< 57-66	One Population	Increasing
	SUMATRAN	118-254	Small and Fragmented Populations Over a Wide Range in S.E. ASia	Decreasing

TABLE 2

RHINOS IN CAPTIVITY

	INDIAN RHINO	BLACK RHINO	WHITE RHINO		ALL RHINO
			SOUTHERN	NORTHERN	
NORTH AMERICA (ISIS+, 31/12/81):					
Current Population	11/11 = 22	26/30 = 56	77/95 = 172	1/0 = 1	115/136 = 251
Institutions with Species	8 (9 Owners)	24 (25 Owners)	48	1	62
Institutions with Singletons	1	4	1	1	Not Applicable
Institutions with Pairs	3	9	28	0	Not Applicable
Recent Reproduction:					
1977	0	3/1 = 4	3/1/1 = 5	0	6/2/1 = 9
1978	0/1 = 1	3/0 = 3	3/0/1 = 4	0	6/1/1 = 8
1979	0	1/1 = 2	5/6/1 = 12	0	6/7/1 = 14
1980	1/0 = 1	2/0/1 = 3	1/5 = 6	0	4/5/1 = 10
1981-82	0/1 = 1	3/1 = 4	2/2/4 = 8	0	5/4/4 = 13
WORLD (STUDBOOKS, 31/12/80):					
Current Population	38/33 = 71	76/92 = 168	245/294 = 539	8/11 = 19	367/430 = 797
Institutions with Species	32	67	118	7	Not Calculated

FIGURE 1

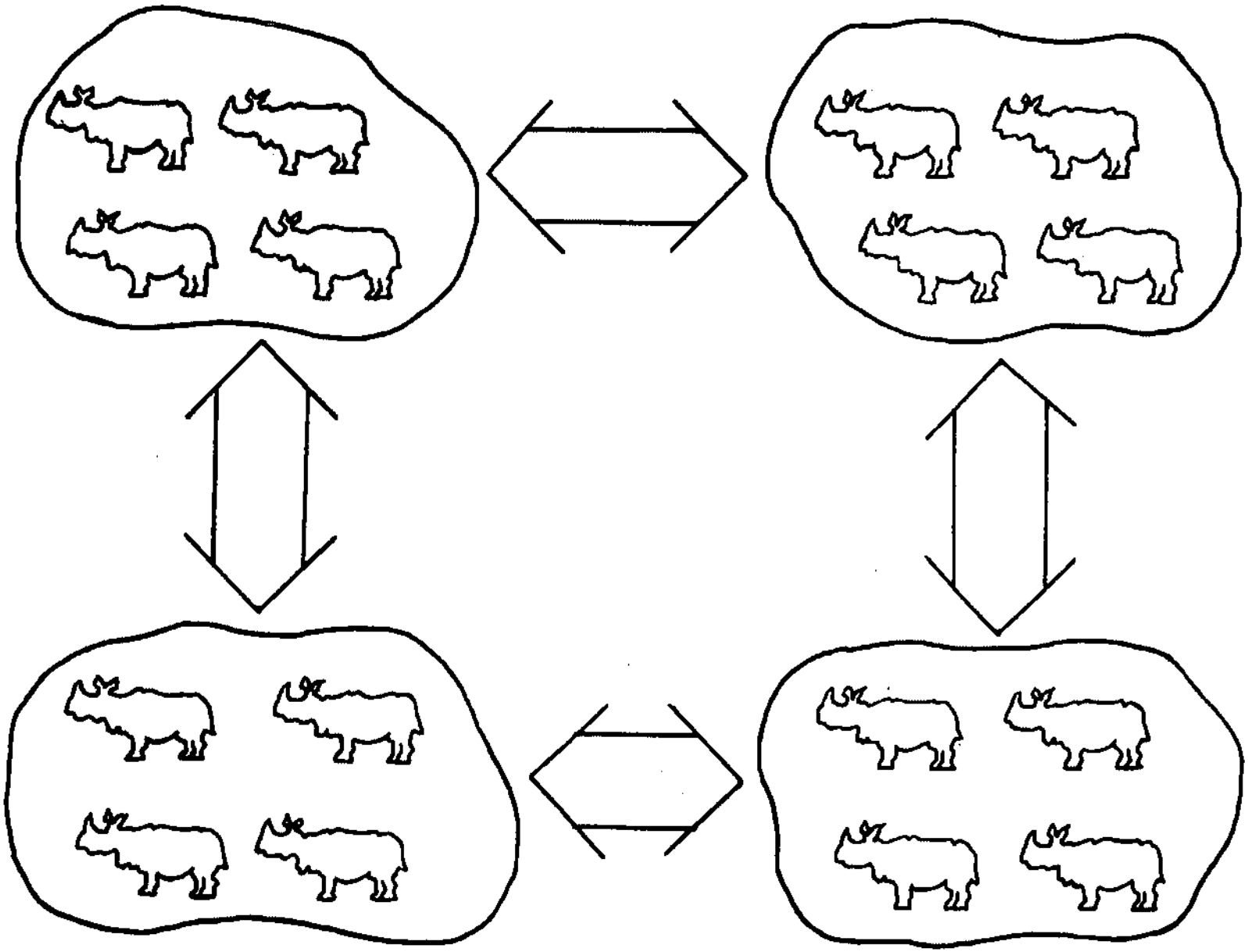


FIGURE 2

DECLINE OF GENETIC DIVERSITY FOR VARIOUS EFFECTIVE POPULATION SIZES (N_E) POSSIBLE FOR A TOTAL POPULATION (N) OF 250

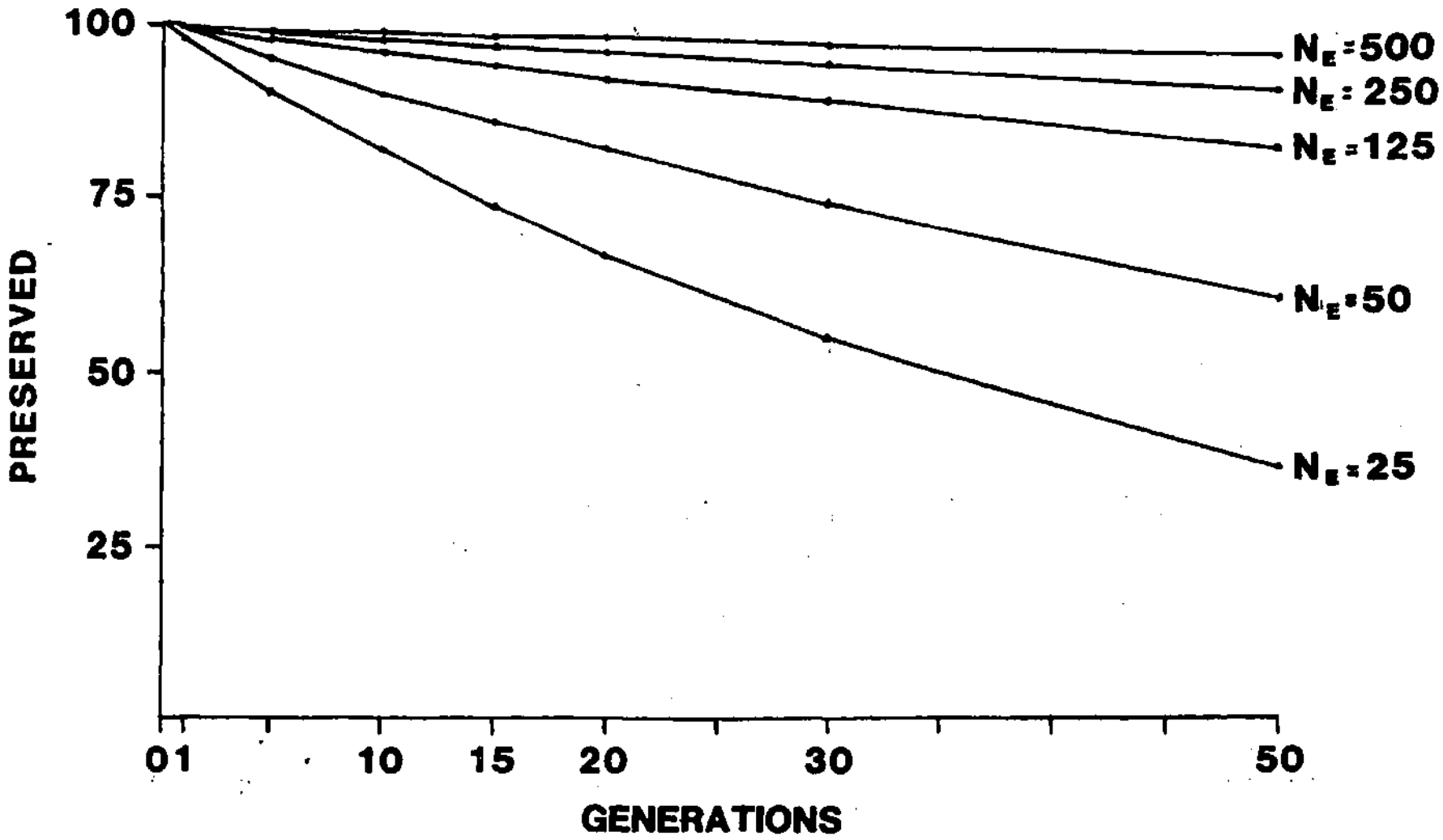


FIGURE 3

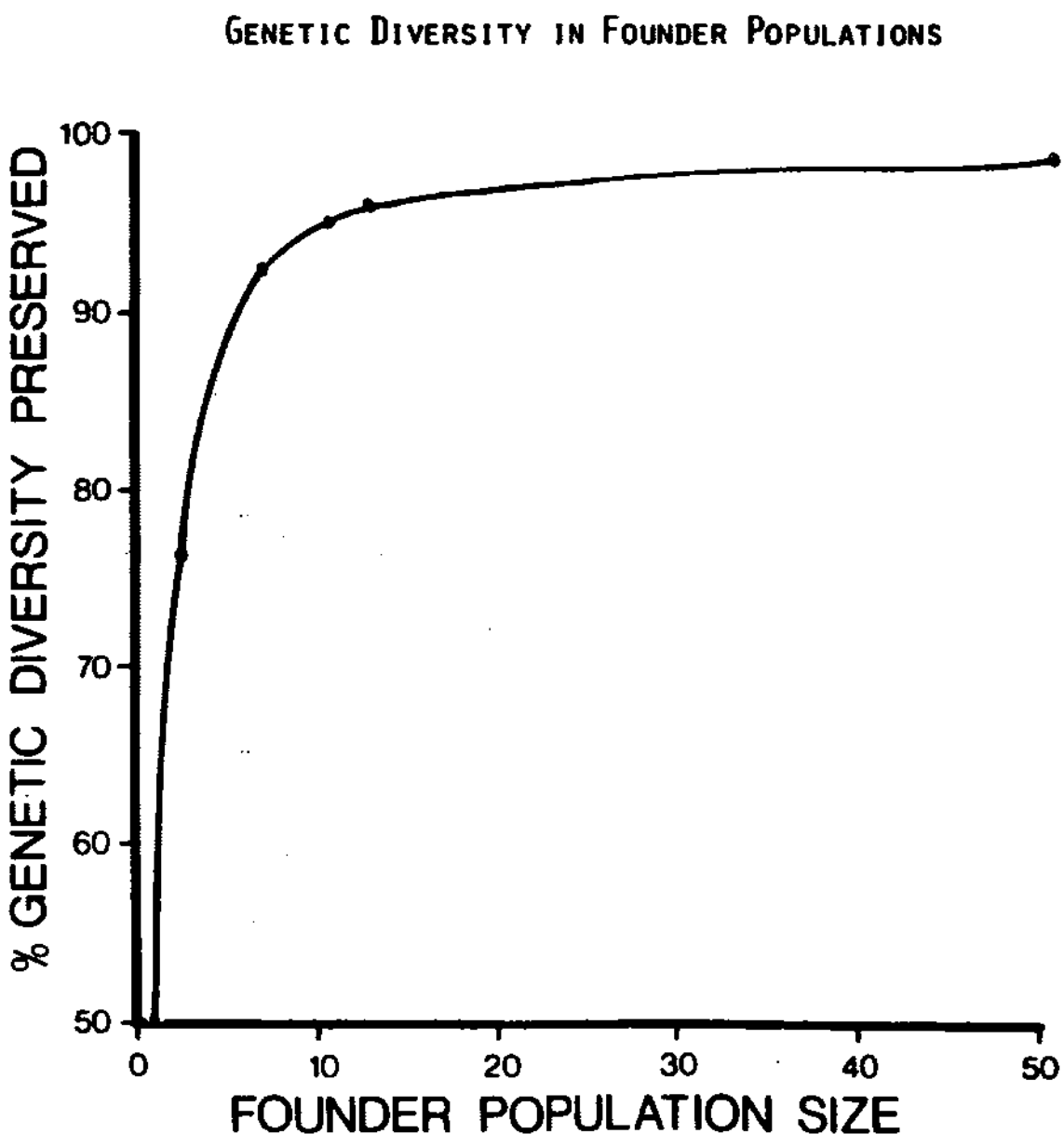

GENETIC DIVERSITY IN FOUNDER POPULATIONS
% GENETIC DIVERSITY PRESERVED
100
90
80
70
60
50
0
10
20
30
40
50
FOUNDER POPULATION SIZE

FIGURE 4

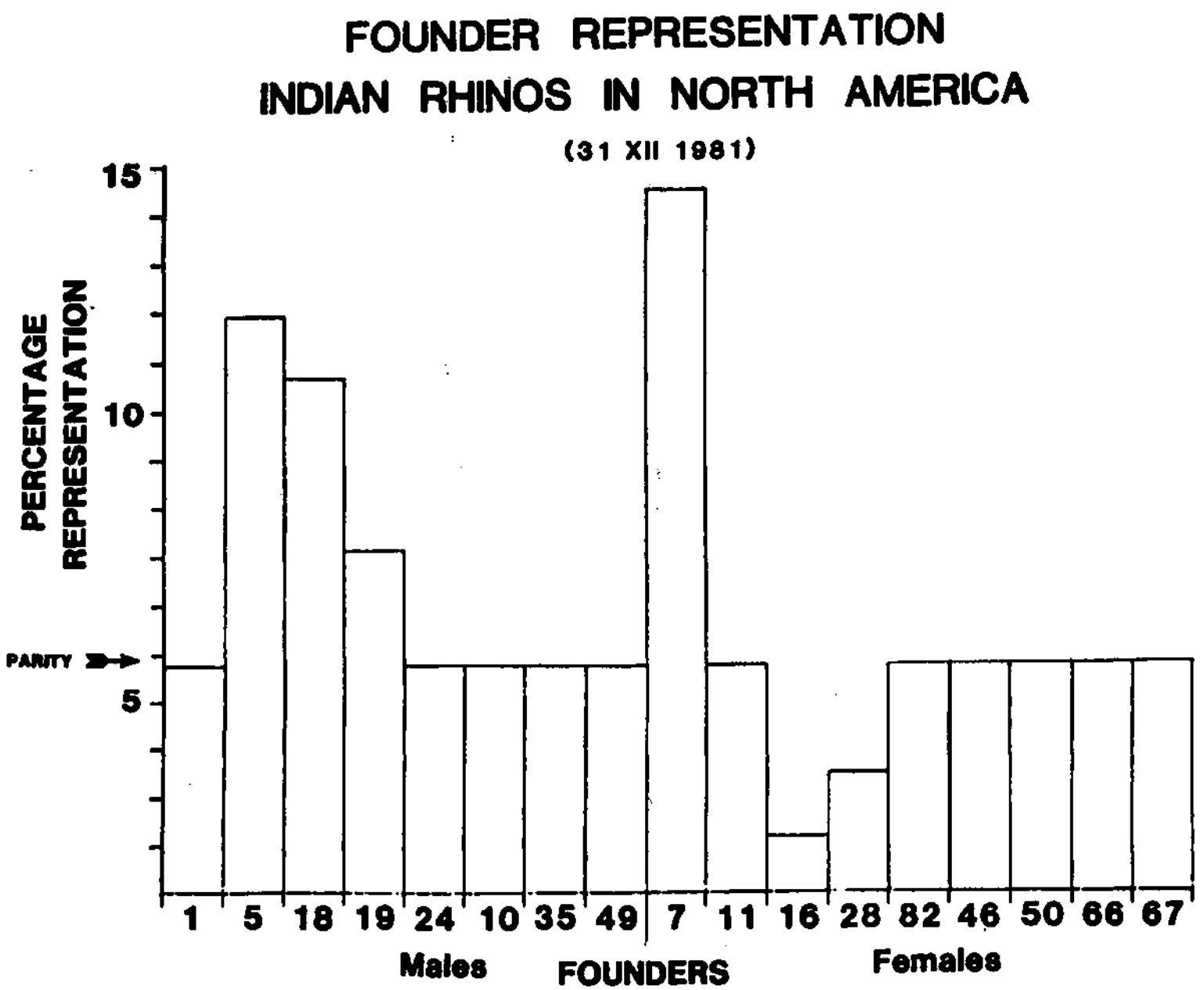

FOUNDER REPRESENTATION
INDIAN RHINOS IN NORTH AMERICA
(31 XII 1981)
PERCENTAGE REPRESENTATION
15
10
PARITY
5
1 5 18 19 24 10 35 49 7 11 16 28 82 46 50 66 67
Males
FOUNDERS
Females

FIGURE 5

GENETICALLY EFFECTIVE SIZE (N_E) AS POPULATION OSCILLATES

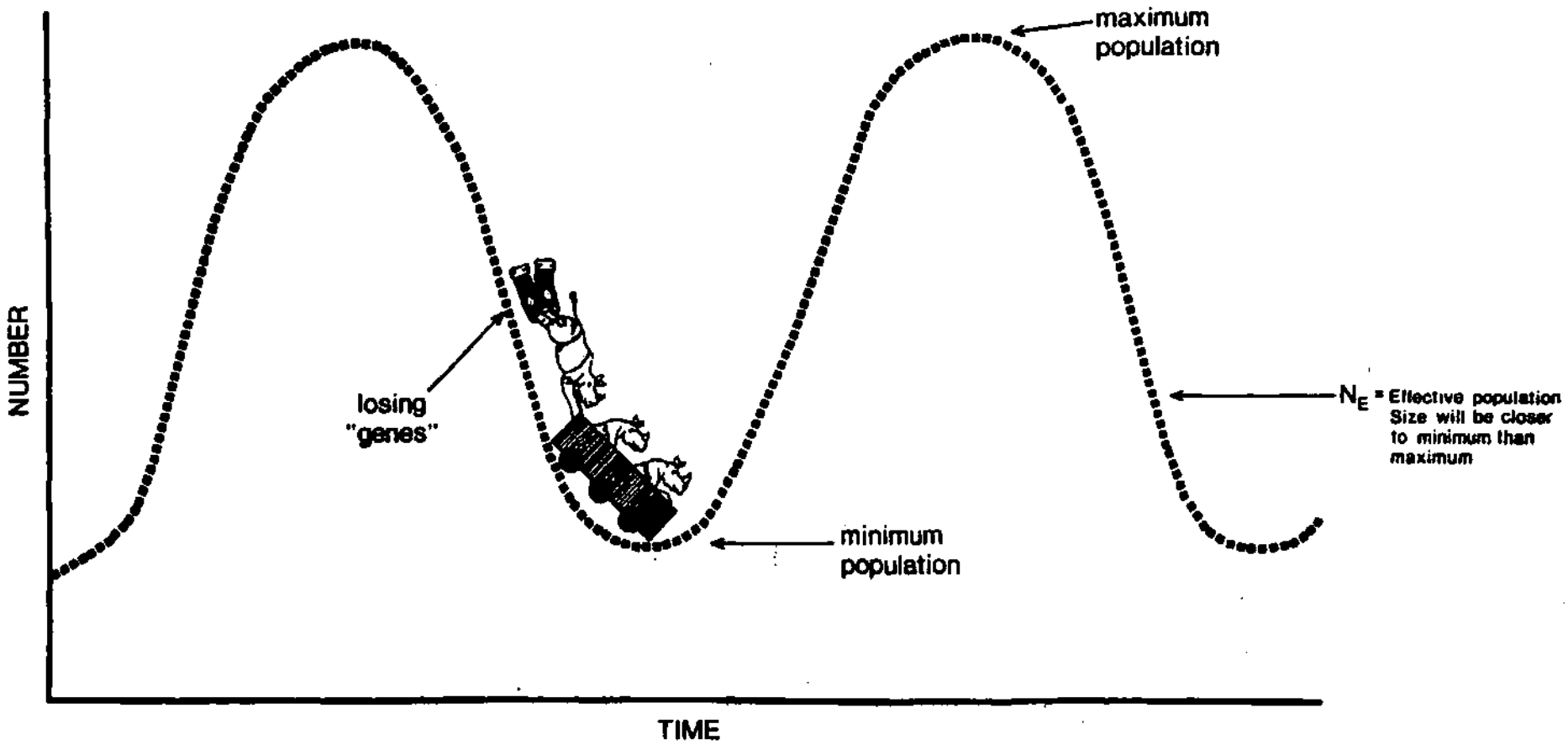
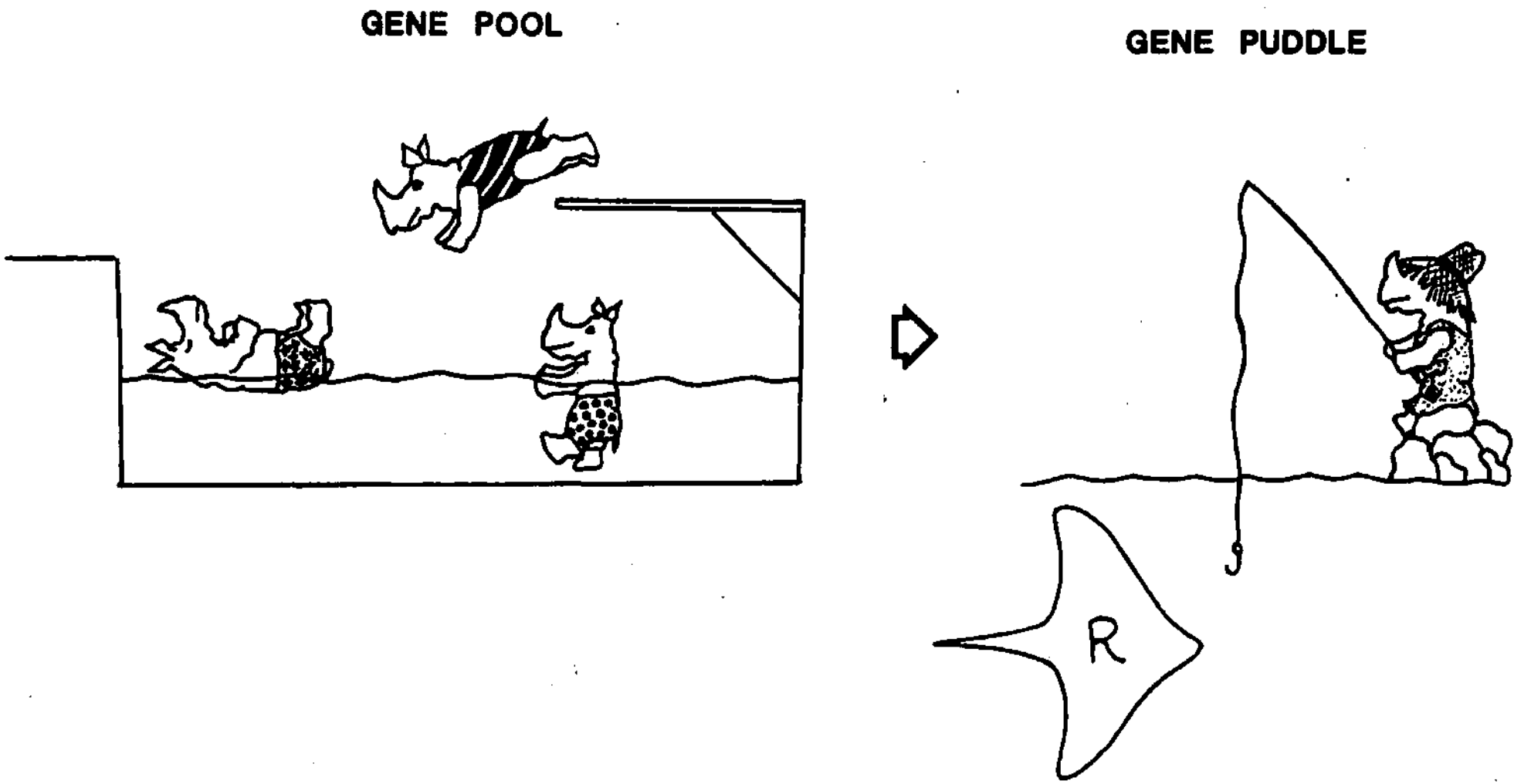


FIGURE 6



Wildlife Section,
Forest Department,
P.O.Box 311,
Sandakan, Sabah,
Malaysia.

Thomas J Foose
Conservation Coordinator,
American Association of Zoological Parks and Aquariums,
Oglebay Park, Wheeling,
West Virginia 26003, U.S.A.

23 November 1982

Dear Dr Foose,

You will probably be aware of the existence of Dicerorhinus sumatrensis in Sabah, and I know that you, among various other groups and individuals over the past few years, have suggested the idea of trying to form a captive breeding unit of this species.

I am working with the Sabah Forest Department on a project sponsored by World Wildlife Fund Malaysia. One of my main aims is to assist in the establishment of new protected areas. One area - known as Silabukan - is of vital importance in the conservation of both rhinoceros and elephant, Elephas maximus. A recent survey of a 240 sq. km. sample area revealed a minimum of eight rhinos and we believe that there may well be 20 or more rhinos throughout this region. Our hope is that a substantial part of the Silabukan region will be preseerved as permanent forest reserve. There is no question of attempting to move rhinos into or out of ~~the region~~ the region for the time being.

There are rhinos scattered in other parts of Sabah, however, including individuals now living in extensive areas being opened up for permanent agriculture. One option is to attempt to catch and translocate these rhinos to safer areas within Sabah. There are many problems associated with such a scheme, not least of which is the lack of an ideal area for their release. The alternative - formation of a captive breeding unit - is the reason I am writing to you.

If a captive breeding unit is to be formed, then the matter is urgent, since areas containing rhinos are now being clear-felled at a fast rate. I believe that the chances of catching rhinos in these areas are quite high. We need expert advice, however, on how to proceed. Firstly, an assessment of the whole situation and suggested phasing for a capture and captive breeding programme would be welcome. Secondly, an idea of the cost of forming and maintaining a captive unit.

I understand that you may be coming to South-east Asia some time in 1983. Would you be willing to come to Sabah to help out on the first point mentioned above? With regard to costs of a captive breeding programme, could you perhaps provide us with an estimate (exclusive of the capture costs)? This need only be approximate, but sufficient to indicate the order of magnitude; the estimate should therefore include cost of constructing the physical structure, maintenance costs, food/medicines and staffing.

With thanks, Yours sincerely,

John Payne

John Payne (Ph.D)