To.

MR. S. DEB ROY
24/4, TYPE V
LODHI COMPLEX
NEW DELHI - 110 003

From.

VALMIK THAPAR

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

INDIAN REGIONAL GROUP
CONVENOR : VALMIK THAPAR
19 Kautilya Marg, Chanakyapuri
New Delhi - 110 021
Tel: 011-3016261; Fax: 011-3019457

May 28, 1993

Dear Colleague,

As discussed at the 1st Cast Specialist Group Meeting I enclose a letter of authority from the Chairman, Cat Specialist Group so as to facilitate the collection of data on `Cats' in the different regions of India.

Do keep in regular touch

All the best

Valmik Thapar

VALMIK THAPAR

SPECIES SURVIVAL COMMISSION

IUCN

CAT SPECIALIST GROUP

<u>To whom it may concern</u>

Mr S. Deb Roy has been asked to collect information on wild cats in India as part of a research project sponsored by the Cat Specialist Group of the IUCN Species Survival Commission through its Indian Regional Group. The information will be collected in a database in Delhi to assist in planning conservation action. Your cooperation will be much appreciated.

Peter Jackson

Peter Jackson
Chairman
21 May 1993

CHAIRMAN: Peter Jackson, M.A. (Cantab.), 1172 Bougy, Switzerland.
Tel/Fax +41 21 808 6012.
DEPUTY CHAIRMAN: Alan Shoemaker, Riverbanks Zoological Gardens, POB 1060,
Columbia, SC 29202-1060, USA. T: +1 (803) 779 8717. Fax 256 6463.
RESEARCH LIBRARIAN: Dr Gail Foreman, Heritage Zoo, 2103 W. Stolley-Pk Rd,
Grand Island, NE 68801, USA. T: +1 (308) 382 3899. Fax 381 2657

To

Mr. S. Deb Roy,
24/4, Type V,
Lodhi Complex,
New Delhi - 110 003.

From:

Valmik Thapar,
New Delhi.

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

INDIAN REGIONAL GROUP
CONVENOR : VALMIK THAPAR
19 Kautilya Marg, Chanakyapuri
New Delhi - 110 021
Tel: 011-3016261; Fax: 011-3019457

June 11, 1993

Mr. Sanjay Deb Roy
24/4, Type V,
Lodhi Complex,
New Delhi - 110 003

Dear Deb Roy,

We are always asking ourselves the question whether meeting, discussions, and dialogue get us anywhere. It is always difficult to assess the impact of what we do, and its ultimate effect. In relation to the tiger, and this will effect the future of other cats, various strategies are underway, as listed below.

1. A new Tiger action plan with both national and international intent. This includes the setting up of a Global Tiger Forum of Tiger Range Countries and a series of initiatives to ban the trade in tiger bones especially in China.

2. Enclosed for your reference is the very recent declaration by China on trade in Rhino and Tiger products. This appears to have been the result of wide public pressure.

I do hope that all of us continue to be as active as we can in collecting and analysing information so as to make constructive interventions which restore a harmony to the Cat Species of this country. I do hope the enclosures help to encourage such a process.

Yours sincerely

Valmik

VALMIK THAPAR

P.S. Please let me know if you have been involved in any way in the census and estimates of the Census of Tigers and Leopards, or any other Cats.

NOTICE PROMULGATED BY THE STATE COUNCIL ON THE PROHIBITION OF TRADE IN RHINOCEROS HORN AND TIGER BONE

Governments of All Provinces, Autonomous Regions and Municipalities,
All Ministries, Commissions and Departments Directly Under
the State Council:

Rhinoceros and tiger are endangered wildlife species under particular international protection, and are both listed into the Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, of which China is a contracting party. To protect these endangered species, in accordance with the Wildlife Conservation Law of the People's Republic of China, the Rules of the People's Republic of China for the Enforcement of the Protection of Terrestrial Wildlife as well as the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the prohibition of trade in rhinoceros horn and tiger bone is hereby reiterated as follows:

1. The import and export of rhinoceros horn and tiger bone(hereinafter referring to any identifiable parts and derivatives such as medicines containing rhinoceros horn and tiger bone and art work) are strictly prohibited. No institution and individual shall be allowed to transport, carry or mail rhinoceros horn and tiger bone into or out of China. Any products marked with the words of "rhinoceros horn" and "tiger bone" shall be treated as containing rhinoceros horn and tiger bone.

2. It is forbidden to sell, purchase, transport, carry or mail rhinoceros horn and tiger bone. The rhinoceros horn and tiger bone presently kept in stocks shall be examined, re-registered, sealed up and properly kept, and the owners shall declare their stocks accurately to forestry departments at provincial level or agencies designated by them. The forestry departments at provincial level or the agencies designated by them shall prepare [illegible] this stock of rhinoceros horn and tiger bone and submit the documentation to the Office of the People's Republic of China for the Administration of the Import and Export of Endangered Species.

3. It is now determined that the pharmaceutical criteria for rhinoceros horn and tiger bone be cancelled, and the pharmaceutical use of rhinoceros horn and tiger bone be prohibited. The traditional Chinese medicines containing rhinoceros horn and tiger bone, which have already been produced, shall be sealed up and forbidden for sale within the duration of

six months commencing from the date of issuance of the present notice.

4. The State encourages the research on the pharmaceutical substitute of rhinoceros horn and tiger bone, and active publicity and extension efforts shall be made on the research achievements. The use of rhinoceros horn and tiger bone for particular purpose, such as research of substitute is subject to the approval of the Ministry of Public Health, and shall be reported to the Ministry of Forestry for recording, and the activities shall be under the supervision and monitoring of local forestry departments.

5. The violation of the present notice, in terms of sale, purchase, transportation, carriage and mailing of rhinoceros horn and tiger bone shall be investigated and dealt with accordingly by the State Industrial and Commerce Administration and the Customs of the People's Republic of China. For the cases of speculation, profiteering or smuggling, the judicial department shall investigate and affix the responsibility for the crime. Confiscated rhinoceros horn and tiger bone shall be transfered to local forestry departments above county level to handle in accordance with relevant regulations.

6. The present notice shall become effective since the date of issuance. Any previous rules which are inconsistent with the present notice shall accord with the present notice.

STATE COUNCIL OF THE PEOPLE'S REPUBLIC OF CHINA
MAY 29TH, 1993

To Valmik Thapar from Peter Jackson

Administration Moves to Halt International Trade in Tiger and Rhino Parts

To: National Desk, Environment Writer
Contact: Mary Helen Thompson, 202-208-6416, or Pat Fisher,
202-208-5634, both of the Department of the Interior

WASHINGTON, June 9 /U.S. Newswire/ -- Interior Secretary Bruce Babbitt today announced that the Clinton administration has taken steps intended to halt the international trade of tiger bone and rhinoceros horn.

The action, taken pursuant to a resolution of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and in accordance with the Pelly Amendment, is designed to stop Taiwan and the People's Republic of China from continued commercial trade of parts and products from the two species. Both species are in danger of extinction and are protected by CITES.

"The killing ot these grand creatures continues unabated [illegible] clearly on the brink of extinction," said Interior Secretary Bruce Babbitt. "The Pelly Amendment requires us to address this destructive trade, and we have done so."

Under the terms of the Pelly Amendment to the Fishermen's Protective Act of 1967, the Secretary of the Interior is required to issue a certification when nationals of a foreign country are engaged in trade that diminishes the effectiveness of any international conservation program for an endangered or threatened species, such as CITES.

On June 1, Secretary Babbitt sent letters to officials in Taiwan and the Peoples Republic of China, informing them of the department's findings and of his intentions to certify them under the Pelly Amendment. The letter gave Taiwan and the People's Republic of China 30 days to provide substantive information to warrant reconsideration of the U.S. Fish and Wildlife Service findings. After the 30 days, absent findings to the contrary, the department intends to certify them under the Pelly Amendment. This could ultimately lead to a presidential decision on trade sanctions against them.

The Chinese government has announced rhino horns and tiger bones will no longer be legal in Chinese traditional medicines. The government has made it illegal to buy, sell, trade or transport rhino horns and tiger bones, and it gave manufacturers six months to sell medicine already produced with the parts or products of rhinos and tigers.

"We're very encouraged by the apparent shift by the Chinese government," said Secretary Babbitt. "But it must commit to the destruction of existing stockpiles of rhino horns and to the full implementation of resolutions adopted by CITES countries which call for strong enforcement."

Destroying stockpiles is the swiftest means of controlling the international trade, and makes it much more difficult for poachers to discreetly sell harvested animal parts on an international market.

The Department of the Interior actions were [illegible] response to a resolution adopted at a June 1992 CITES meeting calling for an end to the rhino trade. The department subsequently received a petition pursuant to the Pelly Amendment from the World Wildlife Fund and the National Wildlife Federation. The action was expanded beyond rhino horns because the U.S. Fish and Wildlife Service had been monitoring the Asian trade in tiger bone as well as the trade in rhinoceros products at the time the petition was received.

The action on the tiger is the first time ever that the department has considered certification for trade in a species without being prompted by a petition. In addition, it is only the second time the Department of the Interior has acted under its Pelly Amendment authority in the 20 years since the signing of CITES.

The petition also targeted the Republic of Korea and the Republic of Yemen. Since the petition was filed in November, both of these governments have announced plans to accede to CITES and have taken affirmative steps to close down their domestic rhino trade. As a result, the department is withholding a decision on Pelly Amendment certification of these two countries at this time, but their actions are being closely monitored by the Fish and Wildlife Service, which must report back to the Secretary within 30 days on their progress.

-0-

/U.S. Newswire 202-347-2770/

The above is the use of the Pelly Amendment by the U.S.A. to halt trade in Tiger bone and Rhino horn.

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP
INDIAN REGION, 19, KAUTILYA MARG,
NEW DELHI - 110 021
TEL : 3016261 FAX : 3019457

April 13, 1994

Dear Colleague,

I enclose for your reference details of the CITES meeting in Geneva followed by details of U.S.A's sanctions against Taiwan which are historic in the history of wildlife preservation. Something has finally happened on this issue of Tiger trade. A collective effort by all concerned people all over the world has produced a result.

All the best

Valmik Thapar

Valmik Thapar
(VICE-CHAIRMAN, ASIA)

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

Mr S. Deb Roy IFS (retd)
24/4 Type 5
Lodi Complex
New Delhi 110 003
India

2 May 1994

Status Survey of the Tiger in India

Dear Deb,

Your proposed status survey of the tiger in India, in collaboration with Ullas Karanth, is the highest priority in the view of the Cat Specialist Group. I hope that it can be implemented in the very near future, as time for the tiger is short. The survey would be financed by the Global Tiger Patrol organization.

Apart from ascertaining the number of tigers in the Project Tiger reserves, it is essential to confirm the existence of tigers in all other areas, and to assess their chances of survival and breeding potential. Recommendations should then be made as rapidly as possible to the government, outlining the measures necessary for conservation: protection of tigers and prey species: rehabilitation of habitat; and revival of genetic corridors. Personnel and financial implications should be included in the recommendations, as well as any requirement for upgrading the legal status of the areas.

The collaboration of your former colleagues in the forest service will be of great assistance in the survey and in the implementation of the recommendations.

I wish you every success in this important venture and look forward to receiving interim and final reports.

Yours sincerely

Peter Jackson

Peter Jackson
Chairman

CHAIRMAN: Peter Jackson MA (Cantab.), 1172 Bougy, Switzerland
Tel/Fax: (+41 21) 808-6012; email: pjackson@clients.switch.ch
DEPUTY CHAIRMAN: Alan Shoemaker, Curator of Mammals, Riverbanks Zoological Park, P.O. Box 1060, Columbia, SC 29202-1060, USA
Tel: (+1 803) 779-8717; Fax: (+1 803) 256-6463
RESEARCH LIBRARIAN: Dr Gail Foreman, Director, Grand Isle Heritage Zoo, P.O. Box 1345, Grand Island, NE 68802, USA
Tel: (+1 308) 382-3899; Fax: (+1 308) 381-2657

GLOBAL TIGER PATROL

Integration between man, nature and the environment

Mr S Deb Roy
24/4 Type V
Lodi Road Complex
New Delhi 110003
India

3 May 1994

Dear Deb,

I am writing to confirm our discussions in early April about your proposed project - "Status Survey of Tigers In India".

Since you and I have already discussed the proposed project in some detail there are no outstanding questions in my mind either regarding the need for such an initiative or the implementation plan. Peter Jackson, Chairman of the IUCN Cat Specialist Group had earlier endorsed the urgent need for such a comprehensive survey and we have both had further opportunity of talking further with him about his views. I think he has again written to confirm his endorsement.

The proposal should proceed as it stands and you have agreed that collaboration with Ullas Karanth would be both positive and beneficial to the final outcome of such an important undertaking.

Since you are both an Associate of ours and a member of the Cat Specialist Group, you know already that you can call on any appropriate technical inputs that you may require from these sources as well as from your colleagues from the forest service.

Since I wrote briefly outlining Global Tiger Patrol's intention to support your project to Shri Kamal Nath, the Hon. Minister for Environment and Forests, on April 4, I am assuming that GTP need not correspond further with the Ministry on the subject.

With every good wish.

Sincerely,

Peter Lawton

Peter Lawton
Chief Executive

Administered by The Ranthambhore Trust (No. 328126)
"Grantchester", Linden Gardens, Leatherhead, Surrey KT22 7HB, England • Tel: 0372 374916/372026 Fax: 0372 373429 e-mail: tigerpatrol@gn.apc.org

मंत्री
पर्यावरण एवं वन
भारत

MINISTER
ENVIRONMENT & FORESTS
INDIA

18 AUG 1994

Dear Colleague,

Shri Deb Roy, who is a wildlife expert, retired as Additional Inspector General of Forests in Govt. of India two years ago. We are utilising his expertise as a Consultant in our Eco-development programmes. Shri Deb Roy has now taken up an externally aided project for examining and analysing certain aspects of the status of the tiger in India. The project is not aimed at merely the estimation of the number of tigers afresh, since this has already been done in our modern census last year. Shri Deb Roy rather wants to study the potential tiger areas that require attention on priority basis, and thus to assist the breeding potentiality and survivals percentage of the species in areas where viable tiger populations exist even though they may be outside of Project Tiger areas.

This project has been strongly recommended by the Inidan Union for the Conservation of Nature, since the result of such an unprecedented research study would be invaluable in the planning of future strategy. This will also help us greatly in formulating programmes to be taken up by the Global Tiger Forum which has been established at India's initiative.

He proposes to visit Tiger Reserves and also other forest areas, after thorough discussion with State Government officials. Naturally, the success of Shri Deb Roy's project will depend heavily on the help and cooperation of the State Wildlife and Forest Officers.

I would therefore request you to kindly issue necessary instructions to all concerned in the State to provide complete cooperation to Shri Deb Roy and his team members when they approach the forest and wildlife authorities of your State. They may please be allowed to visit all protected areas, and be permitted to stay at Forest Rest Houses etc, so that their data collection will be authentic and proper. Needless to say, we shall be sharing the results of the project with you, and this would help the State Government as well in formulating its wildlife plans and policies.

With kind regards,

Yours sincerely,

(KAMAL NATH)

GLOBAL TIGER PATROL

Integration between man, nature and the environment

22nd November 1994

S. Deb Roy
Block 4 Type V
#24 Lodhi Road Complex
New Delhi 110 003

Dear Deb Roy,

Please refer to our conversation during the July IUCN Cat Specialist Group meeing in Delhi and subsequent discussions concerning the proposal to publish an authoritative book/report on the status of the Indian tiger. Since the survival of the tiger is gravely threatened, a status report spelling out the threats faced by the tiger and the remedial measures that could be taken to save this magnificent animal is urgently needed. Based on our publication we hope to create an international lobby to save the tiger from certain extinction with the involvement and committment of the Governments of the tiger range countries as well as NGOs.

Global Tiger Patrol will pay a royalty of pounds sterling 3390 out of which you should have already received as advance £540. £750 will be remitted to you in February 1995 and the final payment of £2100 by the end of March 1996.

With your experience and expertise we hope to come out with an authoritative publication on the status of the Indian tiger.

I look forward to meeting you again.

Yours sincerely,

Peter Lawton
Executive Director

Administered by The Ranthambhore Trust (No. 328126)
"Grantchester", Linden Gardens, Leatherhead, Surrey KT22 7HB, England • Tel: 0372 374916/372026 Fax: 0372 373429 e-mail: tigerpatrol@gn.apc.org

TIGER STATUS SURVEY

To: S Deb Roy ✓
CC: Joanna Van Gruisen
From: Peter
Date: 1 March 1995

Further to our discussion today and prior to detailed deliberation on the review note, I am just confirming a few points that we have agreed.

1. We concentrate all our efforts on Madhya Pradesh since it has the largest number of tigers and also it will provide us with a logical format for extending the survey into other states.

2. In order to proceed we need to agree a schedule of comprehensive field study between now and the 1995 monsoon. Deb Roy to finalise, with a plan for somebody to be in the field for around 30 days per month.

3. We immediately identify and check out potential field assistants to be briefed and deployed according to the above schedule into the key areas of MP. Joanna to contact Gitanjali Tiwari, Bharat Bhushan and Ragu Chandawat and Hashim Tyabji (via his spouse). Deb Roy needs to meet these people if they are keen and available to agree the parameters for field work and terms of 'consultancy'.

4. Deb Roy has agreed to produce a field survey brief and describe the parameters of this work (and finalise the questionnaire) prior to any meeting with potential field research assistants.

5. A comprehensive field visit should be planned and agreed within the next few days for Madhya Pradesh for most of March.

6. Contiguity areas: we agreed that adjoining states should be looked at alongside the work in Madhya Pradesh. However, given financial and logistic constraints I personally feel that this should be done at this stage by post/questionnaire as much as possible, rather than dissipate too many energies on areas even slightly out of the Madhya Pradesh prioritisation.

PeN

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

Mr Deb Roy
24/4 Type 5
Lodhi Complex
New Delhi 110 003
India

17 May 1995

Dear Deb,

Peter Lawton has shown me your report on the tiger survey, which is very depressing. It is particularly worrying that prey populations are in such poor shape outside the principal protected areas. Peter and I agreed that the priority is to complete your surveys of Madhya Pradesh and Uttar Pradesh as they are representative of "good" tiger areas. Detailed data are not necessary as your expert impressions provide a sound basis for our report. We should aim to have the report ready by November.

All good wishes.

Peter

CHAIRMAN: Peter Jackson MA (Cantab.), 1172 Bougy, Switzerland
Tel/Fax: (+41 21) 808-6012; email: peterjackson@gn.apc.org
DEPUTY CHAIRMAN: Alan Shoemaker, Curator of Mammals, Riverbanks Zoological Park, P.O. Box 1060, Columbia, SC 29202-1060, USA
Tel: (+1 803) 779-8717; Fax: (+1 803) 256-6463
RESEARCH LIBRARIAN: Dr Gail Foreman, Director, Grand Isle Heritage Zoo, P.O. Box 1345, Grand Island, NE 68802, USA
Tel: (+1 308) 382-3899; Fax: (+1 308) 381-2657

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

CHAIR:
Peter Jackson
1172 Bougy
Switzerland
Tel/Fax: +41 (021) 808-6012
Email: peterjackson@gn.apc.org

DEPUTY CHAIR:
Alan Shoemaker
Riverbanks Zoological Gardens
P.O. Box 1060
Columbia, SC 29202-1060
USA
Tel: +1 (803) 779-8717
Fax: +1 (803) 256-6463

VICE-CHAIRS
***Asia*:**
Valmik Thapar
19 Kautilya Marg
New Delhi
India
Tel: +91 (011) 301-6261
Fax: +91 (011) 301-9457
Email: tigerlinking@axcess.net.in

***Cheetah*:**
Laurie and Daniel Marker-Kraus
P.O. Box 247
Windhoek 9000
Namibia
Tel: +264 (065) 811.812
Fax: +264 (061) 248.344

***Eurasian lynx*:**
Urs and Christine Breitenmoser
Villettengässli 4
3074 Muri b. Bern
Switzerland
Tel/Fax: +41 (031) 952-7382
Email: breitenmoser@zos.unibe.ch

***Snow leopard*:**
Helen Freeman
4649 Sunnyside Av. No. #325
Seattle, WA 98103
USA
Tel: +1 (206) 632-2421
Fax: +1 (206) 632-3967

***Projects*:**
Kristin Nowell
233 Hope Street #2
Mountain View, CA 94041
USA
Tel/Fax: +1 (415) 968-8148

RESEARCH LIBRARIAN:
Gail Foreman
Utica Zoo
Steele Hill Road
Utica, NY 13501
USA
Tel: +1 (315) 738-0472
Fax: +1 (315) 738-0475

Mr S. Deb Roy
24, Block 4, Type V
Lodhi Road Complex
New Delhi 110 003
India

23 August 1995

Dear Deb,

I am very sorry to have been so long in replying to your letter and not to have been in touch since I was in Delhi. Because of all the travelling my desk has been piled with paper and I am having great difficulty in catching up.

Unfortunately, I have not been able to persuade IUCN to take up the issue of the World Bank ecodevelopment programme in India. It is felt that without a detailed examination of the project, which they cannot do, no convincing representation could be made to the World Bank. There is such a line-up of people behind the project that it is hard to get anyone to listen. As you say, so much money had been poured in, and there are many people who are benefitting from it. It's an old, old story.

Maybe if the general elections result in a change of government, the project will be looked at again.

I look forward to your report on the situation in UP and MP, although I doubt if it will offer much cheer. In the past few months I have grown more and more depressed about the tiger's future, particularly when there are scandals like Sansar Chand. Little effort seems to be made to crack down on the trade in other tiger range countries, although during my visit to the Russian Far East I was told that there seemed to be a decline in poaching because their were no buyers - it was thought that the Chinese had cracked down, but it may be only a lull. We shall see what happens during next winter's snows.

All good wishes.

Peter

cases move with the 'North' — who are the real controllers of the W.B/GEF. But if you think, I have not gone 'crazy' and I am talking sense, then you may yourself take up the issue with the World Bank in the interest of the Tiger, as the Chairman of the Cat Specialist group. There is nothing to lose, but there may be one voice from the 'North' rising above the din of thy short sighted gain.

I have taken up the issue with some one whom I know in the W. Bank and shall persue as long as I can. When do I see you again? Trust this finds you well.

Warm regards,

Yours sin—

I understand Mr. S.C. Dey is basically against captive breeding for reintroduction. Also I have changed my residential address which is given above. I am not yet on phone, when I get the phone, I will inform you.

Dear Peter,

you have probably received my coments about C.B.S.G's intentions of captive (now, of course, conservation!!!) breeding of the Tiger for introduction/reintroduction into the wild. I feel, from your letter of the 23rd August, the reasons of your depression in relation to the future of the Tiger may unfortunately be real ~~true~~. Human community has lost all its touch ~~with~~ and links with Mother nature in relentless pursuit of materialism. Everything comes next to his (or his clan) interest. ~~That~~ Man wants to save any species of wildlife, including Tiger, is because of his own future interests, not out of compassion nor with any respect for natural creation which is beyond his capabilities to handle. With progress of Science, ~~&~~ man is becoming more and more arrogant, instead of being humble at realising his helplessness to become truely sustainable without nature, despite science! arising out of lack of realisation of facts

Unfortunately such arrogance has captured the drivers' seat, the leadership, everywhere in this planet. I don't consider myself as "Pessimist". I would like to call myself a "Realist." I only hope and pray that I will be proved wrong!

But I feel without any uncertainty, the Tiger has very nearly completed its time span on this planet. The evolutionary process has created the homosapians may be as the last species in the evolutionary process, to bring up the rear! This task the homosapians are doing very well indeed. ~~The~~ Even the infinitely complex and incredibly strong "Life line" has already been weakened and looks definitely vulnerable. Even few decades back this was unthinkable specially on the face of unprecedented scientific achievements, specially of the last one hundred years or so.

Unfortunately science ~~to~~ and its achievements have been diverted the wrong way through misconceptions of pursuit of the materialism which goes diagonally against "Sustainability." The '~~Lords~~' self styled messiahs of 'Ecodevelopment' give an impression of taking the future ecological stability of the Tiger range areas under their arms, with rare arrogance. They are not even ready to listen to and try to understand others' views. Well, this attitude of those, who are sitting pretty at crucial positions to-day is nothing new. Over the ages such arrogance born out of little knowledge has temporarily mislead opinions, only to repent later. But in the instant case, there ~~will~~ shall be nothing left (of the Tiger and its natural habitat) to fall back on and make any attempted amends, once the World Bank / G.E.F. propelled ecoDEVELOPMENT plan bulldozes through Indian cultural and traditional ~~en~~claves which miraculously remains yet out of the evil clutches of the consumerism and Market economy forces.

I don't expect things to improve in the event of any political change. In fact every occassion of such change during the past proved worse for ecological interests and the next should not be any different either. Therefore, I ~~feel~~ feel very strongly that we should keep on making as much noise as possible. The I.U.C.N. higherarchy is not unknown to me. The big ~~to~~ Lords sitting on top is not likely to buy our philosophy, as the top is highly politicised and in most

JACKSON

Conservation Breeding Specialist Group

Species Survival Commission
IUCN -- The World Conservation Union

U.S. Seal, CBSG Chairman

Mr. S. C. Dey
Ministry of Environment &
Forests, Paryavaran Bhavan
C.G.O. Complex, Lodhi Road
New Delhi 110 003,
INDIA

28 August 1995

Dear Mr Dey,

I am writing with respect to recent comments, by members of the CAT Specialist Group on the 'Protocol on the Conservation of the tiger between the government of the Republic of India and the government of the People's Republic of China.' My apologies for the delay in response to your questions, but I have just completed gathering the needed detailed information.

There appears to be a wide range of thoughts and interpretations of a single article (Article IV) in the protocol. Article IV states '*Encourage, on an experimental basis, captive breeding activities, with a view to release of the species into the wild.*' I note that thjs Article follows from the fourth statement in the preamble which provides the foundation for Article IV. The statement is 'Endeavouring to enhance cooperation on the protection of Tiger and making joint efforts to halt the trend of decimation of tiger population to ensure the survival and sustainable development of the species.'

Objections to this article in the protocol have been raised by Peter Jackson, Chairman of the Cat SG of the SSC/IUCN, and members of the Cat SG in a press release of 30 March 1995 and in a communication dated 11 May 1995, to Mr. Kamal Nath, Minister for Environment and Forests, India.

These comments include projections of the near extinction of tigers by 1999, references to events in the Florida panther release program, concerns about programs in China, and statements about the futility of captive programs even in the event of extinction. I have the following comments based upon the best scientific evidence available to us from (1) scientists in India, China, Russia, Indonesia, and USA, (2) workshops we have conducted in Indonesia, China, and USA, and (3) the Florida panther translocation program.

The projection of near extinction by 1999 for all tigers is contrary to all available evidence for all of the surviving subspecies, except the South China tiger (*Panthera tigris*

12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151, USA
tel: 1-612-431-9325 fax: 1-612-432-2757 e-mail: cbsg@epx.cis.umn.edu

amoyensis) which probably numbers fewer than 30 in the wild. There is no doubt that the risk of extinction over the next 50-100 years is high and that poaching contributes to this risk. Prevention of extinction will require continuing responsive adaptive management programs throughout the range as threats change from population to population and through time. There is an urgent need for science-based management programs which include biological, physical, and social factors and are designed for each individual protected area and tiger population. Monitoring tools for population, prey, and habitat that provide guidance to management are needed (additional methods are being studied at the Wildlife Institute of India). It is necessary to determine the population effects of different levels of poaching on the population as a guide to the management effort needed. Programs meeting these needs for the Sumatran tiger in Indonesia are now underway and it appears likely that tiger poaching is now minimal in reserves in Sumatra. According to the field workers in Russia, poaching of tigers is not significant although other habitat factors are of concern, and the risk of near extinction by 1999 is very low.

The field studies on Florida panthers (*Felis concolor coryi*) have included reintroductions of wild and captive bred animals into unoccupied habitat and translocations of wild-caught panthers to unoccupied and occupied habitat. All animals released were fitted with radio collars and monitored 2-3 times a week. The releases are managed as an experimental program so that animals can be recaptured and removed in the event of problems or movement outside the agreed areas. A similar approach has been used successfully in the reintroduction of the Red Wolf in the South-eastern USA over the past 8 years.

Both approaches have been successful for panthers in terms of survival, capturing their own prey, and acceptance of local habitat. The first set of studies were in North Florida using captive-bred and wild-bred animals. There was no difference in survival. All of these animals have now been removed with the completion of the studies. A description of the wild panther translocation program into currently occupied habitat areas is enclosed. In summary 8 wild-caught females have been released since March of 1995 and all are surviving. They are monitored 2-3 times per week by radiotelemetry. No adverse human contacts have occurred as yet. No breeding has occurred but the releases were late or outside of the breeding season. These releases are into ecosystems containing native Florida panthers and are intended to augment the genetic diversity of the wild population according to a genetic management plan developed over a period of 3 years in collaboration with CBSG (copy enclosed).

We recognize that tigers, with a different social system and offering a greater threat to people, will require genetic augmentation and reintroduction methodologies designed to fit their species characteristics. We believe that it is essential that these methodologies be developed for possible use in management of wild tiger populations as we gain more knowledge and experience with the effects of habitat fragmentation and small populations. Current work on isolated small populations indicates that loss of genetic heterozygosity is inevitable and that local populations will be lost to unexpected environmental events. Wildlife managers need to be prepared to genetically supplement or replace lost populations as needed. Given the fragmentation of the protected areas for tigers in India, such tools may be needed in the future for management of the isolated populations. These actions need to be based upon the kind of analysis, planning, and management implementation that has gone into the Florida panther program and the Sumatran tiger program.

CBSG, at the request of the Chinese Association of Zoological Gardens (CAZG), has undertaken a series of collaborative workshops in China to assure that the animals and programs are managed to serve as a resource for support of the wild population. The first 2 week working program assembled information on the South China tigers held in 19 Chinese zoos now or in the recent past, developed a studbook, established the goals and objectives of the management and captive breeding program and led to agreements for the continued development of the program. The participants from 18 zoos and the CAZG were knowledgeable, prepared, and worked intensively for the 3 days of the workshop. A copy of our summary report is enclosed. The final report has been prepared in Chinese and English. The Chinese paid their in-country expenses for this workshop. A second 3 week working visit to the zoos holding most of these tigers is scheduled for November of 1995. People from the CAZG will also participate in a Tiger GASP and reproductive biology program at the Southeast Asian Zoo Association meeting in October in Taiwan. Discussions have begun on undertaking a similar program for the North China tiger (*P. t. altaica*). This program may focus early on a reintroduction program but that needs a carefully managed captive program and the development of a protected park area before reintroductions are started. These programs are only a beginning but they represent a significant commitment by the CAZG. We hope to expand this program to PHVAs for the wild populations in China and to link the wild and captive programs and managers. We have already conducted a PHVA in China for the Baiji dolphin.

In summary, we believe that a full range of methodologies are going to be needed to assure the continued survival of healthy populations of tigers in the wild. We will need to approach these complex problems with a long term commitment to adaptive management strategies combining biological, physical and human social factors and based upon an evolutionary learning approach. We will make mistakes. We need to learn from them with a continuing program of information collection during policy implementation which recognizes that policies and management actions are experiments to be tested.

Sincerely yours,

U. S. Seal

U. S. Seal, Chairman CBSG

cc: Rabb, Tilson, Walker, Stuart, Jackson, Ferguson, Shuling, Thapar, Swells, Tilt, CBSG

IUCN
The World Conservation Union

SPECIES SURVIVAL COMMISSION

CAT SPECIALIST GROUP

CHAIR:
Peter Jackson
1172 Bougy
Switzerland
Tel/Fax: +41 (021) 808-6012
Email: peterjackson@gn.apc.org

DEPUTY CHAIR:
Alan Shoemaker
Riverbanks Zoological Gardens
P.O. Box 1060
Columbia, SC 29202-1060
USA
Tel: +1 (803) 779-8717
Fax: +1 (803) 256-6463

VICE-CHAIRS
Asia:
Valmik Thapar
19 Kautilya Marg
New Delhi
India
Tel: +91 (011) 301-6261
Fax: +91 (011) 301-9457
Email: tigerlinking@axcess.net.in

Cheetah:
Laurie and Daniel Marker-Kraus
P.O. Box 247
Windhoek 9000
Namibia
Tel: +264 (065) 811.812
Fax: +264 (061) 248.344

Eurasian lynx:
Urs and Christine Breitenmoser
Villettengässli 4
3074 Muri b. Bern
Switzerland
Tel/Fax: +41 (031) 952-7382
Email: breitenmoser@zos.unibe.ch

Snow leopard:
Helen Freeman
4649 Sunnyside Av. No. #325
Seattle, WA 98103
USA
Tel: +1 (206) 632-2421
Fax: +1 (206) 632-3967

Projects:
Kristin Nowell
233 Hope Street #2
Mountain View, CA 94041
USA
Tel/Fax: +1 (415) 968-8148

RESEARCH LIBRARIAN:
Gail Foreman
Utica Zoo
Steele Hill Road
Utica, NY 13501
USA
Tel: +1 (315) 738-0472
Fax: +1 (315) 738-0475

Mr S.C. Dey
Addl Inspector General
of Forests (Wildlife)
Paryavaran Bhavan
CGO Complex, Lodhi Road
New Delhi 110 002
India

8 September 1995

Dear Mr Dey,

Dr U.S. Seal has sent me a copy of his letter to you dated 28 August about the tiger situation. It is primarily a reaction to the statement I issued at the press conference in Delhi on 30 March (Appendix I). For the benefit of those who also received copies of Dr Seal's letter I repeat the opening paragraphs of my statement:

"The tiger will be virtually extinct in the wild by 1999 unless India and the other range states declare open war on poachers and illegal traders and throw all the resources required into the battle. Some scattered individuals will remain and produce some young for a decade or two in the 21st century, but, in fact, we shall have seen the end of the tiger.

"A review of the situation in India and south-east Asia shows that poaching is accelerating, with well-organized illegal trade networks operating, sometimes with the connivance of officials. Actual seizures indicate that hundreds of tigers are being poached every year in India alone, primarily for traditional Chinese medicine.

"If the governments of tiger range states do not have the political will to save the tiger, then the future is bleak for wild nature and human welfare. Tiger conservation does not involve just a single species. It means saving large tracts of Asia's tropical forests and their wildlife. Forests and the natural world in general are the foundation of all life on earth, including that of humans, who rely on complex ecological systems for food, water, clean air, and many products used in their lives. Economic development will ultimately fail unless recognition is given to the vital importance of maintaining natural systems, of which the tiger is a part and a symbol."

This statement represented the consensus of the views of members of the Indian sub-group of the Cat Specialist Group, who had just met in Kanha National Park. They included, without doubt, some of the most experienced wild tiger specialists and field managers in the world. They are listed in Appendix II of this letter, together with other members of the group.

Dr Seal does not name the persons who have provided "the best scientific evidence" available to him in order to state: "The projection of near extinction by 1999 for all tigers is contrary to all available evidence for all of the surviving species except the South China tiger".

I do not think anyone can offer more authentic opinions of the tiger situation than members of the Cat Specialist Group. The high level of poaching in India is clearly indicated by the many seizures of bones and other parts in the past few years. Seizures this year have included the remains of some 50 tigers (Valmik Thapar, pers.comm.), and this can only represent the tip of the iceberg. Many poachers and traders have been arrested, often as a result of underground work by Cat Group members and representatives of TRAFFIC, the international wildlife trade monitoring organization. Unfortunately, most have been released on bail, and there has been a very low level of conviction.

According to the Project Tiger Directorate, a census in 1993 produced a total of 3,750 tigers in India. However, an analysis of the regional reports by members of the Steering Committee of Project tiger, including Valmik Thapar and Deb Roy, suggested that the number could be as low as 2,750. Many tigers, perhaps as many as half, are outside protected areas. In 1993, only three of the 19 special tiger reserves recorded a population of 100 or more tigers (Kanha 100; Corbett 123; and Sundarbans 251). Eight reserves had fewer than 50 tigers. Only half the totals can be considered breeding animals.

Dr Raghunandan Chundawat, Senior Scientist at the Wildlife Institute of India, points out that if an Indian tiger population of 3,750 is used in a model as one large population, there will be a longer survival period than for a population of 30-35 individuals, which is, in fact, the size of the average effective population (i.e. breeding population) in most protected areas in India. Mr Deb Roy, who has been investigating the situation outside reserves, says that tigers there are not breeding.

Dr Chundawat adds: "The extinction processes caused by habitat degradation, loss of prey and, more importantly, poaching, are active simultaneously on each of India's isolated populations, and therefore, apart from the few tiger reserves with larger populations, there would be little extinction projection difference between India's populations and that of the South China tiger."

In recent months I have travelled extensively in tiger areas in Vietnam and the Russian Far East, as well as India. At a workshop in Hanoi, scientists from Cambodia, Laos and Vietnam reported on the serious situation facing their tigers because of poaching and habitat loss, and the problems of providing protection. The open display of tiger products in markets throughout south-east Asia is clear evidence of active poaching. Most countries in the region have inadequate staff and funding to protect tigers and other wildlife.

In Russia, the number of Siberian tigers, reduced to only about 50 in the 1940s, had risen by 1990 to between 350 and 400. In 1992-93, a wave of poaching started and Russian experts estimated that 100 or more tigers were lost. At the Global Tiger Forum in Delhi in March 1994, Russia's Deputy Minister for the Environment, Mr Amirkhan Amirkhanov, said the tiger population had been reduced to 150-200.

I invite your attention to the enclosed photocopy of a feature article entitled "Poachers Pursue Siberian Tiger to Extinction" (Appendix III) in the International Herald Tribune of 7 September 1995. It contains comments on the dire situation by three members of the Cat Specialist Group, Drs Vladimir Abramov, Dimitriy Pikunov and Dale Miquelle, acknowledged leading experts.

During a recent visit to the Russian Far East, I was told that there appeared to be a decline in poaching at the present time because there were no buyers, possibly due to stringent measures taken by the neighbouring Chinese authorities; but this is no guarantee for the future, and poaching of prey and destruction of habitat is still going strong.

During my visit, I spent a month travelling through Siberian tiger habitat. I was appalled by the number of trucks hauling out timber, cut by American, Japanese and Korean companies for export. Large areas are being clear-felled, thus fragmenting tiger range. In particular, the loggers are taking the Korean pine (*Pinus coraiensis*), which is crucial to the tiger because its large seeds provide food for the wild boar, the tiger's main prey. Poaching for food of prey species, such as deer and pig, is widespread - and this applies to India as well as other tiger countries. The decline in prey species inevitably leads to a decline in tiger numbers.

Dr Seal says that it appears likely that tiger poaching in Sumatran reserves is now minimal. I would like to think it is. However, given the large size of some of the reserves and the difficulty of policing them, as well as Indonesia's poor record of controlling wildlife trade in the past, I remain doubtful. It may be noted that in the period up to late 1993, when import of tiger parts was legal in South Korea, 44.5% of the imports of tiger bone were recorded as coming from Indonesia. Except for 26.9% from China, imports from all other range countries were below 10% (Mills, J. and Jackson, P. 1994) (Appendix IV).

The case of the South China tiger illustrates my prediction for the future of the tiger in general. It was virtually extirpated as a pest in an official campaign in the 1950s and 60s. Tiger numbers were reduced from 4,000 in 1949 to an estimated 50-80 in 1986 (Lu Houji 1987). Since then, a few scattered tigers have survived in the mountain ranges of the southern Chinese provinces, and must be doomed. Dr Seal's China programmes involve building a zoo population.

Captive breeding and re-introduction

Given our generally poor knowledge of tiger population numbers, argument over the possible time of extinction could be endless. However, it is agreed that the tiger is one of the most endangered species, and that the utmost effort is required to save it. In this situation, are experiments in captive breeding and re-introduction valuable?

We in the Cat Group agree that pure-bred captive populations of tigers are valuable for biological research and educational display, but not with a view to experiments in re-intrdouction. I and my Indian colleagues insist that India's top priority is to safeguard the 60% of the world tiger population that it holds, and not to divert resources to programmes which we believe have little value for tiger conservation. That is the basis for our condemnation of Article 4 of the Sino-Indian Protocol on tiger conservation, which encourages experimental captive breeding and release programmes.

Throughout tiger range, habitat is being lost to an extent that, even if reintroduction of tigers were possible, there would be no place for them, or enough prey left to support a viable population.

As Dr Chundawat states: "Management's goal should be to prevent and reduce further fragmentation of the tiger population and, wherever possible, provide corridors to connect isolated populations. If this is done so that a series of metapopulations is created, such genetic manipulation as Dr Seal suggests will not be necessary.

"Moreover, if we are unable to conserve the existing tiger populations, how can we expect to manage reintroduced populations with their added inherent problems? If we cannot provide adequate protection for existing wild populations, there can be no assured protection for a reintroduced population. Protection is the most important issue: without it, reintroduction cannot succeed; with it, we do not require reintroduction."

Dr Chundawat's comments apply equally to the fragmented tiger populations in other countries.

At the Delhi press conference, I stated that there were no records of the successful release of captive-bred or raised tigers, and explained the problems involved in such projects. I invite attention to the enclosed IUCN "Guidelines for Re-introductions" (Appendix V) produced by the Re-introduction Specialist Group to indicate the immense and long-term problems that have to be tackled. Basically, the reasons for the disappearance of the species involved have to be identified and action taken to restore suitable conditions before any complicated reintroduction project can be attempted.

The proposed establishment of a second home for the Asiatic lion in Palpur Kuno reserve in Madhya Pradesh is a good example of what is involved: villages and livestock to be moved; prey populations boosted over a period of several years; and education of the local people to win acceptance of the project before the first translocation of a wild pride from the Gir. The estimated cost of these initial steps given in the project proposal is $7,000,000; this does not include the potential cost of the continuous management that will be required. The sources from which this money will come have yet to identified. Political and social issues have still to be tackled.

Dr Seal writes of the need for "science-based management programs which include biological, physical and social factors and are designed for each individual protected area and tiger population". He cites the case of the Florida panther *Puma concolor coryi*, of which only 30-50 adults survive under intense human pressure and on the brink of total extinction. Under strict scientific control, captive-bred and translocated animals have been released experimentally as part of a recovery programme. Dr Seal says that "no adverse human contacts have occurred as yet". It is true that the captive-bred animals, having been trained to hunt before release, settled quite well in the wild. However, five out of the 10 panthers in the programme had to be re-captured: three (either captive-born or held for several years in captivity) because they were killing and/or feeding on (domestic) calves; one male panther strayed twice outside the experimental re-introduction area; and a female panther was removed "for exhibiting 'a casualness attitude' around humans", according to an official report.

In an attempt to improve the degenerate genetic condition of wild Florida panthers, some Texas cougars *Puma concolor cougar*, the nearest subspecies, are now being released into the wild population. Whether this experiment is a success can only be known after several generations of panthers, which means many years.

The Florida Panther Recovery Programme has been going on for two decades. The total spent is not immediately available to me, but clearly amounts to many, many millions of dollars. There are no more Florida panthers now than there were when the programme began, and their prospects remain poor.

Dr Seal states: "We recognize that tigers, with a different social system offering a greater threat to people (than Florida panthers), will require genetic augmentation..."

What Dr Seal means is unclear. The social systems of Florida panthers and tigers are broadly similar. What sort of genetic augmentation could reduce the threat to humans or change the social system of tigers?

Technical problems aside, the ultimate issue is political. The precautions found necessary to control the release of captive-bred and translocated wild Florida panthers highlights the major problem which would be involved in release of tigers: most people do not want dangerous animals in their vicinity, and we are faced with a situation where there is little, if any, tiger habitat available where there are no people.

Released animals can be strictly monitored so that they can be removed in the event of a perceived threat to human interests. The problem is that removal is only likely to occur after an incident, which may not be damaging in itself, but may provoke adverse reactions in an already concerned human community that are counter-productive to efforts to conserve wild nature.

I still hope that my pessimistic scenario does not come to pass. Given effective protection against poaching, and loss of habitat and prey species, the tiger could survive, because it is in its reproductive prime. The Siberian tiger, the Asiatic lion, the great one-horned and white rhinos have all rebounded after being reduced to very low numbers. And there is evidence that the cheetah went through at least one bottleneck in past ages but numbers some 10,000 today. However, all these recoveries occurred in very different circumstances from those that exist today, when all large mammals are under siege and require active protection. Human population and economic development pressures are destroying the habitat and ecosystems which form the foundation for the existence of large mammals.

Mr Dey, I have been involved in tiger conservation for 25 years, and been particularly closely associated with Project Tiger in India, where I earlier lived for 18 years. I rejoiced at the successes achieved in the 1970s and 1980s, only to be shocked by the setbacks caused, especially by poaching for bones, in this decade. My experience in tiger countries this year has left me deeply depressed about the future of the tiger. This is not a time for doubtful and costly experiments, but for rigorous protection of the tigers that exist.

In closing, I should like to quote Dr George Schaller, Director for Science of the Wildlife Conservation Society, who recently wrote as follows:

> "The five remaining tiger subspecies could be preserved in captivity. But for what? Any reintroduction program for big cats is exceedingly difficult, time-consuming and expensive. Liberated tigers must learn to hunt and they may attack livestock and people. And widespread fear of the powerful predator will make them locally unwelcome, even if a suitable forest can be found. If a country truly wants free-living tigers, its first priority must be to study, vigorously protect, and manage those it still has. It must be done now before the radiance of the magnificent tiger, a symbol of physical beauty, power and lithe grace, disappears forever into the forest's shadow." (Wildlife Conservation June 1995).

With warm regards.

Yours sincerely,

Peter Jackson
Chairman

Lu Houji. 1987. *Habitat availability and prospects for tigers in China* in Tigers of the World. eds Tilson, R.L. and Seal, U.S. Noyes Publications. NJ, USA.

Mills, J. and Jackson, P. 1994. *Killed for a Cure.* TRAFFIC International, Cambridge UK.

cc Seal, Rabb, Tilson, Tilt, Walker, Stuart, Ferguson, Shuling, Thapar, Swells, Tilt, Sunquist, Seidensticker, Smith, Rabinowitz, Schaller.

Appendix I

CAT SPECIALIST GROUP

Species Survival Commission

THE WORLD CONSERVATION UNION (IUCN)

Mailing address: 1172 Bougy, Switzerland

Press conference by Peter Jackson,
Chairman, IUCN Cat Specialist Group
New Delhi, India, 30 March 1995

The tiger will be virtually extinct in the wild by 1999 unless India and the other range states declare open war on poachers and illegal traders and throw all the resources required into the battle. Some scattered individuals will remain and produce some young for a decade or two in the 21st century, but, in fact, we shall have seen the end of the tiger.

A review of the situation in India and south-east Asia shows that poaching is accelerating, with well-organized illegal trade networks operating, sometimes with the connivance of officials. Actual seizures indicate that hundreds of tigers are being poached every year in India alone, primarily for traditional Chinese medicine.

If the governments of tiger range states do not have the political will to save the tiger, then the future is bleak for wild nature and human welfare. Tiger conservation does not involve just a single species. It means saving large tracts of Asia's tropical forests and their wildlife. Forests and the natural world in general are the foundation of all life on earth, including that of humans, who rely on complex ecological systems for food, water, clean air, and many products used in their lives. Economic development will ultimately fail unless recognition is given to the vital importance of maintaining natural systems, of which the tiger is a part and a symbol.

India

India has become a killing ground for tigers. Undercover investigations by members and associates of the Cat Specialist Group and TRAFFIC International have been involved in the seizure of the bones, skins and claws, which could account for around 100 tigers poached in the past two years. The seizures also included 206 leopard skins, 18 snow leopard skins, 3 clouded leopard skins, 565 leopard cat skins and 773 skins of desert, jungle, marbled and fishing cats, not to mention other species. Seizures of thousands of skins and other parts of a whole range of Indian animals have been made independently by the police.

Illegal trade networks which convey tiger bones and other parts to consumer countries, primarily China, South Korea and Taiwan, have been identified. Skins are smuggled to other countries. Fiftytwo persons were arrested and charged in these cases. The involvement of Kashmiri militants and traders, as well as Tibetans, has been established.

The number of tigers known to have been killed is only the tip of the iceberg. Application of the "iceberg formula" (i.e. what is visible is only a fifth of the whole) to the above figures suggests that over 500 tigers may have been poached in the past two years. The loss of female reproductive potential and the disruption of the social system of tigers, which leads to low cub survival, means that the impact is far greater than the actual number of tigers lost.

The situation is almost certainly worse in other tiger range countries in South-East Asia and the Russian Far East, which together hold fewer than 2,000 of the tens of thousands of tigers which existed a century ago. There is no evidence that effective protection is being provided in these countries. Tiger parts are openly displayed, even in capital cities.

->

The Sino-Indian Protocol on Conservation of the Tiger

The Sino-Indian Protocol on Conservation of the Tiger is a welcome step towards international cooperation, but Indian members of the Cat Specialist Group who met at Kanha on 20-21 March consider that it has some objectional features.

Article IV states:

> "Encourage, on an experimental basis, captive breeding activities with a view to release of the species into the wild."

This article has no relevance to the problem of tiger conservation in India and diverts attention, resources and effort from the urgent task of protecting existing tiger populations, which are gravely threatened by poaching for skins, bones and other parts for Chinese medicine. India has between 3,000 and 4,000 tigers and protecting them must be given the highest priority. They breed well and there is clearly no need whatsoever for releasing captive-bred tigers.

Captive breeding programmes can be valuable for biological research, but they are expensive. Release in the wild would be far more expensive, even for a single tiger, let alone the number which would be required to re-establish a healthy population. But there are no records of successful release of captive-bred tigers in the wild. Young tigers need to learn how to live and hunt in the wild from their mother over a period of up to two years before they become independent.

Areas exist in India where tigers once lived but have recently been extirpated, but there is no chance of captive-bred tigers surviving there if the reasons for the absence of wild tigers are not addressed, primarily poaching. Given that the authorities have not been able to stop the massive poaching wave now going on, it is obvious that captive-bred tigers, reared at great expensive, would be killed too.

The idea that existing tiger populations could be "topped up" with captive-bred animals is not practical. Tigers have a tight-knit social organization in which males defend territories containing several females, who also do not tolerate intruders. Introduced tigers, even given some training in captivity, would face the hostility of tigers in release areas. Animals without territories, such as an introduced tiger, are liable to be killed, or be forced to move to fringe areas to live on livestock. They may clash with local people, with possibly fatal consequences. This would seriously antagonize these communities and be counter-productive to the whole concept of tiger and wildlife conservation.

In the light of the above, the Indian members of the Cat Specialist Group recommend that the Government of India should seek China's agreement to the deletion of Article IV of the Sino-Indian protocol. As a sovereign country, China can pursue any domestic policy it chooses and would not be affected by the deletion.

The Cat Group also points out that the phrase in the Preamble referring to "sustainable development of the species" is nonsense. Human intervention in natural evolution of a wild species, means that it ceases to be a wild species. If the phrase is meant to refer to "sustainable use", it is inappropriate and objectionable and should not be included in an agreement on conservation of the tiger.

Madhya Pradesh

With 900 tigers reported by the 1993 census, Madhya Pradesh holds about one-sixth of the surviving world population, and is about to declare itself a "Tiger State". Accompanied by Valmik Thapar, Vice-Chairman (Asia) of the Cat Specialist Group, and Peter Lawton, Chief Executive of Global Tiger Patrol, I have just spent two weeks visiting the Pench, Kanha, Bandhavgarh and Panna tiger reserves. They are places of exceptional natural beauty and value to India, and they contain a wide spectrum of the country's rich wildlife.

We found evidence of tigers in Kanha, Bandhavgarh and Panna (where we saw one tiger). We did not find tracks in Pench, but the reserve staff reported recent sightings. Dr Ullas Karanth, who has carried out many years of study of tigers and prey in Nagarhole National Park, has chosen Pench for a scientific survey of tiger presence using strategically-located camera traps, and will later carry out a similar survey in Kanha.

Over 50 poaching incidents have occurred in Madhya Pradesh in the past six months, one of them on the eve of our arrival in Bandhavgarh, in which an attempt was made to implicate a well-known conservationist. The police have recovered skins and bones of 16 tigers. More than 30 people have been

->

arrested and prosecuted, and the police believe that hundreds are involved in organized illegal trade.

Apart from direct poaching, the tiger is threatened by habitat degradation caused by livestock grazing in the four reserves. In Panna, for example, there are 16 villages within the reserve and 40 outside which send in livestock. Some areas are bare of vegetation, except for a few trees and large patches of lantana, an exotic weed. If Panna is to survive as a haven for tigers and other wildlife, immediate action is required to move villages, control livestock grazing and rehabilitate the land. Diamond mining and stone quarrying on the reserve boundaries are also contributing to degradation and polluting rivers.

In general, we were impressed by the dedication of Project Tiger staff, but concerned that, except for Kanha, vital resources, such as vehicles, binoculars and personnel have not been provided by the central and state governments to enable them to carry out their mission. We have decided to provide emergency aid.

At the same time, we urge the authorities to act at once to carry out their commitment to saving the tiger and its habitat. The large number of Indians, as well as foreigners, who visit the reserves shows what a high value people place on wild nature.

Members of the Cat Specialist Group are concerned about the situation in many places in India. Lack of resources is handicapping protection and management and there are fears that at least 11 of the Project Tiger reserves may soon deteriorate below the point of no return. They include Buxa, Dudhwa, Indravati, Manas, Nagarjunasagar, Palamau, Panna, Pench, Ranthambhore, Sariska and Valmiki. The situation is well known to the authorities, and in no case is the situation irreversible if immediate action is taken.

It is unfortunate that at this very moment of crisis, the Finance Ministry has placed a moratorium on purchase by Project Tiger of vehicles, which are essential if the war against poachers is to be won. International organizations, government and non-government, are ready to provide funds if invited to do so.

Vietnam and Malaysia

Earlier this month I visited Vietnam, where we held a workshop on tiger conservation attended also by representatives of Cambodia and Laos. Compared with India, little is known of their tiger populations, except that they have been drastically reduced. The three countries agreed to cooperate because tigers are mainly found in the mountains which span their frontiers.

All three countries lack resources and personnel to deal with the grave situation. Action projects were drafted for each country, and a representative of WWF International pledged the necessary funds.

Tiger parts are openly displayed in these countries. In Hanoi, I found over 40 tiger canine teeth made into pendants in just four curio shops within a radius of 100 metres.

In Malaysia, which has estimated its tiger population at 600-650 without actual surveys, around 250 complaints of livestock predation were received by the Wildlife Department in 1994. Although Malaysia is a relatively wealthy country, wildlife management and protection staff have not received adequate support. Officials said they would welcome cooperation with their Indian counterparts.

Global Tiger Forum

Eleven tiger range countries agreed in Delhi in March 1994 to establish a Global Tiger Forum to coordinate their tiger conservation programmes. To become effective five ratifications are required. At the present time only two have been received. India itself only ratified the treaty one month ago. The lack of urgency and political will displayed could be fatal for the tiger.

CONCLUSION

THE FINAL BATTLE TO SAVE THE TIGER MUST BE LAUNCHED NOW. FURTHER DELAY CAN ONLY LEAD QUICKLY TO THE EXTINCTION OF THE TIGER.

->

Appendix II

CAT SPECIALIST GROUP

Species Survival Commission

THE WORLD CONSERVATION UNION (IUCN)

The Cat Specialist Group is a volunteer panel of 167 biologists, wildlife managers and conservationists from 50 countries who are experts on the 36 species of wild cats. It is one of over 100 specialist groups which form part of the Species Survival Commission of IUCN - The World Conservation Union, the largest scientific conservation organization in the world.

Cat Specialist Group members present at the Kanha meeting 20-21 March 1995

Mr Peter Jackson,
Chairman, IUCN Cat Specialist Group. Project Officer, WWF Operation Tiger 1972-79. Author of Endangered Species: Tigers (Apple Press 1990)
Mr Valmik Thapar, Member, Project Tiger Steering Committee, Vice-Chairman (Asia), IUCN Cat Specialist Group. Author of four books on the tigers of Ranthambhore.
Dr Ullas Karanth. Associate Research Scientist, World Conservation Society/New York Zoological Society, and a member of the official Tiger Crisis Cell.
Mr Sanjoy Deb Roy. Member, Project Tiger Steering Committee. Retired Additional Inspector General of Forests (Wildlife) and former Chief Wildlife Warden, Assam, and Field Director, Manas Tiger Reserve.
Mr Pranabes Sanyal, Conservator of Forests, West Bengal. Former Field Director Sundarbans and Buxa Tiger Reserves.
Mr Madhav Gogate, Conservator of Forests (Research), Maharashtra. Former Field Director, Melghat Tiger Reserve.
Dr Raghunandan Chundawat, Senior Wildlife Scientist, Wildlife Institute of India.
Mrs Anne Wright. Independent conservationist.
Ms Belinda Wright. Executive Director, Wildlife Protection Society of India. Joint Producer of the National Geographic Special "Land of the Tiger".
Ms Shomita Mukherjee, Research Scientist, Wildlife Institute of India.
Mr Peter Lawton, Chief Executive, Global Tiger Patrol (UK).

Other members

Mr H.S.Panwar, former Director, Wildlife Institute of India, Director, Project Tiger, Field Director, Kanha Tiger Reserve.
Dr A.J.T. Johnsingh, Joint Director, Wildlife Institute of India.
Dr Ravi Chellam, Senior Scientist, Wildlife Institute of India.
Dr Kalyan Chakravarti, Deputy Director (Wildlife Conservation), Eastern India, and former Field Director, Sundarbans Tiger Reserve.
Dr P.C. Kotwal, Indian Institute of Forest Management, and former Scientific Officer, Kanha Tiger Reserve.
Dr M.K. Ranjitsinh, former Joint Secretary, Ministry of Environment and Forests, and one of the leading scientific experts on tigers and other Indin wildlife.
Mr M.A. Rashid, Former Chief Conservator of Forests (Wildlife), Gujarat. Specialist on Asiatic lion.
Mr Fateh Singh Rathore. Former Field Director, Ranthambhore Tiger Reserve.
Mr Vinod Rishi, Secretary, Global Tiger Forum and Deputy Director, Wildlife Conservation. Former Field Director, Sundarbans Tiger Reserve.
Mr Arjan Singh. Leading independent tiger specialist and naturalist. Raised and reintroduced a tigress and two leopards to Dudhwa National Park.
Mr Brijendra Singh. Member, Steering Committee, Project Tiger. Leading naturalist and tiger specialist. Hon. Warden, Corbett National Park.
Mr Mahendra Vyas, Mahendra, Advocate, Rajasthan High Court, and specialist on wildlife legislation.

Russian Wildlife Endangered / **Asian Medical Demands Fuel Brisk Trade**

Poachers Pursue Siberian Tiger to Extinction

By Michael Specter
New York Times Service

USSURI RESERVE, Russia — Fueled by economic chaos and wide-open borders, a new generation of poachers has chased the Siberian tiger and many less renowned animals nearly to extinction in the lush cedar forests here.

Russians in this Pacific Coast region 9,700 kilometers (6,000 miles) from Moscow, where unemployment is high and the minimum monthly wage is little more than $20, have in the last three years begun to flood nearby Asian markets with animal parts sought by hundreds of millions of Chinese, Japanese and Koreans for use in traditional medicines.

And the parts are used in some untraditional ways, too. Four sex glands of the male kabarga, a type of gazelle, will trade in Seoul these days evenly for a new Jeep Cherokee. Twenty years ago, local conservation experts say, they fetched two bottles of vodka.

Although many animals are valuable, none is more coveted than the world's largest cat, the Siberian tiger, whose skin, bones, eyes, whiskers, teeth and internal and sexual organs are in continual demand for everything from skin cures to tooth medicine.

The poaching, often by hunters using automatic weapons and night-vision devices, has begun to alter the fragile balance of nature in the forests of the Russian Far East.

Not just the tiger, but a whole range of wildlife has fallen prey to the insatiable demands of the Asian medical market, from ginseng, which grows here, to the rare Japanese crane and musk deer, both of which are rapidly disappearing. Black marketeers peddle the gallbladders of endangered Asiatic black bears in the lobby of the Hotel Vladivostok for $10 a gram. It is possible to buy a healing plaster containing tiger bones at the airport on the way out of town.

"Most people just look at the tiger problem by itself," said Alexander S. Gruzdyev, one of the inspectors who heads a new anti-poaching task force set up in Vladivostok by the Russian government but paid for by international conservation organizations. "You can't look at the tiger alone. The area where he lives is shrinking every year. And that's due to development and hunting of other animals and pollution. All these things interact, and none of them can be easily separated from any other."

Under communism, Russia's borders were emphatically shut, guns were forbidden and international commerce was almost impossible.

All that has changed with a vengeance since 1991. With open borders, Russians are now well aware of how eager many Asians are to get hold of ingredients they consider essential to maintaining and improving health.

Amur, or Siberian, tigers once roamed broadly from the Pacific to the edge of Lake Baikal. But as development and human habitation pushed east, the number of tigers shrank steadily. Now they live only in the forests north of Vladivostok.

TEN years ago, scientists say, there were about 500 Siberian tigers in the Pacific Coast regions of Primorsky and Khabarovsk. Now, with a dead tiger worth as much as $25,000 on the open market, most think there are fewer than half that number.

Much of the poaching of other animals does not even have anything to do with making money. Wild boar, deer and reindeer are all hunted avidly and usually illegally by people who know that a few such animals can keep their families fed through the long winter. But those animals are what tigers eat, too, and the fewer there are of them the farther each animal has to roam for its prey — sometimes hundreds of kilometers.

The plenitude of wildlife here makes it hard for some hunters to take warnings seriously. Russia has more brown bears and endangered black bears than the rest of the world, and 8 of the world's 12 crane species. It is a vital habitat for not just for the Siberian tiger and Amur leopard, but also for the musk deer and the Saiga antelope, whose horns are ground into a powder to reduce fevers.

The Russian government, with enormous aid from international groups like the World Wildlife Fund, Britain's Tiger Trust and the Hornocker Wildlife Research Institute in Idaho, has established 22 tiger preservation areas in this area.

Here, in the 44,504-hectare (110,000-acre) Ussuri Reserve, officials have forbidden further road building, construction of houses and logging. They have even dismantled a small town that sat in the middle of territory that was favored by tigers.

But none of that prevented poachers from killing at least 65 tigers in this area last year — a quarter of all those believed to be alive. Scientists and environmentalists here say that if the pace does not slow quickly, the tiger could disappear from the wild within a couple of years.

"Poaching has always been a way of life in Russia," said Vladimir K. Abramov, the scientific director of the Ussuri Reserve. "It's not easy to explain to people who have lived here their whole lives why it's bad or what the consequences might be. And now everything is so much more accessible than it was before that enforcement is almost impossible."

THE Russian government has so little money that all salaries of the two special anti-poaching task forces here are paid by international environmental organizations.

Laws alone will not be enough to stop the poaching. Timber and other goods, including those smuggled illegally, are now shipped from private docks directly to Korea. Middlemen hire hunters and arrange for the parts to be spirited out of the country. Perhaps most important, guns are now easy to buy at stores like one called Sniper, which sell all the necessities to the eager hunter in Vladivostok.

"I have lived here all my life," said Dmitri G. Pikunov, chief of the laboratory of wild animals at the Far East Branch of the Russian Academy of Sciences. "I have seen hunting rise and fall. I have seen it banned and come back. I myself love to hunt. But I have never seen the opportunity for people to make money combine so completely with their economic problems."

Punishments for those people who are caught are still minimal. So far this year, according to official statistics, 119 people have been caught hunting illegally in Primorsky, 46 caught fishing illegally and 30 caught cutting timber where they were not allowed.

Nobody was sentenced to jail, and the total of all fines for all those caught, 40 million rubles or about $9,000, is less than the cost of a few endangered black bears, which are often killed and left in the wild with only their gallbladders missing.

The laws, even new ones intended to curb poaching, are so weak that rangers rarely have cars and are not even permitted to carry weapons to protect themselves.

The results of unregulated hunting are easy to see. In one small area on Lake Khanka, near China, all 10 tigers that lived there have been killed in the last three years.

Now the region is packed with wolves, which the tigers had always kept at bay. They have picked the area clean of deer, reindeer and many of the boar, and because they are now without prey, they are spreading out to seek new territory.

Thanks to heavy lobbying and millions of dollars from Western governments and environmental groups, thousands of kilometers of the Pacific territories may soon be designated as off limits to development. But the pressure to cut the timber and mine the fields has never been fiercer.

"Any conservation effort like this is always really about people management," said Dale G. Miquelle, an American tiger researcher who has spent more than three years here. "And managing people is tough. You can win a whole series of victories and one vital setback will ruin you. But we have not been defeated yet. And if I thought we couldn't win, I wouldn't be here."

S. Morgan/Greenpeace

A tiger skin is recovered from poachers in a forest in Primorsky. The animal's parts are highly coveted for medicines in Asia.

The New York Times

TOMORROW

There was a time when Latin America railed against the cultural imperialism it saw emanating from the United States. Those days are over. A universal, homogenized popular culture is on the rise.

Russia Metes Out Blame

TRAVEL UPDATE

Appendix IV

Table 14

Total South Korean imports of Tiger bone by country, 1970-October 1993, (in order of total quantities)

Exporting country	Kg	% of total
Indonesia	3994	44.5%
China	2415	26.9%
Thailand	607	6.8%
Malaysia	493	5.5%
India	248	2.8%
Singapore	195	2.2%
Taiwan	150	1.7%
Hong Kong	120	1.3%
Madagascar	100	1.1%
Bhutan	30	0.3%
USA	20	0.2%
Japan	3	0.03%
Others	606	6.7%
Total	**8981**	

Source: Customs Administration, South Korea.

Appendix V

RSG

IUCN/SSC Re-introduction Specialist Group

c/o AFRICAN WILDLIFE FOUNDATION
P.O. Box 48177, Nairobi, Kenya
Tel: (254)-2-710367
Tlx: 22152 AWF KE
Fax: (254)-2-710372

DRAFT GUIDELINES FOR RE-INTRODUCTIONS

INTRODUCTION

These policy guidelines have been drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission[1], in response to the increasing occurrence of re-introduction projects world-wide, and consequently, to the growing need for specific policy guidelines to help ensure that the re-introductions achieve their intended conservation benefit, and do not cause adverse side-effects of greater impact. Although the IUCN developed a Position Statement on the Translocation of Living Organisms in 1987, more detailed guidelines were felt to be essential in providing more comprehensive coverage of the various factors involved in re-introduction exercises.

These guidelines are intended to act as a guide for procedures useful to re-introduction programmes and do not represent an inflexible code of conduct. Many of the points are more relevant to re-introductions using captive-bred individuals than to translocations of wild species. Others are especially relevant to globally endangered species with limited numbers of founders. Each re-introduction proposal should be rigorously reviewed on its individual merits. It should be noted that re-introduction is always a very lengthy, complex and expensive process.

Re-introductions or translocations of species for short-term, sporting or commercial purposes - where there is no intention to establish a viable population - are a different issue and beyond the scope of these guidelines. These include fishing and hunting activities.

This document has been written to encompass the full range of plant and animal taxa and is therefore general. It will be regularly revised. Handbooks for re-introducing individual groups of animals and plants will be developed in future.

1. DEFINITION OF TERMS

a. "Re-introduction": an attempt to establish a species[2] in an area which was once part of its historical range, but from which it has been extirpated or become

---

1 Guidelines for determining procedures for disposal of species confiscated in trade are being developed separately by IUCN for CITES.

2 The taxonomic unit referred to throughout the document is species: it may be a lower taxonomic unit (e.g. sub-species or race) as long as it can be unambiguously defined.

extinct[3] ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

b. "Translocation": deliberate and mediated movement of wild individuals or populations from one part of their range to another.

c. "Re-inforcement/Supplementation": addition of individuals to an existing population of conspecifics.

d. "Conservation/Benign Introductions": an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.

2. AIMS AND OBJECTIVES OF RE-INTRODUCTION

a. Aims:

The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which was has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

b. Objectives:

The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these.

3. MULTIDISCIPLINARY APPROACH

A re-introduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from: governmental natural resource management agencies; non-governmental organisations; funding bodies; universities; veterinary institutions; zoos (and private animal breeders) and/or botanic gardens, with a full range of suitable expertise. Team leaders should be responsible for coordination between the various bodies and provision should be made for publicity and public education about the project.

4. PRE-PROJECT ACTIVITIES

4a. BIOLOGICAL

---

[3] CITES criterion of "extinct": species not definitely located in the wild during the past 50 years.

(i) **Feasibility study and background research**

- An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.

- Detailed studies should be made of the status and biology of wild populations (if they exist) to determine the species' critical needs; for animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases. For migratory species, studies should include the potential migratory areas. For plants it would include biotic and abiotic habitat requirements, dispersal mechanisms, reproductive biology, symbiotic relationships (e.g. with mycorrhizae, pollinators), insect pests and diseases. Overall, a firm knowledge of the natural history of the species in question is crucial to the entire re-introduction scheme.

- The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.

- The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.

- A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.

(ii) **Previous Re-introductions**

- Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing re-introduction protocol.

(iii) **Choice of release site and type**

- Site should be within the historic range of species. For an initial re-inforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. In some circumstances, a re-introduction or re-inforcement may have to be made into an area which is fenced or otherwise delimited, but it should be within the species' former natural habitat and range.

  A conservation/ benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.

- The re-introduction area should have assured, long-term protection (whether formal or otherwise).

(iv) Evaluation of re-introduction site

- Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the foreseeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/political or cultural environment since species extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.

- Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal.

- Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.

(v) Availability of suitable release stock

- It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely-related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.

- Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.

- Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.

- If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.

- Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.

- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process <u>before</u> shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after retesting, the animals may be placed for shipment.

- Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk.

- Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.

- Most species of mammal and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training and their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

- Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

vi) **Release of captive stock**

- Most species of mammal and birds rely heavily on individual experience adn learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training and their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

- Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

4b. SOCIO-ECONOMIC AND LEGAL ACTIVITIES

- Re-introductions are generally long-term projects that require the commitment of long-term financial and political support.

- Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.

- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.

- Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.

- The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures as necessary.

- Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.

- If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.

5. PLANNING, PREPARATION AND RELEASE STAGES

- Approval of relevant government agencies and land owners, and coordination with national and international conservation organizations.

- Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.

- Identification of short-and long-term success indicators and prediction of programme duration, in context of agreed aims and objectives.

- Securing adequate funding for all programme phases.

- Design of pre- and post- release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data. Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforseeably favourable.

- Appropriate health and genetic screening of release stock, including stock that is a gift between governments. Health screening of closely related species in re-introduction area.

- If release stock is wild-caught, care must be taken to ensure that: a) the stock is free from infectious or contagious pathogens and parasites <u>before</u> shipment and b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.

- If vaccination prior to release, against local endemic or epidemic diseases of wild stock or domestic livestock at the release site, is deemed appropriate, this must be carried out during the "Preparation Stage" so as to allow sufficient time for the development of the required immunity.

- Appropriate veterinary or horticultural measures as required to ensure health of released stock throughout programme. This is to include adequate quarantine arrangements, especially where founder stock travels far or crosses international boundaries to release site.

- Development of transport plans for delivery of stock to the country and site of re-introduction, with special emphasis on ways to minimize stress on the individuals during transport.

- Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).

- Establishment of policies on interventions (see below).

- Development of conservation education for long-term support; professional training of individuals involved in long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.

- The welfare of animals for release is of paramount concern through all these stages.

6. POST-RELEASE ACTIVITIES

- Post release monitoring is required of all (or sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable.

- Demographic, ecological and behavioural studies of released stock must be undertaken.

- Study of processes of long-term adaptation by individuals and the population.

- Collection and investigation of mortalities.

- Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.

- Decisions for revision, rescheduling, or discontinuation of programme where necessary.

- Habitat protection or restoration to continue where necessary.

- Continuing public relations activities, including education and mass media coverage.

- Evaluation of cost-effectiveness and success of re- introduction techniques.

- Regular publications in scientific and popular literature.

1

Dear Peter, I received your communication through Valmik - that regarding captive breeding of the Tigers raised by Dr. U. Seal. I feel this matter raised with the statutory authority of wildlife management of our country, which at present holds more than 60% of the global tiger population, is potent with very serious and dangerous portents and consequences in the field of conservation of the Tiger, particularly at the present crucial period.

First of all let me tell you expressly that I stand by my earlier arguments about the matter of captive breeding with an objective to reintroduce or relocate Tigers in the wild. I support your views in full, but would like to elaborate a little further.

The way the matter has been presented, speaks only about obsession about captive breeding in the name of science. I find, instead of evaluating the merits, demerits and various intricacies of such a venture, emphasis has been cleverly laid only on the positive aspects to justify the one way thoughts of C.B.S.G. claiming ex-situ conservation as the objective.

I don't go into the old controversy of Tiger's can be successfully bred and introduced into the wild. I don't think any one who claim's to know the tiger ~~very~~ well, would differ from these view, in view of the life-style of the tiger so far studied and understood. Government of India policy of conservation of wildlife is not species oriented. The policy has emphasized all importance on total ecosystems preservation, which is admitted ~~as~~ unambiguiously as the right approach. It need's hardly any mention that the widely acclaim ~~initial~~ sucess of the project tiger had come about by religiously following the above concept. The tiger being at the apex of the biological pyramid in the natural ecosystems, wherever it occured, is the end user of the biomass generated by these ecosystem. Obviously it probably does'nt need any explanation, ~~as~~ is to why tiger and its habitat (floral and faunal biomass ~~composites that constitute~~, as also the inorganic mass, the climatic condition and geographical location etc.) is inseparable ~~in~~ in dealing conservation objective.

Taking the argument that successful captive breeding and subsequent/reintroduction of the tiger into the wild may be a possibility, I still fail to agree that future survival of the species in the area of introduction/reintroduction can be assured because of the immense biotic influence of rising human population level in and around any area of possible introduction of the species. The first and primary requisite of successful establisment of ~~a wild~~ any species in the wild, is to ensure complete elimination of the dessimating factors that had been responsible for disappearance or local extinct of the species in its earlier range or any part there of. It's all too well known to be mentioned afresh that physical extermination ~~by~~ of the species, depletion of the prey base and severe abuse, ~~&~~ degradation of the natural habitat of the tiger is the reason for tiger's elimination from a major part of its earlier range. Despite all efforts, at national and inter national level, their is hardly any improvement in the situation almost any where. In fact the dessimating factors are excruciating the tiger in a ~~wise~~ vice grip much more than ever.

During the last year I have visited some of the tiger habitats in central India, (which is ~~a~~ considered as a bestion of Tiger) which ~~are~~ are located outside the protected area system. Such areas in India (Tiger area outside the protected area system) are in record (1993 Census) to hold over 50% of the total tiger population of the country. But the indications I got in the field ~~reads~~ leaves no doubt that in reality ~~is~~ the tiger in such areas is in a precarious condition. ~~It~~ There is hardly any resident tiger population breeding in these areas. Only some juveniles and some older tigers (mostly males) disperse out of the protected area, either being pushed out or ~~seeking to~~ to establish new areas. Such tigers naturally forms only a vagrant population, which fall easy victim to poachers.

Even the tiger in the protected areas are not as safe as they used to be a decade back. The poachers long arms have successfully penetrated into ~~many~~ most protected areas ~~through~~ organised underworld traffikers, mainly for bone trade. I do not want to go into any details of what I observed, but I am left with no doubt that the tiger is clearly on its way out from these areas. The importance of such areas outside the protected area network can not be over emphasized in maintaining viable populations of the species. I have been an unfortunate witness of the ~~elim~~ local elimination of the species in many areas of this country under biotic influence during last 4 decades of my association with the conservation of the species. I don't think I will make any mistakes about the above inference, even though I sincerely wish and prey that I will be proved wrong. I fact the causative factors of the decline of the tiger are worsening with passage of time. I can not see any way of re establishing tiger populations unless these causative factors are eliminated or seriously controlled. It is inconsequential if their intended populations comes through captive breeding or otherwise, even and assuming that captive breeding and reintroduction of the tiger ~~shall~~ could be successful.

I admit that I know very little about PHVA analysis (except reading from some papers about the subject). But at the same time whatever I understand about the subject raises serious doubts about the efficacy of such analysis of ~~the~~ a species which occupy very complicated multitype tropical ecosystems consisting of numerous tropic level. The situation pertaining to the survival of the tiger is directly related to human encroachment into the ecological domain of the tiger. PHVA analysis, I reckon, ? cannot measure upto the ecological damage caused to any

Species by man, an so may be misleading. I would give an example, their had been around 40 Rhinos in a wildlife sanctuary named Laokhowa in ~~[illegible]~~ the beginning of 1983. This population had been built ~~[illegible]~~ from a very small no. of ~~s~~ Rhinos as a result of dispersal from mainly Khaziranga and some other areas, The situation had been quiet favourable to the Rhinos with a happy situation of a sizeable breeding population established in the area. But unfortunately in 1983 serious political unrest engulfed this area, bringing in its wake very serious law and order problem and in a matter of ~~a~~ month or two the entire population of the Rhino of ~~the~~ Laokhowa was completely lost to poaching ~~aided by~~ because of temporary lawlessness. In Manas their had been a rhino population closed to 100 (±) till 1988. This population had also been built from these original slender population ~~in the~~ (early ~~RD~~ 50's). Political unrest leading to insurgency engulfed this area also since 1988 and present status of rhino in Manas is indeterminate but precarious. Serious doubts have been expressed by many whether rhino do exist in Manas at all at the moment. If Jaldapara population of the Rhino's (below 40) is considered to be viable from a PHVA analysis, no stress of imagination would have projected, the Rhino population of ~~Jaldapara~~ Lao Khowa of 1983 and ~~m~~ Manas population of Rhino's in 1988 to be off doubtful viability. The fact is, some ~~expo~~ spurts of ~~unmeasurable~~ unpredictable human activities, eliminated (very nearly eliminated) a threatened species from these protected areas, ~~abtract~~ (Ecological viability) this would suggest that P.H.V. Analysis may be of →

Such instances of local extinction of species are very common in many parts of this world, which put a big question mark on the efficacy of PHVA analysis, may be except for justify captive breeding efforts, ~~species~~ for reintroduction/introduction of species.

→ very little significance in areas of social/political unrest.

I think it is foolish to debate on the cut of ~~day~~ date of the probable extinction ~~of~~ of the tiger in the wild. Humanity will be wiser, richer and happier if this black day can be delayed. But field indications, ~~as~~ I am afraid, do not provide much hope in India. Time is running out real fast for concerted action in saving the tiger. I am afraid Seal letter may provide ~~the~~ scope for complasance, which can be lethal in case of the tiger.

Comments made above relates to India only. Actually it is human activities that has forced the tiger in to the extinction threshold and not because of ~~any~~ purely ecological reasons. What is required now it to put an end to such dessimating human activities. For this an all out global effort is immediately required. Further we are with our backs to the wall. Their is absolutely no room for meanouvering, we can not afford to commit mistakes or even take chances on the plea that we will learn from our mistakes, as indicated by Seal.

I don't know when "conservation" replaced "captive" in the abbreviation of C.B.S.G, but it appears to me to be a very clever ploy of covering up the real objectives under pressure.

I am grateful to you for asking me comments about ~~all~~ this subject, which I strongly feel (like always) is going to be strongly counter productive. Please let me know if you could do something with my letter to you about ecodevelopment planning and world bank/GEF funding. I am very anxious to know about that. ?

With love

Sincerely yours

[signature]

Copy to Mr. S.C. Dey

Copy to Mr. Kamal Nath,
~~Honourable~~ Minister ~~[illegible]~~ E & F.
G.O.I.

To Valmik Thapar from Peter Jackson / 7 Sept 1995 (1)

Here is my draft letter to Dey. Please let me have any comments from you, Deb or any others as quickly as possible.

Dear Mr Dey,

Dr U.S. Seal has sent me a copy of his letter to you dated 28 August about the tiger situation. It is primarily a reaction to the statement I issued at the press conference in Delhi on 30 March. For the benefit of those who also received copies of Dr Seal's letter I repeat the opening paragraphs:

> The tiger will be virtually extinct in the wild by 1999 unless India and the other range states declare open war on poachers and illegal traders and throw all the resources required into the battle. Some scattered individuals will remain and produce some young for a decade or two in the 21st century, but, in fact, we shall have seen the end of the tiger.
>
> A review of the situation in India and south-east Asia shows that poaching is accelerating, with well-organized illegal trade networks operating, sometimes with the connivance of officials. Actual seizures indicate that hundreds of tigers are being poached every year in India alone, primarily for traditional Chinese medicine.
>
> If the governments of tiger range states do not have the political will to save the tiger, then the future is bleak for wild nature and human welfare. Tiger conservation does not involve just a single species. It means saving large tracts of Asia's tropical forests and their wildlife. Forests and the natural world in general are the foundation of all life on earth, including that of humans, who rely on complex ecological systems for food, water, clean air, and many products used in their lives. Economic development will ultimately fail unless recognition is given to the vital importance of maintaining natural systems, of which the tiger is a part and a symbol.

The statement represents the consensus of the views of members of the Indian sub-group of the Cat Specialist Group, who had just met in Kanha National Park. They include, without doubt, the most experienced wild tiger specialists and field managers in the world. They are listed in Appendix I of this letter.

Dr Seal does not name the persons who have provided "the best scientific evidence" available to him in order to state: "The projection of near extinction by 1999 for all tigers is contrary to all available evidence for all of the surviving species except the South China tiger".

I do not think anyone can offer more authentic opinions of the tiger situation than members of the Cat Specialist Group. The high level of poaching in India is clearly indicated by the many seizures of bones and other parts in the past few years. Many poachers and traders have been arrested, often as a result of underground work by Cat Group members and representatives of TRAFFIC, the international wildlife trade monitoring organization. Unfortunately, there has been a very low level of conviction and most have been released on bail.

The official census of 1993 produced a total of 3,750 tigers in India. Only 1,766 were in the official tiger reserves, where they are supposed to receive special protection. Only three of the 19 tiger reserves recorded a population of 100 or more tigers (Kanha 100; Corbett 123; and Sundarbans 251). Eight reserves had fewer than 50 tigers. This shows dangerous fragmentation which bodes ill for the tiger.

In recent months I have travelled extensively in tiger areas in Vietnam and the Russian Far East, apart from India. At a workshop in Hanoi, scientists from Cambodia, Laos and Vietnam reported on the serious situation facing their tigers. The appearance of tiger products in markets throughout south-east Asia is clear evidence of active poaching. Most countries in the region have inadequate staff and funding to protect tigers and other wildlife.

In Russia, the number of Siberian tigers, reduced to only about 50 in the 1940s, had risen by 1990 to between 350 and 400. In 1992-93, a wave of poaching started and Russian experts estimated that 100 or more tigers were lost. At the Global Tiger Forum in Delhi in March 1994, Russia's Deputy Minister for the Environment, Mr Amirkhan Amirkhanov, said the tiger population had been reduced to 150-200.

I invite your attention to the enclosed photocopy of today's International Herald Tribune which has a major feature article entitled "Poachers Pursue Siberian Tiger to Extinction" (Appendix II). It contains comments on the dire situation by three members of the Cat Specialist

(2)

Group, Drs Vladimir Abramov, Dimitriy Pikunov and Dale Miquelle, who are internationally-acknowledged as leading experts. I was told that there appeared to be a decline in poaching at the present time because there were no buyers, possibly due to stringent measures taken by the neighbouring Chinese authorities, but this is no guarantee for the future, and poaching of prey and destruction of habitat is still going strong.

During a recent month travelling through Siberian tiger habitat I was appalled by the number of trucks hauling out timber, cut by American, Japanese and Korean companies for export. Large areas are being clear-felled. In particular, the loggers are taking the Korean pine (*Pinus koraensis*), which is crucial to the tiger because its large seeds provide food for the wild boar, which is the tiger's main prey. Poaching of prey species, such as deer and pig, for food is rampant - and this applies to India and other tiger countries. The decline in prey species inevitably leads to a decline in tiger numbers.

Dr Seal says that tiger poaching in Sumatran reserves is now minimal. I would like to think so. However, given the size of the reserves and the difficulty of policing them, as well as Indonesia's poor record of controlling wildlife trade in the past, I remain doubtful. It may be noted that in the period up to late 1993, when import of tiger parts was legal in South Korea, 44.5% of them was recorded as coming from Indonesia. Except for 26.9% from China, imports from all other range countries were below 10% (Mills, J. and Jackson, P. 1994. *Killed for a Cure.* TRAFFIC International) (Appendix III).

Through tiger range, habitat is being lost to an extent that, even if reintroduction of tigers were possible, there would be no place for them, or enough prey left to support a viable population.

The case of the South China tiger illustrates my prediction for the future of the tiger in general. It was virtually extirpated as a pest in an official campaign in the 1950s and 60s. Chinese biologists state that about 3,000 skins were collected (Lu Houji and Shen Helin...). Since then, a few scattered tigers have survived in the mountain ranges of the southern Chinese provinces, and are obviously doomed. The programmes of the Conservation Breeding Specialist Group are aimed primarily at achieving a healthy zoo population of Chinese tigers.

Dr Seal recognizes the dangers posed by small populations and correctly states that "science-based management programs" are required. The expense in money and man-power to run such programmes needs to be considered carefully, particularly since they are unlikely to produce a situation where viable natural tiger populations are restored.

Regarding our condemnation of Article 4 of the Sino-Indian Protocol on tiger conservation, which calls for experimental captive breeding and release programmes, the point we made is that India's top priority is to safeguard the 60% of the world tiger population that it holds, and not to divert resources to programmes which we believe have little value for tiger conservation.

We stated that there are no records of the successful release of captive-bred tigers, and explained the problems involved in such projects. I invite attention to the enclosed IUCN "Guidelines for Re-introductions" (Appendix IV) produced by the Re-introduction Specialist Group and a host of other experts to indicate the immense and long-term problems that have to be tackled.

Dr Seal refers to the desperate case of the Florida panther and the release of captive-bred and translocated animals and says "no adverse human contacts have occurred as yet". It is true that the captive-bred animals, having been trained to hunt before release, settled quite well in the wild. However, five out of the 10 panthers in the programme had to be re-captured: three (either captive-born or held for several years in domestic ? captivity) because they were killing and/or feeding on calves; one panther strayed twice outside the experimental re-introduction area; and a female panther was removed "for exhibiting 'a casualness attitude' around humans", according to an official report. (2)

This experience illustrates what would be a major problem concerning release of tigers. Most people do not want dangerous animals in their vicinity, and we are faced with a situation where there is little if any tiger habitat where there are no people.

Mr Dey, I have been involved in tiger conservation for 25 years, and been particularly closely associated with Project Tiger in India. I rejoiced at the successes achieved in the 1970s and 1980s, only to be shocked by the setbacks caused especially by poaching for bones in this decade. My experience in tiger countries this year has left me deeply depressed about the future of the tiger. As the press statement said:

> "If the governments of tiger range states do not have the political will to save the tiger, then the future is bleak for wild nature and human welfare."

Peter

Conservation Breeding Specialist Group

Species Survival Commission
IUCN -- The World Conservation Union

U.S. Seal, CBSG Chairman

Mr. S. C. Dey
Ministry of Environment &
Forests, Paryavaran Bhavan
C.G.O. Complex, Lodhi Road
New Delhi 110 003,
INDIA

28 August 1995

Dear Mr Dey,

I am writing with respect to recent comments, by members of the CAT Specialist Group on the 'Protocol on the Conservation of the tiger between the government of the Republic of India and the government of the People's Republic of China.' My apologies for the delay in response to your questions, but I have just completed gathering the needed detailed information.

There appears to be a wide range of thoughts and interpretations of a single article (Article IV) in the protocol. Article IV states '*Encourage, on an experimental basis, captive breeding activities, with a view to release of the species into the wild.*' I note that this Article follows from the fourth statement in the preamble which provides the foundation for Article IV. The statement is 'Endeavouring to enhance cooperation on the protection of Tiger and making joint efforts to halt the trend of decimation of tiger population to ensure the survival and sustainable development of the species.'

Objections to this article in the protocol have been raised by Peter Jackson, Chairman of the Cat SG of the SSC/IUCN, and members of the Cat SG in a press release of 30 March 1995 and in a communication dated 11 May 1995, to Mr. Kamal Nath, Minister for Environment and Forests, India.

These comments include projections of the near extinction of tigers by 1999, references to events in the Florida panther release program, concerns about programs in China, and statements about the futility of captive programs even in the event of extinction. I have the following comments based upon the best scientific evidence available to us from (1) scientists in India, China, Russia, Indonesia, and USA, (2) workshops we have conducted in Indonesia, China, and USA, and (3) the Florida panther translocation program.

The projection of near extinction by 1999 for all tigers is contrary to all available evidence for all of the surviving subspecies, except the South China tiger (*Panthera tigris*

12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151, USA
tel: 1-612-431-9325 fax: 1-612-432-2757 e-mail: cbsg@epx.cis.umn.edu

amoyensis) which probably numbers fewer than 30 in the wild. There is no doubt that the risk of extinction over the next 50-100 years is high and that poaching contributes to this risk. Prevention of extinction will require continuing responsive adaptive management programs throughout the range as threats change from population to population and through time.' There is an urgent need for science-based management programs which include biological, physical, and social factors and are designed for each individual protected area and tiger population. Monitoring tools for population, prey, and habitat that provide guidance to management are needed (additional methods are being studied at the Wildlife Institute of India). It is necessary to determine the population effects of different levels of poaching on the population as a guide to the management effort needed. Programs meeting these needs for the Sumatran tiger in Indonesia are now underway and it appears likely that tiger poaching is now minimal in reserves in Sumatra. According to the field workers in Russia, poaching of tigers is not significant although other habitat factors are of concern, and the risk of near extinction by 1999 is very low.

The field studies on Florida panthers (*Felis concolor coryi*) have included reintroductions of wild and captive bred animals into unoccupied habitat and translocations of wild-caught panthers to unoccupied and occupied habitat. All animals released were fitted with radio collars and monitored 2-3 times a week. The releases are managed as an experimental program so that animals can be recaptured and removed in the event of problems or movement outside the agreed areas. A similar approach has been used successfully in the reintroduction of the Red Wolf in the South-eastern USA over the past 8 years.

Both approaches have been successful for panthers in terms of survival, capturing their own prey, and acceptance of local habitat. The first set of studies were in North Florida using captive-bred and wild-bred animals. There was no difference in survival. All of these animals have now been removed with the completion of the studies. A description of the wild panther translocation program into currently occupied habitat areas is enclosed. In summary 8 wild-caught females have been released since March of 1995 and all are surviving. They are monitored 2-3 times per week by radiotelemetry. No adverse human contacts have occurred as yet. No breeding has occurred but the releases were late or outside of the breeding season. These releases are into ecosystems containing native Florida panthers and are intended to augment the genetic diversity of the wild population according to a genetic management plan developed over a period of 3 years in collaboration with CBSG (copy enclosed).

We recognize that tigers, with a different social system and offering a greater threat to people, will require genetic augmentation and reintroduction methodologies designed to fit their species characteristics. We believe that it is essential that these methodologies be developed for possible use in management of wild tiger populations as we gain more knowledge and experience with the effects of habitat fragmentation and small populations. Current work on isolated small populations indicates that loss of genetic heterozygosity is inevitable and that local populations will be lost to unexpected environmental events. Wildlife managers need to be prepared to genetically supplement or replace lost populations as needed. Given the fragmentation of the protected areas for tigers in India, such tools may be needed in the future for management of the isolated populations. These actions need to be based upon the kind of analysis, planning, and management implementation that has gone into the Florida panther program and the Sumatran tiger program.

CBSG, at the request of the Chinese Association of Zoological Gardens (CAZG), has undertaken a series of collaborative workshops in China to assure that the animals and programs are managed to serve as a resource for support of the wild population. The first 2 week working program assembled information on the South China tigers held in 19 Chinese zoos now or in the recent past, developed a studbook, established the goals and objectives of the management and captive breeding program and led to agreements for the continued development of the program. The participants from 18 zoos and the CAZG were knowledgeable, prepared, and worked intensively for the 3 days of the workshop. A copy of our summary report is enclosed. The final report has been prepared in Chinese and English. The Chinese paid their in-country expenses for this workshop. A second 3 week working visit to the zoos holding most of these tigers is scheduled for November of 1995. People from the CAZG will also participate in a Tiger GASP and reproductive biology program at the Southeast Asian Zoo Association meeting in October in Taiwan. Discussions have begun on undertaking a similar program for the North China tiger (*P. t. altaica*). This program may focus early on a reintroduction program but that needs a carefully managed captive program and the development of a protected park area before reintroductions are started. These programs are only a beginning but they represent a significant commitment by the CAZG. We hope to expand this program to PHVAs for the wild populations in China and to link the wild and captive programs and managers. We have already conducted a PHVA in China for the Baiji dolphin.

In summary, we believe that a full range of methodologies are going to be needed to assure the continued survival of healthy populations of tigers in the wild. We will need to approach these complex problems with a long term commitment to adaptive management strategies combining biological, physical and human social factors and based upon an evolutionary learning approach. We will make mistakes. We need to learn from them with a continuing program of information collection during policy implementation which recognizes that policies and management actions are experiments to be tested.

Sincerely yours,

U. S. Seal

U. S. Seal, Chairman CBSG

cc: Rabb, Tilson, Walker, Stuart, Jackson, Ferguson, Shuling, Thapar, Swells, Tilt, CBSG

#A16 Shalimar Apartments
South Extension Plaza II
209 Masjid Moth
New Delhi 110 049

Peter Jackson
Chairman Cat Specialist Group
1172 Bougy
Switzerland

11 September, 1995

Dear Peter,

I received through Valmik your communication regarding captive breeding of tiger as raised by Dr. U. Seal. I feel that this matter raised with the statutory authorities of wildlife management of our country which at present holds more than 60% of the global tiger population is potent with very serious and dangerous portents and consequences in the field of conservation of the tiger, particularly at the present crucial period.

First let me tell you expressly that I stand by my earlier arguments about the matter of captive breeding with an objective to reintroduce or relocate tigers to the wild. I support your views in full, but would like to elaborate a little further.

The way the matter has been presented speaks only of an obsession about captive breeding in the name of science. I find, instead of evaluating the merits, demerits and various intricacies of such a venture, emphasis has been laid only on the positive aspects, to justify the one way thoughts of C.B.S.G. claiming ex-situ conservation as the objective.

I do not go into the old controversy of whether tiger can be successfully bred and introduced into the wild or not. I do not think anyone who has any claim to know the tiger well, would differ from these views, bearing in mind the tiger's lifestyle as far as it has been studied and understood. The Government of India's policy for the conservation of wildlife is not species oriented. The policy has emphasized all importance on total ecosystems preservation, which is admitted unambiguously as the right approach. It hardly needs mention that the widely acclaimed initial success of Project Tiger came about by religiously following this above concept. Being at the apex of the biological pyramid in the natural ecosystem wherever it occurs, the tiger is the end user of the biomass generated by these ecosystems. It should not need any explanation as to why the tiger and its habitat - the floral and faunal biomass as also the inorganic mass, the climatic condition and geographical location etc.- are inseparable when dealing with conservation objectives.

Even if successful captive breeding and subsequent reintroduction of the tiger to the wild is a possibility, I still fail to agree that the future survival of the species in the area of introduction/reintroduction can be assured because of the immense biotic influence of rising human population level in and around any possible introduction of the species. The first and primary requisite of the successful establishment of any species in the wild, is to ensure complete elimination of the decimating factors that had been responsible for the disappearance or local extinction of the species in its earlier range or any part thereof. It is all too well known that physical extermination of the species, depletion of prey base and severe abuse and degradation of the natural habitat of the tiger is the reason for its elimination from a major part of its earlier range. Despite all efforts at a national and international level, there is hardly any improvement in the situation anywhere. In fact the decimating factors are continuing to strangle the tiger in a vice like grip more than ever.

During the last year I visited some of the tiger habitats outside the protected area system in central India, which is considered a bastion for tiger. Such areas, outside the PAs, according to the 1993 census, hold over 50% of the total tiger population of the country. But the indications I got in the field leaves no doubt that in reality the tiger in such areas is in a precarious condition. There is hardly any resident tiger population breeding in these areas. Only some of the juveniles and some older tigers (mostly males) disperse out of the PAs, either being pushed out or seeking to establish new areas, Such tigers naturally form only a vagrant population which fall easy victim to poachers.

Even the tiger in the protected areas are not as safe as they used to be a decade back. The long arms of the poachers have successfully penetrated into most protected areas through organized underworld traffickers, mainly for the bone trade. I do not want to go into details of what I observed, but I am left with no doubt that the tiger is clearly on its way out from these areas. The importance of such areas outside the PA network cannot be overemphasized in maintaining viable populations of the species. I have unfortunately been witness of the elimination of the species in many areas of this country under biotic influence during the last four decades of my association with the conservation of tiger. I do not think I make any mistake about the above inference, even though I sincerely wish and pray that I will be proved wrong. In fact the causative factors of the decline of the tiger are worsening with the passage of time. I cannot see any way of re-establishing tiger populations unless these causative factors are eliminated or seriously controlled. It is inconsequential if the intended populations come through captive breeding or otherwise, even assuming that captive breeding and reintroduction of the tiger could be successful.

I admit that I know little about P.H.V.A. except for reading some papers on the subject. But at the same time whatever I have understood about the subject raises serious doubts about the efficacy of such analysis of a species which occupies very complicated multi-tier tropical ecosystems, consisting of numerous tropic levels. The situation pertaining to the survival of the tiger is directly related to human encroachment into the ecological domain of the tiger. P.H.V. analysis cannot, I feel, measure up to the ecological damage caused to any species by man and so may be misleading.

I would give an example: there were around 40 rhinos in a wildlife sanctuary in Assam, named Laokhowa at the beginning of 1983. This population had been built up from a very small number of rhinos as a result of dispersal from Kaziranga mainly and some other areas. The situation had seem quite favourable for the rhinos with a happy situation of a sizeable breeding population established in the area. But unfortunately in 1983 serious political unrest engulfed the region bringing in its wake very serious law and order problems and in a matter of only a month or two, the entire population of rhinos in Laokhowa was completely lost to poaching because of this temporary lawlessness. In Manas, until 1988 there was a rhino population of around 100 animals. This population had also been built up from an original slender population (early 1950's). Political unrest leading to insurgency engulfed this area also since 1988 and the present status of rhino in Manas is indeterminate but very precarious. Serious doubts have been expressed by many as to whether rhinos still exist in Manas at all at the moment. If the Jaldapara population of rhinos (below 40) is considered viable from a P.H.V. analysis, no stretch of the imagination would have projected the Laokhowa situation of 1983 and the Manas situation of 1988 to be of doubtful viability. But the fact is that a spurt of unpredictable human activities eliminated (or very nearly eliminated) a threatened species from these protected areas. This would suggest that P.H.V.A. for ecological viability may be of very little significance in areas of potential social/political unrest. Such instances of local extinction of s species are very common in many parts of the world, which puts a big question mark on the efficacy of P.H.V.A. - except for maybe justifying captive breeding efforts for reintroduction/introduction of a species.

I think it is foolish to debate the cut-off date of the probable extinction of tiger in the wild. Humanity will be wiser, richer and happier if this dark day can be delayed. But field indications, I fear, do not provide much hope in India. Time is running out really fast for concerted action n saving the tiger. I am afraid that Dr. Seal's letter may provide scope for complacence, which can be lethal in the case of the tiger.

The comments made above relate to India only. Actually it is human activities that have forced the tiger into the extinction threshold and not because of purely ecological reasons. What is required now is to put an end to such decimating human activities. For this an all out global effort is immediately required. Further we are with our backs to the wall. There is absolutely no room for manoeuvring, we cannot afford to commit mistakes or even take chances on the plea that we will learn from our mistakes, as indicated by Seal.

I do not know when "conservation" replaced "captive" in the abbreviation of C.B.S.G., but it appears to me to be a very clever ploy of covering up the real objectives under pressure.

I am grateful to you for asking me to comment on this subject which I strongly feel, as always, is going to be strongly counter productive.

Warmest regards.

Sincerely yours,

S. Deb Roy

c.c. Mr Kamal Nath, Honourable Minister, Environment & Forests, G.O.I.
Mr S.C. Dey, Addl. I.G.F. (Wildlife)
Valmik Thapar, Vice-Chairman Cat Specialist Group (Asia)

To CCF, Wildlife, Tiger bearing states
Directors, Project Tiger Areas
Tiger N.G.O.'s
Other interested persons

From for Sally Walker, Convenor, CBSG, India

Date 27 September 1995

Dear Colleagues :

As the conservation of Tiger has become such a difficult task, new ways of assembling information and assessing problems may be required.

One of the methodologies which has emerged in the last half-decade is the Population and Habitat Viability Assessment Workshop, using a combination of tools and techniques which vary from the psychology of group dynamics to the mathematics of simulation modelling, the relatively new science of remote sensing and GIS and the sociology of human demography. I enclose a copy of an excellent Report of a Workshop on the Sumatran tiger which was held in 1992, facilitated by the Conservation Breeding Specialist Group.

India is of such a geographical area and diversity, with pockets of tigers in areas which may be completely isolated or connected with other areas, that when thinking of tiger population and habitat dynamics, it is necessary to think of a state or area wise analysis.

This Report is being circulated simply to introduce you to some possibilities of a new perspective on the tiger population(s) in your area. If you have questions or would like more information on the CBSG processes and tools, please feel free to write and ask.

P.H.V.A. Workshops are intended solely to help wildlife theorists and practitioners find a common ground and a fresh vision of what needs to be done for species in trouble. The ultimate goal is to save the tiger forever ... whatever it takes.

Conservation Breeding Specialist Group, INDIA
65 Bharati Colony, Peelamedu, Coimbatore 641 004 India
Phone 91 422 571 087 Fax 91 422 573 269

Sumatran Tiger Report: Population & Habitat Viability Analysis

Padang, West Sumatra, 1992

Tilson, R. K. Soemarna, W. Ramono, S. Lusli, K. Traylor-Holzer, U.S. Seal. Sumatran Tiger Population and Habitat Viability Analysis Report. IUCN/SSC Captive Breeding Specialist Group, Apple Valley, MN. 1994: 1-146.

Cover Photo: Provided by Mike Griffiths.

SUMATRAN TIGER POPULATION AND HABITAT VIABILITY ANALYSIS REPORT

OF THE CAPTIVE BREEDING SPECIALIST GROUP
OF THE SPECIES SURVIVAL COMMISSION
OF IUCN -- THE WORLD CONSERVATION UNION

25 MARCH 1994

Editors:

Ronald L. Tilson
Minnesota Zoo, Apple Valley, MN, USA

Komar Soemarna
Indonesian Forest Protection and Nature Conservation, Indonesia

Widodo Ramono
Indonesian Forest Protection and Nature Conservation, Indonesia

Sukianto Lusli
WWF-Kerinci Seblat National Park, Sumatra, Indonesia

Kathy Traylor-Holzer
Minnesota Zoo, Apple Valley, MN, USA

Ulysses S. Seal
IUCN/SSC CBSG, Apple Valley, MN, USA

A Joint Endeavor of the
Indonesian Forest Protection and Nature Conservation (PHPA)
&
IUCN/SSC Captive Breeding Specialist Group

SUMATRAN TIGER
POPULATION & HABITAT VIABILITY ANALYSIS REPORT

TABLE OF CONTENTS

Executive Summary

SUMATRAN TIGER POPULATION & HABITAT VIABILITY ANALYSIS

The first Population and Habitat Viability Analysis (PHVA) Workshop for Sumatran tigers (*Panthera tigris sumatrae*) was held 22-26 November 1992 in Padang, West Sumatra, Indonesia. For the past decade tiger populations in Sumatra have been set between 600 to 1,000 animals, and these estimates were guesses at best. In an effort to more systematically evaluate the distribution, status, threats and viability of Sumatra's remaining wild tigers, IUCN/SSC CBSG and the AZA Tiger Species Survival Plan (SSP) were invited by the Indonesian Directorate General of Forest Protection and Nature Conservation (PHPA) to help coordinate such a workshop. PHVA workshops use computer models (called Vortex) to simulate the deterministic and stochastic, or random, processes that threaten small populations and to explore what effects various management options may produce on the survival of the population.

Within this century eight recognized subspecies of tiger ranged over most of Asia; three were of Indonesian origin on the islands of Bali, Java and Sumatra. The Bali tiger (*P.t. balica*) went extinct 56 years ago; the Javan form (*P.t. sondaica*) was lost 22 years ago. Now the Sumatran form is close to extinction in the wild. The lesson we must learn from these losses is that the last official report on the Javan tiger suggested it would survive if left alone in its last refuge--the Meru Betiri National Park in eastern Java. It didn't survive. More recently, similar recommendations have been suggested for conserving Sumatran tigers. Experience has shown, however, that traditional conservation management guidelines for large felids like tigers have failed or are failing in Indonesia and elsewhere in most of Asia. Extinction of two Indonesian subspecies, and a third called the Caspian tiger (*P.t. virgata*), is ample documentation [the South China (*P.t. amoyensis*) and Siberian (*P.t. altaica*) tigers are also on the verge of extinction]. We need a new vision to save tigers.

This PHVA Workshop was generously supported by Ralston Purina's Big Cat Survival Fund, administered through the American Zoos and Aquariums Association's (AZA) Conservation Endowment Fund (CEF), and the Directorate General of PHPA. Other contributors included the European Endangered Species Programme (EEP -- London, Arnhem and Chessington Zoos), the World Wildlife Fund for Nature (WWF) -- Indonesia Programme, and the Minnesota Zoo. This workshop would have never occurred without their help. Jansen Manansang (Taman Safari Indonesia) took responsibility for organizing the hotel, and Ramon Janis (PHPA) took care of local arrangements with government officials in Padang, West Sumatra.

The agenda was prepared initially by Bapak Abdul Bari (PHPA), Widodo Ramono (PHPA), Sukianto Lusli (WWF Kerinci-Seblat) and IUCN/SSC CBSG. Bapak Komar Soemarna took over when Bari left for the University of Indonesia. To prepare PHPA staff from the National Parks and protected areas of Sumatra, an overland trip through Sumatra, beginning in Medan in the north and finishing in Bandar Lampung in the south, was scheduled in July 1992. During this eight-day odyssey, covering 1,500 km, PHPA and KSDA Offices in Medan (Gunung Leuser), Bukittinggi, Padang, Sungai Penuh (Kerinci-Seblat), Air Hitam, Bengkulu (Barisan Selatan), Lubuklinggau, Kotabumi, Sukadana (Way Kambas), and Bandar Lampung, were visited before crossing the Sunda Straits by ferry for Java.

The purpose of the trip was to inform everyone of the goals of the upcoming Sumatran Tiger PHVA Workshop, and to leave a set of questions along with computer generated maps of each national park overlaid with 100 km^2 grids, requesting information or verification of Indonesian Forestry land-use categories, major vegetation zones, and relative tiger distribution within each grid. The idea was to gather as much information as possible before the workshop, so that our time together could be spent on analysis and recommendations rather than presentation. For the most part this strategy worked.

In the interim the map-linked database, using Atlas Geographic Information System (GIS) software, was being refined at the Minnesota Zoo. Satellite imagery overlays of vegetation cover of Sumatra (from World Conservation Monitoring Center-WCMC) were matched up with Indonesian land-use and forest status maps (series RePPProT 1988) and Geographical maps (1988 series). This database gave a comprehensive spatial analysis of Sumatra which allowed distinctions such as lowland rainforest from montane forest from mangrove forest, protected forest from non-protected forest, rivers from roads, agriculture from bush, and etc. This technique put the H (for Habitat) into the PHVA acronym, and was considered by workshop participants to be a valuable analytical process and an indispensable training tool.

The workshop had a strong contingent of PHPA staff, including Kepalas, Chief Balais, Sub-Balais, and other park staff from the major protected areas of Sumatra -- Gunung Leuser, Berbak, Kerinci-Seblat, Barisan Selatan, and Way Kambas National Parks -- and the smaller protected areas of Lingga Isaq, Lembah Anai, Bajang Air Tarusan Utara, Kerumutan, Seberida, Bukit Rimbang Baling, Peranap, Siak Kecil, Air Sawan, and Batang Merangin Barat. The process was strengthened by the participation of a diverse group of international tiger specialists: Michael Hutchins & Robert Wiese, AZA Director and Assistant Director of Conservation & Science; Sarah Christie, EEP Sumatran Tiger Coordinator; David Pepper-Edwards, Australasian Species Management Programme (ASMP) Sumatran Tiger Coordinator; Scott Frazier, Asian Wetlands Bureau; Jet Bakels, Rijksuniversiteit Leiden; David Smith, University of Minnesota; Mike Griffiths, WWF-Gunung Leuser National Park; Ann Byers, Kathy Traylor-Holzer and Thomas Faust, Minnesota Zoo; David Wildt, National Zoo; Leslie Johnston, Omaha Zoo; and Gerald Brady, AZA Sumatran Tiger SSP Coordinator.

The workshop began with an overview of the PHVA process, moved on to GIS and tiger verification reports from PHPA staff living in the protected areas, recognized the role of cultural concepts in shaping human conduct towards tigers, and considered the threats tigers are now experiencing in Sumatra. Most discussions were in Bahasa Indonesia and were conducted in English when necessary. The working groups were led by Bapaks Poniron (Gunung Leuser), Mega (Kerinci-Seblat), Kurnia (Way Kambas), Frazier (Berbak), and Widodo (Barisan Selatan). The working group reports were synthesized by Komar, Widodo and Effendy (PHPA-Bali Barat), and a set of short- and long-term recommendations for Sumatran tiger conservation were generated and approved.

Tiger troubles were apparent. There was news that 1,081 tiger skins or mounts were recently registered with the Indonesian government following an amnesty on illegal products. Unprotected forest on the edge of National Parks was being lost, and forests within two parks are split by major roads, possibly fragmenting resident tiger populations. With this information in hand, viability analyses of discrete tiger populations using Vortex software were generated. The results were discouraging.

The general consensus was that there were probably fewer than 400 tigers living in five major protected areas of Sumatra. Another 100 or fewer tigers outside of the protected areas were probably not going to survive for long. Gunung Leuser National Park is probably the most secure large area for tigers, Berbak National Park probably has the best habitat for tigers but is the least secure, Way Kambas also has good habitat for tigers but is too small, and Kerinci-Seblat, although the largest, is too fragmented and subject to heavy poaching. Removal of tigers, either through poaching or official trapping of problem animals, is the most sensitive variable of wild tiger populations to consider when projecting their long-term viability. At the end of the workshop we all felt that the future for tigers in Sumatra is not good. It is clear that a national conservation strategy that emphasizes immediate action will be necessary if Indonesia is serious about not losing their only remaining tigers -- *Panthera tigris sumatrae*.■

Problem Statement

SUMATRAN TIGER
POPULATION & HABITAT VIABILITY ANALYSIS

The declining status of all tigers, and the Sumatran tiger in particular, is due to habitat loss and fragmentation, resulting in populations too small for long-term survival in the majority of the national parks and game reserves established to protect them. Poaching for medicinal and economic purposes further exacerbates the small, fragmented population dilemma. Other factors contributing to the overall decline in tiger numbers include decreasing prey availability and increasing tiger control as a result of livestock depredation and human-tiger interactions.

In the case of the Sumatran tiger, an estimated 400-650 tigers *[editors' note: estimate of tiger numbers were reduced at PHVA Workshop]* are believed to be living in five mostly disjunct national parks: Gunung Leuser, Kerinci-Seblat, Berbak, Barisan Selatan, and Way Kambas, and smaller protected areas throughout Sumatra. These numbers are estimates only, are not based on quantitative methods, and are thus not considered reliable. There is little or no gene flow among these separate populations, poaching is ongoing but undetermined in scope, and human encroachment continues to erode the edges of the protected areas.

Of the five extant subspecies of *Panthera tigris*, two subspecies, *P.t. sumatrae* (Sumatran tiger) and *P.t. amoyensis* (South China tiger), were recognized as "critical" based on the Mace-Lande criteria at the May 1991 Joint meeting of the IUCN/SSC Captive Breeding Specialist Group, IUCN/SSC Cat Specialist Group and AAZPA Felid Taxon Advisory Group. Due to the wide distribution of the species group and differing problems faced by individual populations, a Population and Habitat Viability Analysis (PHVA) was highly recommended for the taxon, with a PHVA workshop for *P.t. sumatrae* as a top priority.

The goals of this workshop are to:

- conduct a metapopulation and habitat viability analysis by utilizing a Geographic Information System (GIS) for all wild populations of Sumatran tigers;
- formulate management strategies for each population with risk assessments to prevent extinction and achieve the objective of maintaining viable, self-sustaining populations within the historic range of this subspecies; and
- prepare a report of the analyses and results of the meeting with recommendations to the Indonesian Directorate General for Forest Protection and Nature Conservation (PHPA), IUCN Cat & Captive Breeding Specialist Groups, and the CBSG Tiger Global Animal Survival Plan (GASP).

The following workshop objectives will be addressed:

- estimate probable populations of tigers in protected areas of Sumatra using GIS-based habitat assessment techniques, the degree of fragmentation of these populations, and their probabilities for long-term survival with no intervention;

- determine numbers of tigers and subpopulations required for various probabilities of survival and preservation of genetic diversity for specified periods of time (i.e., 50, 100, 200 years) given known sizes of protected areas;

- identify reliable field methods for monitoring population status, assessing prey base, habitat structure and evaluating the cultural perspective of tigers in regards to human-tiger interactions;

- explore the role of exchanges among disjunct tiger populations to maintain viable populations; and;

- formulate and evaluate the possible role of captive propagation as a component of the above management options.

The combination of the above objectives form the basis of the national conservation management strategy for Sumatran tigers. This document will be prepared in draft form during the workshop, and will be reviewed and revised by all participants during the workshop to achieve agreement on its content before departure. It will include specific recommendations and priorities for management and research of both captive and wild populations. Once consensus is reached the document will be translated into Bahasa Indonesian for distribution and implementation throughout Indonesia. The results of this workshop will be refined and used as a model for developing PHVAs for remaining extant subspecies elsewhere in Asia.■

Jm w
Ambil lampiri
Utk pengumpulan

DEPARTEMEN KEHUTANAN

DIREKTORAT JENDERAL PERLINDUNGAN HUTAN DAN PELESTARIAN ALAM

Gedung Pusat Kehutanan Jl. Jend. Gatot Subroto Telp. 583033 - 583037 JAKARTA
Alamat Kawat : Ditjen PHPA JAKARTA
Sekretariat Direktorat Jenderal PHPA, Gedung Pusat Kehutanan Jakarta,
Jl. Ir. H. Juanda No. 15 telp. 324013 Bogor
Direktorat Perlindungan Hutan, Jl. Ir. H. Juanda No. 100 Telp. 323972 Bogor.
Direktorat Pelestarian Alam, Jl. Ir. H. Juanda No. 15 Telp. 323067 Fax. 323067 Bogor.
Direktorat Taman Nasional dan Hutan Wisata, Jl. Ir. H. Juanda No. 100 Telp. 321014 Bogor.
Direktorat Penyuluhan Konservasi Sumber Daya Alam, Gedung Pusat Kehutanan Jakarta.

Nomor : 1856/VI/PA-5/92. JAKARTA/BOGOR 26 Sept. 1992.
Lampiran :
Perihal : Lokakarya Harimau Sumatra di Padang

Kepada Yth.

1. Sdr. Kepala Taman Nasional Gunung Leuser
2. Sdr. Kepala Taman Nasional Kerinci Seblat
3. Sdr. Kepala Taman Nasional Bukit Barisan Selatan
4. Sdr. Kepala Taman Nasional Way Kambas
5. Sdr. Kepala Sub Balai KSDA Jambi

di -

Sumatera

Sehubungan dengan akan diselenggarakannya Lokakarya Harimau Sumatera di Padang pada tanggal 22 s/d. 29 Nopember 1992, maka dengan ini kami sampaikan beberapa hal sebagai berikut :

1. Penyelenggaran workshop ini akan melibatkan para pakar dari dalam dan luar negeri yang direncanakan akan diikuti peserta sebanyak 55 orang. Workshop ini diharapkan dapat memberi input management tentang konservasi jenis Harimau Sumatera dimasa depan.

2. Informasi detail tentang distribusi Harimau Sumatera pada wilayah Saudara sangat bermanfaat sebagai bahan pendukung workshop ini, untuk itu Saudara Sukianto Lusli (WWF Kerinci Seblat and Tiger Workshop Co-Coordinator) akan bertugas mengumpulkan peta dimaksud dari Saudara. Peta tersebut harus memuat informasi lengkap berupa (a) penggunaan lahan (TGHK) dan areal penutupan lahan hutan, (b) kondisi tegakan hutan, (c) kehadiran Harimau Sumatera, (d) jenis-jenis satwa yang merupakan mangsa Harimau.

3. Guna menyeragamkan informasi yang akan dimuat di peta tersebut diminta kesediaan Saudara agar dapat mencantumkan informasi-informasi di atas disertai dengan indikator masing-masing informasi tersebut disetiap grid peta dimaksud. Disarankan agar dicantumkan lengkap data peta diantaranya tahun dibuat, skala, dan versi peta dan sebagainya.

Setelah Saudara menyelesaikan peta dimaksud, harap Saudara mengirimkan data tersebut kepada Saudara Sukianto Lusli dengan alamat Taman Nasional Kerinci Seblat Jl. Bukit Lebah Daun Sungai Penuh Jambi paling lambat tanggal 20 Oktober 1992 untuk dikompilasi dan diolah menjadi dasar topik dari diskusi.

Demikian disampaikan atas perhatian dan kerjasamanya diucapkan terima kasih.

Direktur Pelestarian Alam

DEPARTEMEN KEHUTANAN RI
DIREKTORAT JENDERAL PERLINDUNGAN HUTAN DAN PELESTARIAN ALAM

Abdul Bari IB
NIP. 080013096

Tembusan: Kepada Yth.
1. Para Kepala Kanwil Departemen Kehutanan se Sumatera
2. Para Kepala Balai Konservasi Sumber Daya Alam se Sumatera
3. Para Kepala Sub Balai Konservasi Sumber Daya Alam se Sumatera

001b/kj-1/230992

OPENING ADDRESS

Sutisna Wartaputra
Director General of PHPA

It gives me great pleasure to welcome you all to this island of Sumatra in the Indonesian archipelago to participate at this important International Workshop on Sumatran Tigers. Indonesia once had three subspecies of tiger: in Sumatra, Java and Bali. Unfortunately, as a result of competition with man, the Bali tiger and probably the Javan tiger have become extinct. Today only the Sumatra tiger survives. Its long-term survival in Sumatra will, however, depend not only on strict legal protection and preservation of its habitats but more importantly on our ability to minimize tiger depredations on the one hand and to improve the livelihood of the people living near tiger reserves on the other. Without these people's support, our conservation efforts are unlikely to pay any dividend in the long run.

The Sumatran tiger, like the other large predators and a few of the mega-herbivores such as the elephant, is a species where the basis for its conservation in the wild must be in terms of aiming to keep human settlements and wildlife refuges well separated. This is becoming increasingly difficult to achieve, given the demography of the human populations in Indonesia. Prior to about 1900 when agricultural settlement in Sumatra first led to a substantial degree of deforestation, most of the island was covered in primary forest. Presumably up to that time, although its population density will always have been low, the Sumatran tiger was more or less continuously distributed throughout the whole island. Less than a century later, we find that predator has been squeezed out of huge tracts of forested areas. The conversion of primary forest into agricultural holding is a particularly serious cause of conservation problem in Sumatra, and the tiger has been among the species most seriously affected by it. The IUCN *Red Data Book* lists all the extant subspecies of tiger as endangered.

The government of Indonesia, in recognition of the importance of biodiversity in general and the long-term survival of such keystone species as the rhino, tiger and elephant in particular, has made a long-standing commitment to protect as much as possible the country's natural wealth and heritage. Already Indonesia has established more than 400 conservation areas covering 52,000 km^2 of forest land. In Sumatra many of the important conservation areas such as the Gunung Leuser NP, Kerinci-Seblat NP, Barisan-Selatan NP, Way-Kambas NP, and Berbak NP are large enough to maintain viable populations of tigers. The major national parks in Sumatra cover more than 25,000 km^2 of forest, and they protect not only the Sumatran tiger but also vital watersheds as well as thousands of other animal and plant species, many of them rare or endangered.

The tiger is very exacting in its conservation requirements for two other reasons. The need for extensive forest cover with good populations of mammalian herbivore species as its prey is clear. The other factor is the very high commercial value of the pelt (and bones), which despite strict CITES ban, is still traded illegally in the international market by smugglers. Trade in tiger skin and bones is therefore highly profitable, and even given well-organized customs enforcement, it would be inherently extremely difficult to control, let alone eliminate.

Given this background, the overwhelming emphasis in conservation policy must be on maintaining forest cover over large areas uninterrupted by human settlements and roads, where remoteness, difficulty of terrain and density of cover provide natural protection. The second axiom in any conservation policy for the Sumatran tiger, given the greatly reduced distribution, is that even quite small local populations are valuable and should be protected wherever feasible. Outside the large reserves in Sumatra, there are still tigers struggling to survive in forest patches surrounded by a hostile landscape dominated by man. In such small areas, tiger populations are small and fragmented. Small populations are very vulnerable to extinction, brought about by too much inbreeding and genetic drift. One way of avoiding inbreeding in small isolated populations of tigers would be to link such areas with larger, more secure conservation areas through the establishment of forest corridors.

In addition to such *in-situ* conservation measures, a few tigers could be bred in captivity as the management of "problem" tigers -- ones that often attack livestock as well as humans. Such chronic marauding tigers and man-eaters could be captured for breeding in captivity in zoos. However, despite the tremendous success observed in the breeding of tigers in captivity in Western zoos to date, the potential benefits of reintroduction may not compare with the probable strong opposition from local inhabitants and the substantial financial resources which would be required.

In the final analyses, tiger conservation would require international assistance to boost our national efforts. Such assistance should clearly emphasize the provision of training of wildlife personnel, park planners and zookeepers and the sufficient outlays of funds to protect and manage the tiger habitats in Sumatra.

Finally, the crucial factor in the long-term survival of the tiger in Indonesia is the human population. In a country of over 180 million people with a potential to double within the next 30 years, we must never forget the fact that the people's legitimate aspirations to the enhanced standard of living will cause greater pressure on undisturbed forest habitat than sheer growth in human numbers. Unless we have the ability to meet the impoverished farmers living along the periphery of tiger preserves, there may be no tigers or wilderness areas left for us to protect in the year 2020.

On this gloomy note I leave you to deliberate on the prospects for survival of the magnificent predator in Sumatra -- the Sumatran tiger. With the blessing of Allah the Great, I open this workshop officially.■

Workshop Agenda

SUMATRAN TIGER
POPULATION & HABITAT VIABILITY ANALYSIS

Pangeran's Beach Hotel, Padang, West Sumatra
23-26 November 1992

Sunday, 22 November	
	Workshop participants and attendees arrive in Padang.
	Late afternoon registration.
18:00-19:00	Workshop Coordinators meet (after dinner) to finalize agenda.
Monday, 23 November	
09:00-10:30	Workshop convenes.
	Opening comments (Sutisna, Komar, Padang officials, Seal, Tilson, Hutchins)
	Overview of tiger biology and other papers (Tilson, Smith, Bakels, Griffiths)
11:00-12:00	PHVA overview/initial construction of tiger models (Seal, Tilson, Wiese)
13:30-14:30	Presentation of map-linked database (Tilson, Faust, Sukianto)
14:30-17:30	Working groups/Sumatran Protected Areas (Komar, PHPA staff)
	Data verification for protected areas (Komar, PHPA staff, Tilson, Sukianto, Seal)
20:00	Continue working groups
Tuesday, 24 November	
08:30-12:00	Status reports of working groups (Komar, Poniran, Mega, Kurnia, & other Chiefs)
	Overview of global tiger management strategies (Komar, Seal, Smith, Tilson)
13:30-16:30	Working groups: Evaluation of management strategy for each protected area (PHPA staff)
16:30	Monitoring wild tiger populations (Smith, Griffiths)
20:30	Continue working groups & tiger videos
Wednesday, 25 November	
08:30-11:30	Working group reports (PHPA staff)
	Status and management options for problem animals (PHPA staff, Smith, Bakels, Jansen)
	Genetic management of metapopulations (Wiese, Wildt, Johnston)
13:30-17:00	Integration of management strategies (Seal, Tilson)
	Reintroductions, relocation and genetic transfer as management options (Seal, participants)
Thursday, 26 November	
09:00-11:30	Workshop draft recommendations: overall and site-specific (Workshop Coordinators)
13:30	Workshop wrap-up
Friday, 27 November	
07:00-20:00	Travel to Kerinci-Seblat National Park, Sungai Penuh, Sumatra

Workshop Participants

SUMATRAN TIGER POPULATION & HABITAT VIABILITY ANALYSIS

From Indonesia:
Sutisna Wartaputra, DG of PHPA
Komar Soemarna, PHPA
Widodo Ramono, PHPA (Bogor)
Hadi Alikodra, Min. Population & Environment
Herman Haeruman, PHPA (Jakarta)
Effendy Sumardja, PHPA (Bali)
Ramon Janis, PHPA Sub-Balai KSDA
Sukianto Lusli, WWF-TNKS
Fachruddin M. Mangunjaya, WWF-TNKS
Jansen Manansang, TSI
Ligaya Tumbelaka, TSI
Russell Betts, WWF-Indonesia
Michael Griffiths, WWF-TNGL
Scott Frazier, Asian Wetland Bureau
Philip Wells, Sumatran Rhino Survey
Neil Franklin, Sumatran Rhino Survey
Abdul Salam Poroh, Pemda I Aceh
M. Tambunan, Biro BKLH
Kurnia Rauf, PHPA-TNWK
Bintoro, PHPA Sub-Balai Aceh
Susilo Legowo, SBKSDA Bengkulu
Muniful Hamid, PHPA Sub-Balai
Maryono Mahmud, PHPA Sub-Balai
Ikin Z. Muttaqien, PHPA Balai
M. Wazir Nengkeman, Kanwil Bengkulu
Burhanuddin Effendy, PHPA
Marthias Pandoe, Harian Kompas
Muslim Latief, Biro Humas KTR Gubernur
M. Zakir, Anggota Polri
Kayat R. Sutaryo, Dinas Kehutanan
Casmir Rachman, Kanwil Sumbar
Bambang Setyo Budi, Kabid Biphut Bkt Tinggi
Nur Muarif, Kanwil Kehutanan Sumbar
Amirunas SH, Jaksa Penuntut Umum Kejak
S. Poniran, PHPA-TNGL
Gatot Santosa, Media Indonesia
Suhasril Sahir, Suara Pembaruan
Iswan Akhir, KB Bukittinggi
Mega Hariyanto, PHPA-TNKS
Syamsul Kamal, KSDA Musirawas Linggau
Usuluddin, SBKSDA Bengkulu
Asmara Widjaya, Pemda Tk I Bengkulu
Lukman Hakim, BKLH Sekwilda Lampung

From outside of Indonesia:
Ronald Tilson, AZA Tiger SSP Coord./Minn. Zoo
Gerald Brady, AZA Tiger SSP/Potter Park Zoo
Thomas Faust, Minnesota Zoo (GIS)
Ulysses Seal, IUCN/SSC CBSG Chair
David Wildt, AZA Felid TAG Chair/National Zoo
L. David Smith, University of Minnesota
Robert Wiese, AZA Conservation & Science
Jet Bakels, Rijksuniversiteit Leiden
Sarah Christie, EEP Tiger Coord./London Zoo
Doug Richardson, London Zoo
D. Pepper-Edwards, ASMP Tiger Coord/Taronga
Kathy Traylor-Holzer, Minnesota Zoo
Leslie Johnston, Omaha's Henry Doorly Zoo
Ann Byers, Minnesota and National Zoos
Michael Hutchins, AZA Conservation & Science
Keith Highley, Earthtrust
Fachrurrazi Ch. Malley, Earthtrust

ESTIMATING HOW MANY TIGERS ARE IN SUMATRA: A BEGINNING

Thomas Faust and Ronald Tilson

INTRODUCTION

Wild tiger are extremely difficult to census because of their secretive nature and near complete avoidance of humans. Even where tigers are censused regularly, as in the tiger reserves of India, their numbers vary from year to year and because the estimates are based primarily upon identification of individual tiger tracks, the reliability of this technique has been suggested to be without scientific basis (Karanth, 1987, 1988, 1993). In Sumatran forests of Indonesia, the census of tigers is compounded by the fact that the national parks are huge, some areas within these parks are practicably inaccessible, and because of low overall prey densities in these habitats, tiger densities are correspondingly low. Remote camera censusing (Griffiths, this report) has provided reasonable estimates of tigers in two areas of Gunung Leuser National Park. This promising technique will need to be greatly expanded in scope before we can use it for ascertaining tiger population estimates throughout Sumatra.

The historical documentation of tigers in Sumatra is meager. In 1978 Borner surveyed Sumatra and estimated the number of tigers to be about 1,000. Since then, Sumatra has undergone much agricultural development and subsequently, pristine tiger habitat has declined. Subsequent surveys of Sumatran tigers by Santiapillai and Widodo (1985, 1987) put the number "not in the thousands but in the hundreds".

Santiapillai and Ramono (1985) first suggested that tiger densities in Sumatra could be as high as 3.7 tigers per 100 km^2. They derived these estimates by extrapolating from tiger densities in optimal habitats of India and Nepal, which are as high as 14 tigers per 100 km^2 (Sankhala, 1979) or as low as 1-2 tigers per 100 km^2 (McDougal, 1977; Smith, 1978; Sunquist, 1981). Santiapillai and Ramono admit that their estimates of tiger distribution were based upon information obtained from local PHPA staff and people living around areas inhabited by tigers, not from direct field observations. With no explanation, they concluded that these estimates were exceptional and that, on average, tiger densities in Sumatra were about 1 tiger per 100 km^2 in mountainous areas and 1-3 per 100 km^2 in optimal lowland habitats (Santiapillai & Ramono, 1987). Using these density estimates, they tentatively suggested that the 26 protected areas in Sumatra could support up to 800 tigers (Ramono and Santiapillai, this report).

At the Sumatran Tiger Population and Habitat Viability Analysis (PHVA) workshop in November 1992, about 35 professional Indonesian forestry and conservation officials assigned to the national parks and protected areas of Sumatra were asked, "How many here in this room have seen a wild tiger?" Four people raised their hands. They were then asked, "How many people have seen tiger tracks?" About one-half of the participants raised their hands. A follow-up question was, "Of those of you who have hands raised, how many have seen tiger tracks ten or more times?" About one-half of the hands went down. Considering that this group comprises the majority of the professional expertise of PHPA from Sumatra, their collective experiences in direct and indirect observations (tiger tracks) strongly suggest that the database was insufficient to make any definitive conclusions regarding tiger population dynamics.

METHODS

With these constraints in mind, we took another approach in estimating tiger distribution and corresponding numbers in Sumatra. A spatial database using Geographic Information System (GIS) was developed for the five major conservation areas of Sumatra. Atlas-GIS was used to map four of the parks: Gunung Leuser, Kerinci Seblat, Berbak and Barisan Selatan; Arc-Info was used to map Way Kambas. Both geological and Land-use/Forest status maps from Indonesia were used to create the spatial database. The layers incorporated into the database were protected areas, vegetation, roads, rivers and settlements.

Indonesian Land-use and Forest Status maps (series RePPProT 1988; scale 1:250,000) were used for protected area boundaries (HSA and HL, see Table 1 for definitions) and vegetation cover. Only vegetation cover within the five major protected areas was digitized from these maps. The main forest types distinguished in the five HSA areas were lowland forest (below 1,000 meters), sub-montane forest (between 1,000-2,000 meters), montane forest (above 2,000 meters), and inland and mangrove swamp. In addition, other vegetation types such as bush and agriculture (along with minor forest types, i.e., calcareous forest) were included in the database.

To estimate vegetation cover outside of the five major protected areas, the World Conservation Monitoring Center (WCMC) provided a digitized coverage of vegetation on Sumatra (series RePPProT 1990; scale 1:2.5 million). WCMC's database only distinguishes between lowland forest, montane forest, inland and mangrove swamp and non-forest. Thus, all areas without forest, such as bush and agriculture, are treated as a non-forest category (Cox and Collins, 1991).

The database created therefore contains a distinction between the information available for vegetation cover inside and outside of the five major protected areas. Outside HSA boundaries all areas without forest are labeled non-forest, while inside HSA boundaries non-forest is divided into bush and agriculture. Roads, towns, and rivers were digitized from geological maps (Geological maps 1988; scale 1:250,000).

Table 1. Categories of protected areas in Indonesia relevant to this report.

HP--Hutan Produksi (Production forest): The removal of timber and other forest products is allowed and regulated to continue on a permanent basis (lowest level of protection).
HL--Hutan Lindung (Protection forest): Forest products can be removed within certain limits.
HSA--Suaka Margasatwa (Game reserve): No activities are permitted that could damage the flora, fauna or landscape; however, permission can be given to allow some traditional use of natural resources, such as hunting, fishing, cutting of timber, and grazing of livestock.
HSA--Cagar Alam (Nature reserve): No activities that could damage the habitat and cause disturbance to wildlife are permitted, except scientific research (upon permission from PHPA).
HSA--Taman Nasional (National park): Level of protection is the same as for the Nature Reserves, except that controlled use for recreation and education is permitted.

To gain input from Indonesian staff of the Directorate General of Forest Protection and Nature Conservation (PHPA) a letter was sent to Mr. Abdul Bari, then the Director of Nature Conservation (PHPA) and Co-Coordinator of the Sumatran Tiger PHVA Workshop, explaining how we were going to go about estimating the distribution of tigers in Sumatra. For purposes of this report this letter is included:

"With this letter we have included a set of five maps, one map for each protected area in Sumatra where tigers are found. Other protected areas may have tigers, but we currently do not have those maps made. The purpose of these maps is to provide a way to estimate the distribution of Sumatran tigers within the five major protected areas of Sumatra: Gunung Leuser, Berbak, Kerinci-Seblat, Barisan Selatan, and Way Kambas. The tiger's distribution will be used to estimate probabilities of long-term survival or mean time to extinction for each population in each protected area. The two smaller protected areas, Berbak and Way Kambas, show little habitat fragmentation. The much larger protected areas are probably highly fragmented. When tiger populations become fragmented, they become smaller and their probability of extinction from environmental, genetic, and demographic stochastic events becomes greater. Thus, long-term conservation strategies to protect Sumatran tigers must consider the protected areas together. If each protected area has a separate conservation strategy independent of the other, the long-term survival of tigers will be uncertain.

We are requesting that each map and a copy of this letter (with the questions) be sent to the Chiefs of each protected area. It is important that this information be gathered quickly, so that we can perform the analyses prior to Tiger PHVA Workshop in Padang, West Sumatra.

Each map has a scale of about 1:250,000 (Berbak and Way Kambas were scaled smaller, the other parks larger). Each map indicates land use patterns (HSA, HL, UNC, etc.) taken from official 1988 RePPProT maps. We have added forest cover or zones (montane, sub-montane, lowland forest, swamps, bush, unclassified, etc.) from WCMC maps (Cambridge, England). We have also indicated major rivers, paved roads, human habitation, and other points of reference (we will continue to add more information up until the November workshop). A latitudinal and longitudinal mark will help with your orientation.

On top of each map we have placed a 10km by 10km grid. This grid will be used to estimate the accuracy of: 1) land use type; 2) forest cover; 3) presence or absence of tigers; and 4) relative density of tiger prey. In some instances the 10km by 10km grid will fall in a transition zone for any or all of the above categories; if so, determine which category is greatest and use that as your answer.

Questions to be Answered
Each protected area map needs to be evaluated by the Chief of that protected area and his staff. Please answer each of the four questions for each 10km by 10km grid (which are numbered).

1) ***Land Use Type:**: Is the land use type indicated for each grid correct? If so, answer yes in the **upper left-hand** corner of each grid. If it is incorrect, answer no in the same spot with the correct land use type (S-HL for example).*

2) ***Forest Cover:** Each grid was developed from satellite imagery that is 20 years old, so the extent of forest cover probably is not current. For each grid, indicate whether the forest cover indicated is correct. If yes, answer yes in the **upper right-hand** corner. If it is incorrect, answer no with the correct forest cover type (e.g., S-BUSH).*

3) ***Presence or Absence of Tigers:** Have tigers, or any sign of tigers (tracks, sounds, scrapings, scats, etc.) been observed in this grid at any time during the last three years? If yes, put a H (harimau for tiger) in the **lower right-hand** corner of the grid. If any signs of tiger cubs were also observed, put a HH (for mother and cubs) in the **lower right-hand** corner. If tigers have never been observed in this grid, answer no in the same spot.*

4) ***Tiger Prey:** If tiger prey (deer, pig, wild cattle, medium-sized mammals, etc.) are found in this grid, indicate in the lower left-hand corner of the grid:*
   - *Many tiger prey present (more than 25 animals)*
   - *Moderate tiger prey present (less than 25 animals)*
   - *Almost no tiger prey present (less than 5 animals)*

   (Editors' note: This category caused the most confusion and was abandoned during the PHVA).

The maps were returned to PHPA in Jakarta and returned to Minnesota for analysis. New maps based upon this information were then prepared for the PHVA workshop.

ANALYSIS OF VEGETATION AND LAND USE PATTERNS

Data were added to the maps at the Sumatran Tiger PHVA Workshop in Padang, Sumatra based on input from the five working groups. The working groups consisted of park officials, field biologists and other individuals with experience working in Sumatra. Each working group was led by the park chief of their respective parks.

SUMATRAN TIGER POPULATION ESTIMATES

The Sumatran Tiger PHVA concentrated on the long-term viability (100 years) of tigers in HSA areas. Other areas, namely HL, were also discussed in terms of tiger numbers but an extensive analysis was not performed on these protected areas, because most of them are scheduled for conversion to agricultural purposes, are extremely small in size and isolated from larger protected areas. This report, as part of the Sumatran tiger PHVA process concentrates on tiger distribution in the five national parks.

In an effort to gain an estimate of tiger numbers in a protected area, we used Griffiths (this report) estimates of tiger home range sizes in Gunung Leuser National Park, who provides the only available data on home range sizes for male Sumatran tigers. He estimated a male tiger has a home range size of about 180 km^2 in elevations from 100-600m. Based on data obtained for prey availability at higher elevations, he estimated a minimum home range size of 274 km^2 at elevations between 600-1,700m and 380 km^2 above 1,700m for males. Female home range sizes were estimated by dividing male home range sizes in half, using data from Nepal; from which he estimated densities for female tigers of 90 km^2 between 100-600m, 137 km^2 between 600-1,700m and 190 km^2 above 1,700m.

We assigned Griffiths' (this report) three tiger densities to available types of vegetation derived from our GIS analysis. For this report, **high tiger density** was placed at 1 tiger per 180 km^2 for a male and 90 km^2 for a female, **medium tiger density** was 1 tiger per 274 km^2 for a male and 137 km^2 for a female and **low tiger density** was placed at 1 tiger per 380 km^2 and 190 km^2. Griffiths' estimates are based on elevation and do not strictly apply to vegetation type, but are close, and help provide a rough estimate of tiger numbers based upon the available data.

Low tiger densities (1 male tiger per 380 km^2, 1 female tiger per 190 km^2) were assigned to montane forest and agricultural. Although agricultural areas may have a higher prey-base (and thus would be good tiger habitat), given poaching and poisoning pressures from humans and the tiger's propensity to avoid humans, it is unlikely that tigers would have an extensive part of their home range covering agricultural lands.

Medium tiger densities (1 male tiger per 274 km^2, 1 female tiger per 137 km^2) were assigned to submontane forest and peat-swamp forest. Submontane forest on the maps roughly corresponds to Griffiths' data (medium tiger densities were from 600 to 1700m, on our maps it is 1,000m to 2,000m). Peat-swamp habitat was assigned to this category, based upon conflicting reports of its suitability as tiger habitat (see section on Berbak National Park, below).

High tiger densities (1 male tiger per 180 km^2, 1 female tiger per 90 km^2) were assumed for lowland forest, swamp (except peat swamp forest), bush and logged forest. Logged forest was included in the high density category because secondary forest is thought to have a higher prey-base than primary forest [(Santiapillai and Ramono, 1987), however, see Wilson and Johns (1982)]. Bush and swamp were included in the high density category based upon the argument that tigers are especially associated with these habitats (Santiapillai and Ramono, 1987).

Tiger numbers for the five national parks were estimated in two ways: 1) using the vegetation cover on the RePPProT (1988) maps stored in the GIS database, and 2) using tiger presence as indicated on the maps by park officials at the PHVA workshop. Kerinci Seblat, Way Kambas, Barisan Selatan and Gunung Leuser all have complete data sets and both methods were used for these parks. Berbak was analyzed using only the vegetation types from the GIS database. The results follow.

RESULTS

GUNUNG LEUSER NATIONAL PARK

There were 177 units in the database for Gunung Leuser, which included adjacent areas. There were 128 units labelled for protection status (88 HSA, 10 HL and 30 NP) and 123 units filled with vegetation cover (49 lowland, 50 submontane, 15 montane, 2 swamp, 2 logged and 5 agriculture). Twenty-eight units were labelled with tiger presence (3 tigers with cubs, 23 tigers and 2 no longer have tigers but they were present in the last three years) and 61 units were labelled for estimated prey-base (38 high, 20 medium and 3 low).

HSA areas: Gunung Leuser had 21 HSA units labelled with tigers (18 tigers, 2 tigers with cubs and 1 tiger within the last five years). The working group only labelled the grids where tigers were known to occur. Much of the park has not been surveyed; thus, there are many more units of suitable tiger habitat for which data are currently unavailable.

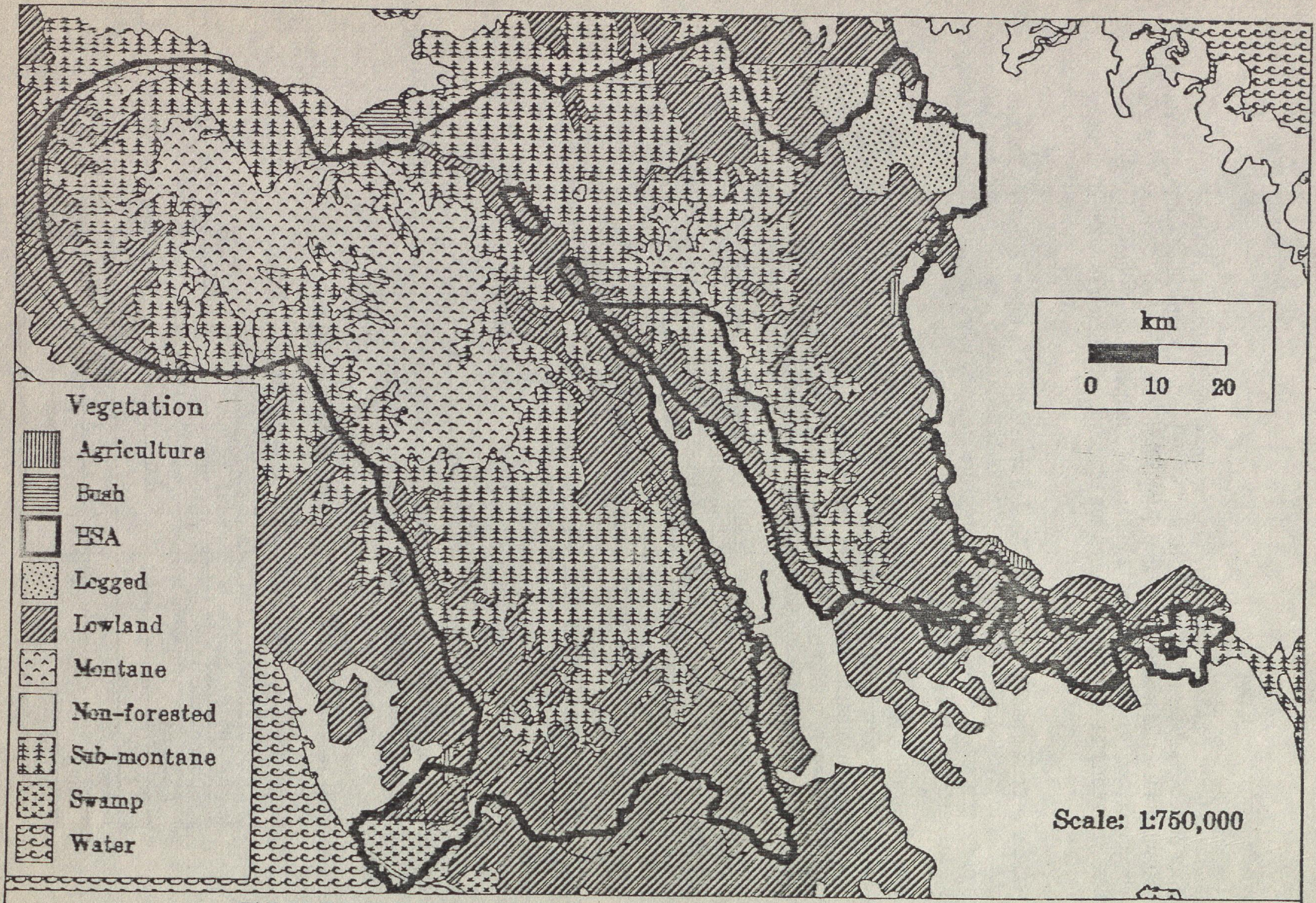
Many of the units for which data were unavailable are of the same kind of vegetation types as units indicated as having tigers present. Tiger presence was indicated by the working group as occurring primarily in lowland and submontane areas. There are many more units of these forest types in the park. Given that tigers are known to utilize submontane and lowland forest, for the purposes of this study, it was assumed that all lowland and submontane areas have tigers present.

Tiger estimates from vegetation in GIS database (data from vegetation analysis): There are 3,749 km^2 of high density habitat (1 tiger per 180 km^2 of lowland, logged, bush and swamp) in Gunung Leuser, for an estimated 20-21 male and 41-42 female tigers. There are 3,644 km^2 of submontane forest in Gunung Leuser, for an estimated 13-14 male and 26-27 female tigers. There are 1,502 km^2 of montane forest and agriculture in Gunung Leuser, for an estimated 3-4 male and 7-8 female tigers. The total population of tigers in Gunung Leuser was thus estimated to be between 110-116; 36-39 male and 74-77 females.

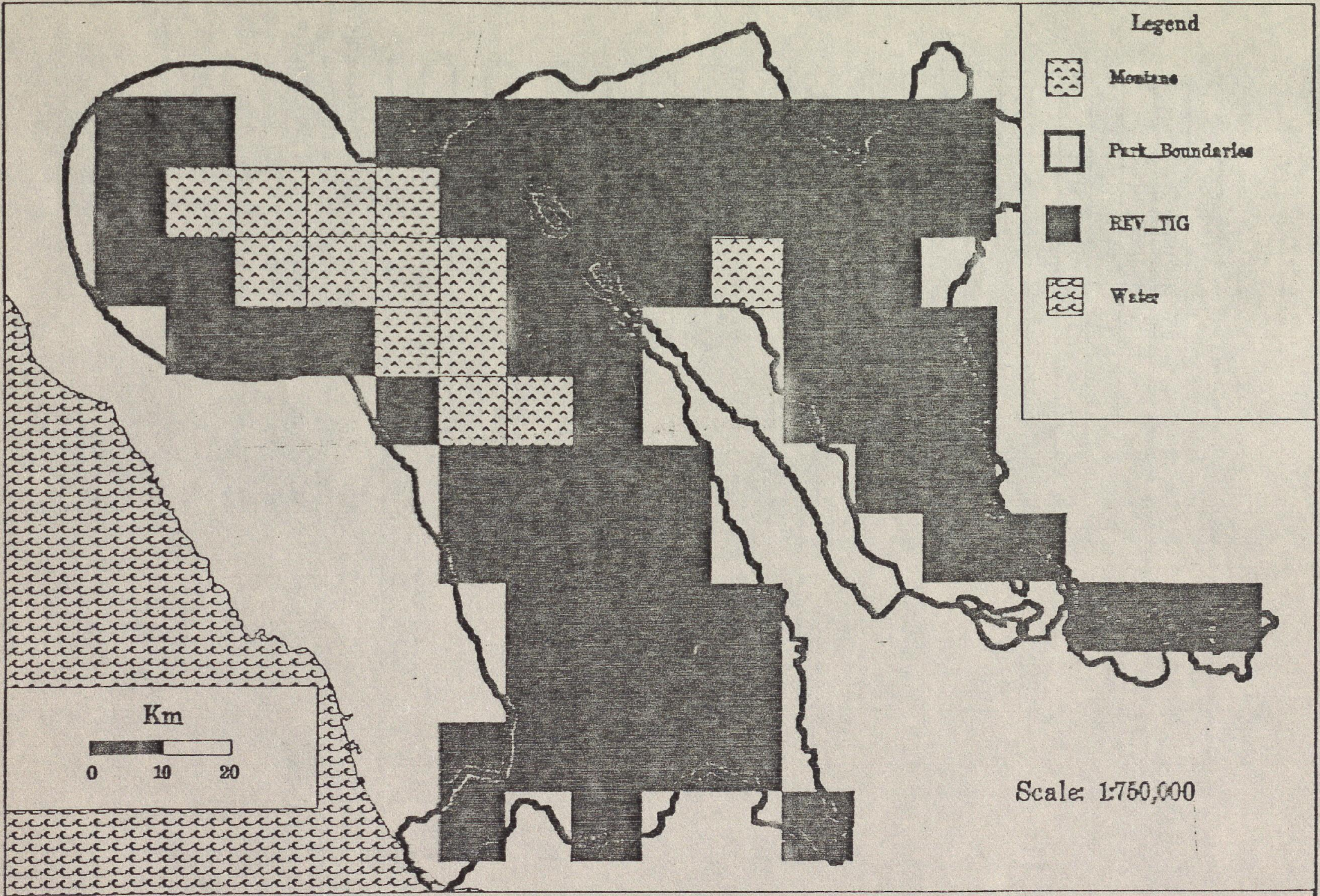
Tiger estimates from HSA areas (from data received at the PHVA workshop): There were 31 units labelled as lowland, swamp and logged. Two units were not labelled and were assigned lowland forest status based on the GIS database. One of the units labelled as swamp was indicated as not having tiger presence and was therefore removed from the analysis. Therefore, there were 30 units of the high density category comprising 3,000 km^2, for an estimated 16-17 male and 33-34 female tigers. There were 41 submontane units in the grid, for an estimated 14-15 male and 29-30 female tigers. There were 15 montane units in the plot, for an estimated 3-4 male and 7-8 female tigers. The total population was thus estimated to be between 102-108 tigers (33-36 male and 69-72 female).

Table 2. Vegetation analysis of Gunung Leuser National Park (8,903 km^2, from RePPProT 1988).

Vegetation type	Total Area (km^2)
Montane	1,461
Sub-montane	3,614
Lowland	3,413
Swamp	24
Bush	45
Agriculture	41
Logged	268



GUNUNG LEUSER NATIONAL PARK
Vegetation cover (from RePPProT 1988)



GUNUNG LEUSER NATIONAL PARK
Revised tiger distribution

Table 3. Grid of Gunung Leuser National Park.

Land-use	Vegetation	Tigers	Amount of prey H	M	L	NL
HSA (87)	Ll (25)	T (13)	11	0	0	2
		T/C (2)	1	0	0	1
		NL/T (9)	3	6	0	-
		NoL (1)	-	-	-	-
	Sm (41)	T (5)	4	0	0	1
		NL/T (18)	11	7	0	-
		NoL (18)	-	-	-	-
	M (15)	NL/T (6)	0	3	3	-
		NoL (9)	-	-	-	-
	Sw (2)	H (1)	0	0	0	1
		NL/T (1)	1	0	0	-
	Lg (2)	NL/T (2)	2	0	0	-
	NoL (2)	NL/T (2)	1	1	0	-
HL (10)	Ll (6)	T (1)	0	0	0	1
		NL/T (2)	0	2	0	-
		NoL (3)	-	-	-	-
	Sm (4)	NoL (4)	-	-	-	-
NP (28)	Ll (18)	T (4)	2	0	0	2
		T/C (1)	1	0	0	0
		H (1)	0	0	0	1
		NoL (12)	-	-	-	-
	Sm (5)	NL/T (2)	1	1	0	-
		NoL (3)	-	-	-	-
	Ag (5)	NoL (5)	-	-	-	-

Legend: Ll = Lowland forest, Sm = Submontane forest, M = Montane forest, Sw = Swamp, Ag = Agriculture, Lg = Logged; T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years, NL = Units not marked for amount of prey, NL/T = Grids marked with amount of prey but not tiger presence, NoL = Grids with no labels.

KERINCI SEBLAT NATIONAL PARK

There were 414 units in the Kerinci Seblat database with the following classifications: protection status (108 HSA, 47 HL and 259 non-protected); vegetation (150 lowland, 52 submontane, 2 montane, 9 swamp, 51 bush and 150 agriculture); tiger presence (12 tiger with cubs, 280 tigers, 92 no longer have tigers but they were present in the last three years, 28 never had tigers and 2 tiger presence not indicated); prey-base (144 high, 159 medium and 108 low).

Kerinci Seblat had 94 HSA units that were labelled for tigers; 3 were labelled for tigers with cubs. HSA areas had 3 units labelled as tigers with cubs, whereas non-protected and HL areas had 11 units labelled for the presence of cubs. This suggests that the breeding population is concentrated outside of HSA areas. If only HSA areas provide for the protection of tigers in the future, then the data would indicate that the tiger population in Kerinci Seblat is threatened if the forest cover of the non-protected areas is converted to agriculture.

<u>Tiger estimates from vegetation in GIS database (data from vegetation analysis):</u> There are 5,028 km^2 of lowland and bush in Kerinci Seblat, for an estimated 27-28 male and 55-56 female tigers. There are 4,146 km^2 of submontane forest in the database, for an estimated 15-16 male and 30-31 female tigers. There are 813 km^2 of montane forest and agriculture in Kerinci Seblat, for an estimated 2-3 male and 4-5 female tigers. The total population is between 133-139 tigers, 44-47 males and 89-92 females.

<u>Tiger estimates from HSA areas (from data received at the PHVA workshop):</u> There were 45 units of lowland and bush labelled with the presence of tigers, for an estimated 25 male and 50 female tigers. There were 30 units of submontane forest labelled for tiger presence, for an estimated 10-11 male and 21-22 female tigers. There were 17 units of agriculture and montane labelled for the presence of tigers, for an estimated population of 4-5 male and 8-9 female tigers. The total population was thus estimated between 118-122 (39-41 males and 79-81 females).

Table 4. Vegetation analysis of Kerinci Seblat National Park (10,018 km^2, from RePPProT 1988).

Vegetation type	Total Area (km^2)
Montane	249
Sub-montane	4,146
Lowland	4,804
Bush	224
Agriculture	566
Water Bodies	10

Table 5. HSA units for Kerinci Seblat National Park.

Land-use	Vegetation	Tigers	Amount of prey		
			H	M	L
HSA (106)	Ll (44)	T (41)	14	16	11
		T/C (1)	1	0	0
		H (1)	0	1	0
		N (1)	0	0	1
	Sm (35)	T (28)	13	8	7
		T/C (2)	2	0	0
		H (4)	1	2	1
		N (1)	0	0	1
	Ag (19)	T (15)	4	7	4
		H (2)	1	0	1
		N (2)	0	1	1
	M (2)	T (2)	2	0	0
	B (3)	T (3)	2	1	0
	Sw (3)	H (3)	0	2	1

Legend: Ll = Lowland forest, Sm = Submontane forest, M = Montane forest, Sw = Swamp, B = Bush, Ag = Agriculture; T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years.

Table 6. Protected forests units surrounding Kerinci Seblat National Park.

Land-use	Vegetation	Tigers	Amount of prey		
			H	M	L
HL (47)	Ll (26)	T (20)	5	10	5
		H (3)	1	2	0
		N (3)	0	2	1
	Sm (9)	T (4)	2	1	1
		H (5)	2	0	3
	Ag (11)	T (8)	5	0	3
		T/C (1)	1	0	0
		H (1)	0	1	0
		N (1)	0	0	1
	B (1)	T/C (1)	1	0	0

Legend: Ll = Lowland forest, Sm = Submontane forest, B = Bush, Ag = Agriculture; T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years.

Table 7. Nonprotected units around Kerinci Seblat National Park.

Land-use	Vegetation	Tigers	Amount of prey H	M	L	NL
NP (259)	Ll (80)	T (57)	19	28	10	0
		T/C (3)	3	0	0	0
		H (8)	1	5	2	0
		N (12)	0	3	9	0
	Ag (118)	T (67)	39	19	9	0
		T/C (2)	1	1	0	0
		H (46)	9	20	17	0
		N (1)	0	0	1	0
		No L (2)	-	-	-	-
	Sm (8)	T (5)	1	2	2	0
		T/C (1)	1	0	0	0
		H (2)	0	1	1	0
	Sw (6)	T (4)	0	4	0	0
		H (2)	2	0	0	0
	B (47)	T (24)	8	9	6	1
		T/C (1)	1	0	0	0
		H (15)	2	9	4	0
		N (7)	0	2	5	0

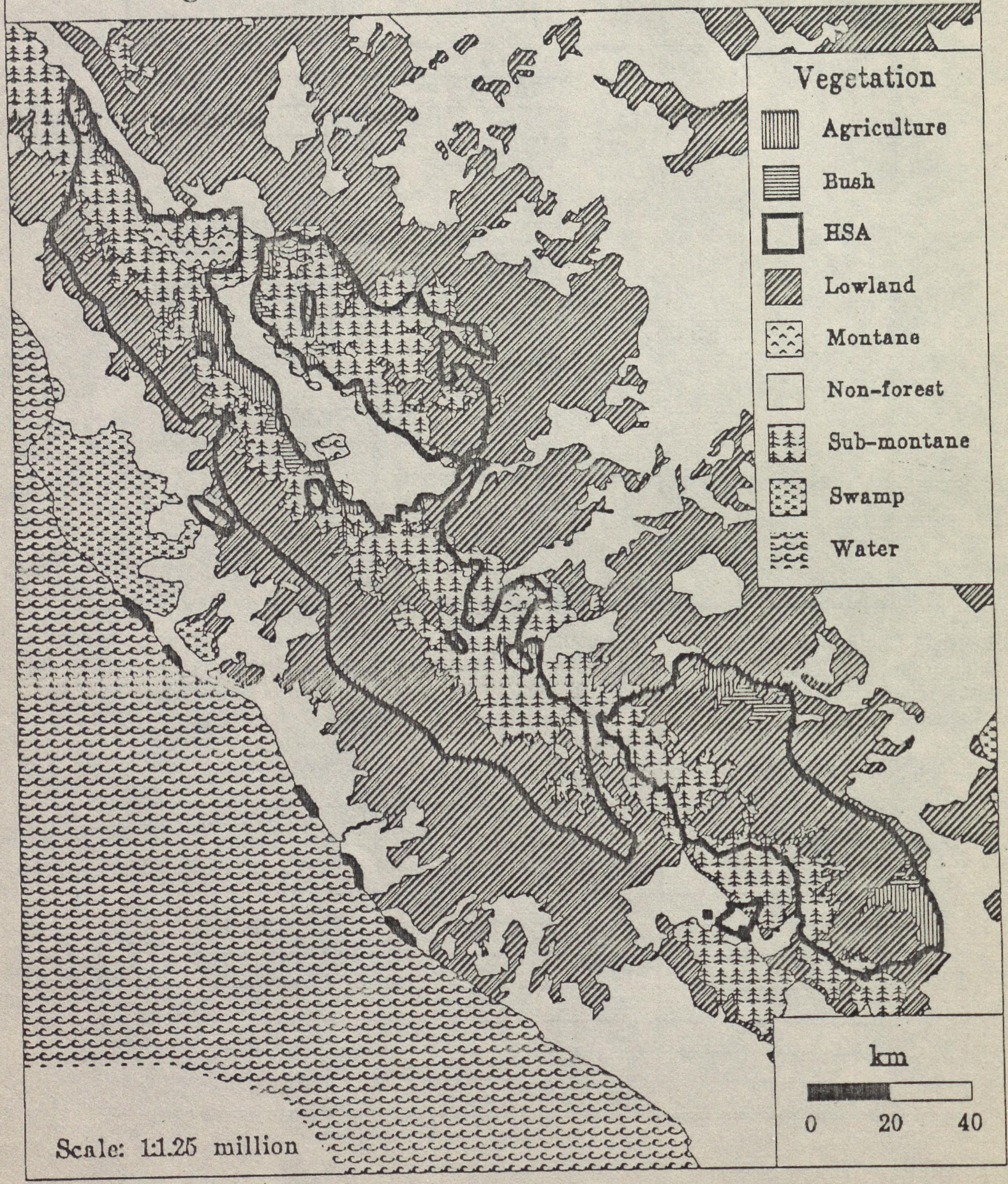
Legend: Ll = Lowland forest, Sm = Submontane forest, Sw = Swamp, B = Bush, Ag = Agriculture; T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years, NL = Units not marked for amount of prey.

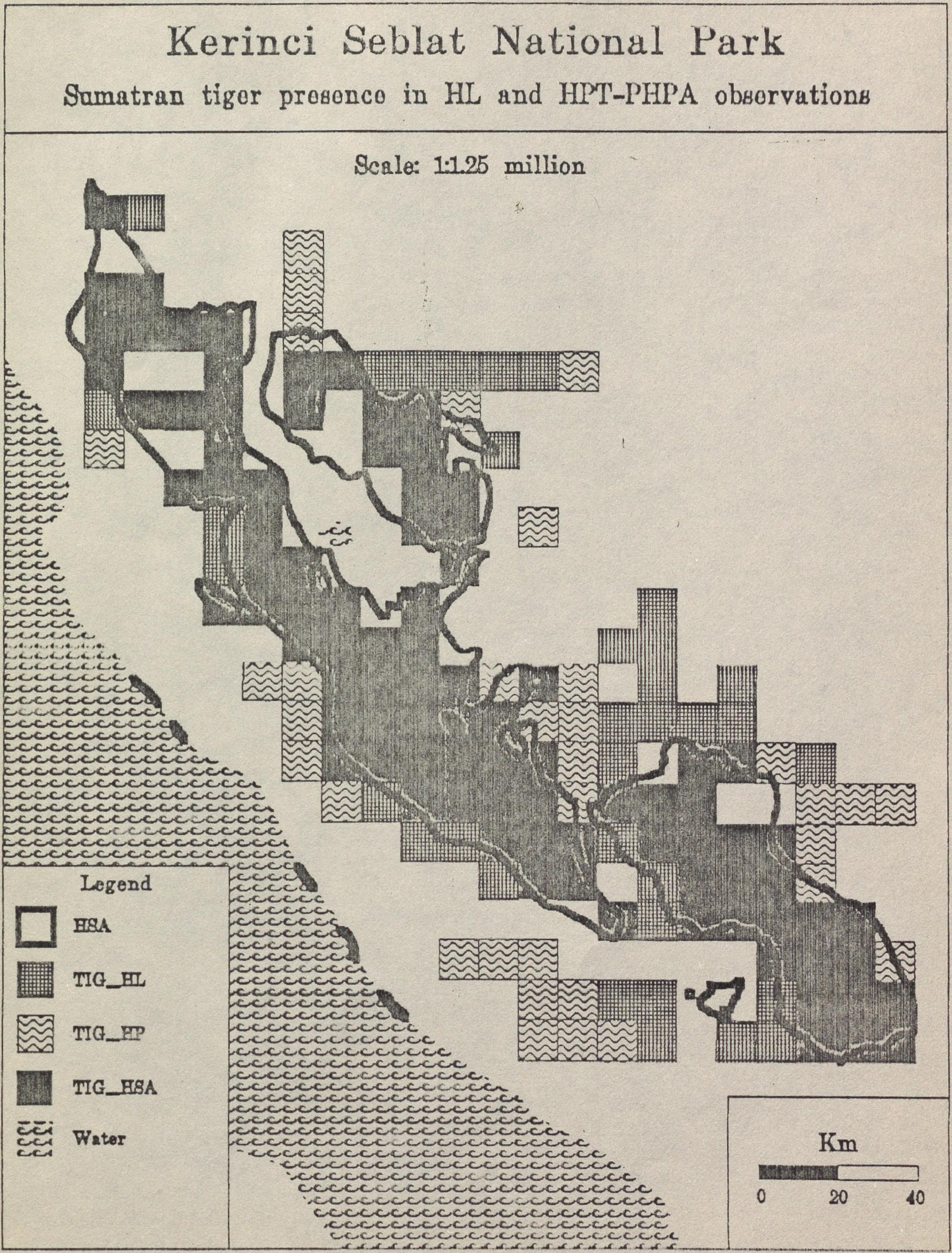
Table 8. Tiger presence surrounding Kerinci Seblat National Park.

Protection Status	Vegetation	Tigers	Tigers w/ cubs
HL (34)	Ll (20)	20	0
	Sm (4)	4	0
	B (1)	0	1
	Ag (1)	0	1
HPT (33)	Ll (16)	16	0
	Sm (4)	3	1
	B (2)	2	0
	Ag (11)	11	0

KERINCI SEBLAT NATIONAL PARK

Vegetation cover (from RePPProT 1988)





Kerinci Seblat National Park
Sumatran tiger presence in HL and HPT-PHPA observations
Scale: 1:1.25 million
Legend
HSA
TIG_HL
TIG_HP
TIG_HSA
Water
Km
0
20
40

Barisan Selatan National Park

There were 299 units in the Barisan Selatan grid database, 59 were labelled with information. The units were labelled for protection status (34 HSA, 4 HL and 21 non-protected), vegetation class (36 lowland, 11 submontane and 12 agriculture), tiger presence (27 tigers, 19 no longer have tigers but they were present in the last three years and 13 never had tigers) and estimated prey-base (31 high, 23 medium, 4 low and 1 not labelled).

There were 34 HSA units in Barisan Selatan; of these 19 had tigers (17 lowland, 1 submontane and 1 agriculture), 12 had tigers within the last three years and 3 never had tigers (*editors' note: tigers may be fragmented into five populations.*

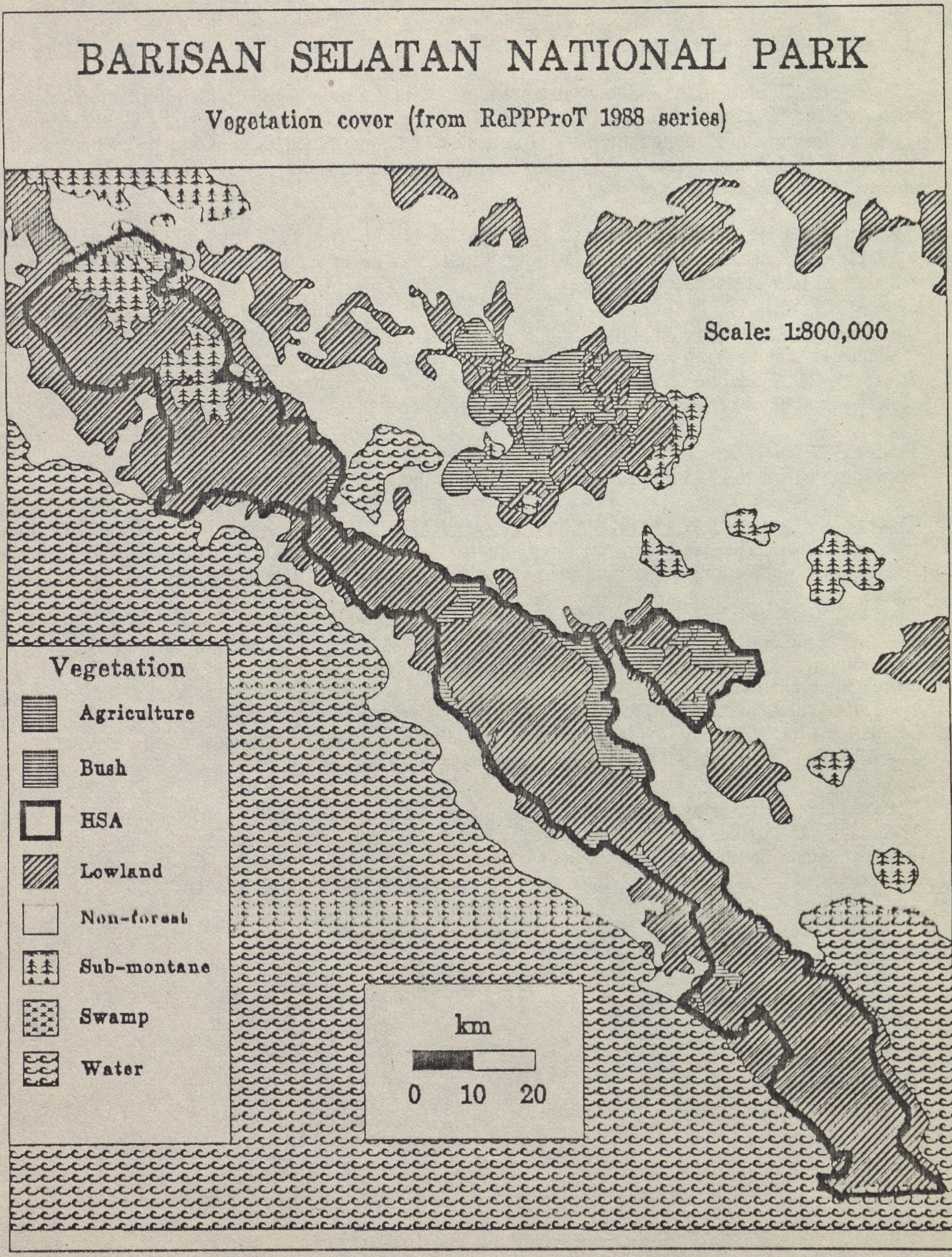
Tiger estimates from vegetation in GIS database (data from vegetation analysis): There are 2,715 km^2 of bush, lowland and swamp forest in Barisan Selatan. This results in an estimate of 15-16 male and 30-31 female tigers. There are 268 km^2 of submontane and 324 km^2 agriculture within park boundaries. This results in estimates of 1-2 male and 3-4 female tigers.

From the GIS vegetation analysis, the male population is estimated to be between 16-18 and the female population between 33-35 tigers, or a total population between 49-53 tigers.

Tiger estimates from HSA areas (from data received at the PHVA workshop): From the tiger distribution received at the PHVA workshop, the tiger population of Barisan Selatan appears to be fragmented into five separate populations. The number of individuals is estimated for each population, from south to north.

The first population has 1,000 km^2 of lowland forest, for an estimated population of 5-6 male and 11-12 female tigers. The second population has 200 km^2 of lowland forest and 100 km^2 of agriculture, for an estimated population of 1-2 male and 2-3 female tigers. The third population has 200 km^2 of lowland and 100 km^2 of submontane forest, for an estimated population of 1-2 male and 2-3 female tigers. The fourth population 4 has 200 km^2 of lowland forest, for an estimated population of 1-2 male and 2-3 female tigers. The fifth population has 100 km^2 lowland forest with an estimated tiger pair.

The total population, using tiger presence from the grid, was estimated to be between 9-13 males and 18-22 females. If the tiger population is fragmented as depicted, there is suitable tiger habitat between these populations and because the distances between the populations are not great, tigers can probably cross these areas. Therefore, the populations are more than likely not genetically isolated.



BARISAN SELATAN NATIONAL PARK
Vegetation cover (from RePPProT 1988 series)
Scale: 1:800,000
Vegetation
Agriculture
Bush
HSA
Lowland
Non-forest
Sub-montane
Swamp
Water
km
0 10 20

Barisan Selatan National Park

Sumatran tiger presence-PHPA observations

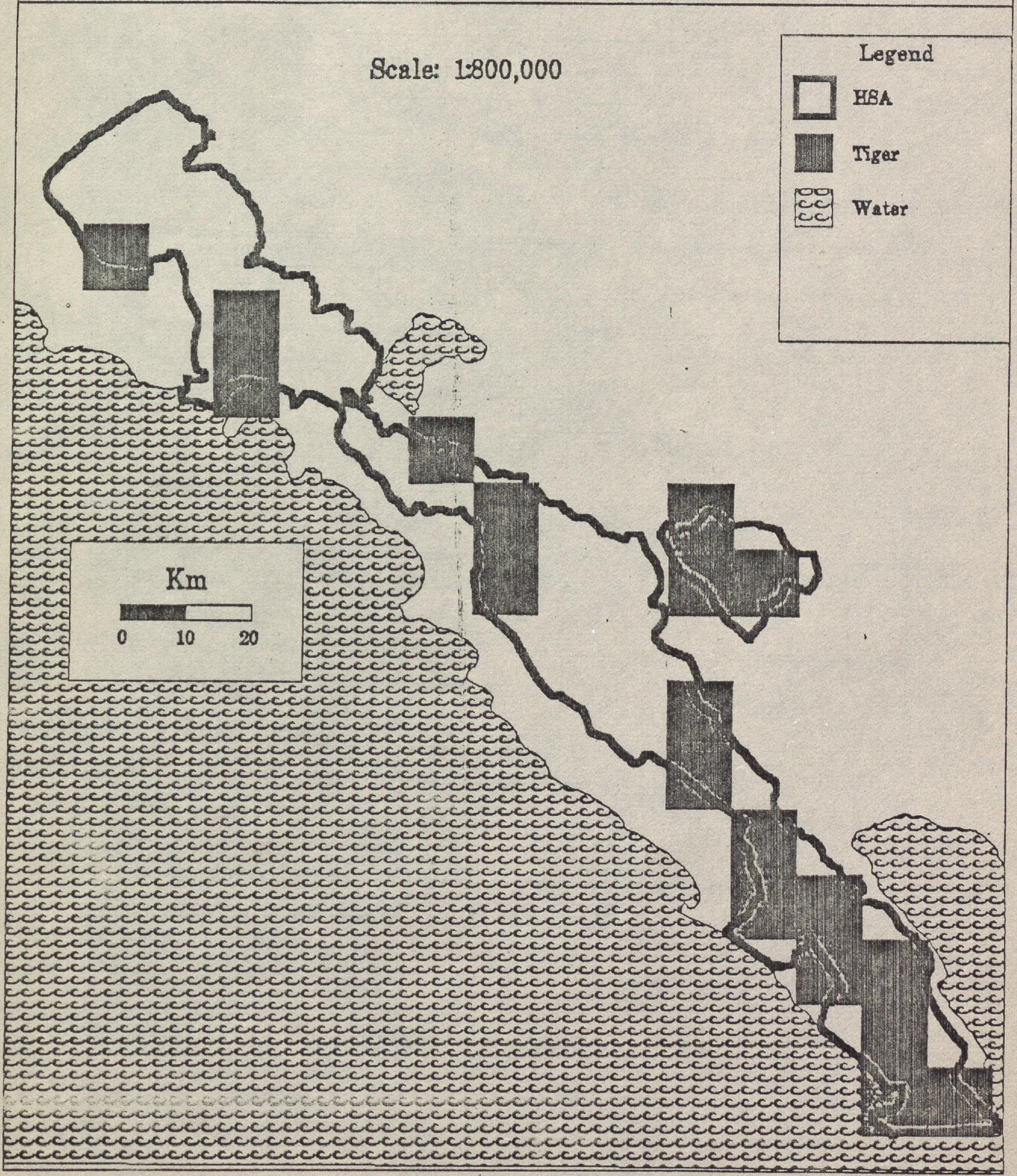


Table 9. Vegetation analysis from Barisan Selatan National Park (3309 km², from RePPProT 1988).

Vegetation type	Area (Km²)
Lowland	2,643
Submontane	268
Swamp	16
Bush	57
Agriculture	324

Table 10. Grid of Barisan Selatan National Park.

Land-use	Vegetation	Tigers	Amount of prey			
			H	M	L	N L
HSA (34)	Ll (25)	T (17)	12	4	0	1
		H (6)	2	4	0	0
		N (2)	1	1	0	0
	Sm (8)	T (1)	1	0	0	0
		H (6)	4	2	0	0
		N (1)	0	1	0	0
	Ag (1)	T (1)	1	0	0	0
HL (4)	Ll (2)	H (2)	2	0	0	0
	Sm (2)	T (1)	1	0	0	0
		N (1)	0	1	0	0
NP (21)	Ll (9)	T (6)	4	2	0	0
		H (2)	2	0	0	0
		N (1)	0	0	1	0
	Sm (1)	H (1)	0	1	0	0
	Ag (11)	T (1)	1	0	0	0
		H (2)	0	2	0	0
		N (8)	0	5	3	0

Legend: Ll = Lowland forest, Sm = Submontane forest, Ag = Agriculture, T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years, NL = Grids not marked for amount of prey.

WAY KAMBAS NATIONAL PARK

There are a total of 28 units in the Way Kambas database. The units were labelled for protected status (16 HSA, 9 non-protected and 3 were not labelled); vegetation class (8 lowland, 9 swamp, 3 bush and 5 agriculture); tiger presence (10 tigers, 3 tigers with cubs, 11 no longer have tigers but they were present within the last three years and 1 never had tigers); and prey-base (19 high, 1 medium and 5 low).

There were 12 HSA units labelled with the presence of tiger in the Way Kambas grid; 3 labelled as tigers with cubs and 9 with tigers.

There were 16 units labelled as HSA in the revised GIS database, totalling 1,600 km^2. However, Way Kambas is actually 1,300 km^2. This represents a 300 km^2 increase in the size of the park. The discrepancy can be attributed to units that overlapped the ocean (364 km^2). While the area of the park is overestimated, the goal is to approximate where tigers are distributed.

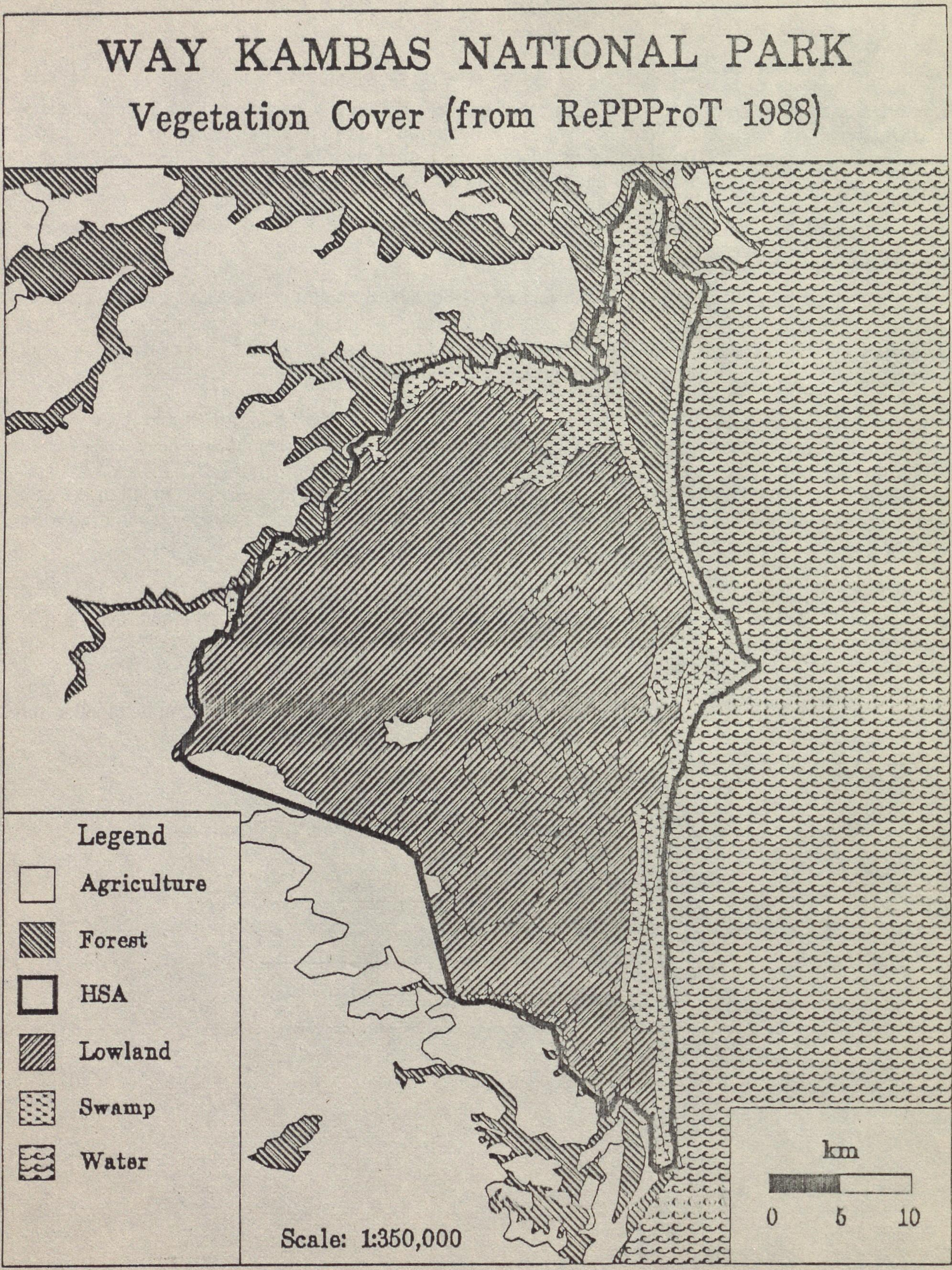
There is a discrepancy between the area of bush in the GIS database (RePPProT 1988) and in the grid as revised by the working group (800 km^2 GIS, 300 km^2 grids). This corresponds with a discrepancy between the same two databases in the amount of lowland forest (200 km^2 from GIS database, 700 km^2 from the revised grid). The RePPProT (1988) maps came from older satellite data; thus much of the area listed as bush in the GIS database is now secondary forest (70% of Way Kambas was logged in the 1960's and 70's).

Tiger estimates from vegetation in GIS database (data from vegetation analysis): There are 1,295 km^2 of lowland, swamp and bush in the park (agriculture has been excluded because of its small size), for an estimated 7-8 male and 14-15 female tigers. The population size from the GIS vegetation analysis was estimated between 21-23 individuals.

Tiger estimates from HSA areas (from data received at the PHVA workshop): All 12 units labelled for tigers had lowland, bush or swamp, for an estimated 6-7 male and 13-14 female tigers. The total population was estimated at 19-21 tigers.

Table 11. Vegetation analysis of Way Kambas National Park (1300 km^2, from RePPProT 1988).

Vegetation type	Area (in km^2)
Lowland	198
Bush	804
Swamp	293
Agriculture	19


WAY KAMBAS NATIONAL PARK
Vegetation Cover (from RePPProT 1988)
Legend
Agriculture
Forest
HSA
Lowland
Swamp
Water
Scale: 1:350,000
km
0
5
10

Way Kambas National Park

Sumatran tiger presence-PHPA observations

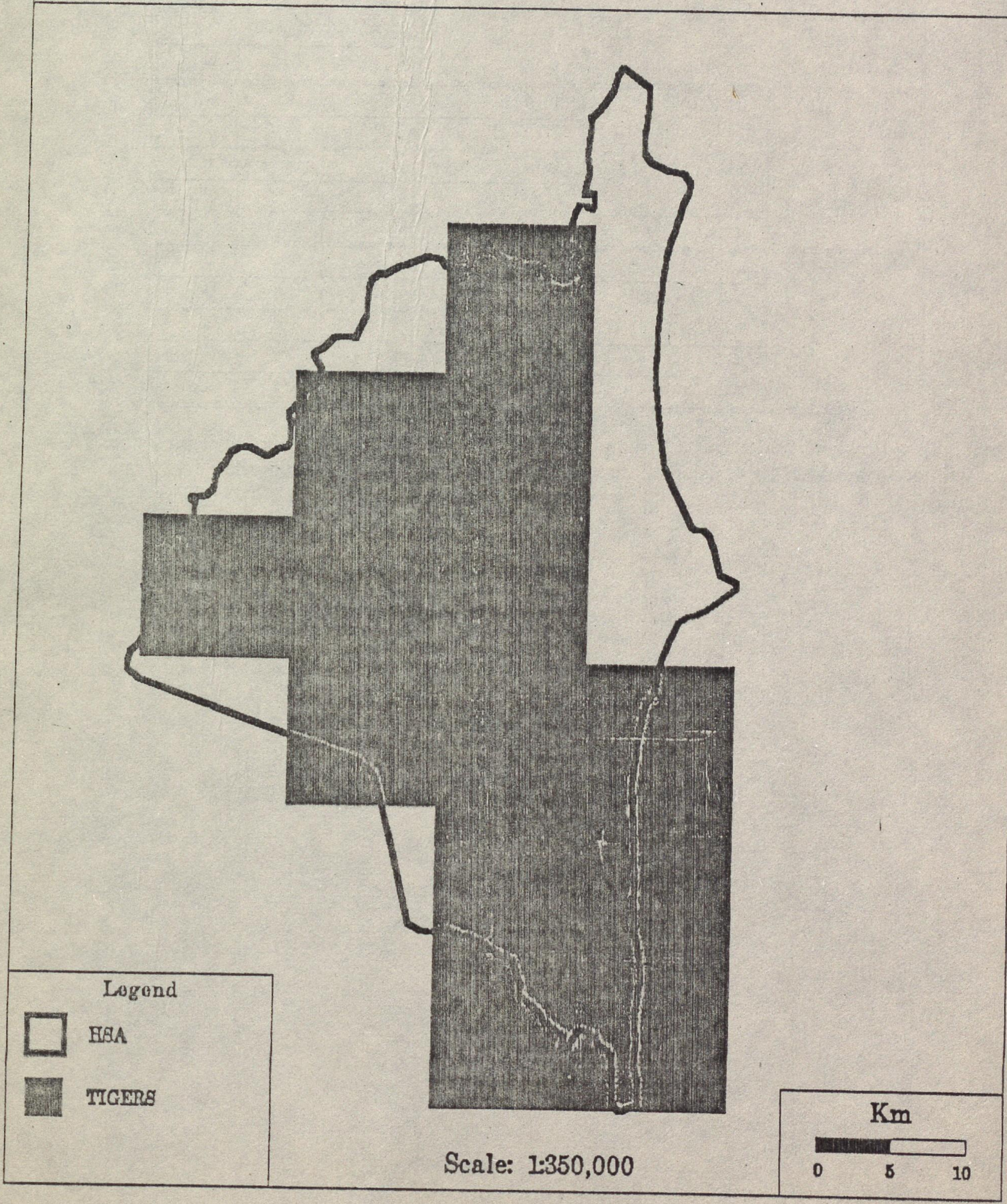


Table 12. Grid of Way Kambas National Park.

Land-use	Vegetation	Tigers	Amount of prey		
			H	M	L
HSA (16)	Ll (7)	T (4)	4	0	0
		T/C (3)	3	0	0
	Sw (7)	T (3)	2	0	1
		H (4)	2	1	1
	B (2)	T (2)	2	0	0
NP (9)	Ll (1)	T (1)	1	0	0
	Sw (2)	H (1)	1	0	0
		N (1)	1	0	0
	B (1)	H (1)	1	0	0
	Ag (5)	H (5)	2	0	3

Legend: Ll = Lowland forest, Sw = Swamp, B = Bush, Ag = Agriculture; T = Tiger presence, T/C = Tiger with cubs presence, H = Historical presence of tigers, N = No tigers within last five years.

BERBAK NATIONAL PARK

There were 123 units in the Berbak database; only 13 were filled with any information. The only information received for the units was tiger presence.

Only 10 HSA grids were labelled for tiger presence; no other data were received. Berbak is a peat-swamp forest. Santiapillai and Ramono (1985) and Seidensticker (1986) estimated that this type of forest cannot support a high prey-base, thus it was poor tiger habitat. However, Santiapillai and Ramono (1985, 1987) have suggested that Berbak has a large number of tigers, and therefore consider Berbak to be an important reserve. There is little information available on the distribution of tigers in Berbak. Based on the literature, tigers utilize all of the vegetation types within the park. We will therefore assume that tigers occupy the entire park.

Recently, Berbak was changed from a game reserve to a national park. When this occurred the size of the park was reduced. The park was originally 2,447 km^2 and is now 1,716 km^2.

Tiger estimates from vegetation in GIS database (data from vegetation analysis): Using the vegetation types that occur within current park boundaries, there are 120 km^2 of swamp and logged forest. This results in an estimate of 1 male and 1-2 female tigers. There are 1,517 km^2 of peat-swamp forest, for an estimate of 5-6 male and 11-12 female tigers. The total estimated population for Berbak is between 18-21 tigers, 6-7 males and 12-14 females.

Table 16. Vegetation analysis of Berbak NP (1,716 km^2, from RePPProT 1988).

Vegetation type	As G.R. (km^2)	Currently (NP) (km^2)
Swamp	393	115
Peat Swamp	1,863	1,517
Agriculture	186	75
Logged	5	5

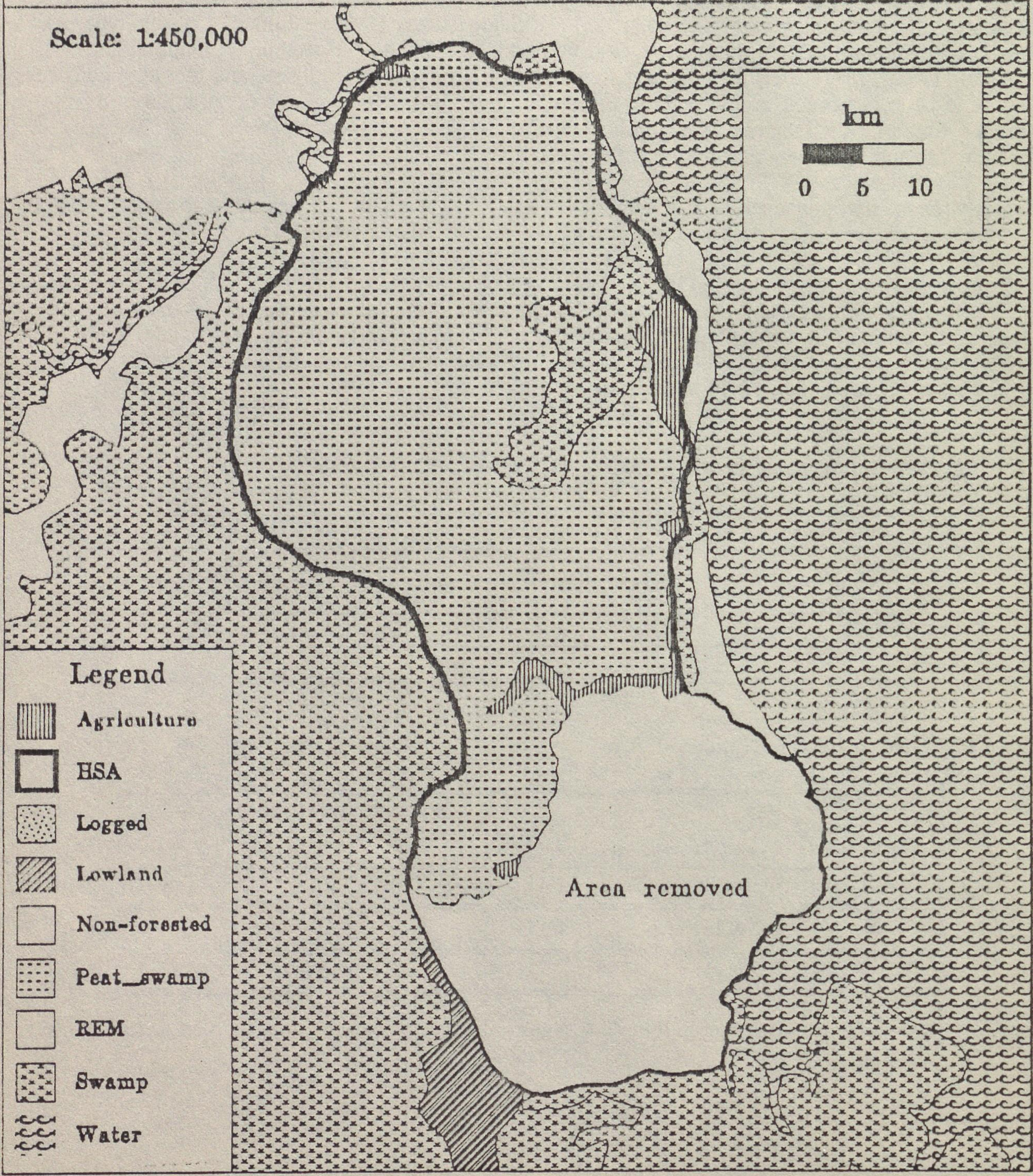
Table 17. Grid of Berbak National Park.

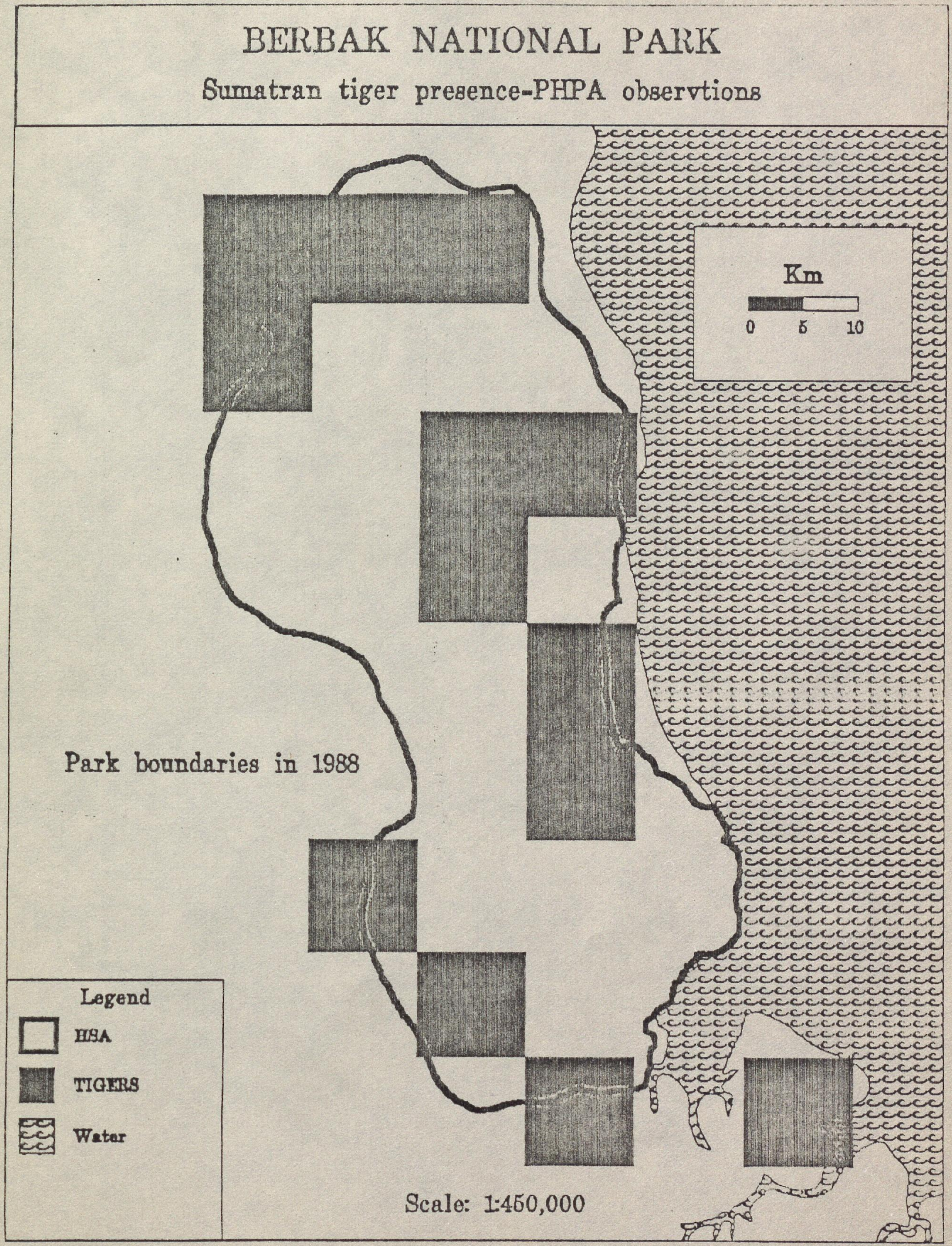
Land-use	Vegetation	Tigers	Amount of prey			
			H	M	L	NL
HSA (11)	Sw (11)	T (11)	0	0	0	11
HL (1)	Sw (1)	T (1)	0	0	0	1
NP (1)	Ag (1)	T (1)	0	0	0	1

Legend: Sw = Swamp, Ag = Agriculture; T = Tiger presence; NL = Units not marked for amount of prey.

BERBAK NATIONAL PARK

Vegetation cover (from RePPProT 1988)




BERBAK NATIONAL PARK
Sumatran tiger presence-PHPA observtions
Km
0 5 10
Park boundaries in 1988
Legend
HSA
TIGERS
Water
Scale: 1:450,000

TIGER MANAGEMENT OUTSIDE OF HSA AREAS

Protection (HL) and certain classifications of production forest are intended to be managed with forest cover intact. If this occurs then the assumption that only HSA areas should be considered as tiger management areas needs to be reevaluated. These areas currently have tigers and in the case of production forest, logging may improve an area as tiger habitat. Therefore, the role of protection and production forest in the maintenance of viable populations of tigers needs to be examined around Kerinci Seblat (data for areas adjacent to the other parks are unavailable).

In addition to tiger areas within Kerinci Seblat, there are 67 units with tiger presence in protected status other than HSA (34 HL and 33 HPT). Of the 34 HL, two units are labelled with the presence of tigers with cubs (1 bush and 1 agriculture) and 32 units are labelled with tigers (20 lowland, 4 submontane and 8 agriculture). There are 33 units labelled with HPT. One unit is labelled tiger with cubs (submontane). The other 32 units are labelled for tigers (3 submontane, 16 lowland, 11 agriculture and 2 bush).

All areas are connected or potentially connected by suitable habitat to tiger areas within Kerinci Seblat, and thus represent potential areas that could be managed for tigers to enhance the present tiger population. HL areas have an estimated 14-17 male and 29-32 female tigers. HPT areas have an estimated 13-15 male and 27-29 female tigers. We previously considered our analysis within Kerinci Seblat to be an overestimate, based on numbers provided at the workshop. The estimations outside of HSA areas may likewise be overestimated. However, regardless of actual numbers these areas can be important to the overall viability of Kerinci Seblat's tiger population.

Table 18. Summary of tiger population estimates for five protected areas.

Protected Area	Vegetation analysis			Tiger distrib. from plots			PHVA
	M	F	Total	M	F	Total	Total
Barisan Selatan	16-18	33-35	49-53	9-13	18-22	27-35	68
Berbak	6-7	12-14	18-21	6-7	12-14	18-21	50
Gunung Leuser	36-39	74-77	110-116	33-36	69-72	102-108	110
Kerinci Seblat	44-47	89-92	133-139	40-41	80-82	120-123	76
Way Kambas	7-8	14-15	21-23	6-7	13-14	19-21	20
Kerumutan	-	-	-	-	-	-	30
Rimbang	-	-	-	-	-	-	42
Totals			339-361[a]			268-287[a,b]	396

[a] Does not include other parks with tigers (Rimbang and Kerumutan)

[b] Includes estimates from vegetation analysis of Berbak National Park.

FUTURE DIRECTIONS

The results and analysis presented here provide a beginning, not the final result, of a commitment to ensure the long-term viability of free-ranging Sumatran tigers. As such, there are several issues that need to be further explored to gain better estimates of tiger distribution and densities. Within the context of this paper, these include: expansion of the database to include all viable tiger habitats, including both protection and production forest; identification of unsuitable habitat within these areas; better estimation of tiger home range sizes in tropical rain forest habitat; and better evaluation of the threats to wild tiger populations.■

REFERENCES

Borner, M. 1978. Status and conservation of the Sumatran tiger. *Carnivore*, 1(3): 27-40.

Cox, R. and Collins, M. 1991. Indonesia. Pp. 141-165 in Mark Collins, Jeffrey Sayer, and Timothy Whitmore (Eds.). *The Conservation Atlas of Tropical Forests: Asia and the Pacific.* Simon Schuster Co.: New York.

Karanth, K.U. 1987. Tigers in India: A critical review of field censuses. Pp. 118-131 in R. Tilson and U. Seal (eds.). *Tigers of the World: The Biology, Biopolitics, Management and Conservation of an Endangered Species.* Noyes Publications: Park Ridge, NJ.

Karanth, K.U. 1988. Analysis of predatory-prey balance in Bandipur Tiger Reserve with reference to census reports. *Journal of Bombay Natural History Society*, 85(1): 1-8.

Karanth, K.U. 1993. Relevance of big cat numbers to their conservation. *Cat News*, 19: 11-12.

McDougal, C. 1977. *The Face of the Tiger*. Rivington Books: London.

Sankhala, K. 1979. Tigers in the wild -- their distribution and habitat preferences. Pp. 43-59 in S. Seifert and P. Muller (eds). *International Symposium on the Management and Breeding of the Tiger.* Zoologischen Garten Leipzig: Leipzig.

Santiapillai, C. and Ramono, W. 1985. On the status of the tiger (*Panthera tigris sumatrae* Pocock, 1829) in Sumatra. *Tigerpaper*, 12(4): 23-29.

Santiapillai, C. and Ramono, W. 1987. Tiger numbers and habitat evaluation in Indonesia. Pp. 85-91 in R. Tilson and U. Seal (eds.). *Tigers of the World*. Noyes Publ.: Park Ridge, N.J.

Seidensticker, J. 1986. Large carnivores and the consequences of habitat insularization: Ecology and conservation of tigers in Indonesia and Bangladesh. Pp. 1-41 in S. Miller and D. Everett (eds.). *Cats of the World: Biology, Conservation and Management.* National Wildlife Federation: Washington, D.C.

Smith, J.L.D. 1978. Smithsonian tiger ecology project. Rep. No. 13, Smithsonian Institute: Washington, D.C.

Sunquist, M.E. 1981. The social organization of tigers (*Panthera tigris*) in Royal Chitwan National park, Nepal. *Smithson. Contrib. Zool.*, 336: 1-98.

Wilson, W. and Johns, A. 1982. Diversity and abundance of selected animal species in undisturbed forest, selectively logged forest and plantations in East Kalimantan, Indonesia. *Biological Conservation*, 24: 205-218.

ESTIMATING POACHING AND REMOVAL RATES OF TIGERS IN SUMATRA

Ronald Tilson and Kathy Traylor-Holzer

"Poaching and illegal trade in tiger products are widespread throughout Asia. By their clandestine nature, both are difficult to detect. Poachers may bury tiger remains, including skins, if bones are the target. Unless there are sufficient forest guards, tiger carcasses are unlikely to be found and soon vanish. While skins can be easily identified, only a handful of experts can identify tiger bones, which can be readily transported and mistaken for other (legitimate) animal bones, in which there is normal trade" (Jackson, 1993). Tiger products are being sold in local markets in Laos (Martin, 1992), Vietnam (Jackson, 1993), and Thailand (Rabinowitz, 1993), and trafficking of tiger products has been documented in India and Nepal (Jackson, 1993) and in Indonesia (Mills, 1993; Anonymous, 1994). Outside of tiger range countries, large numbers of bones and other tiger products have been found in Taiwan (Nowell, 1993) and South Korea, many of which were from Indonesia (Mills, 1993). It is China, however, by virtue of its large population, is the largest consumer and producer of manufactured medicines containing tiger parts (Nowell, 1993; Linden, 1994).

Opinions differ on how exactly poaching and the illegal trade in tiger products impact wild populations. In recent years increased poaching levels have been documented in India, Nepal and the Russian Far East, and the consumption of tiger products in China, Taiwan and South Korea continues unabated (Jackson, 1993). The question is: From where did all of these tiger parts originate? No one knows for sure from where or at what rate tigers are being removed from the wild. The general consensus, however, is that the free-ranging populations across Asia are decreasing, and unless poaching is stopped, or at least the demand for tiger products (which contributes to poaching) is stopped, these numbers will continue to decrease.

At the Sumatran Tiger PHVA Workshop we attempted to quantify this information in regards to Sumatra and Sumatran tigers. We have a number of sources to evaluate that provide some indication of how many tigers are being lost to poaching and poisoning, as well as how many tigers are being officially removed by PHPA when they come in conflict with local villagers. These sources are:

Official PHPA Reports:

- At the PHVA Workshop, PHPA staff estimated that, on average, about 17 incidents involving problems with tigers are reported every year from the five national parks of Sumatra. Of these 17 instances, PHPA reported that about 12 resulted in tiger losses; about six through poaching or poisoning and another six through official removal by PHPA (see Vortex section of this report). These estimates are only for the five national parks of Sumatra and do not include other instances involving tigers living in much smaller and fragmented forest patches designated as game reserves or protection (and production) forests.

- The Indonesian Ministry of Forestry requires registration permits for all persons keeping endangered species. The initial registration period was to extend from February through May of 1992 (Decree No. 301/Kpts-II/1992) but was extended to October 1992 (Decree No. 479/Kpts-VI/1992). A total of 1,081 mounted tigers were reported to have been registered at the time of the PHVA workshop (*Conservation Indonesia*, 8(3), 1992). The origin of these tigers was undetermined, but presumably they were from Sumatra originally, or were captive-born offspring from either wild-caught or privately-held tigers.

- Registered tiger specimens included 100 stuffed Sumatran tigers kept in houses of government officials and businessmen in South Sumatra. Another 200 stuffed tigers are held by private individuals in Lampung and about 300 in Palembang (*KOMPAS*, 1 June 1992).

International Trafficking Reports:

- South Korean customs administration statistics show that, between 1975 and 1992, South Korea imported 3,720 kg of tiger bones from Indonesia. Traders in Southeast Asia report that the amount of dried tiger bones from a single tiger ranges from 6-11 kg, which implies South Korea imported the equivalent of 338-620 tigers over the 18 year period. In fact, Indonesia accounted for 61% of the total tiger bone import (6,128 kg) for South Korea (Mills, 1993, *Cat News* No. 19).

  In the last three years alone (1991-1993), 475 kg, or about 20 tigers annually, were exported to South Korea (Mills, 1993, *Cat News* No. 19).

- Tiger bone is an important ingredient for nine South Korea companies in the manufacture of pharmaceutical products. As of 15 October 1992 the *East Asian Medical Journal*, a South Korean bi-monthly newspaper, carried a full-page price list for Chin Hyung Dried Medicine Materials Company listing tiger bone at US$ 1,600/kg (3.3 million Rp/kg) (Mills, 1993, *Cat News* No. 19).

- In Singapore the retail price for a well-tanned adult Sumatran tiger skin is about US$ 2,000 (4.1 million Rp). The retail price for a Sumatran tiger penis is US$ 100 (Martin, Chen and Lin, 1991, *International Zoo News* No. 229).

- In 1993, Traffic International reported that a number of tiger bones were exported from Indonesia to Taiwan and China. Although the amount could not be confirmed at the time of this report, it was reputed to be substantial.

Published Reports:

- In the last decade a number of newspaper reports appeared in *The Jakarta Post* concerning tigers harassing villagers and killing their cattle. In South Aceh province, North Sumatra, a tiger killed and devoured a man and dozens of cows, goats and sheep. In West Aceh province a tigress killed a teenager and dozens of cattle before it was caught by PHPA. Local *pawangs* (traditional tiger charmers) were quoted as having successfully trapped 64 live tigers over several months (*The Jakarta Post*, 1984-85).

- Since 1986 extensive poaching of tigers has been carried out along the forest edge in Gunung Leuser National Park, North Sumatra, especially in the west where the animals have been killed using poisoned baits. Estimates vary as to how many tigers have been killed in this period, but second-hand accounts from the leading poacher indicate as many as 50 tigers were killed between 1986 and 1990. Tiger numbers on the forest edge (much of which is still outside the park) have decreased and now pig numbers (that used to be controlled by tigers) have increased with subsequent loss of crops (Griffiths, this report).

- In a report on Berbak National Park, it was stated that an average of one tiger has been killed in the vicinity of the park each year for the past eight years, according to one PHPA staff member, and three tigers are known to have been poached in 1991 (Frazier, this report).

- In Kerinci, central Sumatra, several traditional methods are used to kill a guilty tiger [one that has killed livestock or humans]. Most widespread is a type of pit trap, consisting of a slowly tilting plank set over a pit. Under the plank, sharp bamboo sticks (*ranjau*) are firmly planted in the ground. When the tiger walks on the plank and gets the bait, the plank will drop and the bamboo sticks will spear the tiger in its belly. Another method involves using a snare in the form of a slipknot from bamboo. From the time firearms were introduced in the region, probably by the Dutch at the beginning of the century, local hunters have used these to kill tigers. Hunters waited with lamp and gun in trees above the remains of the animal killed by the tiger. In several cases Dutch and later Indonesian policemen were asked to kill the tiger (Bakels, this report).

  In Kerinci there is no tradition of building cages to catch tigers, as is done by the neighboring Minangkabau in West Sumatra. In some recent cases a Minangkabau tiger charmer (*pawang harimau*) was involved in Kerinci and caught a tiger in a cage. Local Kerinci inhabitants spoken to absolutely denied they would ever try to catch an innocent tiger [one with no history of attacking livestock or people] (Bakels, this report).

- A much older article reported that on 19 January 1981 a team of PHPA officials and West Sumatran police raided the home of a taxidermist in Padang Panjang, West Sumatra, who, for several years, had been preparing and mounting skins given to him by poachers. The team confiscated 29 tiger skins taken from the forests of Sumatra, including six mounts, eight processed flat skins, and 15 fresh tiger skins still being processed (*Conservation Indonesia*, 5(1), 1981).

Word-of-Mouth Reports:

- A former poacher interviewed in Padang, West Sumatra in 1992 confirmed the relative ease and speed with which tigers are ferried into Singapore. An earlier report of Sumatran tiger skins for sale in Singapore surfaced in 1988, when a British journalist was offered tiger skins and told he could be supplied with 10 pelts per month, mostly from Sumatran tigers (Earthtrust, 1993).

- In 1993, at least two tigers were reportedly killed by police in villages just outside of Kerinci Seblat National Park, central Sumatra (Anonymous, 1993).

- In 1993 a restaurant in the city of Pekanbaru, South Sumatra, offered tiger meat to a group of Chinese tourists as one of its courses (Anonymous, 1993).

- A taxidermist (and possible trafficker) interviewed in Jakarta in 1994 offered a complete Sumatran tiger skin (reputedly wild-caught from Jambi, South Sumatra) for US$ 2,500 (5 million Rp), which included an official permit from PHPA legally registering this specimen in Indonesia. The tiger skin without the permit would have only cost US$ 500 (1 million Rp). He also offered a plastic sack of tiger leg bones for US$ 250/kg (300,000 Rp) as well as claws and canine teeth from tigers for US$ 20 (40,000 Rp) each. This individual stated that most of his customers were from Thailand or South Korea (Anonymous, 1994).

Television Documentary:

- In 1988 Cinecontact Productions produced a video called "Animal Traffic: 31 Tigers". It documented the poaching of a wild tiger somewhere in Sumatra using a wire snare. The poacher reputedly had already caught 30 tigers in the past year; this program documented his 31st. An Indonesian taxidermist in the video claimed to have sold 10 tiger skins within the last year. The narrator estimated that the 9-10 tiger poachers operating at that time in Sumatra could kill up to 200 tigers per year.

REMOVAL OF PROBLEM TIGERS BY PHPA

From time to time wild tigers causing problems for local villagers (primarily by killing and eating their livestock) are captured by PHPA and transferred to Indonesian zoos. Many of these tigers constitute the genetic founders of the Indonesian Zoological Parks Association (PKBSI) Sumatran Tiger Masterplan. The current Indonesian Sumatran Tiger Studbook (1994) lists a total of 30 (18 living) reputed wild-caught tigers from Sumatra (captured from 1965-1992). These tigers, which are outside of the boundaries of the protected areas, need to be removed by PHPA; if not, more than likely they will be poisoned or killed by villagers.

ESTIMATE OF IMPACT ON WILD POPULATIONS

It is almost impossible to estimate how many tigers are being lost to poachers, how many are being killed by poison, and how many are dying naturally. Currently we only have records of tigers that have been caught by PHPA and transferred to the PKBSI for captive breeding and a few reports of tigers being killed by police or other individuals in and around villages. In summary, we attempt to estimate the magnitude of these tiger losses based upon the following logic:

- Fact: PHPA reports that about six tigers per year are legally removed from the wild; these tigers are either killed or are captured and transferred to the PKBSI Sumatran Tiger Captive Program.

- Fact: PHPA officially reports another six tigers are lost annually from the five national parks through poaching.

- Supposition: If the official PHPA registry reports are correct (and assuming these represent tigers mounted over the past 10, 20, or 30 years), this suggests that these taxidermic mounts represent either 36, 54, or 100 tigers per year were poached, depending on the time span.

- Supposition: If the South Korea imports of tiger bones from Indonesia were derived solely from wild tigers, this would account for 20 tigers being poached per year (over the last three years). This does not take into account tiger bone exports to Taiwan, Thailand or China.

- Conclusion: From these numbers, we conservatively estimate that a minimum of 42 tigers are lost annually from the wild population. This minimum number is derived from the following: 6 problem tigers that are removed by PHPA, and 36 tigers poached for taxidermic mounts.

This rate of removal takes into consideration that tiger bone exports may have been derived from the same tigers that were reported as taxidermic mounts or skins. This conservation rate of removal assumes that the taxidermic mounts were obtained at a constant rate and are applicable to the last several years. Also, it is difficult to reconcil historical rates with current rates of removal. Finally, not all of these tigers were necessarily wild-caught; some may have been derived from captive-born animals from the private sector.

However you interpret this information, one unescapable conclusion is that tigers are being lost from the wild, and that tiger products are leaving Indonesia and entering the pharmaceutical industry elsewhere in Asia. Vortex modelling (see Vortex section of this report) suggests that losses of wild tigers at the above rate will reduce even relatively large wild tiger populations, such as those in Gunung Leuser and Kerinci Seblat National Parks, to non-viable levels.■

REFERENCES

Anonymous. 1993. End of the road. *Asia Week*, 5 May 1993, pp. 35-38.

Anonymous. 1994. Personal communication.

Earthtrust. 1993. *The Market for Tiger Products on Taiwan: A Survey*. Earthtrust Report, 11 pp.

Jackson, P. 1993. The status of the tiger in 1993 threats to its future. *Cat News*, 19: 5-11.

Linden, E. 1994. Tigers on the brink. *Time*, 143(13): 44-51.

Martin, E. 1992. The trade and uses of wildlife products in Laos. *TRAFFIC Bulletin*, 13(1): 23-28.

Martin, E., Chen, L. and Lin, C. 1991. The breeding centre for Siberian tigers in China. *International Zoo News*, 38/4(229): 11-14.

Mills, J. 1993. Tiger bone trade in South Korea. *Cat News*, 19: 13-16.

Mitchell, A. 1981. PPA strikes blow against illegal trade in protected animals. *Conservation Indonesia*, 5(1): 1-2.

Nowell, K. 1993. Tiger bone in Taipei. *TRAFFIC Bulletin*, 13(3): 112-114.

Rabinowitz, A. 1993. Estimating the current abundance of the Indo-Chinese tiger in Thailand. *Biological Conservation*, 65(3): 213-217.

WWF Indonesia Programme. 1992. Sustainable use of wildlife: The key to preventing further species decline in Indonesia. *Conservation Indonesia*, 8(3): 2-4.

POPULATION BIOLOGY AND ANALYSES FOR SUMATRAN TIGERS

Ulysses Seal, Komar Soemarna and Ronald Tilson

INTRODUCTION

The tiger population on Sumatra is fragmented and isolated in 5-12 reserves and surrounding unprotected areas. Migration between some of these areas may be possible based upon the presence of forested corridors. However, no natural migration is possible among the five National Parks, so that the tiger populations in each now must function and be managed as separate genetic and demographic population units.

These small and isolated tiger populations are at risk of extinction from the interaction of random and deterministic processes (e.g., skewed sex ratio, failure to locate mates, disease, genetic drift, inbreeding depression, fighting, reduction in populations of prey animals, poaching, and poisoning). These populations and their habitat will require intensive management if the Sumatran tiger is to survive in the national parks for even 50 to 100 years.

The need for and effects of intensive management strategies can be modelled to suggest which practices may be the most effective in preserving the individual tiger populations. A stochastic population simulation modeling package, VORTEX 6.2 written by Robert Lacy and Kim Hughes was used as a tool to study the interaction of multiple variables treated stochastically to gain assist a better understanding of the effects of different management manipulations.

The VORTEX program is a Monte Carlo simulation of the effects of deterministic forces as well as stochastic demographic, environmental, and genetic events on wildlife populations. VORTEX models population dynamics as discrete, sequential events (e.g., births, deaths, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or as random variables that follow specified distributions. VORTEX simulates a natural population by stepping through the series of events that describe the typical life cycle of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters which enter into the model and because of the random processes involved in nature. Interpretation of the output depends upon knowledge of the biology of the Sumatran tiger, the conditions affecting each of the individual populations, and possible changes in the future. The output is constrained by the input. Where needed input data are not available or uncertain, data from other tiger populations or best guesses by tiger experts were provided as input. The results from the simulations can be used to suggest the most critically needed data to provide more reliable results and thus assist the design of needed research for management of the populations.

MODEL INPUT

Tiger natural history data used for the VORTEX model (Tables 1, 2, 5, 6) were taken from published studies on the *Panthera tigris tigris* in the Royal Chitwan National Park (Smith, 1992, pers. comm.), unpublished data contributed by the workshop participants (see Wiese et al., this report), information from people working in the individual Protected Areas, and information from the studbooks for captive tiger populations.

Carrying Capacity: Carrying capacity or K defines an upper limit for the population size, above which additional mortality is imposed in order to return the population to K. In other words, VORTEX uses K to impose a ceiling model of density-dependence on survival rates.

Habitat size and prey availability (density) are indicators of carrying capacity of the respective Parks and surrounding areas. Estimates of possible and probable tiger population numbers (animals 1 year and older) in the respective protected areas ranged from 25 to 150 animals. There are areas with fewer than 25 tigers but it is unlikely that any of the protected areas will sustain more than 150 animals. Therefore, 4 carrying capacities of 25, 50, 100, and 150 tigers to encompass this range were included in the sets of scenarios simulated (Table 4).

We did not include any trends in carrying capacity over time since the range was encompassed by the K values used. We also did not include any annual variation in K since this is unknown for these areas and such changes tend to have minimal effects on large carnivore populations (as opposed to sustained changes).

Age First Reproduction: VORTEX defines breeding as the time when young are born, not the age of sexual maturity. VORTEX also assumes discrete intervals of years in the case of tigers. For tigers on average the age of first reproduction in wild populations appears to be 3 years for females and 4 years for males although younger animals in captivity can breed. These values were used in all of the simulation scenarios. The breeding structure was assumed to be polygynous.

Litter Size: Environmental variation in reproduction is modelled by entering a standard deviation (SD) for the percent of females producing litters each year (Tables 5, 6). VORTEX then determines the percent breeding each year of the simulation by sampling from a binomial distribution with the specified mean (e.g., 50%) and SD (e.g., 12.5%). Thus about 66% of the time, the percent of females breeding will fall within ± 1 SD of the mean; about 95% of the time it will fall within ± 2 SD of the mean. The relative proportions of litters of each size (1, 2, 3, etc.) are kept constant; what is varied from year to year is the percent breeding (litter size > 0) and the percent not breeding (litter size = 0).

The maximum litter size observed in wild tigers is 5 cubs (also litters with more than 5 cubs comprise less than 2% of captive litters). Most information on wild tiger litter sizes is based upon observation of cubs 3-6 months of age and thus does not represent birth litter sizes. Data on *P. t. tigris* indicate mean litter sizes of 3 at this age. Limited field observations in Sumatra indicate a mean of 2 cubs at about 6 months of age. We therefore made litter size one of the variables included in all of the systematic comparisons using mean litter sizes of 2 or 3 (Table 2, Table 4, column headed 'Lit # Mean'). The distributions of litter sizes for the respective means were set as follows:

Table 1. Distributions of litter sizes used in the scenarios to achieve a mean litter size of either 2 or 3 with 50 % of females producing no litter each year.

Mean litter# =	2	3
Size 0=	50%	50%
Size 1=	10	0
Size 2=	30	12
Size 3=	8	29
Size 4=	2	8
Size 5=	0	1

The proportion of females breeding each year determines the mean interbirth interval. This interval is reported to be 2 years in wild tigers so that 50% of adult females, on average do not produce litters each year. A modest amount of annual variation was included using a standard deviation of 12.5%. The sex ratio at birth is taken as equal (0.50 proportion of males) based upon observations of more than 500 litters in captive populations.

Males Breeding: The breeding system modeled by VORTEX assumes that mates are randomly reshuffled each year and that all animals that can breed have an equal probability of breeding. A proportion of the males - 50% - were excluded from the breeding pool in a given year in the base scenarios to reflect the fact that some males are excluded from breeding by the social structure.

Two conditions for males were modelled. The one used for most scenarios, allowed only 50% of the adult males to be in the breeding pool. Because of concerns that for small populations the number of males might be limiting reproduction by females and thus increase the probability of extinction, if the adult male population dropped to one animal, we also did a set of simulations for K=25 with all adult males in the breeding pool (compare files A18-A25, A54-A57 with similar numbered files without the 'A' prefix in Table 4). This set of simulations also allowed estimation of the impact of this restriction on males breeding on the rate of loss of genetic heterozygosity in the small population.

Age of Senescence: VORTEX assumes that animals can breed (at the species typical rates) throughout their adult lifespans. The maximum life expectancy is not used if the species does not reproduce throughout its entire life. This age was estimated as 15 years for wild tigers based upon several known age animals in Nepal and this value was used in all of the scenarios. Reproduction in captive female tigers appears to decline after 12 years of age.

Mortalities: Mortality as a percent (between 0.0 and 100.0) may be entered for each age class of immature females and males. Once reproductive age (adult) is reached, the annual probability of mortality remains constant over the life of the animal in these models and is entered only once. The mortality schedule used in all of the scenarios for the Sumatran tigers is drawn from the data on *P. t. tigris* in Nepal.

Table 2. Mortality schedule for females and males of immature and adult age classes, with standard deviations calculated from the field data with values as %).

Age	Females	Males
0 - 1	35 ± 16%	35 ± 16%
1 - 2	15 ± 10	15 ± 10
2 - 3	40 ± 15	30 ± 11
3 - 4		30 ± 15
Adults	10 ± 5	20 ± 8

Inbreeding: A population with the level of inbreeding depression of one lethal equivalent per diploid genome may have one recessive lethal allele per individual (as in the Recessive Lethals model in VORTEX); or it may have two recessive alleles per individual, each of which confers a 50% decrease in survival; or it may have some combination of recessive deleterious alleles which equate with one fully lethal allele per individual. Natural selection does not remove deleterious alleles at heterotic (or overdominant) loci (because all alleles in this model are partly deleterious when homozygous), thus the effects of inbreeding are unchanged during repeated generations of inbreeding. The default number of lethal equivalents for the Heterosis model is 3.14 which is a median value obtained in a study of 40 mammalian species (Ralls et al. 1988).

Inbreeding depression has been observed in inbred lines of captive Siberian tigers (*P. t. altaica*). Negative impacts of inbreeding on reproductive parameters has been documented for cheetahs, Asian lions, and Florida panthers (Roelke and O'Brien, 1993). To include this potential threat in these models the Heterosis model in VORTEX was used in which we entered the number of "lethal equivalents" as 3.14. The inclusion of inbreeding was varied systematically in the scenarios developed for the Sumatran tiger populations, Table 4, so that comparisons were made under identical conditions with this factor present or absent.

Threats: Major potential threats for the wild populations of Sumatran tigers include continued loss of habitat, increasing fragmentation of remaining habitat, reduction of prey species density, removal of tigers for control purposes, and poaching for bone and skin or other products. Wild tiger populations, perhaps because of their relative isolation and thin distribution, are not known to have been affected by epidemic disease.

The impact of habitat loss has been modelled by using different carrying capacities as a guide to the changing risk of extinction with decreasing population size. Removals, on a continuing basis were modelled by using the harvest module of VORTEX with either 0, 2 or 4 adult tigers, split evenly between the sexes, removed per year. This in effect is a systematic increase in annual adult mortality. Scenarios that included losses modelled as less frequent events (catastrophes) did not include these systematic harvests or removals.

Catastrophes: Catastrophes can be thought of as the extreme of environmental variation. Catastrophes are events that impact either reproduction or survival. Catastrophes can be habitat destruction, floods, fire, disease, poaching, etc. Catastrophes do happen and are very real considerations when attempting to model the fate of small populations. We define the impact of these catastrophes in terms of effects on reproduction and survival. A catastrophe may have occurred when a mortality rate is noted that is statistically higher than the normal variation. The reproduction and survival rates for catastrophe years are obtained by multiplying the (non-catastrophe) probability of reproduction or surviving by a severity factor. The severity factor ranges from 0.0 to 1.0. Entering 0.0 indicates a total loss of reproduction or survival for the population and 1.0 indicates that the catastrophe, if it occurs, will have no effect.

Catastrophes in wild tiger populations might include large scale fires (which they might escape but suffer the consequences of reduction in the prey base), abrupt forest removal, unusual declines in the prey population, and poaching for bone and skin or other products. Since poaching events tend to be more episodic, occurring at uncertain intervals we modelled separately the impact of events occurring on the average either at 5 (20% probability) or 10 (10% probability) year intervals. The event, in both cases, was given a severity effect of 0.90 on survival (about 10% additional loss of animals to the population, i.e. 2-3 animals in a population of 25-30 animals) and no effect on reproduction of the remaining animals. This may underestimate the negative effects on reproduction of the potential social disruption that may occur.

Table 3. SUMATRAN TIGER - DEMOGRAPHY

File	Lit # Mean	Catas	Inb H	Results							
				Population Growth			100 Years				Te
				Deter r	Stochastic r	SD	Pe	N	SD	He	
K=25, N=25, 50% Males Breeding, Inbreed=H & 3.14 LE											
018	3	N	N	.086	.054	.262	.404	20	6	.298	53
019	3	N	H	.086	-.006	.260	.944	11	6	.310	54
022	3	10%	N	.076	.042	.269	.494	19	6	.283	50
023	3	10%	H	.076	-.014	.267	.964	10	6	.299	48
020	2	N	N	.031	-.004	.252	.754	17	7	.298	45
021	2	N	H	.031	-.038	.252	.998	3		.278	42
024	2	10%	N	.021	-.016	.260	.840	16	7	.261	44
025	2	10%	H	.021	-.049	.264	1.00	-	-	-	35
K=50, N=25, 50% Males Breeding, Inbreed=H & 3.14 LE											
010	3	N	N	.086	.071	.209	.042	44	9	.541	42
011	3	N	H	.086	.019	.211	.324	26	14	.561	71
014	3	10%	N	.076	.058	.216	.058	41	28	.534	49
015	3	10%	H	.076	.002	.224	.546	21	14	.526	68
012	2	N	N	.031	.011	.209	.344	34	13	.514	54
013	2	N	H	.031	-.030	.224	.914	13	9	.551	59
016	2	10%	N	.021	-.002	.226	.514	31	14	.480	49
017	2	10%	H	.021	-.043	.241	.976	12	8	.564	50
K=100, N=75, 50% Males Breeding, Inbreed=H & 3.14 LE											
034	3	N	N	.086	.076	.184	.004	90	13	.779	34
035	3	N	H	.086	.051	.178	0	82	20	.775	-
038	3	10%	N	.076	.064	.191	0	89	16	.740	-
039	3	10%	H	.076	.035	.186	.02	65	26	.746	57
036	2	N	N	.031	.022	.172	.02	71	25	.744	72
037	2	N	H	.031	-.005	.184	.30	42	29	.722	79
040	2	10%	N	.021	.006	.188	.160	59	29	.676	53

041	2	10%	H	.021	-.029	.207	.70	28	24	.670	66
K=150, N=75, 50% Males Breeding, Inbreed=H & 3.14 LE											
026	3	N	N	.086	.076	.177	0	140	16	.830	-
027	3	N	H	.086	.058	.174	.002	129	24	.838	39
030	3	10%	N	.076	.065	.181	0	134	21	.825	-
031	3	10%	H	.076	.044	.176	.020	117	33	.828	70
028	2	N	N	.031	.021	.167	.028	110	35	.803	61
029	2	N	H	.031	-.000	.172	.182	69	43	.784	75
032	2	10%	N	.021	.009	.182	.110	100	41	.754	63
033	2	10%	H	.021	-.020	.191	.460	46	36	.744	72
K=25, N=25, Catas=20%, 0.9 Survival Severity											
054	3	20%	N	.065	.026	.277	.632	18	7	.270	50
055	3		H	.065	-.024	.278	.992	9	10	.398	44
056	2		N	.011	-.031	.271	.928	15	7	.341	41
057	2		H	.011	-.056	.271	1.00	-	-	-	33
K=50, N=25, Catas=20%, 0.9 Survival Severity											
046	3	20%	N	.065	.045	.224	.150	41	11	.522	51
047	3		H	.065	-.008	.235	.712	21	13	.523	65
048	2		N	.011	-.017	.237	.708	28	14	.496	49
049	2		H	.011	-.051	.247	.992	9	5	.399	45
K=100, N=75, Catas=20%, 0.9 Survival Severity											
070	3	20%	N	.065	.054	.193	.004	86	17	.723	86
071	3		H	.065	.021	.194	.118	58	28	.720	74
072	2		N	.011	-.010	.209	.418	55	29	.638	57
073	2		H	.011	-.040	.219	.838	17	13	.620	60
K=150, N=75, Catas=20%, 0.9 Survival Severity											
062	3	20%	N	.065	.055	.184	.004	131	23	.816	73
063	3		H	.065	.034	.180	.014	110	36	.808	78
064	2		N	.011	-.005	.191	.208	70	42	.713	65
065	2		H	.011	-.030	.203	.624	37	34	.713	69

All Males in Breeding Pool, K=25, N=25, H=3.14											
A18	3	N	N	.086	.053	.261	.388	20	6	.335	52
A19	3		H	.086	-.003	.259	.898	10	5	.391	56
A20	2		N	.031	-.000	.250	.732	16	7	.346	48
A21	2		H	.031	-.038	.253	.996	7	4	.445	42
A22	3	10%	N	.076	.043	.267	.494	19	6	.325	54
A23	3		H	.076	-.013	.268	.968	11	7	.349	50
A24	2		N	.021	-.017	.264	.878	15	7	.331	43
A25	2		H	.021	-.048	.261	1.00	-	-	-	38
All Males in Breeding Pool, K=25, N=25, H=3.14											
A54	3	20%	N	.065	.026	.277	.610	18	6	.316	51
A55	3		H	.065	-.025	.282	.994	11	11	.229	44
A56	2		N	.011	-.031	.275	.932	14	8	.336	40
A57	2		H	.011	-.059	.270	1.00	-	-	-	32

Age Distribution: We initialized all of the models with a stable age distribution which distributes the total population among the various age classes. The initial population sizes used were 25 for K=25 or 50 and 75 for K=100 or 150. VORTEX automatically enters values for all age classes, proportionate to the stable age distribution.

Base Models: Two basic models were constructed from the available life history data using mean litter sizes of either two or three cubs (column 2 in Table 3) with all other variables the same. The other parameters systematically varied were carrying capacity (25, 50, 100, 150), inbreeding depression (column 4 - present or absent using a heterosis model with 3.14 lethal equivalents), and catastrophes (column 3 - absent, or present with a frequency of 10 or 20% and a survival severity factor of 0.9).

The two basic models do not include effects of annual harvests, inbreeding depression, catastrophes, or further habitat degradation. The effects of these additional factors were systematically added to the basic models to evaluate their impact on the risk of extinction and population dynamics. These factors generally increase the probability of extinction, decrease surviving population sizes, and decrease the amount of genetic variation remaining in the simulated population.

RESULTS OF SIMULATION MODELLING

The simulation scenarios were run 500 times (iterations) with projections for 100 years. Output results are summarized at 10 year intervals in the reports for the individual scenarios and were the source of the data for the time series figures. Each individual scenario is identified with a file number in column 1 of the Table. The simulations were run using VORTEX version 6.2 dated 8 January 1994. This software and manual are available from the IUCN/SSC CBSG Office (12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, USA).

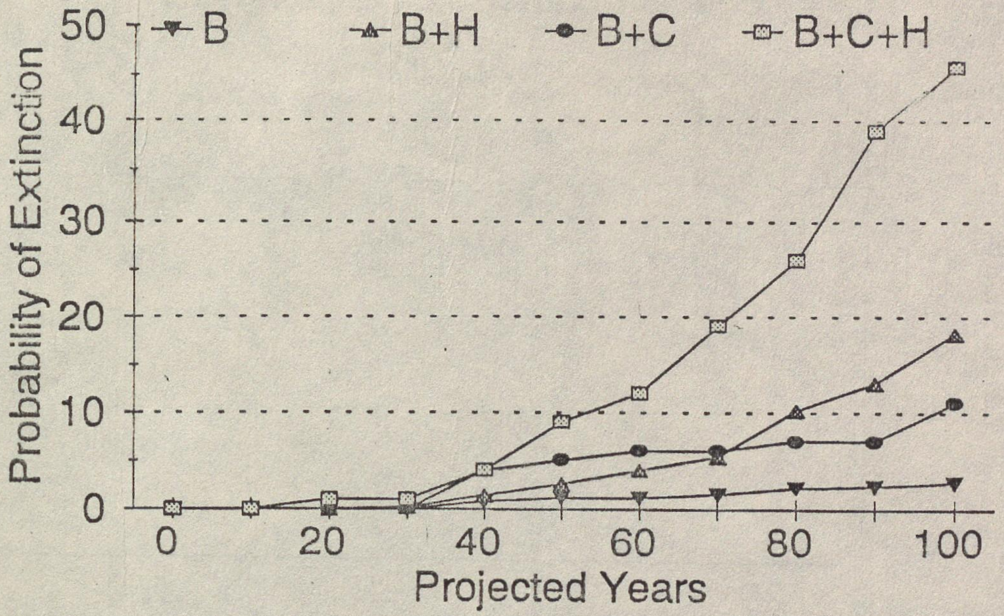
Deterministic Results

Growth rate - r: The deterministic growth rate (intrinsic rate of increase) calculated by a Leslie matrix algorithm is recorded in the 5th column in Table 3. Positive values are necessary for a population to survive and in principle a zero value would characterize a stable population which is neither growing or declining. Note in Table 3 that the deterministic growth rate is not sensitive to differences in carrying capacity or to the presence of inbreeding, or to the presence of environmental variance included as standard deviations in mortality and reproduction. The addition of a catastrophe does reduce the deterministic r since it is averaged into the calculations of the Leslie matrix.

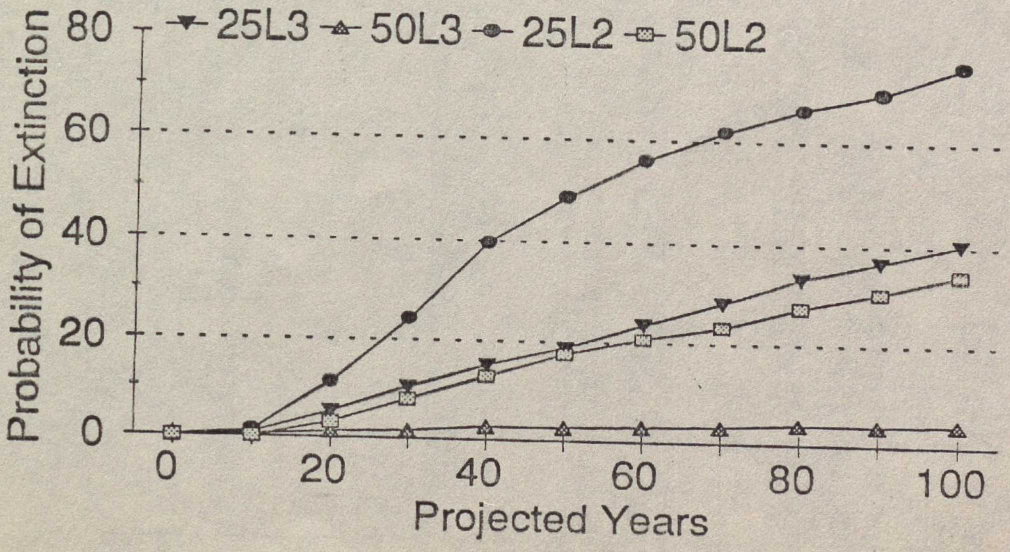
Other Deterministic Values: The generation times in most of the scenarios were about 7 years for females and 6.8 years for males (Tables 4 & 6). Thus a 100 year projection spans about 14 generations. The sex ratio of adult males to females in a stable population was calculated at 0.522. This value of about 1 adult male per 2 females reflects the combined effects of a one later age of first reproduction for males and the higher adult male mortality rate. Lambda is calculated from r and can be used for the % annual growth rate (i.e.: [lambda - 1.000] x 100 = annual % growth rate). A stable age distribution for each sex and age class is also presented. This will be the same regardless of K or H if the mortality and reproduction rates values are the same. These calculated age distributions are useful estimates for comparison with collected field data on population age structure as a check on the status of the population, on census methods or for detection of unusual events in the population.

SUMATRAN TIGERS PHVA

Interactions of L=2, K=150, H, & C10

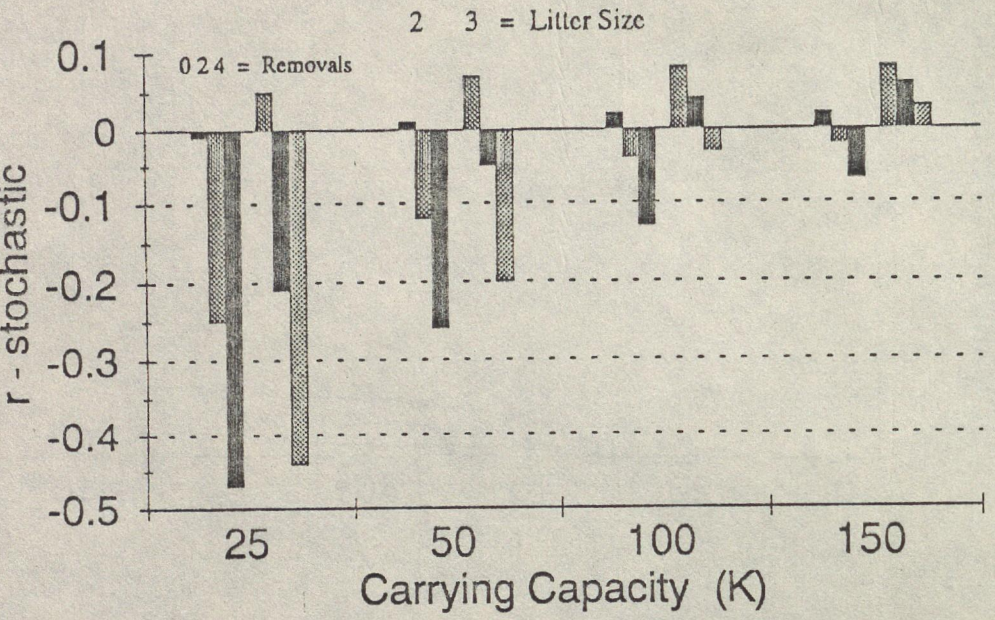


Effect of Litter Size and K



SUMATRAN TIGER DEMOGRAPHY

Effects of Litter Size & Removals



Effects of Litter Size & Removals

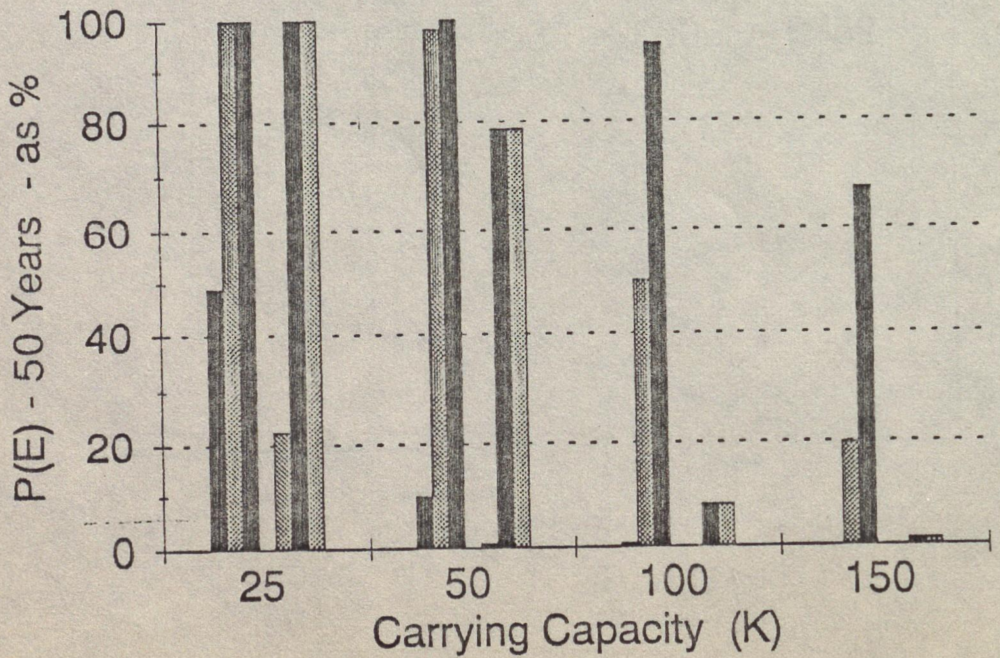


Table 4. For the Sumatran tiger in the base scenarios (files 18, 10, 34, and 26) with a mean litter size of 3 and with K=25, 50, 100, 150 but without the inclusion of inbreeding or catastrophes the deterministic values calculated for each scenario are the same.

Deterministic population growth rate (based on females, with assumptions of no limitation of mates, no density dependence, and no inbreeding depression):

r = 0.086 lambda = 1.089 R0 = 1.830

Generation time for: females = 7.05 males = 6.77

Stable age distribution:

Age Class	Females	Males
0	0.154	0.154
1	0.092	0.092
2	0.072	0.072
3	0.040	0.046
4	0.033	0.030
5	0.027	0.022
6	0.022	0.016
7	0.018	0.012
8	0.015	0.009
9	0.013	0.006
10	0.010	0.005
11	0.009	0.003
12	0.007	0.003
13	0.006	0.002
14	0.005	0.001
15	0.004	0.001

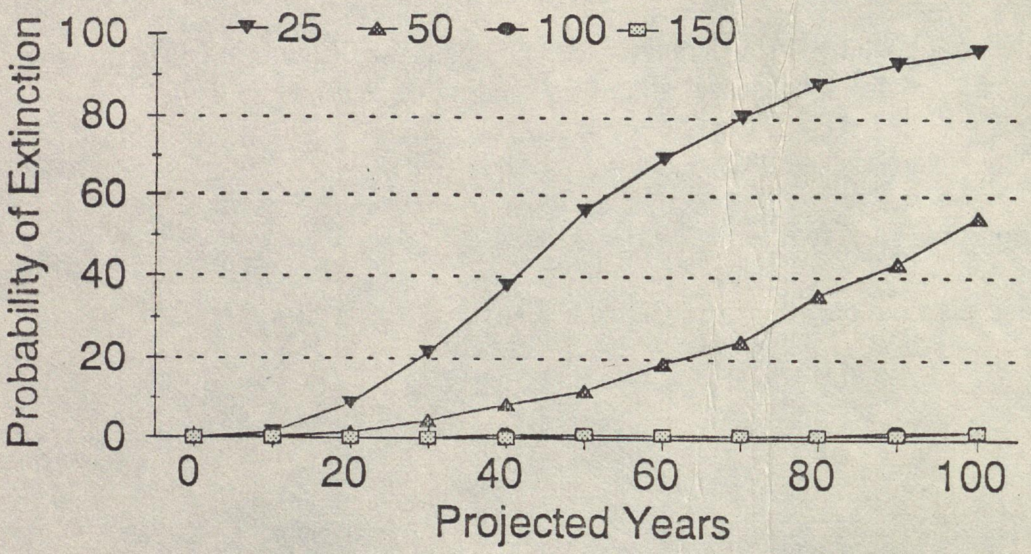
Ratio of adult (>= 4) males to adult (>= 3) females: 0.522

Stochastic Simulation Results

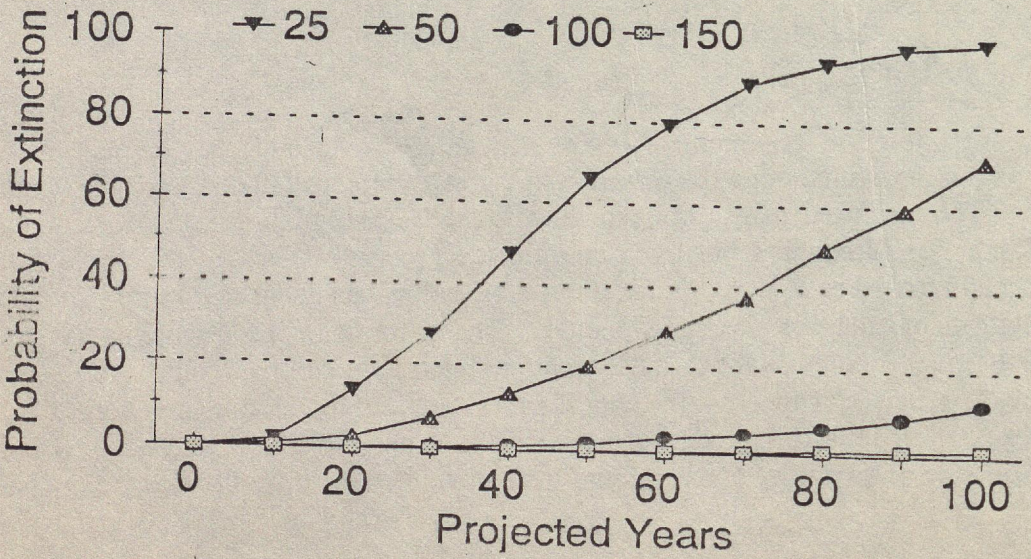
Litter Size: It is possible for a population to have a negative stochastic growth rate and a significant risk of extinction even though the deterministic growth rate, calculated from the Leslie matrix, is positive. This occurred many times in these stochastic simulation scenarios for the Sumatran tiger (Table 3). Although a positive deterministic growth rate (r) for the population was obtained for mean litter sizes of two or three cubs, the r value was decreased more than half in the scenarios with a mean litter size of two cubs. These comparisons might lead to the interpretation that if given enough habitat the Sumatran tiger populations should be able to rebound and grow to carrying capacity, if other factors leading to decline are controlled. However this interpretation fails to include normal environmental variability and the possible effects of population size, inbreeding, or occasional catastrophes, which are difficult to control in wild populations.

SUMATRAN TIGERS PHVA

Effect of K & Catastrophe F=10%

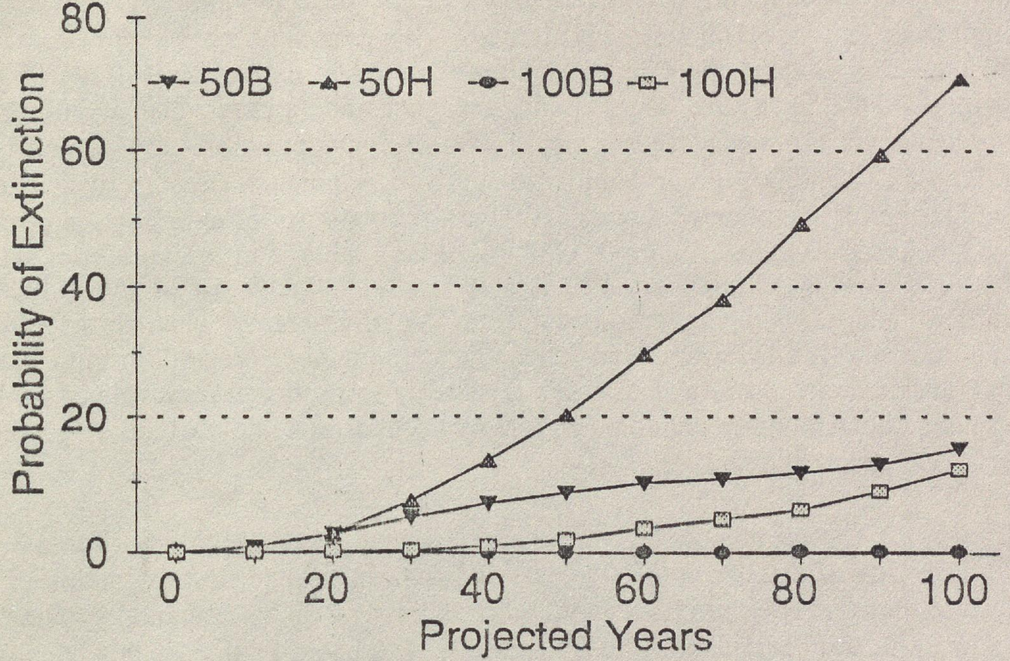


Effect of K & Catastrophe F=20%

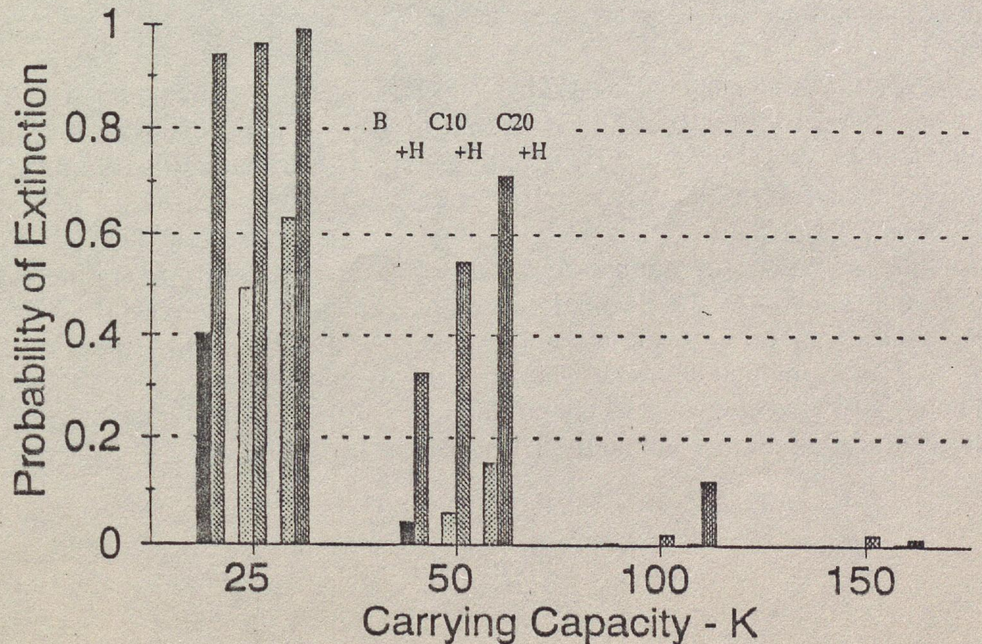


SUMATRAN TIGERS PHVA

Interaction of K=50 or 100, H, & C=20%



Interactions of K, H, & C



The viability of populations with mean litter sizes of 2, in these simulations, is not encouraging for population sizes less than 100 animals (Figures 1 - 4), even in the absence of removal losses and with no inbreeding depression effects. The probability of extinction (Pe) at 100 years was 75% for K=25 and 34% for K=50. The viability at higher population levels (K=100 or 150) was sustained only if there are no inbreeding depression or catastrophe effects - which is unlikely (Figures 1 & 4). The 100 year probability of extinction quickly rises from 2% to 16-46% depending upon the combination of threats. This high probability of extinction is a refection of the negative stochastic r values (Figure 3) which will inevitably lead to extinction. Thus it will be important to determine if a litter size of 2 is a persistent characteristic of any of the Sumatran tiger populations and to evaluate reasons for these small litters or whether they have better survival than comparable aged animals in other tiger populations. The addition of catastrophes or inbreeding accelerates the risk of extinction (Figure 1). Additional removals of adult animals further increases the risk of extinction (Figure 4) and assures the extinction of the smaller populations in less than 50 years.

Carrying Capacity: The base population with K=25 and no threats included (Table 3, file 018) has a 40% probability of extinction in 100 years and a mean time to first extinction of 53 years. This is despite positive deterministic and stochastic growth rate values. The surviving populations range in size from about 8 to 25 animals. A notable feature of this base scenario is the large 70% loss of genetic heterozygosity in the 14 generations. This amounts to a loss of about 5 per cent per generation. This rate of loss is about 10-fold greater than the suggested maximum rate of 0.5% per generation to minimize potential adverse effects of inbreeding. A similar 5% rate of loss in Florida panthers resulted in evidence for severe inbreeding depression in the wild population.

Increase in the carrying capacity to 50 produced a 10-fold reduction in Pe to 4.2% (Table 3). Another doubling of K to 100 yielded another 10-fold reduction in Pe to 0.4% (Figures 7 & 12). Surviving population sizes at 100 years in scenarios with K=50 or greater were near K.

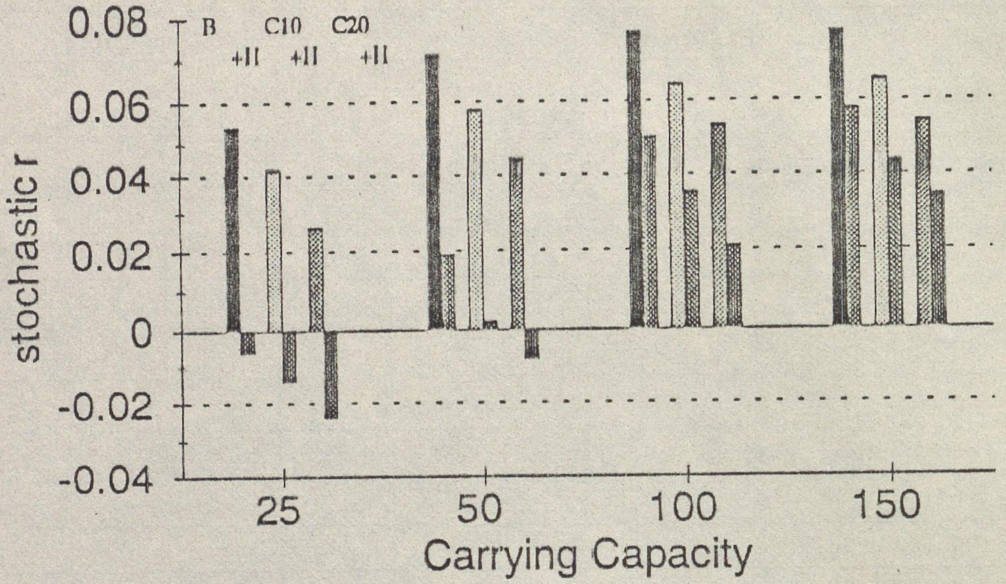
Catastrophes: Catastrophe frequencies of 10% and 20% were tested (Figures 5 & 6 & 9 & 10). The severity of 0.9 on survival is similar to a loss of 10% of the population on the average of once in either 5 or 10 years. Populations of 100 or greater were able to sustain this rate of loss with populations near carrying capacity at 100 years.

A similar picture emerged for annual removals of 2 or 4 animals from the different size populations (Figures 3 & 4). This would be comparable to the removal of 10 or 20 animals every 5 years and 20 or 40 animals every 10 years. At the longer time interval between the removals in the larger populations there is an opportunity for replacement and even breeding by the replaced animals between events to restore the population to carrying capacity. The removal of an absolute number of animals annually has, as expected, a much greater effect on the smaller populations.

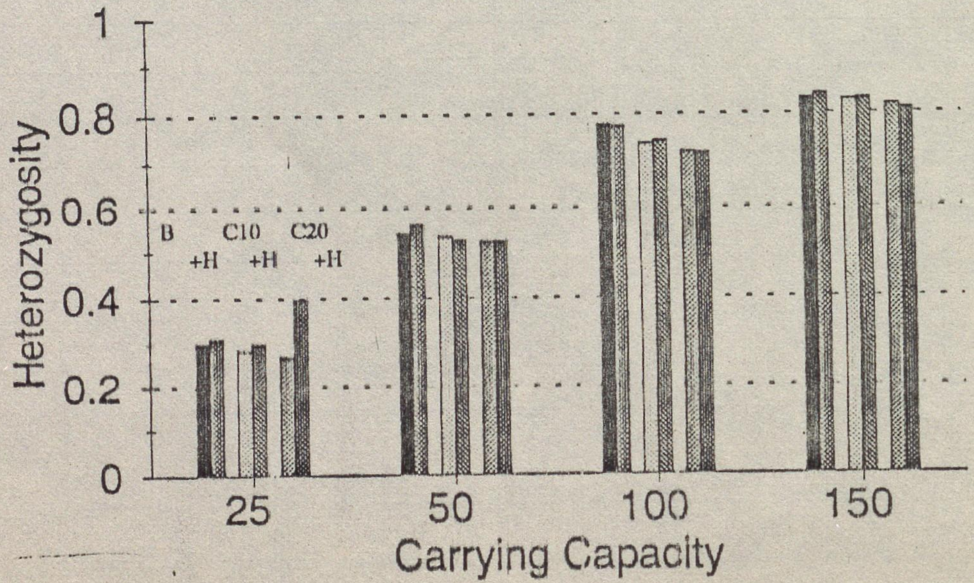
Table 5. SUMATRAN TIGER - DEMOGRAPHY - EFFECTS OF REMOVALS											
File				Results							
	Lit # Mean	K	Rem ova ls	Population Growth			100 Years				Te Yrs
				Deter r	Stochastic r	SD	Pe	N	SD	He	
No Harvests, No Catastrophe, No Inbreeding											
018	3	25	0	.086	.05	.27	.404	20	6	.298	53
020	2	25	0	.031	-.01	.26	.754	17	7	.298	45
010	3	50	0	.086	.07	.21	.042	44	9	.541	42
012	2	50	0	.031	.01	.21	.344	34	13	.514	54
034	3	100	0	.086	.08	.19	.004	90	13	.779	34
036	2	100	0	.031	.02	.17	.020	71	25	.744	72
026	3	150	0	.086	.08	.18	0	140	16	.830	-
028	2	150	0	.031	.02	.17	.028	110	35	.803	61
2 Adults Removed, No Catastrophe, No Inbreed											
	3	25	2	.086	-.21	.39	1	0			
	2	25	2	.031	-.25	.36	1	0			
	3	50	2	.086	-.05	.30	.974	29	12	.597	
	2	50	2	.031	-.12	.29	1	0			
	3	100	2	.086	.04	.20	.204	82	21	.769	
	2	100	2	.031	-.04	.23	.865	54	28	.754	
	3	150	2	.086	.06	.18	.026	133	23	.851	
	2	150	2	.031	-.02	.20	.585	85	43	.842	
4 Adults Removed, No Catastrophe, No Inbreed											
	3	25	4	.086	-.44	.47	1	0			
	2	25	4	.031	-.47	.45	1	0			
	3	50	4	.086	-.20	.38	1	0			
	2	50	4	.031	-.26	.38	1	0			
	3	100	4	.086	-.03	.27	.872	69	27	.747	
	2	100	4	.031	-.13	.30	1	0			
	3	150	4	.086	-.03	.21	.296	122	33	.816	
	2	150	4	.031	-.07	.26	.957	88	45	.827	

SUMATRAN TIGER

Interactions of H, C, & K

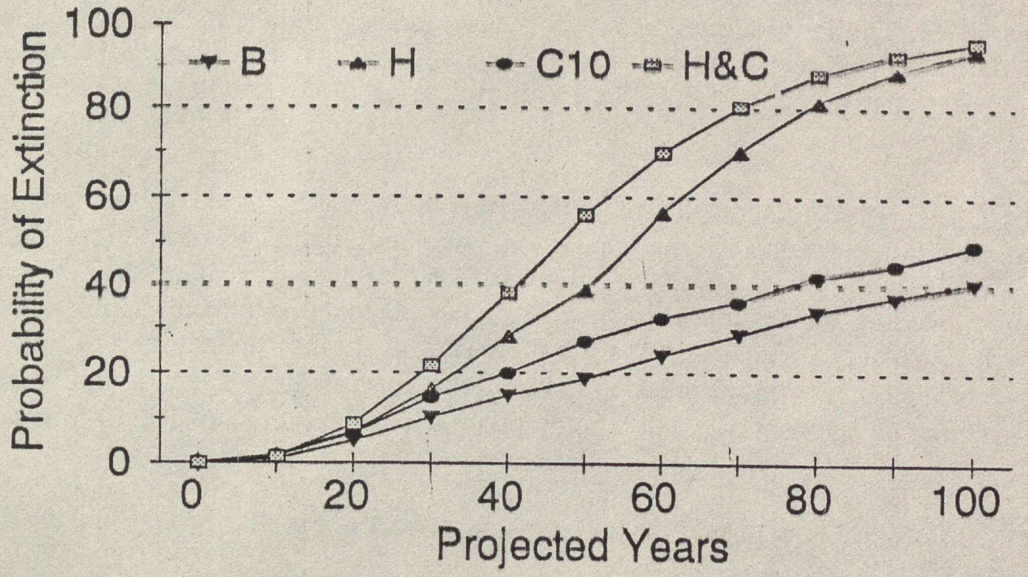


Interactions of K, H, & C

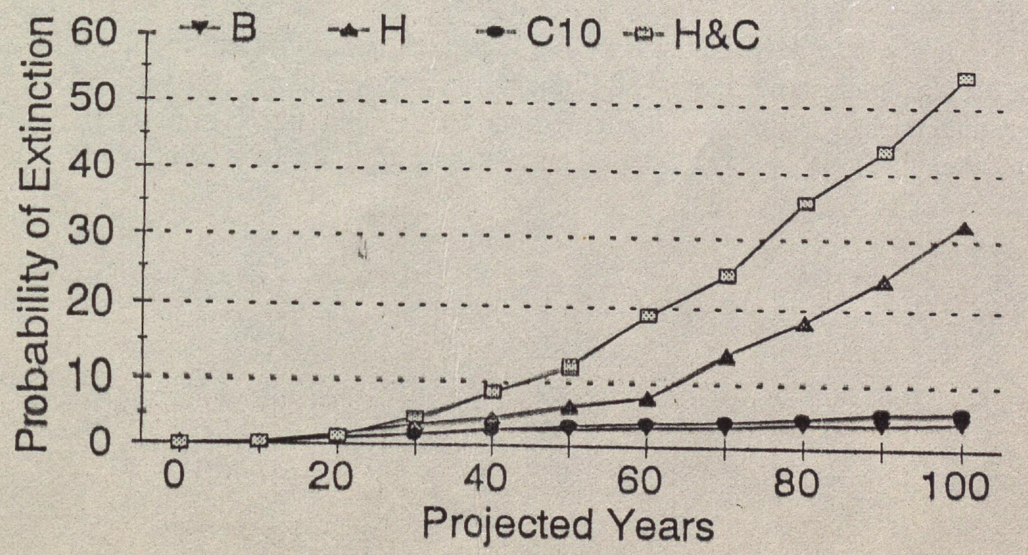


SUMATRAN TIGERS PHVA

Interaction of K=25, H, & C=10%



Interaction of K=50, H, & C=10%



Proportion Males in Breeding Pool: An increase of the proportion of males in the breeding pool from 50 to 100% in populations with K=25 had no effect on the deterministic or the stochastic r values (Table 3). The Pe was consistently but very modestly reduced in the populations with a mean litter size of 3. The loss of genetic heterozygosity was also reduced but the rate was still greater than 4% per generation. Thus the basic picture of the extinction risk faced by small populations was not altered.

Inbreeding Depression: Another significant effect of K or population size was seen on proportion of initial heterozygosity retained in the population. At population sizes of 100 and 150 the rate of decline was about 1% per generation whereas at K=50 the loss was about 3% per generation. Addition of inbreeding depression accelerated by 2 to 10-fold the rate of population loss for populations at K=25 or 50. These effects were more significant than the addition of a catastrophe at 10% frequency. If inbreeding depression is significant for Sumatran tigers, it will be necessary to include genetic management in possible interventions for populations of 100 or fewer animals.

CONSERVATION MANAGEMENT RECOMMENDATIONS

1. The highest priority for the conservation management of wild Sumatran tigers is to secure and protect tiger populations (and their habitat) of 100 animals or more.

2. A second priority is to develop conservation management goals and intervention strategies for each of the remaining wild Sumatran tiger populations. This may include demographic and genetic support for populations of less than 100 animals. Special consideration needs to be given to periodic genetic supplementation to populations of 50 or fewer animals.

3. A third priority is to control animal removals, either officially or illegally, from individual populations for whatever purpose such that less than 10% of the population is lost in any five-year period.

4. A fourth priority is to initiate necessary field research and long-term monitoring to establish the critical life history parameters of wild Sumatran tiger populations. Of particular significance is to determine mean litter size. Evaluation of wild-caught tigers brought into the captive population through official removals should be evaluated for indicators of inbreeding depression.

SUMMARY AND INTERPRETATION OF SIMULATION RESULTS FOR EACH PROTECTED AREA

Definitions

Estimated population sizes are for animals 1 year and older. About half this number will be breeding age adults. The estimate of removed tigers includes animals lost to poaching as well as problem animals removed. The estimates of extinction risk are for 100 years with 50 year estimates included in Table 5. In all instances the probability of extinction is high with removals if the mean litter size is 2 cubs. The risk estimates quoted are for litter sizes of 3 with no inbreeding depression but with either 0% (Table 5) or a 10% (Table 3) probability of a catastrophe event which reduces survival by 10% in the year of occurrence. We believe that these are conservative estimates because the risks would be greater if inbreeding depression is included in these small population simulation scenarios.

Gunung Leuser National Park

Total area (ha):	≈900,000
Available habitat:	40% (360,000 ha)
Estimated population size:	110 tigers (2000 ha per tiger)
Number tigers removed per year:	2-4

Comments: Risk of extinction is 20% (100 years) given two tigers removed per year (Te mean = 59 years; 80% H_e retained); probability of extinction rises to 87% with four tigers removed per year (Te mean = 45 years; 75% H_e retained).

Kerinci-Seblat National Park

Total area (ha):	≈1,500,000
Available habitat:	40% (600,000 ha)
Estimated population size:	76 tigers (7,895 ha per tiger)
Number tigers removed per year:	6

Comments: Even if the tiger population is assumed to be one population (no fragmentation, which is unlikely), there is essentially a 100% probability of extinction within 50 years (mean=17 years to extinction). Poaching/removal has an overwhelming effect on the survival of the population.

Barisan Selatan National Park

Total area (ha):	≈356,800
Available habitat:	79% (281,872 ha)
Estimated population size:	68 tigers (4,145 ha per tiger)
Number tigers removed per year:	1

Comments: This population, with only one tiger removed per year, has less than 1% probability of extinction in 100 years, with 84% H_e retained. However, this simulation did not include catastrophes or inbreeding effects, which may increase the Pe to 10% in 100 years in this size population.

Berbak National Park

Total area (ha):	≈162,700
Available habitat:	70% (113,890 ha)
Estimated population size:	50 tigers (2,278 ha per tiger)
Number tigers removed per year:	2

Comments: Highly likely to go extinct (Pe = 97%) within 100 years (mean=31 years to extinction). Although the estimated population is smaller than that for Kerinci, the Berbak population does slightly better in the simulations because of the lower estimated level of removed/poached individuals. If the model starts with an initial population of 150 tigers (50 adults in park, 50 adults in the proposed surrounding HL area, 50 immatures), then there would be a 1% probability of extinction, with 85% H_e retained.

Way Kambas National Park

Total area (ha):	≈130,000
Available habitat:	75% (97,500 ha)
Estimated population size:	20 tigers (4,875 ha per tiger)
No. tigers removed per year:	0

Comments: Probability of extinction is 40-70% (depending upon mean litter size) within 100 years (mean=48 years to extinction). Even though no animals are being removed from the population, random events in small populations greatly increase the risk of extinction. Inclusion of inbreeding effects in the simulation model increases the risk of extinction to 94+% or the inclusion of a catastrophe at 10 % probability of occurrence increases the PE to 49%. Both factors are real risks. If the model starts with 40 tigers (additional adults plus some cubs), then there is only 2% probability of extinction, but the population becomes very inbred (only 50% H_e retained). By adding one female to the population every year, the probability of survival remains the same, but the population retains much more heterozygosity, 88% H_e .

Kerumutan Game Reserve

Total area (ha):	≈120,000
Available habitat:	65% (78,000 ha)
Estimated population size:	30 tigers (2,600 ha per tiger)
Number tigers removed per year:	2

Comments: 100% probability of extinction in 50 years with a mean time to first extinction = 15 years.

Rimbang Game Reserve

Total area (ha):	≈136,000
Available habitat:	90% (122,400 ha)
Estimated population size:	42 tigers (2,914 ha per tiger)
No. tigers removed per year:	2

Comments: There is a projected 100% probability of extinction (Te = 25 years). The populations at Kerumutan and Rumbang Game Reserves are very vulnerable to poaching effects (without poaching, results should be similar to Way Kambas with initial population size of 40); therefore, it is important to control poaching.■

Table 6. Input file for a base scenario with an average litter size of 3, K=50, starting population size of 25, no catastrophes, and no inbreeding.

TIGER.010	***Output Filename***
N	***Graphing Files?***
500	***Simulations***
100	***Years***
10	***Reporting Interval***
1	***Populations***
N	***Inbreeding Depression?***
N	***EV correlation?***
2	***Types Of Catastrophes***
P	***Monogamous Or Polygynous***
3	***Female Breeding Age***
4	***Male Breeding Age***
15	***Maximum Age***
0.500000	***Sex Ratio***
5	***Maximum Litter Size***
N	***Density Dependent Breeding?***
50.000000	***Population 1: Percent Litter Size 0***
0.000000	***Population 1: Percent Litter Size 1***
12.000000	***Population 1: Percent Litter Size 2***
29.000000	***Population 1: Percent Litter Size 3***
8.000000	***Population 1: Percent Litter Size 4***
1.000000	***Population 1: Percent Litter Size 5***
12.500000	***EV--Reproduction***
35.000000	***Female Mortality At Age 0***
15.083103	***EV--FemaleMortality***
15.000000	***Female Mortality At Age 1***
10.000000	***EV--FemaleMortality***
40.000000	***Female Mortality At Age 2***
14.770979	***EV--FemaleMortality***
10.000000	***Adult Female Mortality***
5.000000	***EV--AdultFemaleMortality***
35.000000	***Male Mortality At Age 0***
15.083103	***EV--MaleMortality***
15.000000	***Male Mortality At Age 1***
10.000000	***EV--MaleMortality***
30.000000	***Male Mortality At Age 2***
11.114379	***EV--MaleMortality***
30.000000	***Male Mortality At Age 3***
15.000000	***EV--MaleMortality***
20.000000	***Adult Male Mortality***
8.000000	***EV--AdultMaleMortality***
2.000000	***Probability Of Catastrophe 1***
1.000000	***Severity--Reproduction***
1.000000	***Severity--Survival***
10.000000	***Probability Of Catastrophe 2***
1.000000	***Severity--Reproduction***
1.000000	***Severity--Survival***
N	***All Males Breeders?***
Y	***Answer--A--Known?***
50.000000	***Percent Males In Breeding Pool***
Y	***Start At Stable Age Distribution?***
25	***Initial Population Size***
50	***K***
0.000000	***EV--K***
N	***Trend In K?***
N	***Harvest?***
N	***Supplement?***

Table 7. VORTEX output file for the input file listed in Table 1. This is a base scenario with litter size = 3 and K = 50 with no inbreeding, catastrophes, or harvests included.

```
VORTEX -- simulation of genetic and demographic stochasticity

TIGER.010
Sun Jan 23 16:09:09 1994

 1 population(s) simulated for 100 years, 500 iterations
 No inbreeding depression
 First age of reproduction for females: 3   for males: 4
 Age of senescence (death): 15
 Sex ratio at birth (proportion males): 0.50000

Population 1:
 Polygynous mating;
 50.00 percent of adult males in the breeding pool.

 Reproduction is assumed to be density independent.
  50.00 (EV = 12.50 SD) percent of adult females produce litters of size 0
   0.00 percent of adult females produce litters of size 1
  12.00 percent of adult females produce litters of size 2
  29.00 percent of adult females produce litters of size 3
   8.00 percent of adult females produce litters of size 4
   1.00 percent of adult females produce litters of size 5

  35.00 (EV = 15.08 SD) percent mortality of females between ages 0 and 1
  15.00 (EV = 9.90 SD) percent mortality of females between ages 1 and 2
  40.00 (EV = 14.77 SD) percent mortality of females between ages 2 and 3
  10.00 (EV = 5.00 SD) percent annual mortality of adult females (3<=age<=15)
  35.00 (EV = 15.08 SD) percent mortality of males between ages 0 and 1
  15.00 (EV = 9.90 SD) percent mortality of males between ages 1 and 2
  30.00 (EV = 11.11 SD) percent mortality of males between ages 2 and 3
  30.00 (EV = 15.28 SD) percent mortality of males between ages 3 and 4
  20.00 (EV = 8.00 SD) percent annual mortality of adult males (4<=age<=15)
  EVs may have been adjusted to closest values
     possible for binomial distribution.
  EV in mortality will be correlated among age-sex classes
     but independent from EV in reproduction.

 Frequency of type 1 catastrophes: 2.000 percent
   with 1.000 multiplicative effect on reproduction
    and 1.000 multiplicative effect on survival

 Frequency of type 2 catastrophes: 10.000 percent
   with 1.000 multiplicative effect on reproduction
    and 1.000 multiplicative effect on survival
```

Initial size of Population 1:
(set to reflect stable age distribution)

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
	3	3	2	1	0	1	0	1	0	0	0	0	0	0	1	12	Males
	3	3	1	2	1	0	1	1	0	0	1	0	0	0	0	13	Females

Carrying capacity = 50 (EV = 0.00 SD)

Deterministic population growth rate (based on females, with assumptions of no limitation of mates, no density dependence, and no inbreeding depression):
r = 0.086 lambda = 1.089 R0 = 1.830
Generation time for: females = 7.05 males = 6.77

Stable age distribution:

Age class	females	males
0	0.154	0.154
1	0.092	0.092
2	0.072	0.072
3	0.040	0.046
4	0.033	0.030
5	0.027	0.022
6	0.022	0.016
7	0.018	0.012
8	0.015	0.009
9	0.013	0.006
10	0.010	0.005
11	0.009	0.003
12	0.007	0.003
13	0.006	0.002
14	0.005	0.001
15	0.004	0.001

Ratio of adult (>= 4) males to adult (>= 3) females: 0.522

Population1

Year 10
N[Extinct] = 2, P[E] = 0.004
N[Surviving] = 498, P[S] = 0.996
Population size = 40.32 (0.49 SE, 10.98 SD)
Expected heterozygosity = 0.912 (0.001 SE, 0.029 SD)
Observed heterozygosity = 0.968 (0.002 SE, 0.036 SD)
Number of extant alleles = 19.23 (0.20 SE, 4.35 SD)

Year 20
N[Extinct] = 6, P[E] = 0.012
N[Surviving] = 494, P[S] = 0.988
Population size = 43.06 (0.45 SE, 9.99 SD)
Expected heterozygosity = 0.861 (0.002 SE, 0.047 SD)
Observed heterozygosity = 0.906 (0.003 SE, 0.061 SD)
Number of extant alleles = 12.73 (0.12 SE, 2.73 SD)

Year 30
N[Extinct] = 8, P[E] = 0.016
N[Surviving] = 492, P[S] = 0.984
Population size = 42.99 (0.43 SE, 9.45 SD)
Expected heterozygosity = 0.815 (0.003 SE, 0.062 SD)
Observed heterozygosity = 0.858 (0.004 SE, 0.083 SD)
Number of extant alleles = 9.64 (0.10 SE, 2.15 SD)

Year 40
N[Extinct] = 13, P[E] = 0.026
N[Surviving] = 487, P[S] = 0.974
Population size = 43.17 (0.40 SE, 8.85 SD)
Expected heterozygosity = 0.770 (0.003 SE, 0.074 SD)
Observed heterozygosity = 0.812 (0.004 SE, 0.096 SD)
Number of extant alleles = 7.65 (0.08 SE, 1.78 SD)

Year 50
N[Extinct] = 13, P[E] = 0.026
N[Surviving] = 487, P[S] = 0.974
Population size = 43.48 (0.40 SE, 8.90 SD)
Expected heterozygosity = 0.730 (0.004 SE, 0.094 SD)
Observed heterozygosity = 0.772 (0.005 SE, 0.118 SD)
Number of extant alleles = 6.40 (0.07 SE, 1.51 SD)

Year 60
N[Extinct] = 15, P[E] = 0.030
N[Surviving] = 485, P[S] = 0.970
Population size = 43.77 (0.39 SE, 8.54 SD)
Expected heterozygosity = 0.693 (0.005 SE, 0.107 SD)
Observed heterozygosity = 0.727 (0.006 SE, 0.130 SD)
Number of extant alleles = 5.52 (0.06 SE, 1.36 SD)

Year 70
N[Extinct] = 16, P[E] = 0.032
N[Surviving] = 484, P[S] = 0.968
Population size = 43.49 (0.40 SE, 8.75 SD)
Expected heterozygosity = 0.648 (0.006 SE, 0.134 SD)
Observed heterozygosity = 0.684 (0.007 SE, 0.154 SD)
Number of extant alleles = 4.86 (0.06 SE, 1.29 SD)

Year 80
N[Extinct] = 19, P[E] = 0.038
N[Surviving] = 481, P[S] = 0.962
Population size = 43.60 (0.38 SE, 8.32 SD)
Expected heterozygosity = 0.614 (0.006 SE, 0.142 SD)
Observed heterozygosity = 0.647 (0.007 SE, 0.162 SD)
Number of extant alleles = 4.37 (0.06 SE, 1.22 SD)

Year 90
N[Extinct] = 19, P[E] = 0.038
N[Surviving] = 481, P[S] = 0.962
Population size = 44.19 (0.40 SE, 8.83 SD)
Expected heterozygosity = 0.579 (0.007 SE, 0.160 SD)
Observed heterozygosity = 0.612 (0.008 SE, 0.181 SD)
Number of extant alleles = 3.95 (0.05 SE, 1.13 SD)

Year 100
N[Extinct] = 21, P[E] = 0.042
N[Surviving] = 479, P[S] = 0.958
Population size = 43.73 (0.39 SE, 8.52 SD)
Expected heterozygosity = 0.541 (0.008 SE, 0.171 SD)
Observed heterozygosity = 0.568 (0.009 SE, 0.192 SD)
Number of extant alleles = 3.65 (0.05 SE, 1.09 SD)

In 500 simulations of Population1 for 100 years:
21 went extinct and 479 survived.

This gives a probability of extinction of 0.0420 (0.0090 SE),
or a probability of success of 0.9580 (0.0090 SE).

21 simulations went extinct at least once.
Of those going extinct,
mean time to first extinction was 42.19 years (6.29 SE, 28.82 SD).

No recolonizations.

Mean final population for successful cases was 43.73 (0.39 SE, 8.52 SD)

Age 1	2	3	Adults	Total	
5.85	4.44	2.96	6.97	20.22	Males
5.83	4.60		13.08	23.51	Females

Without harvest/supplementation, prior to carrying capacity truncation,
mean growth rate (r) was 0.0709 (0.0009 SE, 0.2087 SD)

Final expected heterozygosity was 0.5406 (0.0078 SE, 0.1712 SD)
Final observed heterozygosity was 0.5676 (0.0088 SE, 0.1924 SD)
Final number of alleles was 3.65 (0.05 SE, 1.09 SD)
****

TIGER POPULATION MANAGEMENT

Robert Wiese, David Wildt, Ann Byers, and Leslie Johnston

Tiger populations in Sumatra are fragmented and isolated into 5-12 small reserves that have varying degrees of migration between them. In the case of the five distinct National Parks, no natural migration is possible. These small isolated populations are at greater risk from random and deterministic processes (e.g., skewed sex ratio, failure to locate mates, disease, genetic drift, inbreeding, etc.) that are effectively less in large populations. Therefore, these populations will require intensive management if the Sumatran tiger is to survive for a considerable amount of time in the future.

From a conservation management standpoint the primary goal should be to reduce the number of tigers removed to the lowest level possible. This should primarily involve the elimination of poaching wherever possible. In addition, alternatives to the removal of problem animals should be explored to determine if it may be possible to allow some problem animals to remain in the population. Of course, some problem animals will always need to be removed.

Another priority for management should be the retention of the largest tracts of habitat possible and to avoid fragmentation of the designated tiger parks and reserves whenever possible.

Finally, the third priority for the effective management of the Sumatran tiger should be increased investigation into the biology of this subspecies. Specifically, it will be important to quantify the tigers' fecundity and mortality rates on Sumatra.

Many of the reserves and some of the national parks or their fragments are too small to retain a viable population of tigers over the long-term. Reserves that cannot support a population of more than 50 tigers with no removal, or reserves that possess a larger population but experience removal pressure will require continuing intensive management assistance. This assistance will take the form of either augmentation of an existing population with additional tigers, genetic management, or the reestablishment of populations that have become extirpated. Passive management or no action will lead to a gradual extinction of the Sumatran tiger through attrition of the existing populations through time.

Augmentation will be required in populations that have reduced heterozygosity and begin to show inbreeding depression and/or in populations which experience severe demographic perturbations such as highly skewed sex ratios. Although augmentation or establishment are not issues requiring immediate attention, investigation into their feasibility should begin now, before the situation becomes critical. The following section discusses several scenarios which may be considered by the managers for population augmentation.

SCENARIOS FOR THE GENETIC MANAGEMENT OF ISOLATED POPULATIONS

I. No Action.
As stated above, this management decision will lead to a slow decline in the number of extant tiger populations on Sumatra with the eventual extinction of the subspecies in all but the very largest parks. Even the largest population in Gunung Leuser may be at risk in the future if no action is selected.

II. Translocation of Free-Living Individuals Between or Among National Parks.
In this scenario, animals are moved between or among geographic locations depending upon genetic or demographic need. This would require the capture and physical translocation of living animals. The decision process would include:

a. the site of need for a new individual;
b. the site from which the animal to be translocated is to be captured; and
c. the specific animal to be moved (including sex and age class).

Current knowledge, based upon the assumption that reproductively effective males maintain individual territories, suggests that it would be best to move adult or subadult females rather than similarly aged males. One advantage of this strategy is that the translocated animals are already habituated to the wild, and therefore, have a higher likelihood of surviving over captive bred counterparts. Hands on access to individual animals will increase the database exponentially on the health status of the wild population.

The number of tigers that will have to be transferred among populations to maintain genetic diversity will depend on the amount and type of genetic diversity one wishes to retain and the size of the recipient population. The smaller the population and the more genetic diversity desired, the more migrants per generation required. The specific number of individuals, therefore, will have to determined at the time of plan implementation. This may also be an outlet for problem animals such that they are not removed from the entire metapopulation.

The disadvantages are: 1) the risk of moving living individuals; 2) the possibility of the individuals either moving back to original capture area or becoming transients; and 3) the potential disruption of the existing social structure at the transfer site. Also of concern is the possibility of transmitting as yet unknown pathogens or diseases from one population to another. This scenario will be challenging when the park size is small, because of the difficulty of balancing genetic needs, absolute animal numbers and the total carrying capacity of the habitat.

III. Assisted Reproduction of Wild-Caught Adult Females
In this strategy, adult, free-living females are captured, held in captivity for a brief period to be artificially inseminated, and then are released back into their home range. Semen is collected from wild or captive male tigers and used to inseminate wild-caught females. Following AI, the female is released into her home range. The primary advantage of this approach include avoiding

the need to transfer living individuals between populations. Again, having direct hands on access to wild animals will help establish a database on the medical status of the wild population. The disadvantages are that females must undergo the stress of short-term capture and anesthesia. It also will be difficult, if not impossible, to determine if a female scheduled for capture is potentially pregnant. There are the remote possibilities that: 1) a captured female may lose her territory; or 2) infanticide by the resident male after cubbing. Finally, although AI has been used to produce offspring in the tiger, the technology is not highly efficient at present; additional and parallel studies are required to further refine AI techniques in this species. Also, this scenario would not be adequate to alter demographic sex-ratio instabilities, as the sex of the offspring cannot be selected.

IV. Translocation (Release) of Captive Bred Individuals into Wild Populations
In this strategy, the primary source of new genetic material originates from the Indonesian Captive Breeding Program already in existence and a participant in the Tiger Global Animal Survival Plan. Founders used in this program come from two sources: 1) wild-caught specifically for captive breeding; or 2) problem animals (e.g., transients outside the park boundaries, human or livestock killers or injured/rehabilitated individuals). Artificial insemination can be used within the captive breeding program, and *in vitro* fertilization (IVF) can be considered once laboratory technology is improved. Pregnant females are allowed to deliver offspring in the captive facilities and then the young are released into the wild. Major decisions will include determining the sex and age class of the captive-bred young for release. Given assumptions described in Scenario III, it is expected that the best captive-bred candidates for reintroduction are subadult or adult females.

The major advantage is that a captive breeding program and a state-of-the-art facility already exist in Indonesia. Other advantages are: 1) a high degree of control over the production of genetically valuable tigers; 2) reinforcement of the captive population which serves as insurance for the free-living population; 3) sex of the released animals can be controlled to adjust the sex ratio of the wild population; and 4) clinical history of the animals will be known which can reduce the chance of introducing dangerous pathogens into the wild.

The primary disadvantage is the lack of information on survivorship of captive-bred felids released into native habitats. Experience with other carnivores has shown that a period of training is required for potential release individuals. A detailed set of studies will need to be conducted to determine the minimum training requirements and conditioning of individuals in preparation for release. Other disadvantages are that individuals raised in captivity are habituated to people, and the expenses of a soft-release program.

V. Cross-Fostering of Captive-Born Cubs to Free-Living Resident Females

In this strategy, the primary source of new genetic material originates from replacing newborn wild-born cubs with cubs produced by natural breeding or AI in the captive breeding program. Wild-born cubs will then be cross-fostered to the captive female and become part of the captive breeding program. The advantages of this strategy include the increased chances of survivorship of captive-born cubs in the wild because training will be provided by the free-living foster female. Disadvantages are that intensive monitoring is required of individual females before and after parturition, accurate timing of pregnancy of captive females is required, and the risks to the cubs during the cross-fostering process.

GENETIC RESOURCE BANKING

A major component to genetic metapopulation management of the Sumatran tiger can be the systematic collection, storage and use of genetic material, primarily spermatozoa at present [*editors' note: This recommendation was incorporated into the PKBSI Sumatran Tiger Captive Breeding Masterplan*]. It is recommended that the genetic metapopulation plan for the Sumatran tiger implement the development of a systematic Genetic Resource Bank. The details of a strategy for formulating such a repository are available and organization of the program can be assisted by the IUCN's Captive Breeding Specialist Group.■

PHPA Sumatran Tiger Action Plan

Komar Soemarna, Widodo Ramono, Effendy Sumardja, and Workshop Participants

Short Term Goals:

1. Improve the ability to acquire and manage data for use in GIS system through daily continual monitoring programs.

2. Each Park Chief assign 1-3 people in office to train in use of GIS.

3. Work with tiger researchers (ecology, behavior) in field work and analysis, beginning with a pilot project in Way Kambas NP and later extension into other protected areas.

4. Continue developing mapping system that will use a standardized data format.
   a) lowest level knowledge on data compilation
   b) network on information
   c) provide GIS map for areas outside of National Parks

5. Compile data on tiger-human interactions and evaluate appropriate non-monetary compensation.

6. Establish a Tiger Desk Officer for tiger issues.

7. Integrate a tiger component into the current anti-poaching program wherever tigers occur.

8. Evaluate extending boundaries of protected areas to include larger areas of tiger habitat or to connect tiger habitats (e.g., Berbak NP).

All Kepala (Chiefs of National Parks) as well as all Chief-Balai and Sub-Balai are responsible for short term Goals 1, 2 and 4-8. CBSG Tiger GASP is responsible for Goal 3 and assistance with Goal 4.

See next page for Long-Term Goals.

Long Term Goals:

1. Develop an accurate (standardized) mapping system using GIS to establish the distribution of tigers in Sumatra.

2. Develop a standardized reporting system to report tiger observations from the park guards to the Sub-Balai to the Balai to the Chiefs (Kepala) of the National Parks to the Jakarta PHPA Office.

3. Initiate the necessary field research (e.g., establish home range sizes) in order to establish tiger density in various habitats and protected areas.

4. Develop a strong communication network between the designated Tiger Desk Officer, PHPA and other agencies to foster cooperation and the sharing of information regarding tiger conservation.

5. Integrate *in situ* (protected areas) and *ex situ* (captive breeding) tiger programs in Indonesia, forming a collaboration between tiger conservation management programs.

6. Analyze land use practices in all tiger habitat, including those areas outside of protected areas, and use these data to suggest possible viable population management strategies, including extending protection to additional tiger habitat areas.

7. Incorporate tiger conservation information into broader conservation education programs in Indonesia.

8. Schedule another Sumatran tiger workshop in two to three years to analyze progress toward goals and evaluate more accurately the status of the tiger populations on Sumatra. At that workshop, better information should be available on tiger distribution, density, and the reasons for and rate of tiger loss. This will allow the drafting of an *Indonesian Conservation Strategy for the Sumatran Tiger*.

THE TIGER BY THE TAIL:
On tigers, ancestors and nature spirits in Kerinci

Jet Bakels, Leiden University, Centre of Non-Western Studies, the Netherlands

INTRODUCTION

In this paper I will focus on the meaning of the tiger for the Kerinci people and the role the big cat plays in the daily life of the villagers. Attention will be paid to the traditional rules of behavior that shape human conduct towards this animal. People sharing an ecological niche with the tiger (in the case of Kerinci it is the gardens in the forest where man and tiger can walk into each other) have developed a complex set of ideas about their mighty neighbor. How to avoid the tiger? How to find him? How to befriend him - and how to kill him? The answers to these questions are rooted in the local worldview. Therefore I shall pay attention to Kerinci conceptions of the forest and its inhabitants, 'real' (*nyata*) and 'invisible' (*gaib*). It should be stressed that I will talk about the 'cultural' tiger - a cultural construct - rather than the biological one. Thus I hope to offer a better insight into the way the Kerinci people perceive the tiger. To effectively protect the tiger in a certain region it is indispensable to work in cooperation with the local people. By giving an insight into Kerinci tiger-lore I hope to facilitate this cooperation.

METHODS

The data presented in this paper were collected during a five-month research period in Kerinci Seblat National Park (during November 1991 - May 1992). Most of the time I was a guest in the village of Keluru, situated on the southern border of Lake Kerinci. Several trips however were made to other villages such as Muak, Pulau Tengah, Jujun, Sungai Penuh and Siulak. Information was sought through extensive and repeated interviews with the villagers, especially *adat*-leaders, traditional (male and female) doctors (*dukun*) and hunters.

This fieldwork was carried out as part of a four-year Ph.D. project, focusing on the meaning and role of the tiger and the crocodile in several Indonesian societies. Within the scope of this research I also visited the Minangkabau, the Mentawaians, the Nias- and the Kubu-people.

NAMING THE TIGER

Throughout Indonesia the usual word for tiger is *macan*, derived from Sanskrit or *harimau*, a Malay word. *Macan* and *harimau* can refer to the tiger (*Panthera tigris*), but also to the clouded leopard (*Neofelis nebulosa*) or the leopard (*Panthera pardus*). Only when there is need to specify between the leopard and the tiger, the tiger is called the 'striped' tiger (*harimau/macan loreng*), the leopard the 'black' or 'spotted' tiger (*harimau/macan -kumbang, -dahan or -tutul)*. In Kerinci, people can also refer to smaller cats as 'tigers.' Names I have heard include the *harimau akar* and the *harimau kijang*, both said to be small, spotted felines. For biologists working in the region it is important to be aware of this overlap in the use of the term '*harimau.*'

Once outside the village, in the gardens or the forest, people wouldn't dream of calling the big cat by these names. In the jungle the tiger is the oldest inhabitant; he lived in the forest long before humans came. Now that his domain is entered, it would be impolite to address him directly - as it would be impolite (*kasar*) to address an older person directly by his or her name. Therefore he is called by more respectful names such as 'grandfather-/grandmother-in-the-forest' or 'old-man-of-the-forest' (*nenek/orang tua di rimba*). Also the terms 'general' (*hulu balang*), king-of-the-forest (*raja hutan*) and 'he-who-guards-the-forest' (*penghuni hutan*) are often used.

KERINCI TIGERS

One only has to read travel accounts of the last century to realize the profound influence of tigers on village life in those days. It is therefore not surprising the tiger played an important role in the worldview of the Indonesian peoples. Although the tiger greatly diminished in numbers, in Kerinci he still forms a presence that cannot be neglected. The villagers find his footprints in their gardens; they might even meet him; or a dog, goat or cow might fall prey to the tiger. I estimate that every four to five years a human falls victim to the animal in Kerinci alone.

In the local concept of the tiger many seemingly controversial ideas mix. The tiger can be feared and respected, admired and distrusted, depending on the context. These ideas mirror an ambivalence that is characteristic of all sources of deadly power: it can help and harm you, save or destroy. In the last analysis, however, the tiger is thought of as a good and just animal, that is a friend rather than a foe to the Kerinci people. Many myths describe how the relationship between man and tiger was originally established (Bakels, in press). These stories tell us how in mythical times a deal was made between humans and tigers. The essence of this deal is that humans and tigers will not disturb each other, and respect each other's territory: the forest for the tiger and the village and the cultivated lands for the people.

The Kerinci people conceptually distinguish between several kinds of tigers. The main distinction is between the 'real' or factual tiger (*harimau biasa*) and the spirit-tiger (*harimau roh*). The 'real' tiger is regarded as one of Allah's creatures, just as the other animals are. Nevertheless he is thought to have a particular origin. Old stories speak of how the tiger (and the crocodile) originated from the sperm of an Islamic protagonist or from an amazingly potent male. At first the tiger was friendly and tame, and lived in the house of his 'creator.' But when he grew up he started killing the livestock of his keeper and was banned to the forest. There a deal was made between man and tiger. They were to respect each other's territory and not to disturb each other.

People's attitude to this 'real' tiger is ambivalent. It is thought that he can be mean and aggressive, but on the other hand he is seen as being 'one people' with the spirit-tiger, who would not harm human beings unjustly. It struck me how often characteristics of the spirit-tiger were also attributed to the 'real' tiger; in stories the two tiger-concepts often blend.

Generally it is thought that the tigers that roam the Kerinci forests are not 'real' tigers, but spirit-tigers (*harimau roh*). The spirit tiger is connected to the ancestors of the Kerinci people. Myths relate how, in ancient times a group of people came from the Minangkabau or the Jambi area, and settled in the hills of Kerinci. Here they married, often to what are really the first inhabitants of the area: the spirits (*mambang/bunian/jin*) or gods (*dewa*) that inhabit the forest. Maybe these forest-deities represent the old inhabitants of Kerinci, the people who carved and erected the megalithes found in the area. The offspring of these mythical ancestors form the Kerinci people. In these origin myths tigers play an important role. They are said to accompany these 'founding fathers' of Kerinci as a 'friend' or 'familiar' (*sahabat* or *akuan*) and sometimes it is thought that these first ancestors themselves turned into a tiger after their death. Also the forest-deities are thought to have a tiger as a friend, or to manifest themselves as such. In practice the spirit-tiger is thought of as a manifestation of these first inhabitants: ancestors and/or forest deities. As such, he plays an important role in the social, ritual and mystic domain.

Spirit-tigers are regarded as just and morally good animals. They protect the village against the 'normal' tiger and the gardens against pigs. When somebody of the village would get lost in the jungle, the spirit-tiger would lead him to the edge of the forest (a method well worth remembering: tiger-tracks often do lead to man-made roads).

The communication between man and the spirit-tiger is in the hands of the *dukun* and the *adat*-leaders. During the yearly ritual of *Kenduri Seko* the bond between tiger and humans is reaffirmed. The *Kenduri Seko* is a celebration in honor of the (first) ancestors, the hereditary titles and the holy goods they brought. Central to this ritual is the passing of the hereditary titles of the village-heads to their successors and the homage paid to the holy hereditary goods (*pusaka*) that were brought by the first ancestors (and are therefore connected to the titles as well). During the celebration the ancestors are honored with offerings such as flowers and rice presented to them in the house. Outside the house offerings are presented as well, including raw meat and blood of a water-buffalo that has been slaughtered for the occasion. These offerings are meant for the spirits of the forest, including the spirit tiger. In some villages it is still a tradition that a newly appointed village-leader brings these offerings to (among others) the spirit-tiger: a reflection of the importance of an ongoing relationship between the two. If the tiger would not get this yearly token of respect, or when the *Kenduri Seko* would not be held altogether, it is feared that the tiger would leave the forest and disturb the villagers.

The *Kenduri Seko* can be seen as a reenactment of the founding ritual of each Kerinci village. Oral tradition has it that the founder of the first Kerinci village slaughtered a water-buffalo on a special stone and buried part of the buffalo under it. This offering had to seal a good relationship of the founder with the gods, the spirits, the wild animals (especially the tiger), and the (or his) people. So traditionally, we may conclude, the relationship of the Kerinci people with the surrounding powers of nature (real and supernatural) is one of respect and cooperation. Rules were made to direct this 'good relationship,' and breaking of the rules had - and still has - severe consequences for both sides as I will show later (see crime and punishment).

Dukun also have more individually colored relations with a spirit-tiger and consider them as a 'friend' (*sahabat*) or 'familiar.' The spirit tiger they befriend can be the manifestation of the first ancestors, as was described above, or a more recently deceased relative. The tiger may be called in times of illness and asked for a recipe, mostly consisting of special kinds of herbs. *Dukuns* also say they can ride on these tigers and instruct them to guard their fields. The spirit-tiger is also considered a master in the Indonesian martial art, *pencak silat*. The highest form of silat is the *silat harimau*. Tales tell how originally this silat was learned from a tiger, and a silat teacher will never practice the *silat harimau* without asking the tiger's permission first. When in severe trouble someone might call the spirit-tiger, whose energy can enter the person in need and fill him with a tigerish power. Adversaries, it is said, then see this person as if he were a tiger. Also the spirit-tiger may come himself and confront the aggressor.

I should remark that in most cases this 'friend' is considered to be the spirit-tiger, but in the north of Kerinci, people also told me there were people (*orang bakung*) who befriended 'real' tigers. This might be an example of how often the two categories blend.

Apart from the two discussed main categories (the real- and the spirit-tiger), another remarkable group of tigers should be briefly mentioned. These are the tigers from Pasemah. It is the Kerinci version of an all-Indonesian idea (see Hazewinkel and Wessing; 1986) that, hidden in the deep jungle, lies a village where the tiger-people live. The Kerinci people locate this village in Pasemah (Bengkulu). In their village the tiger people are humans, outside their village they change into tigers. During four months each year their king sends his subjects on a hazardous mission. They have to collect human hearts for his dish. These tigers are very much feared, and *dukun* in many Kerinci villages have the task to magically ward off the danger.

Not everybody in Kerinci agrees on the behavior of these Pasemah tigers. Some maintain they are vicious, others that they will not harm a human being, as long as the *adat*-rules are not broken. Characteristics of the 'real'- and the spirit-tiger are recognizable in the Pasemah tiger.

INTO THE FOREST

The Kerinci habitat of the tiger covers the forest, and also the forestry-gardens on the slopes of the valley. To understand the local conception of the tiger, it is important to understand the conception of his habitat.

In the West the forest is thought of as a neutral domain, to be exploited or protected for respectively economic, ecological or recreational means. In Indonesia the forest is often conceived of as a world in its own right. It is the abode of nature spirits (in Kerinci the *mambang*, *bunian* and *jin*) and of the founding ancestors of the several villages in the valley.

The wild animals of the forest are considered the livestock of the forest-spirits, who herd them, as humans herd their livestock. The forest thus appears not as a neutral or objective domain, but as a cultured abode as well, a 'culture of the beyond' (Schefold 1988), that is to be met on its own terms. Consequently if one wants to enter a primary forest-plot, to walk through, gather forest products or to hunt, the local supernatural beings have to be asked permission first. During a stay in the forest (and the forest gardens) one has to obey a specific set of rules and regulations in order not to disturb or offend the inhabitants. One should not talk loudly and one should behave politely.

It is especially dreaded to offend the tiger, the might 'keeper' and 'king' of the forest (*penghuni/raja hutan*). Primarily one should not speak disrespectfully of the tiger (a man from Keluru village, who once tested this taboo, told me that the next day he found tiger-scratches all around his garden-hut as a warning), and never call him by his direct name. Also all behavior that is associated with that of the tiger is forbidden: walk on all fours, sit with a knee high, take a wooden pestle to the garden (associated with the tiger's tail), eat directly from the pan (*priuk*), etc. Some people protect themselves against possible danger by carrying special amulets. The tiger is especially fond of 'pregnant maidens' (*bunting gadis*); a woman pregnant for the first time. He is said to lick her footprints with relish. Pregnant maidens will never go to their gardens alone, and they protect themselves with amulets. Generally people hold the idea that if one respects the rules of the tiger and forest-spirits once in their domain, there is no need to fear repercussions.

CRIME AND PUNISHMENT

In the human domain, the daily life of the villagers, these supernatural powers play an important role as guardians of the traditional rules of behavior, the *adat*. It is especially the tiger who serves as a judge and protector of the traditional *adat* laws.

While the ancestors were the progenitors of the Kerinci *adat*, it is the ancestral tiger who watches over it. As was laid down in the original oath between humans and tigers, the latter will never disturb humans, with the exception of people who have trespassed the *adat*-rules. In the same way the former do not have the right to kill tigers unless a tiger has attacked a man or his livestock first. Even then, the tiger has to be interred with the proper rituals. Otherwise, the tiger people would come to revenge themselves.

In Kerinci, when a tiger suddenly shows himself during daytime in the neighborhood of the village, when his footprints are suddenly frequently found, the message is understood. Something in the village is wrong. Somebody has broken the *adat*-rules. Maybe somebody has committed adultery or failed to obey the assignments of the village-leaders. Or maybe the village-leaders themselves have failed in the performance of their tasks. People are too afraid to go to the gardens and discuss the situation. Often they have a suspicion about the cause of the tiger's rage, and social pressure is put on the suspect. Generally the person reports his crime to the *dukun* and the *adat* leaders (*depati/depati nenek mamak*), who will impose a penalty. This will be a certain amount of rice, and a chicken or goat. The animals are slaughtered and eaten. The *dukun* or one of the village-chiefs will bring some of the meat to the forest and inform the tiger that the fault has been corrected.

If a tiger goes as far as to attack livestock or even a human being, the tiger has gone too far. Even though it was done by the spirit tiger and the killing may be a just deed, there has to be revenge. If the killing was done by the 'real' tiger, it may be just a mean deed and the animal will have to be killed as well. Some people say that if a tiger kills livestock or a human, it is always the 'real' tiger who is given leeway by the spirit-tiger, who normally would protect the area against these types of tigers. Others maintain that if the animal returns to his bait the next night and is shot, it is a real tiger. If the tiger doesn't return, it is the spirit tiger.

On an analytical level we could say the 'just' tiger performs an important function as a guardian of the human social order. It is interesting to note that he seems to punish, where human means fail; in case of adultery there is no proof, in case of misbehavior by village-chiefs there is nobody in a position to convict them. Also, a psychological fear of an uncontrollable, lurking physical danger is transformed into a controllable social behavioral pattern. "If misfortune cannot be neutralized, it can at least be rationalized" (Valeri, 1985).

In Kerinci, traditionally several methods are used to kill a guilty tiger. Most widespread I found is a type of fall, consisting of a slowly mounting plank. Under the plank, sharp bamboo sticks (*ranjau*) are firmly planted in the ground. When the tiger walks on the plank and gets the bait, the plank will drop and the bamboo sticks will spear the tiger in his belly. I have also heard of a case in which a snare in the form of a slipknot from bamboo was made, and successfully used. From the time fire-arms were introduced in the region, probably by the Dutch in the beginning of the century, local hunters have used these to kill the tiger. They waited with lamp and gun in a tree above the remains of the attacked animal. In several cases Dutch and later Indonesian policemen were asked to kill the tiger.

In all the cases involving local huntsmen, incantations are used to call the tiger. In the incantations it is stressed that the tiger has trespassed the laws and has to receive his rightful punishment. Sometimes the leader of the tigers is addressed and asked to send his guilty subject to the trap to pay his debt. It is presumed that only the guilty tiger will come back to the bait.

Remarkably in Kerinci there is no tradition of building a cage to catch the tiger, as is done by the neighboring Minangkabau (Kartoni, 1978). In some recent cases a Minangkabau tiger-specialist (*pawang harimau*) was involved in Kerinci and caught a tiger in a cage. Everybody I have spoken to absolutely denied they would ever try to catch an innocent tiger.

Although the tiger is guilty, he is killed with respect and his body is ceremonially buried. Before the interment his dead body is resurrected (called *bangung*; to wake up, bring to life) on a bamboo frame. In front of the tiger men and women dance (*pencak silat*) in his honor and incantations are chanted:

Oh grandfather
Grandfather crippled tiger
Who is the guardian
Of the Kingly Mountain

Oh grandfather crippled one
Your grandchild did not behave well
Your grandchild already got lost
And he has to pay his debts
Your laws have been broken

Oh grandfather the crippled one
The *kris* of old time should not shudder
The mirror of former days should not be blurred
Your grandchild already has blood on his paws
The fence has been opened, the border trespassed

Words of the old days we are looking for
Words, that have to be remembered
The debt has to be redeemed
The smoldering fire has already been quenched

CONCLUSIONS

Today, the `king of the forest' has become an endangered species that calls for protection. I have tried to show how in the present worldview of the Kerinci people the tiger takes a respected position, although its role is not free from ambivalence. As generally in Kerinci tigers are considered spirit-tigers, who are respected and whose position is deeply rooted in the traditional worldview of the people, they do not have to fear any danger from the villagers. There exists a delicate relationship between tiger and man, forged in a mythical and holy past. As an outsider I would say the conception of the relationship is inspired by common sense, respect and fear.

Common sense because, as many biologists have stressed, tigers seldom attack humans. The Kerinci people are well aware of that and many have experienced close encounters with tigers in the field where nothing happened. That is, nothing happened physically. Some people got so frightened by finding themselves vis-a-vis the tiger that they stayed in a condition of shock for several days.

Maybe we can apply the term `balance of power' to the man tiger relationship. It is appropriate that because the tiger is feared and has the power to kill, he is not attacked without reason. The human killer would fear the revenge of the tiger-people. For that reason, it is my opinion that a Kerinci hunter, living a rural life in his village, would never attack an `innocent' tiger. As part of the traditional system, he would never hunt a tiger without permission of the local leaders, who, for reasons I have explained above, would never give it. Even if the hunter would not fear revenge, the other villagers would not accept such an endangering of their lives. Probably this mechanism has protected the tiger, but it permitted the traditionally respected, but less feared animals such as the elephant, rhinoceros and deer to be hunted for meat and medicinal or economical gain. Under the influence of demographic pressures and new economic opportunities new values have started to dominate the traditionally held respect for these animals, and other priorities, such as direct economical gain, have been chosen (see also Persoon, 1991).

Based on the conversations I had on this subject with the village youth, I got the strong impression that they hold the same opinion of the tiger as their parents. The here described 'traditional' worldview still forms a living tradition that will not die out within one generation. However men who have left their village and, for example, joined the army or police force (and thus have access to guns) form another category, as does the heterogeneous population of Kerinci's capital Sungai Penuh. In these cases new rationalizations and opportunities erode the traditional patterns. Control on poaching will have to be part of the Kerinci project, as it will have to be part of any program on nature preservation in the world.

Finally, respect, awe and even feelings of friendship and solidarity color the tiger concept--feelings that resound a time in which mankind did (and could) not subdue nature but tried to live in cooperation with it. Because of this traditional respect for tigers, the case for Kerinci offers promising opportunities. It is important however that these ideas are stressed and preserved for the generations to come. To this aim the World Wide Fund for Nature (WWF) and the Indonesian Directorate of Forest Protection and Nature Conservation (PHPA) could set up an educational project. In dealing with the local people it will be indispensable for the WWF/PHPA staff to 'talk the same language,' to understand and to respect local conceptions of nature and animals.

Summing up the social universe, the cultural conception of the tiger encompasses the natural universe. The tiger is not seen as a random killer, but as an ancestral figure who protects and punishes only those who have violated the law. Thus, in Kerinci, not only the people watch over the tiger, the tiger watches over the people.

REFERENCES

Bakels, J. (in press). `But his stripes remain': The tiger in the oral traditions of Kerinci. In J. Oosten (ed.), *Oral Literature*. CNWS: Leiden.

Hazewinkel, J.C. 1986. *De Tijger in Het Volksgeloof*. Tong-Tong: Den Haag.

Kartoni, M.J. 1972. `Tiger capturing sons in Minangkabau, West-Sumatra.' *Sumatra Research Bulletin II*, 1: 24-41.

Persoon, G. 1991. `Ecological balance and innovations: Cases from the forest.' In J.P.M. van den Breemer et al. (eds.), *The Social Dynamics of Economic Innovation*. DSWO Press: Leiden.

Schefold R. 1988. `De wildernis als cultuur van gene zijde: Tribale concepten van 'natuur' in Indonesie.' In *Antropologische Verkenningen: Mens en Milieu*, 7de jaargang, nr.4: 5-22.

Valeri, V. 1985. *Kingship and Sacrifice, Ritual and Society in Ancient Hawaii*. University of Chicago Press: Chicago.

Wessing, R. 1986. *The Soul of Ambiguity: The Tiger in Southeast Asia*. Northern Illinois University: DeKalb.■

CONSERVATION OF SUMATRAN TIGERS IN INDONESIA

Widodo Ramono, PHPA and Charles Santiapillai, WWF-Indonesia

INTRODUCTION

About the turn of the century, there were three subspecies of the tiger (*Panthera tigris*) in Indonesia: *P.t. balica* in Bali; *P.t. sondaica* in Java and *P.t. sumatrae* in Sumatra. Today however, both Bali and Javan tigers have become extinct and only the Sumatran tiger survives. The extinction of the two sub-species of tiger in Indonesia was both rapid and deliberate and it occurred at a time when conservation was already the accepted national policy (Ashby & Santiapillai, 1987). This fact underlines the inherent difficulty in conserving a large predator in environments dominated by man. It shows clearly that much more than mere legal protection and reservation of habitat is needed to safeguard the species in the wild. It therefore calls for a more discretionary and selective strategy to replace our current strategy of responding to crisis in the management of carnivores in general and the tiger in particular. The ecological and behavioural factors that restrict the tiger's range in Sumatra likewise make it susceptible to pressures from man's modification of its habitat. Because of its vulnerability to a spectrum of limiting factors, the tiger in Sumatra faces precarious prospects if its present distribution were to be substantially reduced and populations become small, fragmented and isolated from one another. In Sumatra, tiger habitat is shrinking fast and unless prudent policies are adopted to exploit the timber resources on a sustainable basis, by the year 2000, the tiger will almost certainly be confined to a few large and well protected reserves.

DISTRIBUTION OF THE TIGER

Sumatra prior to 1900 was largely covered in primary forest from Aceh in the north to Lampung in the south. Up to that time, the tiger, although its population density would have been low, was more or less continuously distributed throughout the entire island. Less than a century later, as a result of conversion of primary forest to agricultural holdings, the tiger distribution has become fragmented and substantially reduced (Fig. 1). However, tiger is found in all the eight provinces although in highly populated areas such as the provinces of North Sumatra and Lampung, the animal has been squeezed out of much of its former range.

The fact that the tiger still survives in all the eight provinces in Sumatra points to its adaptability and versatility. However, there are strict limits to its versatility: what is probably particularly important is a variety of mammalian herbivore species being available as prey, fresh water and ample vegetative cover (Schaller, 1967). These requirements are largely met within the network of protected areas in Sumatra (Fig. 2).

There is definite evidence for the presence of tigers in 26 protected areas in Sumatra (Table 1). These areas total 4,564,121 ha or 45,641 km^2 and account for 9.63% of the total land area of Sumatra. Within these areas, the tiger inhabits an altitude range from sea level to over 1,000 m (Blouch, 1984). In addition, tigers are also known outside the network of protected areas, especially in rubber plantations where many of the attacks on man and livestock have been reported.

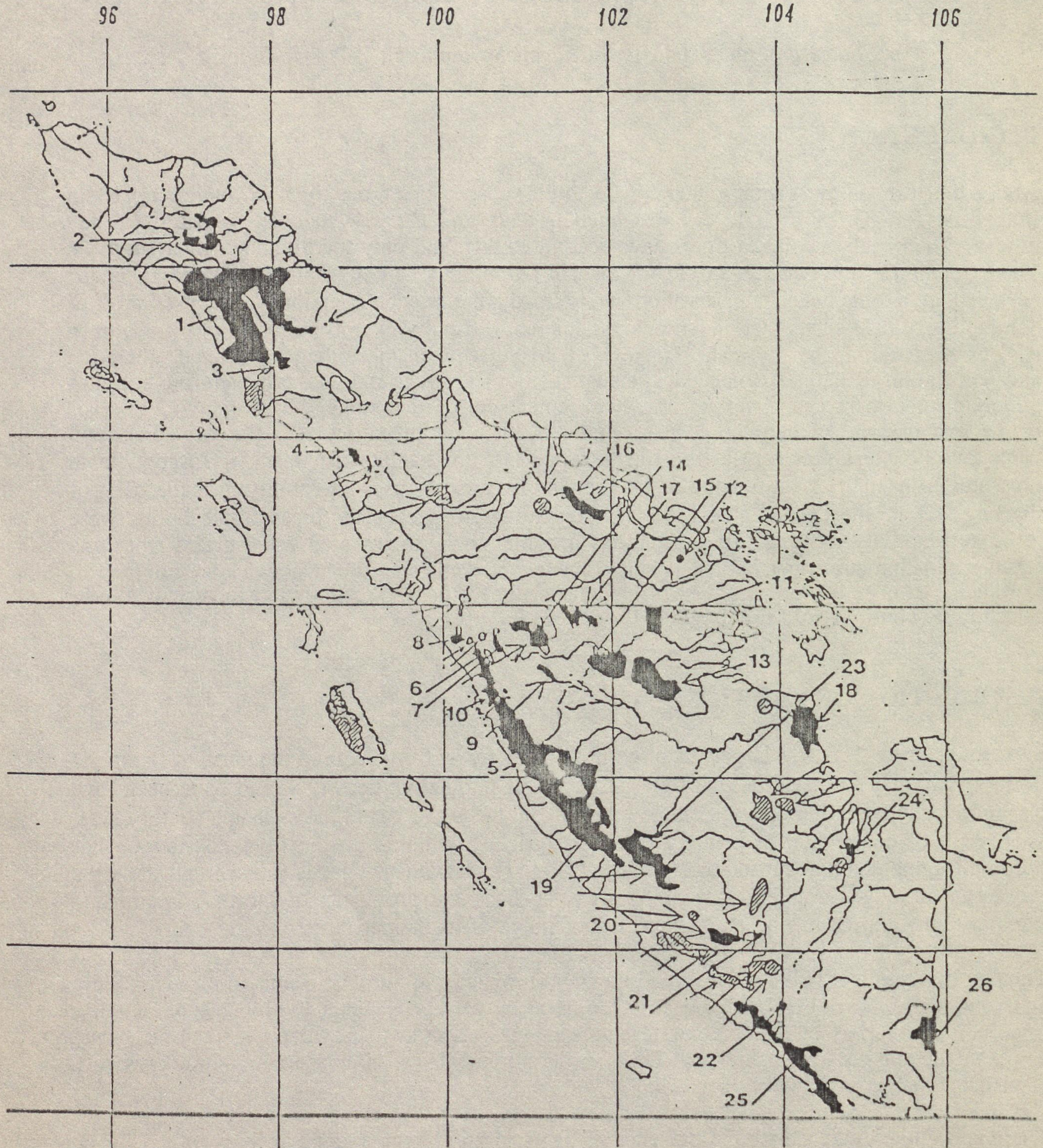


Fig. 1. Distribution of Sumatran tiger (*Panthera tigris sumatrae*). Solid shading: positive evidence of presence of tiger. Cross hatching: extent of additional suitable habitat but where positive evidence is not available. Numbers refer to the areas indicated in Table 1.

Table 1. Protected areas of Sumatra where tigers are found.

No.	Reserve/Park/Forest	Prov.	Status	Area (ha)	Alt. (m)
1	Gunung Leuser	Aceh	NP	792,675	0-3419
2	Lingga Isaq	Aceh	HR	80,000	800-2823
3	Dolok Sembelin	NSum	PFo	33,910	150-1604
4	Sibolga	NSum	NR	20,100	200-1230
5	Kerinci-Seblat	WSum	NP	1,484,650	500-3800
6	Lembah Anai	WSum	PFo	96,002	600-1811
7	Lembah Harau	WSum	PFo	23,476	600-1256
8	Maninjau	WSum	PFo	22,106	600-1724
9	Bkt.Sebelah/Pangean	WSum	PFo	22,803	600-1078
10	Bajang Air Tarusan	WSum	PFo	81,865	500-2000
11	Kerumutan Baru	Riau	GR	120,000	0-0
12	D. Pulau Besar/Bawah	Riau	GR	25,000	0-0
13	Seberida	Riau	NR	120,000	150-830
14	Bkt. Rimbang/Baling2	Riau	NR	146,000	200-1090
15	Peranap	Riau	HR	120,000	120-492
16	Siak Kecil	Riau	NR	100,000	0-20
17	Air Sawan	Riau	GR	140,000	100-176
18	Berbak	Jamb	GR	190,000	0-20
19	Merangin Barat	Jamb	PFo	64,600	1000-1931
20	Gumai Pasemah	SSum	GR	45,883	200-1776
21	Isau-Isau Pasemah	SSum	GR	12,114	500-1431
22	Gunung Raya	SSum	GR	39,500	300-2232
23	Rawas Hulu Latikan	SSum	GR	213,437	300-2384
24	Padang Sugihan	SSum	GR	75,000	0-50
25	Barisan Selatan	Ben/Lam	NP	365,000	0-1964
26	Way Kambas	Lamp	GR	130,000	0-50
	Total			4,564,121	

NB: NP=National Park; NR=Nature Reserve; HR=Hunting Reserve; GR=Game Reserve; PFo=Protection Forest. Underlined areas are lowland forests.

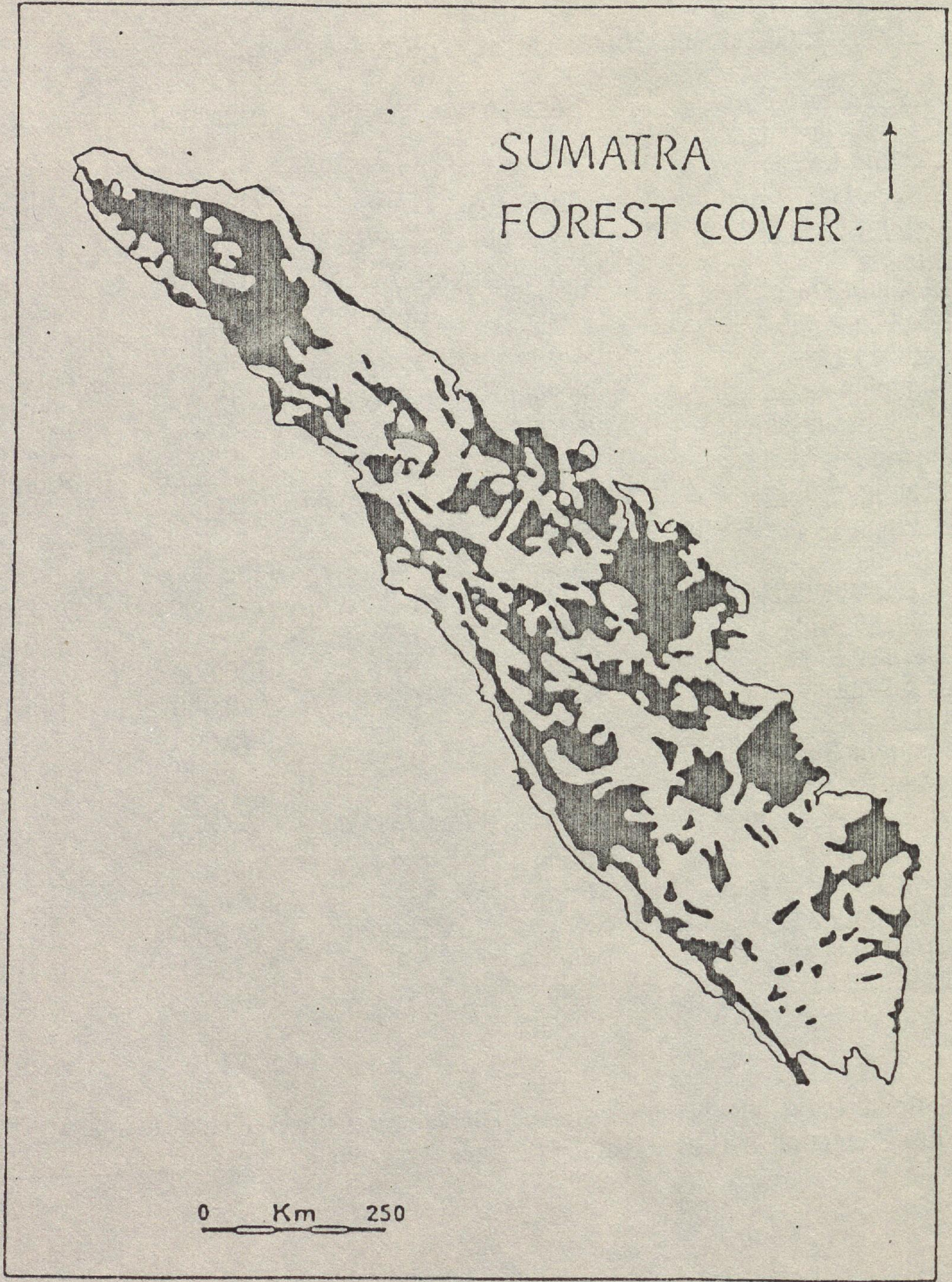


Fig. 2 The extent of forest cover in Sumatra.

Rainforest habitat in general does not support a high biomass of large ungulates (Eisenberg & Seidensticker, 1976). On the other hand, lowland forests support a greater biomass of ungulate prey such as wild pig (*Sus scrofa*), sambar (*Cervus unicolor*) and barking deer (*Muntiacus muntjak*) which are among the species preferred by tiger in Sumatra (Santiapillai & Widodo, 1987). But it is precisely such lowland forest habitats rich in prey species that are fast disappearing in Sumatra as a result of a host of development programmes. It is estimated that between 65% and 80% of the forests in the lowlands of Sumatra have already been lost (Whitten *et al.*, 1984). The mountain areas to date have been less seriously affected, but disruption of continuous cover is already substantial in some cases, and perhaps 15% of their total area may tentatively be estimated as already removed on the evidence available.

Optimum habitat is provided by sub-climax vegetation. Ecotonal habitats are particularly favourable to tiger, as such transitional zones between forest and grasslands support a higher density of tiger's principal prey species.

NUMBER AND DENSITY OF TIGER

The dense and tangled vegetation of the tropical habitats in Sumatra makes it extremely difficult to arrive at even working estimates of the tiger number and density. As the animal is rarely encountered in the forest, much of the data regarding its presence and number must come from information obtained from people living in or around the areas inhabited by tiger and also from the study of the pug marks (McDougal, 1977; Panwar, 1979).

In 1978 Borner surveyed Sumatra and estimated the number of tigers to be about 1,000. Since then, Sumatra has undergone much development and subsequently, the extent of prime tiger habitat has declined. Subsequent surveys of Sumatran tigers in 1984/85 by Santiapillai and Widodo (1985, 1987) put the number not in the thousands but in the "hundreds".

In the optimum habitats in India, tiger densities can be as high as 14 per 100 km^2 (Sankala, 1979). In prime habitat in Nepal, adult tiger densities of 6-7 per 100 km^2 have been recorded, whereas outside such areas, densities are much lower, about 1-2 per 100 km^2 (McDougal, 1977; Smith, 1978; Sunquist, 1981). In Sumatra, tiger densities could be as high as 3.7 per 100 km^2 in such prime tiger habitat as the lowland forests in Bengkulu province (Santiapillai & Widodo, 1985). But this is exceptional and in general, much lower densities are the norm in Sumatra. The tiger in Sumatra can maintain a density of 1 per 100 km^2 in mountainous areas and 1-3 per 100 km^2 in more favourable lowland habitats (Santiapillai & Widodo, 1987).

Of the 26 areas where tigers are known to occur (Table 1), 14 represent lowland forests (underlined in Table 1) and these account for 1,339,488 ha or 13,395 km^2 while the remaining 12 montane forest habitats make up 3,224,633 ha or 32,246 km^2. Taking the maximum density of 3 per 100 km^2, the lowland habitats could support a maximum of 400 animals while, at a density of 1.5 per 100 km^2, the montane areas could support about 484 tigers. On such flimsy estimates, the network of protected areas in Sumatra could support about 800 tigers.

CONSERVATION IMPLICATIONS

The tiger finds itself with its back against the wall in Sumatra. The tiger's prospects for long term survival appear to be grim in a number of protected areas given their small size. Only 12 areas out of the 26 tiger reserves in Sumatra are larger than 1,000 km^2. The smaller reserves are unlikely to support viable tiger populations in the future. Such small populations of tiger currently occurring in these reserves are very vulnerable to local catastrophes. Random changes in the populations, such as marked fluctuations in the sex ratio, have proportionately more impact in smaller populations (Bertram, 1986). One way of avoiding some of the problems associated with managing small populations of tiger would be through the establishment of forest corridors to link smaller reserves with the larger ones - if this is still feasible.

Reserves also need to be zoned and managed. Strict protection must be given to the core areas where the tiger and its prey populations could survive without any interference from man. Multiple-use zones around protected areas are an important feature of the Indian tiger reserves (Bertram, 1986). Our objective is to maintain viable populations of tiger in Sumatra in as many areas as possible without leading to unacceptable conflicts with livestock and human settlements. This is the difficult management goal facing us: how to increase the number of tiger in the wild at the same time reduce the conflicts such an increase will have with humans and their livestock? Tigers being territorial animals, they will eventually space themselves out in any area, thereby force the surplus animals into outlying areas such as buffer zones and multiple-use zones. Conflicts between such transient tigers and man are inevitable in heavily populated areas.

Given the size of the human population in Sumatra, the number of people killed by tigers is indeed very small. Motor cars and snakes kill more people than tigers but attacks on people by tigers, however rare, are given prominence in the press. More common however are attacks on cattle. Such tiger depredations on livestock must be reduced and the farmers and stockmen who suffer such losses must be compensated, otherwise the tigers will forfeit acceptance by the local people, and without local people's support, no conservation program will achieve its desired goal in the long run. If the losses of livestock are exceptional and sustained, then they should be offset by some sort of compensatory adjustment on the part of those who benefit from the predator's survival viz, the society at large (Myers, 1976).

Problem tigers such as "man-eaters" and chronic stock raiders could be captured and accommodated in zoos, where they could be bred and maintained as an insurance against extinctions in the wild *[Editors' note: This recommendation was incorporated into the PKBSI Sumatran Tiger Captive Breeding Masterplan].*

RECOMMENDATIONS

In spite of losses of habitat to date, there is still time for substantial tiger habitat to be maintained, provided that it is not fragmented into inviable units (Ashby & Santiapillai, 1987). Given this situation, we suggest the following strategy:

1. Strengthen the protection of the five key areas in Sumatra such as Kerinci-Seblat NP, Barisan Selatan NP, Gunung Leuser NP, Berbak GR and Way Kambas GR. These key

conservation areas must be divided into core and buffer zones. Intensify the anti-poaching efforts of the guards.

2. Adopt a policy aimed at maintaining as much forest cover over large areas, uninterrupted by human settlements and roads where remoteness, difficulty of terrain and density of cover can provide natural protection.

3. Adopt a policy to keep as much unfragmented habitat outside the protected areas as is practicable on a long-term basis, as a multi-purpose forest where sustainable timber extraction is practised that is compatible with the survival of the tiger and its prey.

4. Identify areas chosen for new settlements in terms of compatibility with nature conservation as well as agricultural suitability to minimise conflicts.

5. Survey additional areas in Sumatra and determine the whereabouts of viable tiger populations. This applies particularly to the remaining unfragmented lowland forests where the species may be present.

6. Strictly control the use of poison especially around tiger reserves. The critical element in the decline of the Javan tiger in Ujung Kulon reserve in West Java was poisoning by nearby pastoralists (Hoogerwerf, 1970).

7. Design land-use patterns in the vicinity of tiger reserves in such a way as to make them compatible with tiger conservation and thus minimise human-wildlife conflicts. Adopt measures to improve the living standards of the people living along the periphery of tiger reserves. The farmers and herdsmen must be convinced that the conservation measures being taken are in their long-term interests, for without the support of the local people, all current efforts to conserve the tiger in Sumatra, whether in the wild or in captivity, are unlikely to succeed.

REFERENCES

Ashby, K.R. and Santiapillai, C. 1987. An outline strategy for the conservation of the tiger (*Panthera tigris*) in Indonesia. In: *Tigers of the World*, Eds. R.L. Tilson and U.S. Seal. Noyes Publications: New Jersey, pp. 411-415.

Bertram, B. 1986. A bright future for the tiger? *New Scientist*, 7 August 1986, 30-33.

Blouch, R.A. 1984. Current status of the Sumatran rhino and other large mammals in Southern Sumatra. *IUCN/WWF Report No: 4*. Bogor, Indonesia.

Borner, M. 1978. Status and conservation of the Sumatran tiger. *Carnivore*, 1: 97-102.

Eisenberg, J.F. and Seidensticker, J. 1976. Ungulates in southern Asia: A consideration of biomass estimates for selected habitats. *Biological Conservation*, 10: 293-308.

Hoogerwerf, A. 1970. *Udjung Kulon: The Land of the Last Javan Rhinoceros*. E.J. Brill: Leiden.

McDougal, C. 1977. *The Face of the Tiger*. Rivingdon Books & Andre Deutsch: London.

Myers, N. 1976. The Leopard *Panthera pardus* in Africa. *IUCN Monograph No. 5*. Morges, Switzerland.

Panwar, H.S. 1979. A note on tiger census technique based on pugmark tracings. *Tigerpaper FAO*, 6: 16-18.

Sankala, K. 1979. Tigers in the wild - their distribution and habitat preferences. In: *International Symposium on the Management and Breeding of the Tiger,* Eds. S. Seifert and P. Muller. Zoological Garten Leipzig: Leipzig, pp. 43-59.

Santiapillai, C. and Widodo, S.R. 1985. On the status of the tiger (*Panthera tigris sumatrae* Pocock, 1829) in Sumatra. *Tigerpaper FAO*, 12(4): 23-29.

Santiapillai, C. and Widodo, S.R. 1987. Tiger numbers and habitat evaluation in Indonesia. In: *Tigers of the World,* Eds. R.L. Tilson and U.S. Seal. Noyes Publ.: New Jersey, pp. 85-91.

Schaller, G.B. 1967. *The Deer and the Tiger: A Study of Wildlife in India*. University of Chicago Press: Chicago.

Smith, J.L.D. 1978. Smithsonian tiger ecology project. Unpublished Report No. 13. Smithsonian Institution, Washington, D.C.

Sunquist, M.E. 1981, The social organization of tigers (*Panthera tigris*) in Royal Chitwan National Park, Nepal. *Smithsonian Contrib. Zool.*, 336: 1-98.

Whitten, A.J., Damanik, S.J., Anwar, J. and Hisyam, N. 1984. *The Ecology of Sumatra*. Gadjah Mada University Press: Yogyakarta.