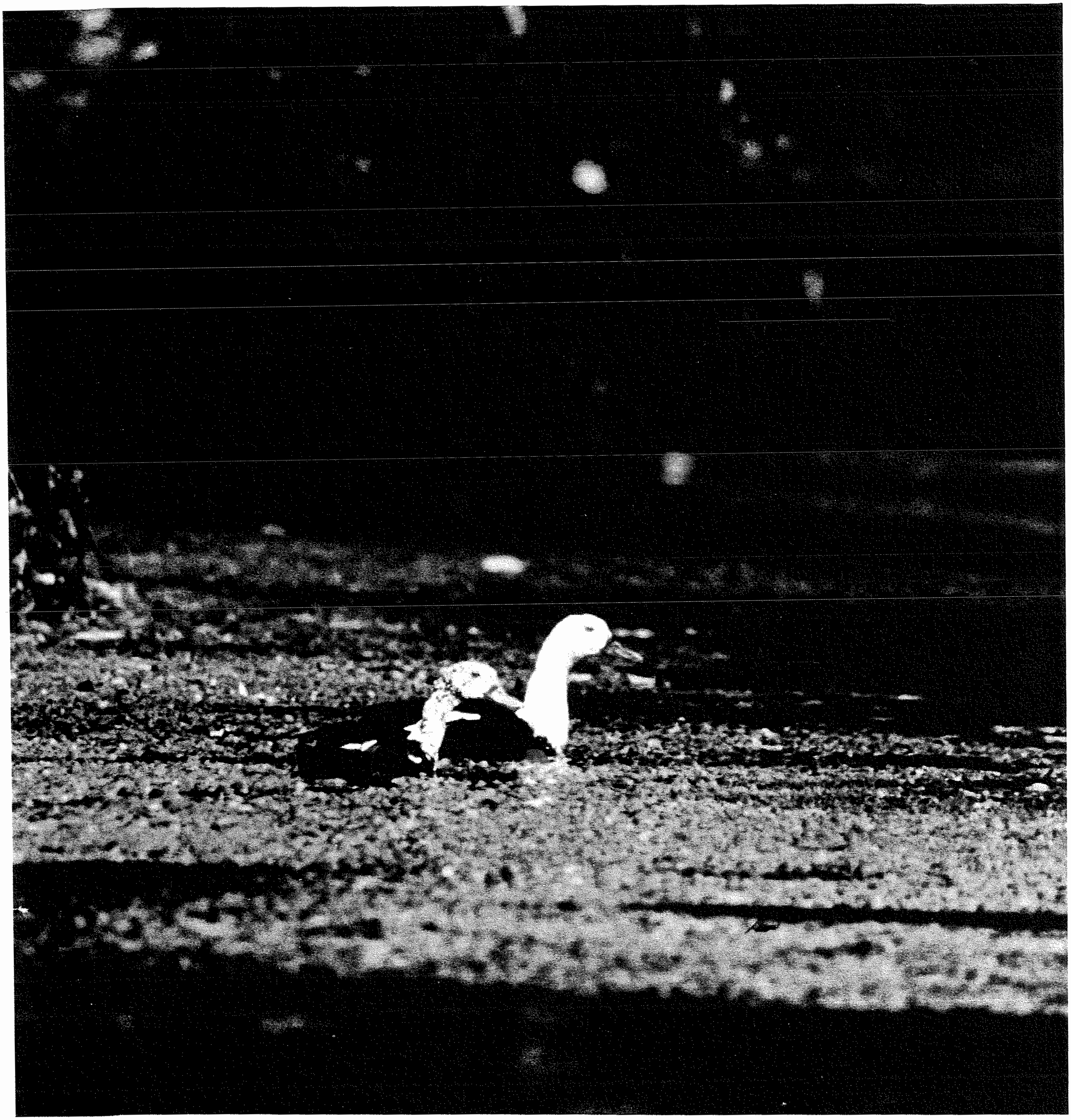


White-Winged Wood Duck
Population and Habitat Viability Analysis

Bandar Lampung, South Sumatra, 1993

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Report

of the Captive Breeding Specialist Group Species Survival Commission of the IUCN

25 January 1994

Workshop Editors:

Mike Ounsted
Asian Wetland Bureau-Indonesia, Indonesia

Komar Soemarna
Indonesian Forest Protection and Nature Conservation, Indonesia

Widodo Ramono
Indonesian Forest Protection and Nature Conservation, Indonesia

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

Andy Green
The Wildfowl & Wetlands Trust, UK

Rudyanto
Birdlife International, Indonesia

Rosie Ounsted

A Joint Endeavor of the
Indonesian Forest Protection and Nature Conservation (PHPA),
Asian Wetland Bureau (AWB)
&
IUCN/SSC Captive Breeding Specialist Group (CBSG)

A contribution of the IUCN/SSC Conservation Breeding Specialist Group, the Indonesian Forest Protection and Nature Conservation (PHPA), and the Asian Wetland Bureau (AWB).

The primary sponsors of the PHVA workshop were The Wildfowl & Wetlands Trust, Jersey Wildlife Preservation Trust, George Williamson & Co. LTD, British Airways Assisting Nature Conservation, and Peoples Trust for Endangered Species.

Cover photo: White Winged Wood Ducks provided by Alain Compost.

Population and Habitat Viability Analysis Report for the White Winged Wood Duck: Ounsted, M., Soemarna, K., Ramono, W., Seal, U.S., Green, A., Rudyanto, Ounsted, R. (eds.). IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN, 1994: 1 - 90.

Additional copies of Population and Habitat Viability Analysis Report for the White Winged Wood Duck can be ordered through the IUCN/SSC Conservation Breeding Specialist Group, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124. Send checks for US $35.00 (for printing and shipping costs) payable to CBSG; checks must be drawn on a US Bank. Funds may be wired to First Bank NA ABA No. 091000022, for credit to CBSG Account No. 1100 1210 1736.

The work of the Conservation Breeding Specialist Group is made possible by generous contributions from the following members of the CBSG Institutional Conservation Council

Conservators ($10,000 and above)

Australasian Species Management Program
Chicago Zoological Society
Columbus Zoological Gardens
Denver Zoological Gardens
Fossil Rim Wildlife Center
Friends of Zoo Atlanta
Greater Los Angeles Zoo Association
International Union of Directors of Zoological Gardens
Metropolitan Toronto Zoo
Minnesota Zoological Garden
Omaha's Henry Doorly Zoo
Saint Louis Zoo
Sea World, Inc.
White Oak Conservation Center
Wildlife Conservation Society-NY
Zoological Society of Cincinnati
Zoological Society of San Diego

Guardians ($5,000-$9,999)

Cleveland Zoological Society
John G. Shedd Aquarium
Loro Parque
Lubee Foundation
North Carolina Zoological Park
Toledo Zoological Society
Wild Animal Habitat
Zoological Parks Board of New South Wales

Protectors ($1,000-$4,999)

Audubon Institute
Bristol Zoo
Caldwell Zoo
Calgary Zoo
Cologne Zoo
Detroit Zoological Park
El Paso Zoo
Federation of Zoological Gardens of Great Britain and Ireland
Fort Wayne Zoological Society
Gladys Porter Zoo
Indianapolis Zoological Society
International Aviculturists Society
Japanese Association of Zoological Parks and Aquariums
Jersey Wildlife Preservation Trust
Lincoln Park Zoo
The Living Desert
Marwell Zoological Park
Milwaukee County Zoo
NOAHS Center
North of England Zoological Society, Chester Zoo
Oklahoma City Zoo
Paignton Zoological and Botanical Gardens
Parco Natura Viva Garda Zoological Park
Penscynor Wildlife Park
Philadelphia Zoological Garden
Phoenix Zoo
Pittsburgh Zoo
Riverbanks Zoological Park
Royal Zoological Society of Antwerp
Royal Zoological Society of Scotland
San Francisco Zoo
Schoenbrunn Zoo
Sedgwick County Zoo
Sunset Zoo (10 year commitment)
Taipei Zoo
The WILDS
The Zoo, Gulf Breeze, FL
Urban Council of Hong Kong
Washington Park Zoo
Wassenaar Wildlife Breeding Centre
Wilhelma Zoological Garden
Woodland Park Zoo
Yong-In Farmland
Zoological Society of London
Zurich Zoological Garden

Stewards ($500-$999)

Aalborg Zoo
Arizona-Sonora Desert Museum
Banham Zoo
Copenhagen Zoo
Cotswold Wildlife Park
Dutch Federation of Zoological Gardens
Erie Zoological Park
Fota Wildlife Park
Givskud Zoo
Granby Zoological Society
International Zoo Veterinary Group
Knoxville Zoo
National Geographic Magazine
National Zoological Gardens of South Africa
Odense Zoo
Orana Park Wildlife Trust
Paradise Park
Perth Zoological Gardens
Porter Charitable Trust
Rolling Hills Ranch (5 year commitment)
Rostock Zoo
Royal Zoological Society of Southern Australia
Rotterdam Zoo
Tierpark Rheine
Twycross Zoo
Union of German Zoo Directors
Wellington Zoo
World Parrot Trust
Zoo de la Casa de Campo-Madrid
Welsh Mt. Zoo/Zool. Society of Wales
Zoologischer Garten Frankfurt

Curators ($250-$499)

Camperdown Wildlife Center
Emporia Zoo
Edward D. Plotka
Racine Zoological Society
Roger Williams Zoo
Thrigby Hall Wildlife Gardens
Topeka Zoological Park
Tropical Bird Garden

Sponsors ($50-$249)

African Safari
Apenheul Zoo
Belize Zoo
Claws 'n Paws
Darmstadt Zoo
Dreher Park Zoo
Fota Wildlife Park
Great Plains Zoo
Hancock House Publisher
Kew Royal Botanic Gardens
Lisbon Zoo
Miller Park Zoo
Nagoya Aquarium
National Audubon Society-Research Ranch Sanctuary
National Aviary in Pittsburgh
Ocean World Taipei Incorporation
PAAZAB
Parco Faunistico "La Torbiera"
Potter Park Zoo
Tenerife Zoo
Tokyo Zoological Park
Touro Parc-France

Supporters ($25-$49)

Alameda Park Zoo
American Loriinae Conservancy
Brandywine Zoo
DGHT Arbeitsgruppe Anuren
Folsom Children's Zoo & Botanical Garden
International Crane Foundation
Jardin aux Oiseaux
King Khalid Wildlife Research Center
Lee Richardson Zoo
Natal Parks Board
Oglebay's Good Children's Zoo
Speedwell Bird Sanctuary

22 February 1995

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Bandar Lampung, Indonesia

8 - 11 November 1993

Supporting Organizations:

The Wildfowl & Wetlands Trust

Jersey Wildlife Preservation Trust

George Williamson & Co. LTD

British Airways Assisting Nature Conservation

People's Trust for Endangered Species

White-Winged Wood Duck in Sumatra
Population and Habitat Viability Analysis Report

Table of Contents

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 1: Executive Summary

4

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 2: White-Winged Wood Duck PHVA Workshop

Executive Summary

White-Winged Wood Duck
Population and Habitat Viability Analysis

The first Population and Habitat Viability Analysis (PHVA) Workshop for the White-winged Wood Duck *Cairina scutulata* in Sumatra was held in Bandar Lampung, Lampung Province, Sumatra, Indonesia, between 8-11 November 1993; PHVA workshops on the Sumatran Rhino and the Asian Elephant were held concurrently.

The workshop was conducted by Ulysses Seal, Chairman of the IUCN/SSC Captive Breeding Specialist Group (CBSG), and Ronald Tilson, Director of Conservation, Minnesota Zoo, coordinated by the CBSG and led by Asian Wetland Bureau - Indonesia. The workshop was attended by 25 people, including White-Winged Wood Duck specialists from India, England and Thailand, PHPA officials and staff, and Indonesian and European students working at Way Kambas National Park. The sponsors of the workshop included The Wildfowl & Wetlands Trust, Jersey Wildlife Preservation Trust, George Williamson & Co. Ltd, British Airways Assisting Nature Conservation Programme and the People's Trust for Endangered Species.

The workshop focused on the status of the White-winged Wood Duck in Sumatra but incorporated relevant information from researchers from Assam and Thailand, two areas where the species is still observed in the wild, and from White-winged Wood Duck captive-breeding specialists. Two main working groups were established to investigate **Distribution and Status** and **Life History and VORTEX Analysis.** Two smaller groups, one comprising workers with first-hand experience of the current situation at Way Kambas National Park and one which included PHPA staff, were convened to discuss **Tourism and Disturbance** and the **Status of known White-winged Wood Duck sites in Sumatra.**

Population numbers for the species on Sumatra were computed by reference to the existing literature and by extrapolation from data from the limited amount of survey work undertaken to date. The principal source of reference was: Green, A.J. (1992) *The Status and Conservation of the White-winged Wood Duck Cairina scutulata: IWRB Special Publication No. 17.* The **known** number of individuals in Sumatra at the beginning of the workshop was *c.* 110 birds in some 20 sites, but new information from the workshop suggests that habitat loss has already reduced this number to 79. The **actual** total population size is estimated to be over 1,000, with most birds in unprotected habitat which is at risk of destruction in the near future: it is believed that up to 90% of remaining habitat is currently unprotected, so that its future cannot be guaranteed. Furthermore, important areas such as Way Kambas National Park, in Lampung Province, and Padang Sugihan Wildlife Sanctuary, in Sumatera Selatan, which enjoy `protected' status, are also vulnerable to abuse by encroachment, degradation and disturbance. Of 10 sites in Lampung and Sumatera Selatan identified in a 1988 survey as holding at least 57 birds, five sites holding 67% of these birds have **already been destroyed.** In recent years observations have been made of White-winged Wood Duck foraging in rice paddies, but this may further threaten the species's existence as farmers are known to have killed birds in order to protect their crops.

In view of the almost total lack of data from birds found in the wild, it was necessary to use information gathered from White-winged Wood Duck held in captivity in order to provide figures for the VORTEX analysis. Successful captive breeding of White-winged Wood Duck has taken place in bird collections around the world, but principally in England and Thailand. PHVA workshops use computer models (the VORTEX programme) 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. VORTEX modelling carried out at this workshop showed that populations of 20 or fewer individual White-winged Wood Duck have a high probability of extinction within 50 years. The population in Way Kambas National Park, believed to number *c.* 30 birds, is therefore the **only known**, potentially viable population currently lying within a protected area.

Specific recommendations were drawn up for the Way Kambas population. These included:

> The establishment of an adequately-resourced **Research Programme** to investigate all aspects of the White-winged Wood Duck's ecology and biology in the National Park and to identify management strategies that will increase the size of White-winged Wood Duck populations.
>
> The institution of **information and training** programmes for managers and park staff, and an **education programme** to promote public interest.
>
> The introduction of measures to improve the **management** of the National Park to maximise its carrying capacity for White-winged Wood Duck. These measures would include the regulation of tourism and the enforcement of legislation to control illegal activities both within and around the boundaries of the park.

On the basis of current knowledge the White-winged Wood Duck in Sumatra qualifies for the highest IUCN category of threat: Critical. The consensus of those attending the workshop was that the species was under serious threat of extinction in Sumatra. It was agreed that, as the Indonesian White-winged Wood Duck is morphologically distinct from the bird found in India, Bangladesh, Thailand, Myanmar, Laos, Vietnam and Cambodia, it should be considered as a separate sub-species. Recommendations for the protection of the White-winged Wood Duck in Sumatra were drawn up. The only case in which recommendations were not agreed by all participants was in respect of measures to reduce disturbance from tourism in Way Kambas National Park, and the differing views are represented by separate statements in the appropriate section of this document. The main recommendations, which represent a consensus of all the participants, are summarised below:

> In order to conserve viable populations of White-winged Wood Duck it is **essential to make extensions to the protected area system.** Those required include extensions to the boundaries of Berbak National Park and Kerumutan Wildlife Reserve.

Further surveys are essential in areas of potential habitat in order to identify and protect further viable populations of White-winged Wood Duck before their habitat is destroyed.

Protection measures for the White-winged Wood Duck should be incorporated into **planning and land-management strategies** both at national and provincial levels, and the resources necessary to enforce regulations should be made available.

As noted above, **research and management trials** should be undertaken at Way Kambas National Park so that it can be used as the model for other sites on Sumatra.

A national **White-winged Wood Duck Working Group** should be established to monitor regularly the status of White-winged Wood Duck and the progress of these recommendations.

Problem Statement

White-Winged Wood Duck
Population and Habitat Viability Analysis

Since the species was first described in 1840, numerous records show that the White-winged Wood Duck *Cairina scutulata* population was widely distributed and that birds were abundant throughout South East Asia, with confirmed records from nine countries.

However, since the 1950s, rapid and extensive man-made modification to wetland rainforests has dramatically contracted the White-winged Wood Duck's critical habitat, and reduced the duck's global population, distributed in fragmented and isolated groups, to an endangered level. The White-winged Wood Duck has become **one of the rarest and most threatened waterfowl in the world.**

The Sumatran population is the largest of the remnant, discrete populations of White-winged Wood Duck, though the substantial morphological differences between continental and Indonesian birds suggest that the Sumatran White-winged Wood Duck could be regarded as a sub-species. If this were so, there should be even greater concern about the survival of the Sumatran population.

Historically the species has been recorded in all eight of Sumatra's provinces, though recent surveys have recorded White-winged Wood Duck in only 20 locations. The most important, known area is located around Sungai Rasau in Way Kambas National Park, where up to 30 birds are thought to have been present for at least five years. However, there could be potentially viable populations in unsurveyed, isolated locations in other suitable forest habitats that remain intact, and also in sites where the species's presence has already been confirmed. The total known population in Sumatra today is *c.* 110 birds.

In Sumatra land-use change on an unprecedented scale and associated shifts in human populations and their activities have been identified as the causes of the catastrophic decline in the indigenous White-winged Wood Duck population, and the species has been protected under Indonesian law by a Government decree made in 1972.

Observations in Sumatra and elsewhere suggest that the White-winged Wood Duck may be able to survive in degraded forests: ducks have also been recorded outside their traditional wetland rainforest habitat, in peat-swamp forests and mangrove areas and feeding in paddy fields. This may indicate either that the species has the potential to exploit these alternative habitats or simply that the loss of natural habitat has forced the birds to utilise these areas.

Successful captive breeding of ducks originating in India and Thailand has led to a higher population of White-winged Wood Duck in captivity than has been recorded in the wild. Although ducklings have been observed in the wild, there is no confirmed record of a White-winged Wood Duck nest in Sumatra, and we have no data on breeding prior to the hatching period. Observations of birds in captivity provide us with baseline data, but such data may not always be relevant to the species in the wild in Sumatra because of the substantial difference between a controlled and the wild environment, and since the Sumatran race is likely to be a distinct sub-species.

In considering their recommendations from this workshop, the participants are acutely aware that time is of the essence - time both for immediate and clear action and to allow the White-winged Wood Duck to adapt and recover to viable population levels in the ecosystems it shares with other fauna and flora.

Goal of the Workshop

The goal of the participants of the White-Winged Wood Duck PHVA Workshop was to:

> Make recommendations, endorsed by all the workshop participants, that will safeguard a viable population of White-Winged Wood Duck in Sumatra.

To achieve this goal the participants set themselves the following objectives:

1) To assess the current status of White-Winged Wood Duck in Sumatra;

2) To assemble existing information, both published and unpublished, on the life history and population size of the species, and to use computer simulation models to evaluate the risks and opportunities;

3) To predict the behaviour and life history of White-winged Wood Duck in the wild, based on experience of the species in captivity;

4) To determine the critical habitat requirements for White-winged Wood Duck in Sumatra, and the location of areas sufficiently large to sustain White-winged Wood Duck populations;

5) To consider the impact on the species of historical, ongoing and predicted habitat changes;

6) To define requirements for viability and delineate metapopulation structures that could achieve population viability, and, within these, to consider the role of captive breeding;

7) To consider whether White-winged Wood Duck in Sumatra should be classified as a sub-race of *Cairina scutulata*, and whether it has specific, unique requirements; and

8) To determine the protection measures that will safeguard suitable habitat.

LAPORAN PENYELENGGARA

Assalamualaikaum Wr.Wb.,

Yang terhormat Bapak Menteri Kehutanan R.I. yang dalam hal ini diwakili oleh Bpk. Kepala Badan Penelitian dan Pengembangan Kehutanan,
Yang terhormat Bapak Gubernur KDH.Tingkat I Propinsi Lampung, yang dalam hal ini diwakili oleh Bpk. Asisten II Sekwilda Propinsi Lampung,
Yang kami hormati Bapak Kepala Kantor Wilayah Departemen Kehutanan Propinsi Lampung,
Para Pakar Internasional di bidang konservasi badak sumatera, gajah asia dan belibis pohon sayap putih, yang terdiri dari IUCN/CBSG, IUCN/SSC AsESG - AsRSG, International Rhino Foundation, Zoo Specialists,
Hadirin sekalian yang berbahagia.

Allow me to report on the preparation of this meeting in Bahasa Indonesia,

Perkenankan kami melaporkan bahwa pada saat ini telah berkumpul para pakar dibidang konservasi satwa badak sumatera, para pakar gajah asia dan para pakar belibis pohon sayap putih, para pelaksana teknis konservasi, pecinta margasatwa dan para pengamat yang berjumlah 60 orang.

Para peminat konservasi satwa tersebut yang berasal dari Amerika Serikat, Inggris, India, Sri Langka, Thailand, Malaysia, New Zealand, Australia dan Indonesia, berkumpul atas kerjasama antara:
Direktorat Jenderal Perlindungan Hutan dan Pelestarian Alam Departemen Kehutanan, dengan
Survival Service Commission (SSC) dari International Union for Conservation of Nature and Natural Resources (IUCN) yang diwakili oleh Captive Breeding Specialists Group (CBSG), dan
Taman Safari Indonesia sebagai anggota IUCN SSC/CBSG.

Dalam rangka memperingati Hari Cinta Puspa dan Satwa Nasional tahun 1993, dengan mengambil tempat di Hotel Marcopolo Bandarlampung di Propinsi yang terkenal gajahnya ini, para pakar dan teknisi tersebut bermaksud untuk membicarakan mengenai konservasi badak, gajah dan belibis pohon sayap putih dalam suatu lokakarya yang bertujuan untuk:
merumuskan saran strategi pengembangan manajemen kawasan konservasi di Sumatera dan dengan sasaran-sasaran:

- analis...

- analisis tentang status terakhir populasi dan distribusi gajah asia dan badak sumatera serta belibis pohon sayap putih,
- habitat dan pola pemanfaatan lahan,
- masalah perburuan liar,
- koordinasi antar instansi lokal terkait dan hal-hal penting lain, dalam perumusan strategi jangka panjang pengembangan manajemen populasi dan habitat satwa-satwa tersebut.
- masalah gangguan gajah

Demikian laporan kami dan akhirnya perkenankan kami memohon kepada Bapak Menteri Kehutanan untuk pada waktunya berkenan membuka Lokakarya ini.

Wassalamualaikum Wr.Wb.

tertanda,

Komar Soemarna MS.
Direktur Bina Kawasan Suaka Alam dan Konservasi Flora Fauna.

MENTERI KEHUTANAN
REPUBLIK INDONESIA

SAMBUTAN PENGARAHAN

MENTERI KEHUTANAN REPUBLIK INDONESIA

PADA LOKAKARYA MENGENAI KONSERVASI GAJAH ASIA, BADAK SUMATERA DAN BELIBIS SAYAP PUTIH

PADA 8-13 NOVEMBER 1993

MARCO POLO, BANDAR LAMPUNG, SUMATERA SELATAN

ASSALAMUALAIKUM WR.WB.

SAUDARA-SAUDARA DIREKTUR JENDERAL, DIREKTUR DAN KEPALA KANTOR WILAYAH SERTA KEPALA DINAS LINGKUP DEPARTEMEN KEHUTANAN YANG SAYA HORMATI.

SAURARA-SAUDARA PARA PESERTA LOKAKARYA, PARA UNDANGAN DAN HADIRIN SEKALIAN YANG SAYA HORMATI.

PERTAMA-TAMA MARILAH KITA MEMANJATKAN PUJI DAN SYUKUR KEHADIRAT TUHAN YANG MAHA ESA, BAHWA KARENA KEHENDAKNYA PADA HARI INI KITA DAPAT BERKUMPUL BERSAMA DI TEMPAT INI DALAM KEADAAN SEHAT WAL`AFIAT DALAM RANGKA MENGHADIRI LOKAKARYA MENGENAI KONSERVASI GAJAH ASIA, BADAK SUMATERA DAN BELIBIS SAYAP PUTIH YANG DISELENGGARAKAN ATAS KERJASAMA DEPARTEMEN KEHUTANAN, DIREKTORAT JENDERAL PERLINDUNGAN HUTAN DAN PELESTARIAN ALAM, YAYASAN MITRA RHINO, IUCN, WWF, AWB, AAZPA DAN IRF YANG TELAH BANYAK MEMBANTU DEPARTEMEN KEHUTANAN, DIREKTORAT JENDERAL PERLINDUNGAN HUTAN DAN PELESTARIAN ALAM DALAM TUGAS KONSERVASI BAIK IN-SITU MAUPUN EKS-SITU DI INDONESIA.

SAUDARA-SAUDARA SERTA HADIRIN SEKALIAN YANG SAYA HORMATI,

PADA KESEMPATAN INI SAYA INGIN MENGEMUKAKAN RASA KEGEMBIRAAN SAYA, KARENA SAUDARA-SAUDARA DAPAT MENGHADIRI LOKAKARYA INI YANG MERUPAKAN RANGKAIAN DARI KEGIATAN KONSERVASI FLORA DAN FAUNA NASIONAL DALAM RANGKA MEMPERINGATI "HARI CINTA PUSPA DAN SATWA NASIONAL (HCPSN)" YANG TELAH DITETAPKAN JATUH PADA SETIAP TANGGAL 5 NOPEMBER. HCPSN INI TELAH DICANANGKAN OLEH PRESIDEN REPUBLIK INDONESIA, DALAM KATA SAMBUTANNYA PADA UPACARA PENCANANGAN TAHUN LINGKUNGAN HIDUP PADA TANGGAL 10 JANUARI 1993 DI TAMAN MONAS, JAKARTA.

SAYA JUGA BERSYUKUR KEPADA TUHAN YANG MAHA ESA, KARENA SAUDARA-SAUDARA DAPAT MENGHADIRI LOKAKARYA INI UNTUK MEMBERIKAN SUMBANGAN SARAN DALAM KONSERVASI GAJAH ASIA, BADAK SIMATERA DAN BELIBIS SAYAP PUTIH. TENTUNYA SUMBANGAN SARAN SAUDARA INI AKAN SANGAT BERARTI BAGI UPAYA MENINGKATKAN PEMBANGUNAN BERWAWASAN LINGKUNGAN YANG BERKELANJUTAN.

TIDAK LUPA SAYA SAMPAIKAN TERIMA KASIH KEPADA SEMUA PIHAK YANG TELAH BERUPAYA, SEHINGGA LOKAKARYA INI DAPAT DILAKSANAKAN, TERUTAMA REKAN-REKAN KAMI DARI IUCN/SSC-CBSG, WWF, AWB AAZPA DAN IRF

SAUDARA-SAUDARA PESERTA LOKAKARYA YANG SAYA HORMATI,

DALAM PENJELASAN UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA TELAH DITEGASKAN BAHWA SATWA LIAR ADALAH SEMUA BINATANG YANG HIDUP DI DARAT, DAN DI AIR, DAN ATAU DI UDARA YANG MASIH MEMPUNYAI SIFAT-SIFAT LIAR, BAIK YANG HIDUP BEBAS MAUPUN YANG DIPELIHARA OLEH SEMUA MANUSIA. GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS

SAYAP PUTIH ADALAH SATWA LIAR YANG TELAH MENGALAMI PENURUNAN POPULASI YANG CUKUP DRASTIS DI ALAM DI TEMPAT HIDUPNYA YANG BEBAS. KETIGA JENIS SATWA LIAR INI ADALAH MERUPAKAN SUMBER DAYA ALAM HAYATI YANG MENEMPATI EKOSISTIM TERTENTU YANG DAPAT DIUSAHAKAN KELESTARIAN DAN KESEIMBANGAN EKOSISTIMNYA SEHINGGA DAPAT LEBIH MENDUKUNG UPAYA PENINGKATAN KESEJAHTE-RAAN MASYARAKAT DAN MUTU KEHIDUPAN MANUSIA. KONS-ERVASI SUMBER DAYA ALAM HAYATI DAN ESKOSISTIMNYA INI ADALAH MERUPAKAN TANGGUNG JAWAB DAN KEWAJIBAN PEMERINTAH SERTA MASYARAKAT.

PARA HADIRIN SEKALIAN YANG SAYA HORMATI,

DALAM UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA TELAH DITETAPKAN BAHWA KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA DILAKUKAN MELALUI KEGIATAN :

1. PERLINDUNGAN SISTEM PENYANGGA KEHIDUPAN
2. PENGAWETAN KEANEKARAGAMAN JENIS TUMBUHAN DAN SATWA BESERTA EKOSISTIMNYA;
3. PEMANFAATAN SECARA LESTARI SUMBER DAYA ALAM HAYATI DAN EKOSISTIMNYA.

SEDANGKAN PENGAWETAN KEANEKARAGAMAN TUMBUHAN DAN SATWA BESERTA EKOSISTEMNYA, DILAKSANAKAN MELALUI KEGIATAN :

A. PENGAWETAN KEANEKARAGAMAN TUMBUHAN DAN SATWA BESERTA EKOSISTEMNYA;
B. PENGAWETAN JENIS TUMBUHAN DAN SATWA

UPAYA-UPAYA PENGAWETAN JENIS TUMBUHAN INI BERPEDOMAN PADA TIGA HAL KEGIATAN SEBAGAI BERIKUT :

1. PENGAWETAN JENIS TUMBUHAN DAN SATWA DILAKSANAKAN DI DALAM DAN DI LUAR KAWASAN SUAKA ALAM
2. PENGAWETAN JENIS TUMBUHAN DAN SATWA DI DALAM KAWASAN SUAKA ALAM DILAKUKAN DENGAN MEMBIARKAN AGAR POPULASI SEMUA JENIS TUMBUHAN DAN SATWA TETAP SEIMBANG MENURUT PROSES ALAMI DI HABITATNYA

3. PENGAWETAN JENIS TUMBUHAN DAN SATWA DI LUAR KAWASAN SUAKA ALAM DILAKUKAN DENGAN MENJAGA DAN MENGEMBANGBIAKKAN JENIS TUMBUHAN DAN SATWA UNTUK MENGHINDARI BAHAYA KEPUNAHAN

TUMBUHAN DAN SATWA DIGOLONGKAN DALAM JENIS :

A. TUMBUHAN DAN SATWA YANG DILINDUNGI;
B. TUMBUHAN DAN SATWA YANG TIDAK DILINDUNGI.

SEDANGKAN JENIS TUMBUHAN DAN SATWA YANG DILINDUNGI DIGOLONGKAN DALAM :

A. TUMBUHAN DAN SATWA DALAM BAHAYA KEPUNAHAN;
B. TUMBUHAN DAN SATWA YANG POPULASINYA JARANG.

GAJAH ASIA, BADAK SUMATERA , DAN BELIBIS SAYAP PUTIH ADALAH TERMASUK DALAM KATAGORI SATWA DALAM BAHAYA KEPUNAHAN, DAN ATAU MERUPAKAN SATWA YANG POPULASI-NYA JARANG . TENTU SAJA KETIGA JENIS SATWA INI DI INDONESIA MERUPAKAN JENIS-JENIS SATWA YANG DILINDUNGI OLEH UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYTATI DAN EKOSISTEMNYA. SEHINGGA SETIAP ORANG DILARANG UNTUK :

A. MENANGKAP, MELUKAI, MEMBUNUH, MENYIMPAN, MEMILIKI, MEMELIHARA, MENGANGKUT DAN MEMPERNIAGAKAN SATWA YANG DILINDUNGI DALAM KEADAAN HIDUP;

B. MENYIMPAN, MEMILIKI, MEMELIHARA, MENGANGKUT, DAN MEMPERNIAGAKAN SATWA YANG DILINDUNGI DALAM KEADAAN MATI;

C. MENGELUARKAN SATWA YANG DILINDUNGI DARI SUATU TEMPAT DI INDONESIA KE TEMPAT LAIN DI DALAM ATAU DI LUAR INDONESIA;

D. MEMPERNIAGAKAN, MENYIMPAN ATAU MEMILIKI KULIT, TUBUH, ATAU BAGIAN-BAGIAN LAIN SATWA YANG DILINDUNGI ATAU BARANG-BARANG YANG DIBUAT DARI BAGIAN-BAGIAN SATWA SATWA TERSEBUT ATAU MENGELUARKANNYA DARI SUATU TEMPAT DI INDONESIA KE TEMPAT LAIN DI DALAM ATAU DI LUAR INDONESIA;

E. MENGAMBIL, MERUSAK, MEMUSNAHKAN, MEMPERNIAGAKAN, MENYIMPAN ATAU MEMILIKI TELUR DAN/ATAU SARANG SATWA YANG DILINDUNGI.

PENGECUALIAN DARI LARANGAN TERSEBUT HANYA DAPAT DILAKUKAN UNTUK KEPERLUAN PENELITIAN, ILMU PENGETAHUAN, DAN/ATAU PENYELAMATAN JENIS SATWA YANG BERSANGKUTAN; TERMASUK PEMBERIAN ATAU PENUKARAN JENIS SATWA KEPADA PIHAK LAIN DI LUAR NEGERI DENGAN IZIN PEMERINTAH. PENGECUALIAN DARI LARANGAN MENANGKAP, MELUKAI, DAN MEMBUNUH SATWA YANG DILINDUNGI DAPAT PULA DILAKUKAN DALAM HAL OLEH KARENA SUATU SEBAB SATWA YANG DILINDUNGI MEMBAHAYAKAN KEHIDUPAN MANUSIA.

SAUDARA-SAUDARA SEKALIAN PESERTA LOKAKARYA YANG SAYA HORMATI,

JELASLAH SUDAH BAHWA UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA SANGAT MENEKANKAN BAGI KEPENTINGAN PEMBANGUNAN BERKELANJUTAN DAN KESEJAHTERAAN MANUSIA. APABILA TERJADI PELANGGARAN TERHADAP LARANGAN SEBAGAIMANA DIMAKSUD DI ATAS, SATWA YANG DILINDUNGI TERSEBUT DIRAMPAS UNTUK NEGARA. JENIS SATWA YANG DILINDUNGI ATAU BAGIAN-BAGIANNYA YANG DIRAMPAS UNTUK NEGARA DIKEMBALIKAN KE HABITATNYA ATAU DISERAHKAN KEPADA LEMBAGA-LEMBAGA YANG BERGERAK DI BIDANG KONSERVASI SATWA, KECUALI APABILA KEADAANNYA SUDAH TIDAK MEMUNGKINKAN UNTUK DIMANFAATKAN SEHINGGA DINILAI LEBIH BAIK DIMUSNAHKAN. PENGAWETAN JENIS

TUMBUHAN DAN SATWA YANG DILINDUNGI HANYA DAPAT DILAKUKAN DALAM BENTUK PEMELIHARAAN ATAU PENGEMBANGAN OLEH LEMBAGA-LEMBAGA YANG DIBENTUK UNTUK ITU.

PEMANFAATAN SECARA LESTARI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA DILAKUKAN MELALUI KEGIATAN :

A. PEMANFAATAN KONDISI LINGKUNGAN KAWASAN PELESTARIAN ALAM;
B. PEMANFAATAN JENIS TUMBUHAN DAN SAWTA LIAR.

DIMANA PEMANFAATAN JENIS TUMBUHAN DAN SATWA LIAR DILAKUKAN DENGAN MEMPERHATIKAN KELANGSUNGAN POTENSI, DAYA DUKUNG, DAN KEANEKARAGAMAN JENIS TUMBUHAN DAN SATWA LIAR. SEDANGKAN PEMANFAATAN JENIS TUMBUHAN DAN SATWA LIAR DAPAT DILAKSANAKAN DALAM BENTUK :

A. PENGKAJIAN, PENELITIAN DAN PENGEMBANGAN;
B. PENANGKARAN;
C. PERBURUAN;
D. PERDAGANGAN
E. PERAGAAN;
F. PERTUKARAN;
G. BUDIDAYA TANAMAN OBAT-OBATAN;
H. PEMELIHARAAN UNTUK KESENANGAN.

HADIRIN SEKALIAN YANG SAYA HORMATI,

UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA JUGA TIDAK MENGABAIKAN PERANSERTA MASYARAKAT, YAITU : PERAN SERTA MASYARAKAT DALAM KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA DIARAHKAN DAN DIGERAKKAN OLEH PEMERINTAH MELALUI BERBAGAI KEGIATAN YANG BERDAYA GUNA DAN BERHASIL GUNA; DALAM

MENGEMBANGKAN PERAN SERTA MASYARAKAT, PEMERINTAH MENUMBUHKAN DAN MENINGKATKAN SADAR KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA DIKALANGAN MASYARAKAT MELALUI PENDIDIKAN DAN PENYLUHAN. PERAN SERTA MASYARAKAT DALAM KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA INI SUDAH TUMBUH KEMBANG SEHINGGA SANGAT MEMBANTU DALAM MENINGKATKAN UPAYA KONSERVASI TUMBUHAN DAN JENIS SATWA YANG DILINDUNGI DI INDONESIA.

BERHASILNYA KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA BERKAITAN ERAT DENGAN TERCAPAINYA TIGA SASARAN KONSERVASI, YAITU :

1. MENJAMIN TERPELIHARANYA PROSES EKOLOGIS YANG MENUNJANG SISTEM PENYANGGA KEHIDUPAN BAGI KELANGSUNGAN PEMBANGUNAN DAN KESEJAHTERAAN MANUSIA (PERLINDUNGAN SISTEM PENYANGGA KEHIDUPAN)

2. MENJAMIN TERPELIHARANYA KEANEKARAGAMAN SUMBER GENETIK DAN TIPE-TIPE EKOSISTEMNYA SEHINGGA MAMPU MENUNJANG PEMBANGUNAN, ILMU PENGETAHUAN, DAN TEKNOLOGI YANG MEMUNGKINKAN PEMENUHAN KEBUTUHAN MANUSIA YANG MENGGUNAKAN SUMBER DAYA ALAM HAYATI BAGI KESEJAHTERAAN (PENGAWETAN SUMBER PLASMA NUTFAH)

3. MENGENDALIKAN CARA-CARA PEMANFAATAN SUMBER DAYA ALAM HAYATI SEHINGGA TERJAMIN KELESTARIANNYA. AKIBAT SAMPINGAN PENERAPAN ILMU PENGETAHUAN DAN TEKNOLOGI YANG KURANG BIJAKSANA, BELUM HARMONISNYA PENGGGUNAAN DAN PERUNTUKAN TANAH SERTA BELUM BERHASILNYA SASARAN KONSERVASI SECARA OPTIMAL, BAIK DI DARAT MAUPUN PERAIRAN DAPAT MENGAKIBATKAN TIMBULNYA GEJALA EROSI GENETIK, POLUSI, DAN PENURUNAN POTENSI SUMBER DAYA ALAM HAYATI (PEMANFAATAN SECARA LESTARI).

UPAYA PEMANFAATAN SECARA LESTARI SEBAGAI SALAH SATU ASPEK KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA, BELUM SEPENUHNYA DIKEMBANGKAN SESUAI DENGAN KEBUTUHAN, DEMIKIAN PULA PENGELOLAAN KAWASAN PELESTARIAN ALAM DALAM BENTUK TAMAN NASIONAL, TAMAN HUTAN RAYA, DAN TAMAN HUTAN WISATA ALAM, YANG MENYATUKAN FUNGSI PERLINDUNGAN SISTEM PENYANGGA KEHIDUPAN, PENGAWETAN KEANEKARAGAMAN JENIS TUMBUHAN DAN SATWA BESERTA EKOSISTEMNYA, DAN PEMANFAATAN SECARA LESTARI.

GAJAH ASIA, BADAK SUMATERA DAN BELIBIS SAYAP PUTIH YANG MERUPAKAN SUMBERDAYA ALAM HAYATI MERUPAKAN UNSUR EKOSISTEM YANG DAPAT DIMANFAATKAN UNTUK MENINGKATKAN KESEJAHTERAAN MASYARAKAT DAN MUTU KEHIDUPAN MANUSIA. NAMUN, KESEIMBANGAN EKOSISTEMNYA YANG HARUS TETAP TERJAMIN. OLEH KARENA ITU, MENGINGAT PENTINGNYA KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA BAGI PENINGKATAN KESEJAHTERAAN MASYARAKAT DAN MUTU KEHIDUPAN MANUSIA, MAKA MASYARAKAT JUGA MEMPUNYAI KEWAJIBAN DAN TANGGUNGJAWAB DALAM MELAKSANAKAN KEGIATAN KONSERVASI.

HADIRIN SEKALIAN PESERTA LOKAKARYA YANG SAYA HORMATI,

LOKAKARYA KONSERVASI GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS SAYAP PUTIH YANG DIMULAI HARI INI, DIHARAPKAN DAPAT MEMBERI MASUKAN DAN MENYEMPURNAKAN HASIL-HASIL LOKAKARYA DAN SEMINAR YANG PERNAH DISELENGGARAKAN.

SEHUBUNGAN DENGAN HAL-HAL YANG TELAH SAYA SAMPAIKAN DIATAS, MENGENAI UNDANG-UNDANG NO. 5 TAHUN 1990 TENTANG KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA, DIMANA KETIGA JENIS DARI GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS SAYAP PUTIH JUGA SEBAGAI SUMBER DAYA ALAM HAYATI DAN MERUPAKAN PULA SATWA LANGKA YANG TELAH DILINDUNGI;

MAKA BESAR HARAPAN SAYA AGAR DALAM LOKAKARYA INI SAUDARA-SAUDARA DAPAT MERUMUSKAN HAL-HAL YANG SANGAT MENDASAR UNTUK DAPAT MENGIMPLEMENTASIKAN KEGIATAN KONSERVASI DARI KETIGA JENIS SATWA LANGKA YANG TELAH DILINDUNGI TERSEBUT AGAR DAPAT BERMANFAAT BAGI KESEJAHTERAAN MASYARAKAT DAN KEHIDUPAN MANUSIA SECARA LESTARI. HAL INI DAPAT MENUNJANG PROGRAM PEMBANGUNAN JANGKA PANJANG TAHAP KE II DIMANA PROGRAM PEMBANGUNAN NASIONAL SAAT INI SUDAH MEMPRIORITASKAN KONSERVASI UNTUK DAPAT MENGENTASKAN KEMISKINAN. SEBAB SELAMA PROGRAM PEMBANGUNAN BELUM DAPAT MENGENTASKAN KEMISKINAN BERARTI PEMERINTAH BELUM BERHASIL MENINGKATKAN UPAYA KONSERVASI SUMBER DAYA ALAM HAYATI DAN EKOSISTEMNYA.

SAYA BERHARAP BAHWA RUMUSAN HASIL-HASIL LOKAKARYA INI DAN PETUNJUK-PETUNJUK PELAKSANAAN YANG AKAN DIHASIL-KAN OLEH PARA PAKAR GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS SAYAP PUTIH, DAPAT SEGERA DIOPERASIONALKAN DILAPANGAN .

SAUDARA-SAUDARA HADIRIN YANG SAYA HORMATI,

SEKALI LAGI SAYA SAMPAIKAN TERIMA KASIH KEPADA PANITIA PENYELENGGARA DAN SAUDARA-SAUDARA PESERTA DALAM BERPERANSERTA DALAM LOKAKARYA INI. SEMOGA SUMBANGAN PEMIKIRAN SAUDARA-SAUDARA DAPAT BERMANFAAT BAGI PENGEMBANGAN KONSERVASI GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS SAYAP PUTIH, DAN SATWA LIAR LAIN PADA UMUMNYA DI INDONESIA.

AKHIRNYA DENGAN MENGUCAPKAN BISMILLAHHIRROHMANIR-ROHIM, DENGAN INI SAYA BUKA LOKAKARYA KONSERVASI GAJAH ASIA, BADAK SUMATERA, DAN BELIBIS SAYAP PUTIH YANG MERUPAKAN RANGKAIAN PERINGATAN KEGIATAN HARI CINTA PUSPA DAN SATWA INDONESIA PADA 5 NOPEMBER 1993.

WASSALAMUALAIKUM. WR. WB.

BANDAR LAMPUNG, 8 NOPEMBER 1993

MENTERI KEHUTANAN

DJAMALUDIN

White-Winged Wood Duck
Population and Habitat Viability Analysis

Bandar Lampung, South Sumatra
8 - 11 November 1993

Workshop Agenda

7 November	Workshop Coordinators meeting (PM)
8 November	Workshop convenes (9:00 AM); Opening comments Overview of white-winged wood duck biology, distribution, status, and threats Presentation of map-linked database and land use patterns PHVA overview/initial modelling of white-winged wood duck populations and GIS Working groups/Sumatran Protected Areas and Vortex models Discussion and data verification of working groups
9 November	Status reports of working groups Overview of white-winged wood duck management strategies Working groups: Evaluation of management strategies
10 November	Working group reports Genetic management of metapopulations Integration of management strategies Workshop draft recommendations: overall and site-specific
11 November	Field trip to Way Kambas National Park Drafting of final report

White-Winged Wood Duck
Population and Habitat Viability Analysis

Workshop Participants:

Komar Soemarna, Director of Nature Conservation-PHPA, Indonesia
Widodo Ramono, Chief Sub-Directorate Species Conservation-PHPA, Indonesia
Michael Ounsted, Asian Wetland Bureau, Indonesia
Rudyanto, Asian Wetland Bureau, Indonesia
Ulysses Seal, IUCN/SSC CBSG Chair, USA
Ronald Tilson, IUCN/SSC CBSG and Minnesota Zoo, USA
Andy Green, The Wildfowl and Wetlands Trust, UK
Rosie Ounsted, Indonesia
Pongpan Laothong, Royal Thai Forest Department, Thailand
Anwaruddin Choudhury, Assam
Teguh Husodo, Padjadjaran University, Indonesia
Hasudungan Pakpahan, Padjadjaran University, Indonesia
Apriawan, PHPA, Way Kambas NP, Indonesia
Daniel Walter Sinaga, Directorate of Forest Protection-PHPA, Bogor, Indonesia
Djoko Setijono, Natural Resources Division, Lampung, Indonesia
Mual Daulay, SBKSDA-Riau, Indonesia
Titus Muladi W., SBKSDA-Sumatera Utara, Indonesia
Siska Saskia Hendarin, WWF Indonesia Programme, Indonesia
Ucang Suparman, SBKDSA-Sumatera Barat, Indonesia
Prie Supriadi, PHPA, Jakarta, Indonesia
Muniful Hamid, SBKSDA-Jambi, Indonesia
Joanne Reilly, Trinity College Dublin, Irish Republic
Kate Wilson, University of Oxford, UK
Colin McHenry, University of Oxford, UK
Guy Hill-Spedding, University of Southampton, UK

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 3: Working Group WWWD Distribution and Status in Sumatra

Working Group Report:
White-Winged Wood Duck Distribution and Status in Sumatra

Working Group Members: Rudyanto, A. Choudhury, Teguh Husodo, Hasudungan Pakpahan, Apriawan, A. Green

Green, A.J. (1992). *The Status and Conservation of the White-winged Wood Duck Cairina scutulata: IWRB Special Publication No. 17* formed the basis of the group's discussion and conclusions (see also Bibliography).

DISTRIBUTION

The White-winged Wood Duck was formerly widespread in Sumatra and Java, where it was first described in 1842. It has been reported historically in all the Sumatran provinces (Aceh, Sumatera Utara, Riau, Jambi, Sumatera Selatan, Lampung, Bengkulu and Sumatera Barat, where there is a possible record from Siberut Island). It was also recorded from West and Central Java, with a possible record from Sempu Island, along the south coast of Java. Since 1980 there have been records from six Sumatran provinces: Lampung, Sumatera Selatan, Jambi, Riau, Sumatera Utara and Aceh. It is most likely that the species has been extinct on Java for at least several decades because of the lack of remaining suitable habitat on the island. There have been no confirmed records from Java since 1907.

The White-winged Wood Duck has been recorded from 29 sites in Sumatra since 1980 (Table 3), but large areas of potential habitat, especially on the east coast, have yet to be surveyed. In the 1980s records were confined to Lampung, Sumatera Selatan and Jambi provinces and at that time it was felt that the species may be restricted to these southern provinces. However, survey work undertaken since 1990 has confirmed the existence of populations in Riau, Sumatera Utara and Aceh, where there is a good chance that the extensive areas of remaining swamp forest still support large populations of the species.

HABITAT USE

The White-winged Wood Duck is confined to areas containing moist tropical forest (believed to be essential for nesting and roosting) holding or providing access to stagnant or slow-moving wetlands (essential for feeding). The massive land-use changes in Sumatra have had a severe and direct impact on the White-winged Wood Duck's traditional lowland rainforest habitat. For example, the majority of known Sumatran sites for the species now contain only secondary forest; breeding in secondary forest has been confirmed in Way Kambas National Park by the observation of ducklings, but no nest has yet been recorded.

In Sumatra, the species appears to use habitats that are more open and degraded than those on the Continent. This is particularly the case in southeast Sumatra, where most of the sites have only small patches of forest amongst grasslands and agricultural areas. In continental Asia, the great majority of records are still received from densely forested areas. There are two likely explanations for this difference. First, many of these Sumatran sites are in the coastal plains, and equivalent lowland plain areas on the continent are at a more advanced stage of destruction. Indeed, most have already been almost totally deforested (e.g., in Peninsular Thailand). In the continental plains, the species probably persisted for some time in similar areas of open forest habitat until the last forest patches were destroyed. Second, the species nests only in tree holes and hollows, and in Sumatra is thought to be dependent for nesting on rengas trees (a complex of trees of family Anonaceae, mainly genera *Melanorrhoea* and *Gluta*), whose sap causes skin blistering in humans. Hence these trees are often left standing when other large trees have been felled, perhaps allowing the White-winged Wood Duck to survive in areas that would otherwise have been clear-felled.

In continental Asia the White-winged Wood Duck is found mainly in tropical wet evergreen and tropical semi-evergreen forest. In Indonesia most White-winged Wood Duck records have come from freshwater swamp and peat swamp forest. There are only a few records outside swamp forest, and most or all of these are from areas with swamp forest nearby. Some Javan records may have been from evergreen forest, and several Sumatran birds have been recorded flying into mangroves. On the continent, there are only confirmed records from swamp forest at two sites, and no evidence of breeding. These apparent differences in habitat use between Indonesia and continental Asia may simply reflect differences in the availability of the various habitat types. Considerable areas of swamp forest were originally present in parts of the continental range (e.g. Myanmar, Thailand, Cambodia, Vietnam), but most of these have long since been extensively cleared. However, the possibility remains that they reflect a real ecological difference between the two races of this species.

The White-winged Wood Duck has been recorded from a variety of relatively small, shallow, sluggish or stagnant wetlands in forest areas. Forest streams, forest pools and small swamps, small forest rivers and marshes are particularly important. The largest stagnant wetlands where the White-winged Wood Duck has been recorded in Sumatra are swamps of up to several square kilometres in area. Swamps used are mainly inland, freshwater and non-acid. However, the species has recently been recorded from areas of acidic coastal swamps in northern Sumatra. Most recent records are from within 10 km of areas of permanent waterlogged plain, suggesting a degree of dependence on permanent freshwater swamps that occur in these areas. The ducks have also been observed feeding in paddy fields, where they have been blamed for crop damage.

POPULATION ESTIMATES

Outside the breeding season, most Anatidae species form large flocks on open wetlands and are therefore relatively easy to census. Since White-winged Wood Duck remain dispersed in small groups (typically 1-3) on small forest wetlands, it is impossible to obtain a rapid, accurate assessment of population size. Because of this, and as a result of a series of expeditions to study the species in the site, Way Kambas National Park is the only site for which there are sufficient data to assess population size with reasonable confidence.

Way Kambas has *c.* 35,000 ha of habitat that could be broadly classified as swamp forest and can be considered suitable for White-winged Wood Duck. A population of *c.* 30 birds is thought to use the Way Kanan area of the park (including Kali Biru and Kali Batin) that contains 6,800 ha of swamp forest. It is unclear whether there are more birds in the park, although it seems likely that there may be up to 60 in total. Survey work in other parts of the park has been very limited to date. Observations suggest that the White-winged Wood Duck present in the Way Kanan area almost certainly utilise the habitat available elsewhere in the National Park, and possibly beyond. If we make the assumption that there are only 30 birds in total, using a total of 35,000 ha of habitat, a conservative estimate of population density would be one bird per 1,200 ha.

Extrapolations can be made using this estimate of population density to estimate the size of other, less well-known populations of White-winged Wood Duck in Sumatra. Although this is the most conservative estimate of White-winged Wood Duck density that can be made from existing data, **there are dangers in extrapolating this density to swamp forest areas elsewhere.** These extrapolations suggest a total population of White-winged Wood Duck of around 500 in protected areas in Sumatra, but this figure has a wide margin of error. Nevertheless, since around 90% of swamp forest in Sumatra currently lies outside protected areas, the total Sumatran population of White-winged Wood Duck is likely to number over 1,000 individuals. However, loss of habitat due to ongoing forest destruction is causing a rapid decline in this total population size.

Table 1 gives estimates of the remaining White-winged Wood Duck populations on a province-by-province basis. Our understanding of the species's habitat needs is still limited, and available data on swamp forest distribution in Sumatra have limited accuracy and precision, so that large areas classified as `swamp forest' may in fact be unsuitable for the species. The extrapolations in Table 1 have therefore been restricted to protected areas or proposed protected areas, for which more accurate habitat information is available and where we can be more confident that the habitat is indeed suitable for the species.

KNOWN POPULATIONS OF HIGHEST CONSERVATION PRIORITY

Most recently identified White-winged Wood Duck populations are found in unprotected forest areas, designated for other land-use, which are therefore unlikely to be able to sustain these populations. There is an urgent need to identify populations that can be protected within conservation areas if the species is to survive through the next century. To date, the four known sites for White-winged Wood Duck that have the best chance of retaining viable populations of the bird in the future are:

Way Kambas National Park in Lampung Province;
Kerumutan and Rengat in Riau Province;
the border area of Berbak National Park in Jambi; and
Singkil Barat and neighbouring areas in Aceh.

Table 1. Population estimate of the White-winged Wood Duck in Sumatra in 1993 (by province).

Province	Available Habitat (swamp forest only) (sq.km.)		Estimated Population (one bird/12 km^2.)	
	Inside Protected Area	Outside Protected Area	Inside Protected Area	Outside Protected Area
Aceh	200	2200	17	Not Known
Sumatera Utara	157	2800	13	Not Known
Sumatera Barat	29	1400	3	Not Known
Riau	1450	31000	121	Not Known
Jambi	1700	3200	142	Not Known
Sumatera Selatan	1200	10000	100	Not Known
Bengkulu	Negligible	Negligible	Negligible	Not Known
Lampung	350	Negligible	60*	Not Known
TOTAL	5086	50600	456	Not Known

* Mostly in Way Kambas National Park. Because of better protection the density in Way Kambas is higher than other in areas.

Note:

(1) In other countries the White-winged Wood Duck is also found in Tropical Evergreen Forest on plains. However, data on such suitable forest areas in Sumatra are not available.

(2) The suitable habitat has been computed by deducting from the 1988 figure the area assumed to have been destroyed during the past five years (based on the five-year period 1983-1988, Table 1.)

These four populations are all in or near a protected area or a previously proposed protected area, and are the main subject of the VORTEX modelling process. Their potential size is considered below.

Way Kambas National Park
This population is thought to comprise 30-60 individuals (see above).

Berbak National Park, and adjoining areas
Available records of White-winged Wood Duck suggest a population of at least 30 birds centred just to the west of the reserve at Air Hitam Dalam and Kumpeh. The presence of birds in the National Park itself has not been confirmed, but the park contains large areas of swamp forest (total 170,000 ha) that are likely to offer suitable habitat. The areas of habitat outside the park are unknown. Assuming 170,000 ha of habitat and one bird per 1,200 ha, the population would be 142. The total population is likely to lie in the range 30-140.

Kerumutan Nature Reserve and adjoining areas
The presence of White-winged Wood Duck has been confirmed at the northern edge of the reserve and in Rengat to the south of the reserve boundary. There were 13 confirmed, different individuals in 1992, indicating that the likely minimum total population is at least 20 and almost certainly 30 individuals. The reserve contains large areas of swamp forest (total 120,000 ha) that are likely to offer suitable habitat. The areas of habitat outside the park are unknown. Assuming 120,000 ha of habitat and one bird per 1,200 ha, the population would be 100. The total population is likely to lie in the range 20-100.

Singkil Barat proposed nature reserve and neighbouring areas
The area of interest here stretches from Tapus in the south (at the northern end of Sumatera Utara Province) to the Kluet extension of Gunung Leuser National Park in the north, a total distance of 140 km. It is possible that the mobility of White-winged Wood Duck is such that the birds in these areas may effectively be part of the same population. Moving from south to north, the presence of White-winged Wood Duck has been confirmed in Tapus (22,000 ha of habitat), Runding (area unknown) just to the south of Singkil Barat (*c.* 85,000 ha) and Kluet (at least 10,000 ha of habitat). Recent reports suggest that the whole Tapus-Kluet area supports *c.* 215,000 ha of swamp forest; the total population must be at least 20 birds, with nine confirmed individuals observed during very limited surveys. Assuming 215,000 ha of habitat and one bird per 1,200 ha, the population would be 180. Making similar assumptions for the separate sites, populations would be 18 in Tapus, 71 in Singkil Barat and eight in Kluet (where the known minimum population is at least four birds). Hence the total population is likely to lie in the range 20-180.

THREATS

The biggest threat to the survival of the White-winged Wood Duck is habitat change. In 1988 only 6.3% of the original primary wetland forest remained (see Table 2), after swamp forest was reclaimed to provide agricultural and plantation land for settlers.

Table 2. Loss of peat and freshwater swamp forest in Sumatra (area in square kilometres).

Province	Original area	1982-1983	1988 (+area degraded)	1988 (Primary)
Aceh	3081	2752	2605	230
Sumatera Utara	4905	3089	3029	31
Sumatera Barat	1942	1617	1535	59
Riau	50238	37230	35622	2558
Jambi	8813	6141	5567	2604
Sumatera Selatan	22286	11853	11720	368
Bengkulu	400	310	?	0
Lampung	1200	798	240	20
TOTAL	92865	63790	60318	5870
% original	100	68.7	65	6.3

(Source: Silvius & Giesen 1992)

In Sumatra, as elsewhere in South East Asia, deforestation is particularly rapid in the lowland plain forests of importance for the species, and all known populations outside protected areas are at risk of being eliminated by habitat destruction in the near future if no preventative action is taken. Drainage of swamps in areas frequented by White-winged Wood Duck has been widespread in Sumatra, and there are plans to drain many more. Drainage of permanent swamps is likely to be the most serious threat, as it reduces the area of feeding habitat during the dry season, when there is least available.

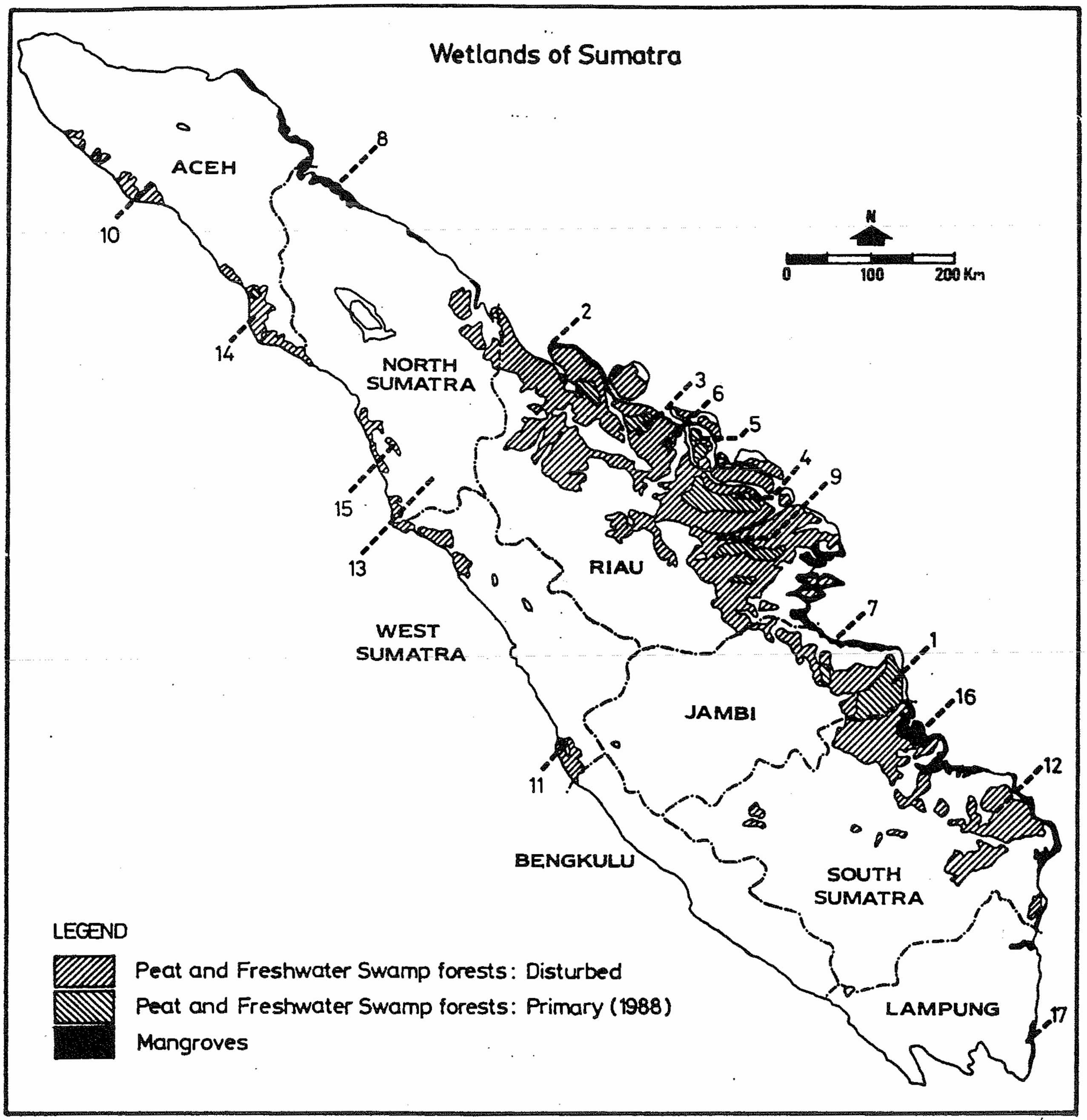
In Sumatra, all wetland forest that continues to lie outside protected areas is likely to be destroyed within the next 15-25 years, leaving a small number of totally isolated, protected areas of which only three are currently known to hold White-winged Wood Duck (Way Kambas, Kerumutan and Kluet). This prediction assumes that areas of 'Production Forest', logged under licence, will be lost, as past experience shows that, once they have been selectively logged, they are generally logged further and reclaimed for other uses. This suggests that 90% of White-winged Wood Duck habitat is likely to be destroyed by 2015 if no further action is taken. Under this scenario, the populations remaining in protected areas may not be viable because of their small size and lack of genetic and demographic exchange with other populations. Thus the species is under high risk of extinction, and conservation action is required urgently. The rate of habitat loss is illustrated below (Table 3) by the analysis of land use in known White-winged Wood Duck sites.

Ongoing habitat destruction is also a problem inside protected areas that hold White-winged Wood Duck populations. For example, the habitat in Padang Sugihan Wildlife Sanctuary has been extensively degraded since its designation, whilst illegal logging was witnessed at Potekait inside the Kerumutan Wildlife Reserve in November 1992.

The <u>use of pesticides</u> in the paddy fields in which White-winged Wood Duck forage in many areas is increasing; White-winged Wood Duck have been recorded feeding in the paddy fields in the rainy season. In some locations the seeds, fish, small crustaceans, worms and molluscs found in the paddies appear to be the birds' primary source of food. The influx of settlers demands more areas of rice production and there has been a corresponding increase in pesticide use. Inappropriate pesticides are known to be used: they are of a strength more suitable for coconut or cacao, and totally unsuitable for use on paddy fields.

<u>Opportunistic hunting</u> is also a threat; there are still many hunters in Sumatra. The hunters are not necessarily indigenous forest dwellers but frequently transmigrants. The normal quarry species are sambar deer, mouse deer and pig, but White-winged Wood Duck and other birds such as Hornbill, Green Pigeon and small waterbirds are also taken. The local method of fishing, `pancing tajur', involves a long line strung with up to 100 hooks being left in the water overnight. White-winged Wood Duck are known to have been caught accidentally by this method of fishing.

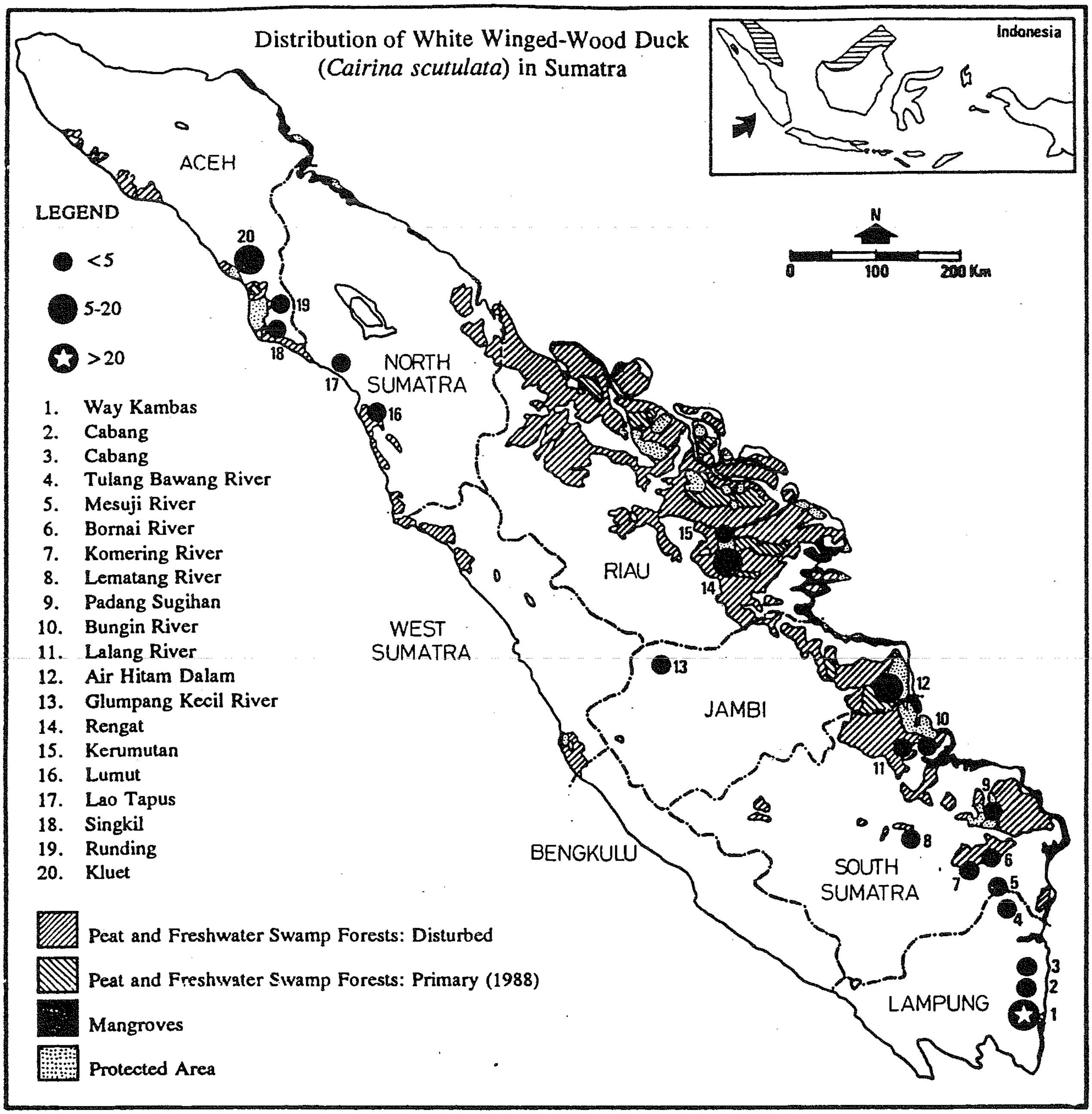
<u>Natural threats</u> include fire, predation, long-term drought and disease. Uncontrolled slash-and-burn clearance still occurs regularly and affects huge areas. The main predators of the species are snakes and monitor lizards, which are capable of climbing up to the nests. Long-term drought dries the forest ponds upon which the species relies for feeding. There is no known occurrence of disease, but this remains a threat to any wild population.



CONSERVATION AREAS:

1. Berbak
2. Berkeh
3. Buaya Bukit Batu (u)
4. Danau Belat/Sekak/Sarang Burung (u)
5. Danau Tanjung Padang (u)
6. Giam Siak Kecil (-)
7. Hutan Bakau Pantai Timur
8. Karang Gading Pantai Timur
9. Kerumutan Baru (-)
10. Kluet
11. Lunang (u/-)
12. Padang Sugihan (-)
13. Rimbo Panti
14. Singkil Barat (-)
15. Siondop (u)
16. Sungai Sembilang (u)
17. Way Kambas (-)

(u) = proposed reserve
(-) = largerly disturbed


Distribution of White Winged-Wood Duck
(*Cairina scutulata*) in Sumatra
Indonesia
N
0
100
200 Km
ACEH
NORTH SUMATRA
RIAU
WEST SUMATRA
JAMBI
BENGKULU
SOUTH SUMATRA
LAMPUNG
LEGEND
<5
5-20
>20
1. Way Kambas
2. Cabang
3. Cabang
4. Tulang Bawang River
5. Mesuji River
6. Bornai River
7. Komering River
8. Lematang River
9. Padang Sugihan
10. Bungin River
11. Lalang River
12. Air Hitam Dalam
13. Glumpang Kecil River
14. Rengat
15. Kerumutan
16. Lumut
17. Lao Tapus
18. Singkil
19. Runding
20. Kluet
Peat and Freshwater Swamp Forests: Disturbed
Peat and Freshwater Swamp Forests: Primary (1988)
Mangroves
Protected Area

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 4: Working Group WWWD Life History and Vortex Analysis

Working Group Report: White-Winged Wood Duck Life History and Vortex Analysis

Members: M. Ounsted, A. Green, P. Laothong, A. Choudhury, Rudyanto, Teguh Husodo, Apriawan, Hasudungan Pakpahan

LIFE HISTORY VARIABLES

Life history variables were estimated using available data. The field data needed to assess the values of these variables accurately are not available, and in particular there are almost no data on mortality rates, breeding success, fluctuations in population size over time and other demographic characters. There have been no studies of the progress of known individuals over time, and no birds have ever been observed at the nest in Indonesia. However, a basic understanding of field biology has been reached by a series of short field studies. In addition, there are considerable data on the species in captivity, although none from the Indonesian race/population. These data were combined with unpublished data from Way Kambas National Park, India and Thailand and general data on other wildfowl species to estimate the variables in the VORTEX model. Ranges of values were used in sensitivity analysis for those variables for which data are particularly lacking.

Below, we treat each variable in the sequence in which it is encountered when running the VORTEX model. We list the values selected for the computer simulations, and briefly describe the rationale for these selections. Data from Way Kambas are indicated by WK.

1) Inbreeding depression?: Yes

There is evidence of inbreeding depression in captivity, with reduced survivorship being observed in more inbred broods, although this was not statistically significant.

2) Correlation between juvenile and adult survivorship?: Yes

Annual variation in water and food supply together with mortality from hunting are likely to affect both reproductive success and adult survivorship. However, it should be noted that, in temperate species of Anatidae, ducklings are highly susceptible to a number of mortality factors (e.g. rainfall, salinity, various predators) that are not thought to influence adult mortality.

3) Monogamous or polygynous?: Monogamous

About 85% of records in the wild are of single or paired birds, and all three pairs observed nesting in the wild (in Bangladesh) showed strong pair bonds, retained throughout the nesting period. The continued high proportion of pairs observed throughout the annual cycle suggests that the species may have long-term pair bonds retained for more than one year as an adaptation to its low density, high dispersion and sedentary habits.

4) Catastrophes:

a) Drought: Rate = once in five years; reproduction reduced by 40%; survival unaffected.

In WK, droughts occur when there is low rainfall in the wet season and are observed at a frequency of about once every five years. Droughts are thought to have a strong effect on breeding success as a result of the small area of wetlands available in the wet season. However, the reduction in feeding habitat is not considered marked enough to cause adult mortality. Population size is likely to be limited by the availability of suitable nesting sites, which may be further reduced during a drought.

b) Disease

In captivity, the birds are highly susceptible to Avian Tuberculosis, while Anatidae generally suffer from a range of diseases. The nature and extremity of diseases in the wild are completely unknown, but it seems certain that such problems exist. However, they were not included in the model.

5) Age at first reproduction?: Females: 2; males: 2

Two years is the average age of first reproduction in captivity; there are no field data.

6) Oldest age at breeding?: 11

In captivity, birds have been known to survive to 17 years, but breeding has been known up to about 11 years (in the range of 10-12).

7) Sex ratio at birth: 50:50

The observed sex ratio in captivity.

8) Maximum brood size: 8

Although clutches of up to 13 have been observed in captivity, broods observed in the wild in WK or elsewhere have not exceeded eight ducklings.

9) Proportion of adult females producing broods of different sizes each year:

P (no brood) =	**60%;**	**40%;**	**20%.**
P (brood = 1) =	**2%;**	**3%;**	**4%.**
P (brood = 2) =	**3%;**	**4%;**	**6%.**
P (brood = 3) =	**5%;**	**8%;**	**10%.**
P (brood = 4) =	**10%;**	**15%;**	**20%.**
P (brood = 5) =	**10%;**	**15%;**	**20%.**
P (brood = 6) =	**5%;**	**8%;**	**10%.**
P (brood = 7) =	**3%;**	**4%;**	**6%.**
P (brood = 8) =	**2%;**	**3%;**	**4%.**

Broods of known size seen in the field (n = 9) have an average of four ducklings. Although all mature females are thought likely to attempt nesting when the population is below carrying capacity, the proportion of nesting females that fail to produce ducklings is generally high in waterfowl. This is particularly true of ground-nesting waterfowl but, due to lower predation, may be lower in hole nesters. There is considerable variation in this proportion of 'nesting failures' in temperate waterfowl between sites and years, but there is no basis for estimating it in this species, therefore we used the typical conservative estimate at the recommendation of CBSG.

10) Brood mortality (age 0-1): Mean = 50-90%

Brood mortality is high in temperate waterfowl, and high in some populations of this species in which hunting is intense (in Bangladesh and India). Casual observation in WK suggests that, in this population, mortality could be as low as 50%. There is no basis for estimating SD in this species, therefore we used the typical conservative estimate at the recommendation of CBSG.

11) Juvenile mortality (age 1-2): Mean = 10-30% (for both males and females)

Adult mortality (age 2-11): Mean = 5-20% (for both males and females)

In typical waterbirds, mortality of fledged immatures is much lower than that of ducklings, but higher than that of adults. Data from captivity suggest an annual, adult mortality rate of 10%. There is no basis for estimating SD in this species, therefore we used the typical conservative estimate at the recommendation of CBSG.

12) All sexually mature males in the breeding pool?: Yes

See numbers 3 and 7 above.

13) Environmental variation in carrying capacity (K): SD = 0

There are no specific data to quantify this parameter. In high rainfall regions such as Sumatra, variation in rainfall is relatively lower than in low rainfall regions. In addition, carrying capacity may be determined by the availability of tree holes, which may remain relatively constant.

14) Trend in carrying capacity: negative, but modelled as a constant.

In most areas of Sumatra, continuing habitat loss and degradation are resulting in a steady reduction of carrying capacity. For example, destruction of swamp forest can be estimated at over 1% per annum (based on Table 2). However, as the rates of such reductions are impossible to quantify for specific populations, and as we decided to model populations which could conceivably become protected from habit loss, K was kept as a constant in the VORTEX models. In WK, habitat protection is now effective and forests appear to be regenerating in most areas. The number of tree holes is increasing as more trees mature, but forest ponds are slowly disappearing as a result of succession.

NUMBER AND SIZE OF POPULATIONS

Single populations were modelled at sizes 20, 60 and 180. This range of sizes was chosen because the four known populations of White-winged Wood Duck with most chance of being conserved are estimated to have populations within this range. The Way Kambas National Park population is thought to number 30-60 birds; the Berbak National Park and vicinity population is estimated at 30-140; the Kerumutan Nature Reserve and vicinity population is estimated at 20-100; the Singkil Barat and vicinity population is estimated at 20-180. See section **Distribution and Status: known populations of highest conservation priority** above for details.

These populations are all separated from each other by at least 200 km, while the Singkil Barat population is *c.* 800 km from its nearest neighbour (Berbak); they are therefore unlikely to undergo any direct genetic or demographic exchange with each other. They are, however, likely to undergo some genetic and demographic exchange with other, closer White-winged Wood Duck populations lying in unprotected areas. However, ongoing habitat loss is making these populations increasingly isolated and is likely to make them totally isolated from other populations within 25 years. This may already be the case for the Way Kambas population, as destruction of White-winged Wood Duck habitat in surrounding areas of Lampung and Sumatera Selatan has already been very extensive.

Because of this increasing isolation, single population models were used, with no metapopulation model involving inter-population exchange. The above life-history details were assumed to be constant between populations, as there is no information to the contrary.

White-Winged Wood Duck Population Biology

Introduction

Populations modelled were set at 20, 60 and 180 birds spanning the range of estimates of lower and upper population sizes in the 5 potential populations on Sumatra. The total population is estimated at 100-500 birds. Since it is uncertain whether there is exchange between these populations they were modelled separately. As noted above, the data sources for these simulation models are largely derived from other waterfowl species and from captive population data for the mainland form of this species. There is no captive population of the Indonesian form. The Indonesian population is being elevated to subspecies status and will be managed separately from the mainland form in captivity and in any strategies for support of the wild populations.

The population simulation models were constructed using VORTEX version 6.1 written by R. Lacy and K. Hughes. The program and a manual are available from the CBSG office.

Program Goals

Short and long term goals for the populations were focused on identification of distribution and numbers and upon protection and enhancement of suitable habitat to allow expansion of population numbers to 100 or more adult birds (50 breeding pairs) in each location. This size for the individual populations would keep the rate of loss of genetic heterozygosity to about 0.5% per generation. If the populations exchange a few birds each generation (1-3 birds every 5 years on the average), then the effective size would be increased.

A long term goal for the white-winged wood duck might be a total of 1000 or more breeding pairs on Sumatra. This size population would gain genetic heterozygosity by new mutation at about the rate of loss by genetic drift. Given a distribution across Sumatra, the risk of extinction of the species would be less than 1% in 100 years based upon current estimates of the frequency and severity of catastrophes and the levels of environmental variance.

Parameter Values

All simulations were run for 50 years with 5 year reports. The exploratory simulations were run 100 times to provide output estimates. Selected scenarios were run 1000 times to provide better statistics.

Parameters held constant in all of the simulations were:

(1) sex ratio of 1:1 at hatching (0.50 in the model),
(2) life expectancy in the wild of 11 years,
(3) monogamous mating,
(4) age of first reproduction of 2 years for both males and females,
(5) all adult males in the breeding pool,
(6) density independent reproduction and mortality under the current conditions,
(7) correlation of environmental variation effects on reproduction and survival,
(8) no trend of change in habitat or K, and
(9) no harvest or supplementation of the populations.

Since there are no data to calculate variance in individual values for the WWWD, a conservative procedure of setting the standard deviation at 1/3 the value of the mean was followed. Each simulation run was initialized with the population size set at K and with a stable age distribution calculated by a Leslie matrix.

Models were constructed to examine the interaction of:

(1) Presence or absence of inbreeding depression using the heterosis option with 3.14 lethal equivalents.
(2) Presence or absence of a catastrophe with a .2 probability (20% or once in 5 years on average), and a 40% reduction in reproduction with no effect on survival.
(3) Starting population size of 20, 60, or 180.
(4) Proportion of females producing no brood (hatchlings) as 60, 40, or 20% in a given year.
(5) Mortality of 50, 70, or 90% of the hatchlings.
(6) Mortality of 10, 20, or 30% by age of 1 year.
(7) Annual mortality of 5, 10, or 20% of adults with no further age dependent effects.

on the population dynamics and risk of extinction of white-winged wood duck populations and to examine the relative impact of each variable on the risk of extinction (sensitivity analysis).

Simulation scenarios were constructed for 612 of the possible 972 combinations of values and run. Some combinations for the population size of 180 were omitted as noted in the discussion below.

Results presented in order across the tables include:

(1) the deterministic 'r' values calculated with a Leslie matrix algorithm, (also calculated were the generation time for each sex, the Ro, the lambda, the adult sex ratio, and the stable age distribution by sex),

(2) the mean stochastic 'r' value and its standard deviation calculated over the 100 (or 1000) runs,

(3) the probability of extinction (Pe), the population size (N) of the surviving populations, and the standard deviations (SD) at 50 years,

(4) the proportion of heterozygosity remaining at 100 years in the surviving populations, and

(5) the mean time to extinction, in years, for the populations that went extinct.

General Observations:

If the deterministic 'r' is negative the population cannot survive under the conditions specified. If the stochastic 'r' is negative, even if the deterministic 'r' is positive, the population will have a significant risk of extinction during the 50 year time period and the population size will be less than carrying capacity. Populations with both 'r' values positive can have a significant risk of extinction and the population sizes can be less than the carrying capacity because of the effects of environmental variation and catastrophes. The rates of population decline may take 10-20 years or more to become evident and may be difficult to detect by typical field surveys because of the wide confidence limits of census methodologies .

We examined the matrix of scenarios for the combinations of variables which would yield an approximately stable population size for carrying capacities of 20, 60, and 180 birds corresponding to the estimated upper and lower limits of the individual populations.

Output Variables and Definitions

The output reports include a listing of all of the inputs for that scenario.

A deterministic Leslie matrix is used to calculate (the effects of any catastrophes included were averaged into the calculation): the deterministic 'r' , lambda, Ro, generation time for each sex, sex ratio of adults, and the stable age structure by sex for the population.

Reports were provided at 5 year intervals for the 100 runs (as requested for all scenarios) yielding 10 data points for the 50 years of the simulations. These time series are instructive for interpretation of trends, comparison of different scenarios, and interpreting the effects of different sources of variation. All statistics are calculated over the 100 runs. Each report includes: (1) Pe or probability of extinction, (2) mean population size of surviving populations with standard deviation, (3) mean expected heterozygosity with standard deviation, (4) mean observed heterozygosity (from the gene drop analysis) with standard deviation, and (5) the mean number of extant alleles at a locus (from a starting number of 2N unique alleles) with standard deviation from the gene drop analysis.

The summary report for the 100 runs of the 50 year projections includes (1) the above 5 items, (2) the mean and median times to extinction with standard deviations, (3) the mean probability of extinction with standard deviation, (4) the mean sex and age structure of the surviving populations, and (5) the mean stochastic 'r' and the standard deviation. An example of the input and output files for a VORTEX run is attached.

Results of the Population Modelling

General

Arrangement of tables: The data output tables contain the output data for combinations of values for mortalities of the 3 age classes with starting population size, presence or absence of inbreeding or catastrophe, and proportion of females producing a brood held constant. Thus each table contains the results of 27 scenarios.

Arrangement of figures: The histograms (Figures 7-18) are designed to illustrate the interactions of 3 variables in their effects on risk of extinction, stochastic growth rate, and loss of heterozygosity at 50 years. The time series (Figures 1-6) compare extinction rates at 5 year time intervals or about 1 generation intervals under different simulation scenarios.

Generation time: The calculated generation times were the same for both sexes and were between 5 and 6 years for most scenarios.

Sex ratio of adults: This was always about 1:1 since no differential sex mortality was imposed, the sex ratio at hatching was set at 1:1, and the age of first reproduction at 2 years was the same for both sexes. This was true for the entire age structure except for random effects in the small populations.

Age structure: The oldest age was set at 11 years. The age structure was the same for both sexes. The deterministic age structure, calculated from a Leslie matrix, can be useful for comparison with field data to provide internal validation of the parameter values estimated. The age structure of the surviving populations at 50 years is given for the 1 year and adult age classes (just prior to the beginning of breeding). About 70-80% of the surviving populations at 50 years were adults and hence potential breeders.

Mortality: Mortality rates for each of the 3 age classes were varied systematically over the ranges of 50-90% for 0-1, 10-30% for 1-2 years, and 5-20% for the adults. Standard deviations were set at 1/3 of the mean which may be conservative for this species.

Reproduction: Mating was monogamous and all adult males were considered to be in the breeding pool. Reproduction was considered to be density independent. The maximum estimated brood size (at time of hatching) was 8. The distribution of brood sizes around the mean of 4 was made symmetrical with 1=2%, 2=3%, 3=5%, 4=10%, 5=10%, 6=5%, 7=3%, and 8=2%. The number of females failing to produce a surviving brood was varied, in different sets of scenarios, from 20-60% with the SD set at 1/3 of the mean.

Inbreeding: Possible effects of inbreeding on risk of extinction were explored using the heterosis model in VORTEX with the number of lethal equivalents set at 3.14.

Carrying Capacity: The carrying capacity was set at one of 3 values - 20, 60, and 180 - based upon estimates of lower and upper limits for the populations on Sumatra. No variance in K or trends was included. Trends might be useful to include, particularly in the larger populations, if a continuing decline in habitat is anticipated. The simulated populations are proportionately truncated across all age classes if K is exceeded in any given year of the simulation. The simulations wee initialized with a stable age distribution calculated from a Leslie matrix by the program.

Other Variables: No models testing the effects of supplementation or harvesting were included. These would be useful if any translocation between wild flocks or supplementation with captive birds are planned.

Effects of Population Size

A population size of 20 was at risk of extinction in 50 years over nearly the full range of mortality and reproductive values examined (Figures 1-4, Tables 1- ?). This was true without the addition of inbreeding depression effects and with the removal of the catastrophe event from the models (Figures 4 &

10, Table ?). Most of these scenarios had positive deterministic and stochastic growth rates (r) (Figure 11, Table) but the variance was high in the stochastic models. This high variance reflects negative growth rates in many of the years which in the small populations led to extinction. Stable populations at K=20 were obtained only with the lowest estimated mortality rates of 50% for 0-1 year, 10-20% for 1-2 years old, and 5% for adults. Surviving populations at K=20 lost 45-55% of their initial heterozygosity by 50 years for an average loss rate of 5% per generation (Figures 16 & 18, Tables).

Addition of inbreeding depression to the models resulted in higher extinction rates for the populations of 20 but had little or no effect on populations of 60 or 180 (Figures 5 & 6, Tables). Inbreeding depression reduced lower final surviving population sizes at 50 years and lowered population stochastic growth rates (Figure 14, Tables). This effect of inbreeding depression on the stochastic growth rate does not appear in the deterministic r value.

Increase of the starting population size and carrying capacity to 60 reduced the risk of extinction 2 to 10 fold under each of the scenarios that had resulted in positive rates of extinction in populations of 20 (Figures 3, 5, 7, Tables). Increase of the population size to 180 yielded low extinction rates and surviving populations under all conditions tested except for 0-1 year mortality rates of 90% (Figures 1 & 7, Tables).

The survival of the white winged wood duck on Sumatra, even for 50 years, under a wide range of scenarios appears to be critically dependent upon population size and habitat carrying capacity. Populations of 100 or greater will be needed if they are to survive without supplementation or replacement.

Effects of Inbreeding

Small populations lose heterozygosity rapidly by drift. If the population or species is vulnerable to inbreeding depression, then small populations will have a higher risk of extinction because of the reduction in growth rates and greater vulnerability to environmental variation. Populations of 60 WWWD lost 20% or more of their heterozygosity in 50 years which is a rate of about 2% per generation. Populations of 180 lost about 10% or 1% per generation. The addition of catastrophes to the models had little effect on the rate of loss of heterozygosity (Figure 18). The surviving populations in models with inbreeding depression tended to have higher levels of heterozygosity.

These rates of loss are higher than might be calculated by

10, Table ?). Most of these scenarios had positive deterministic and stochastic growth rates (r) (Figure 11, Table) but the variance was high in the stochastic models. This high variance reflects negative growth rates in many of the years which in the small populations led to extinction. Stable populations at K=20 were obtained only with the lowest estimated mortality rates of 50% for 0-1 year, 10-20% for 1-2 years old, and 5% for adults. Surviving populations at K=20 lost 45-55% of their initial heterozygosity by 50 years for an average loss rate of 5% per generation (Figures 16 & 18, Tables).

Addition of inbreeding depression to the models resulted in higher extinction rates for the populations of 20 but had little or no effect on populations of 60 or 180 (Figures 5 & 6, Tables). Inbreeding depression reduced lower final surviving population sizes at 50 years and lowered population stochastic growth rates (Figure 14, Tables). This effect of inbreeding depression on the stochastic growth rate does not appear in the deterministic r value.

Increase of the starting population size and carrying capacity to 60 reduced the risk of extinction 2 to 10 fold under each of the scenarios that had resulted in positive rates of extinction in populations of 20 (Figures 3, 5, 7, Tables). Increase of the population size to 180 yielded low extinction rates and surviving populations under all conditions tested except for 0-1 year mortality rates of 90% (Figures 1 & 7, Tables).

The survival of the white winged wood duck on Sumatra, even for 50 years, under a wide range of scenarios appears to be critically dependent upon population size and habitat carrying capacity. Populations of 100 or greater will be needed if they are to survive without supplementation or replacement.

Effects of Inbreeding

Small populations lose heterozygosity rapidly by drift. If the population or species is vulnerable to inbreeding depression, then small populations will have a higher risk of extinction because of the reduction in growth rates and greater vulnerability to environmental variation. Populations of 60 WWWD lost 20% or more of their heterozygosity in 50 years which is a rate of about 2% per generation. Populations of 180 lost about 10% or 1% per generation. The addition of catastrophes to the models had little effect on the rate of loss of heterozygosity (Figure 18). The surviving populations in models with inbreeding depression tended to have higher levels of heterozygosity.

These rates of loss are higher than might be calculated by an analytical function based upon r alone because in the stochastic models the populations will vary in growth and size from year to year. These loss rates of heterozygosity are also higher than are likely to be replaced by new mutation. Thus these calculations need to be extended to estimate the size of a population needed to keep the rate of loss by drift to less than 0.5% per generation or to provide a sufficiently large population to allow replacement of genetic variation at a rate equal to or greater than the rate of loss by drift.

Some pedigree information is available for captive populations of the WWWD that might yield information on the occurrence of inbreeding depression. These populations were started with a small number of founders drawn from the mainland population. However, given the small numbers of this species remaining in the wild on Sumatra, the likely fragmentation of their populations, their continuing decline, and fact that the populations may have been small for 10-20 years or more already it will be important to undertake management to increase the size of the populations, not just halt the decline. Similar concerns apply to the populations in other parts of the range of the WWWD.

Catastrophes

A single catastrophe was modelled to include the effects of periodic droughts on the small areas of wetlands needed for breeding. A frequency of 20% (probability of .2 of occurrence in any given year) and a reduction of breeding success of 40% (severity factor of 0.6 in the model) were used for this event. No effect on survival was included. Possible disease events were not included in any of the models. Their addition would further increase the risk of extinction, particularly in the larger populations if they included a mortality factor. The larger populations, if at greater density, might also be more vulnerable to an epidemic of an infectious disease (JWD volume).

The inclusion of the catastrophe event approximately doubled the risk of extinction in the scenarios for N=20 (Figures 4 and 10) and was additive with the effects of inbreeding depression when it was included. It also produced a decrease in the population growth rate (Figure 14).

Population Growth Rates

The stochastic growth rates were positive under most of the scenarios at all population sizes, except for 0-1 year mortality rates of 90% (Figures 13 & 14, Tables). The deterministic growth rates, which do not include the effects of environmental variance, were higher and when positive would always yield projections of growing populations. However the effects of environmental variance on risk of extinction in these models was profound for the small population sizes. It would be useful to explore the consequences of abrupt expansion of the carrying capacity while starting with the small population size to initialize the model. This would allow exploration of the impact of management actions that might be taken for the duck and its habitat.

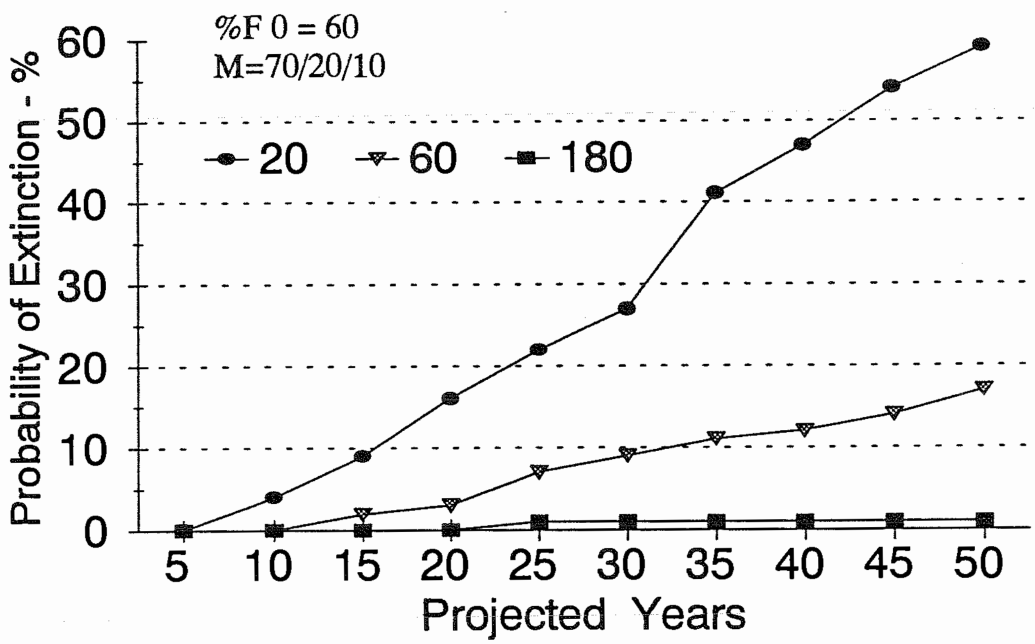
Summary

It is difficult to escape the conclusion that populations sizes of the white-winged wood duck below 50 are high risk of extinction on Sumatra due simply to demographic fluctuations from environmental variance. This risk would be increased if occasional droughts occur which depress reproduction even for 1 year. Occasional genetic exchange between the widely spaced populations of this non-migratory species on Sumatra may have protected the populations against the potential adverse effects of inbreeding in the past. However as the populations continue to decline and become more widely spaced these effects may accelerate the rate of extinction in the small fragments.

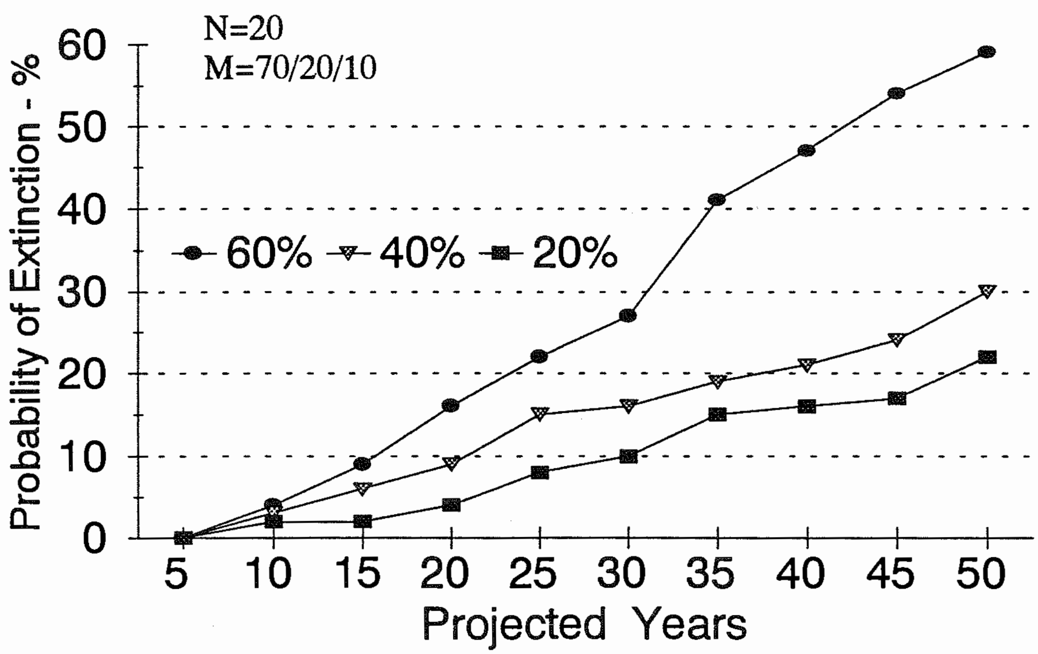
It is likely, at least over the next 20-50 years that the populations will remain fragmented as a result of the patchy distribution of wetlands and nesting habitat. Estimates of the minimal size of isolated populations needed to reduce further management to a minimum may be useful. The range of scenarios we have explored suggest that subpopulations of about 100 breeding pairs would provide protection against extinction in 50 year projections over the range of environmental variation and catastrophes we have modelled. Such populations would lose about 1% of their heterozygosity per generation. Five such protected subpopulations might provide a basis for an overall larger population on the entire island if the species is recognized, accepted, and supported by the public.

Prevention of the extinction of the white-winged wood duck on Sumatra during the next 10 years will require an intensive and systematic management program for this species and its habitat as a part of the other programs for the conservation of wildlife and protection of habitat in National Parks and wetlands on Sumatra.

WOOD DUCK DEMOGRAPHY
Population Size

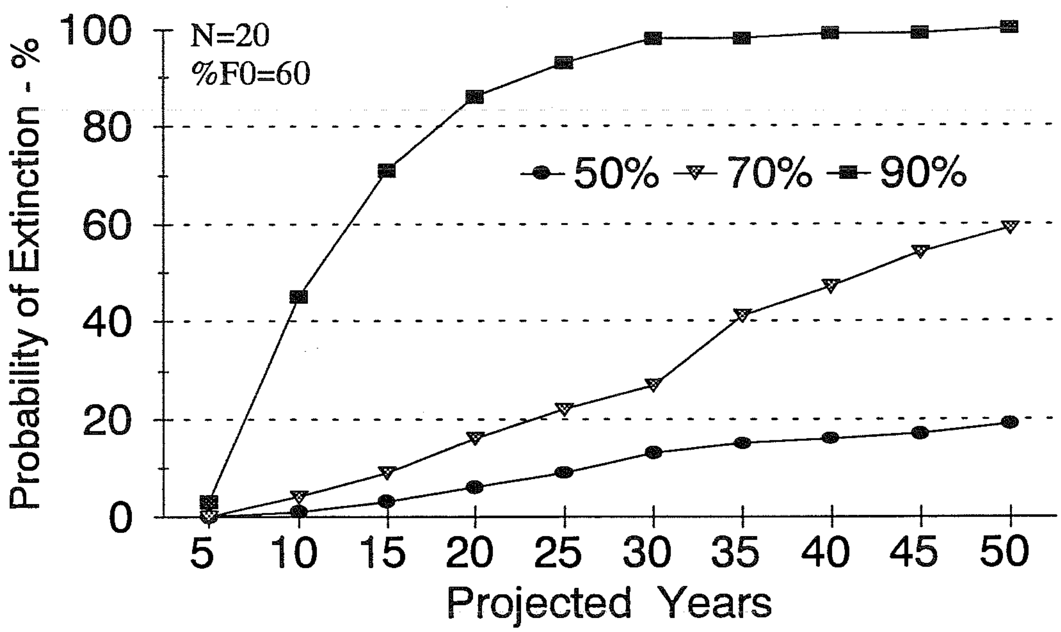


WOOD DUCK DEMOGRAPHY
% Females - No Brood



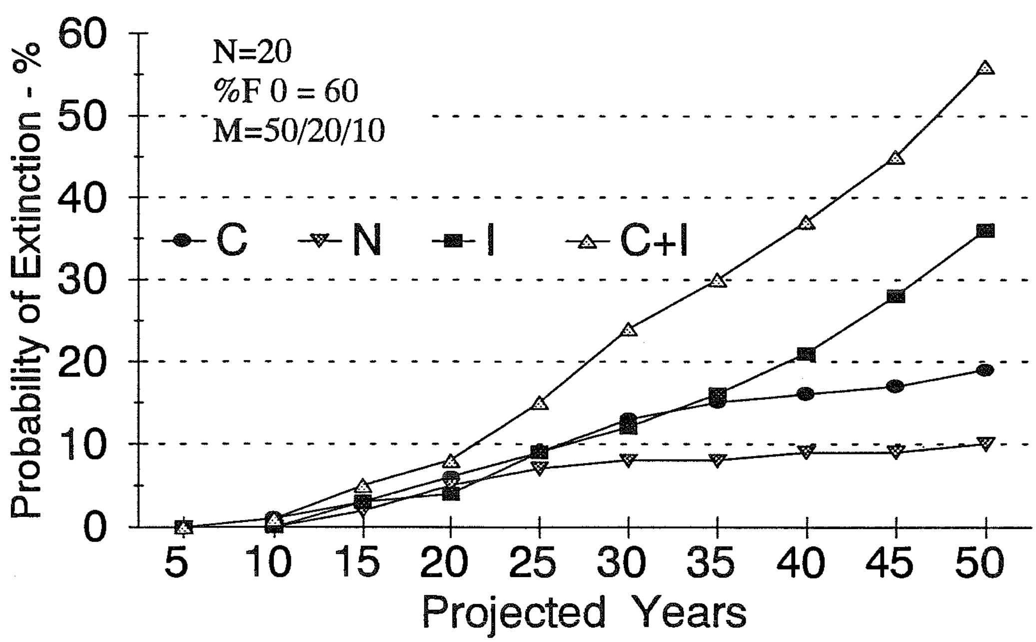
WOOD DUCK DEMOGRAPHY

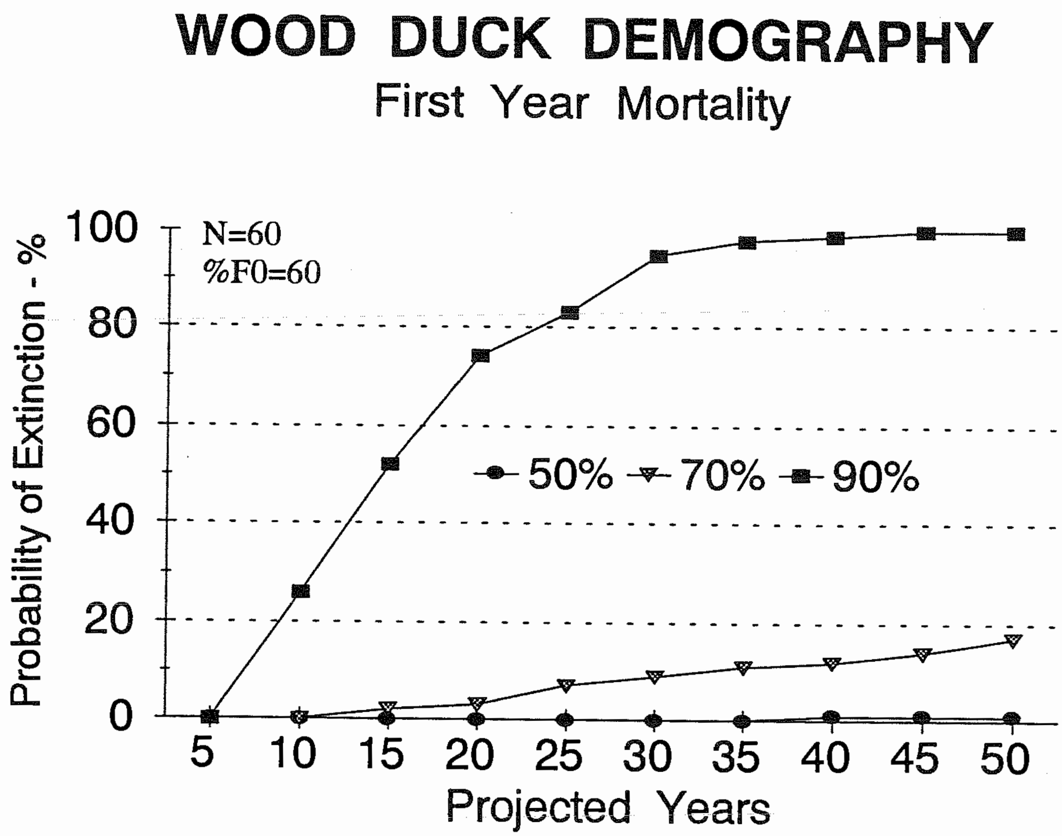
First Year Mortality

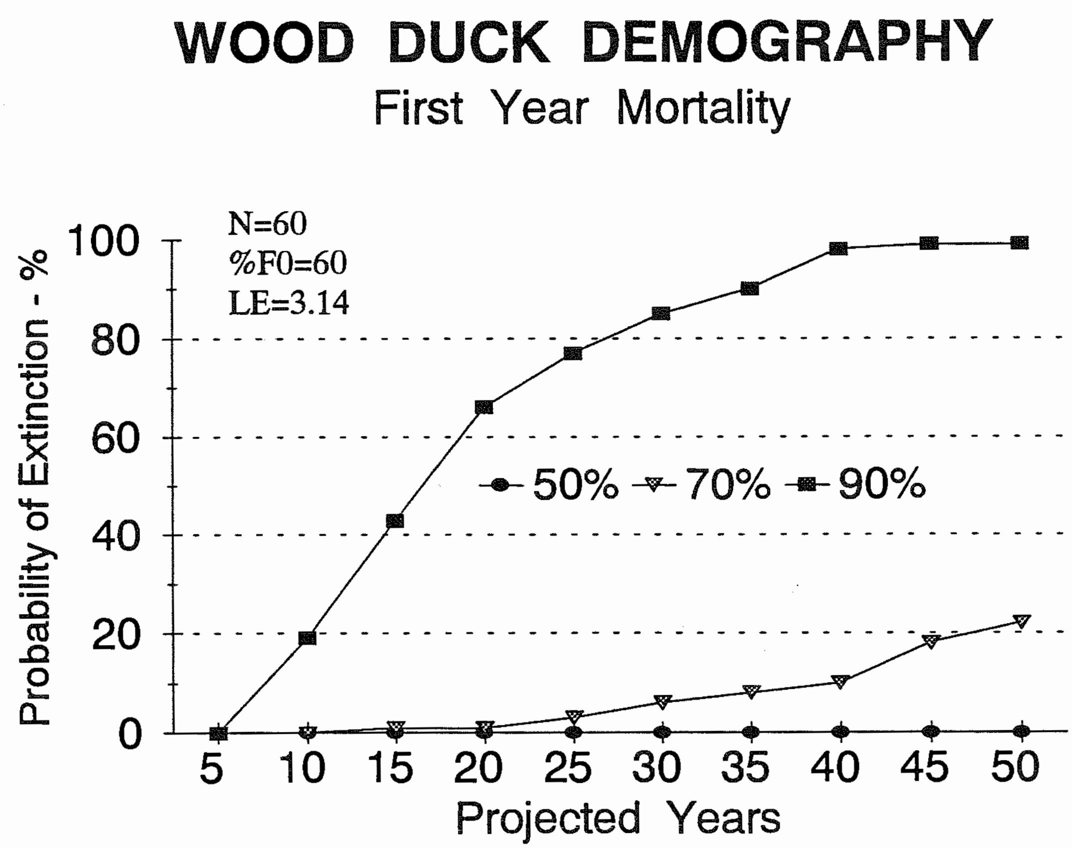


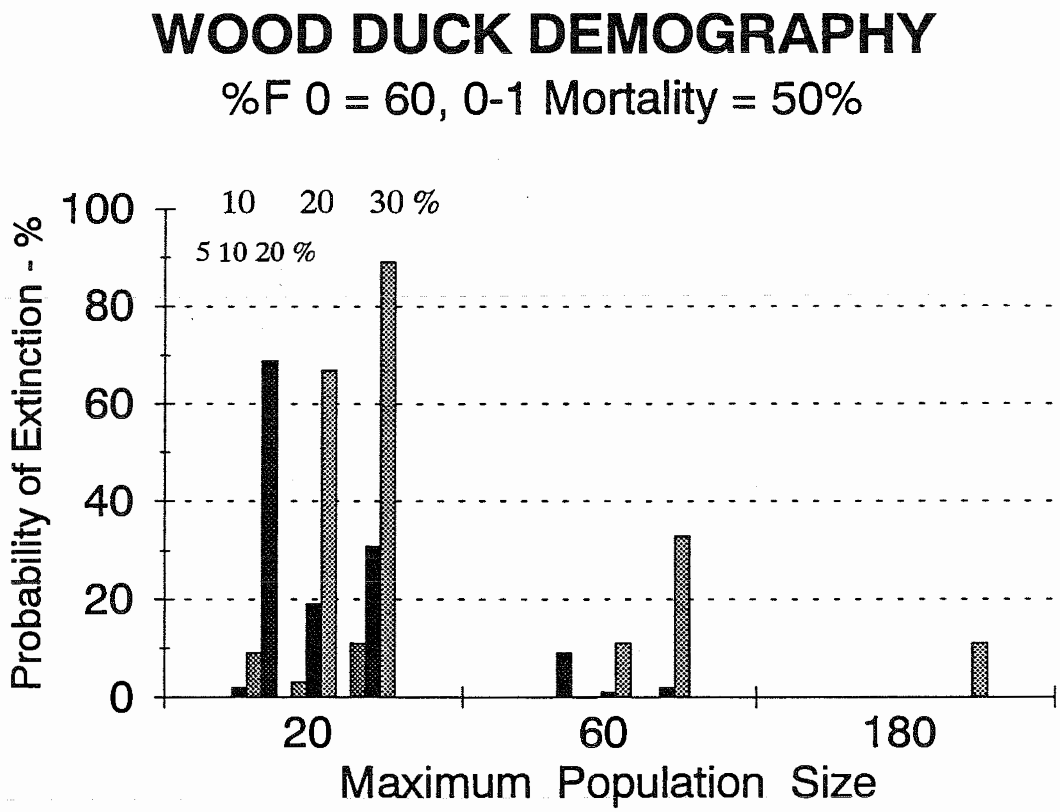
WOOD DUCK DEMOGRAPHY

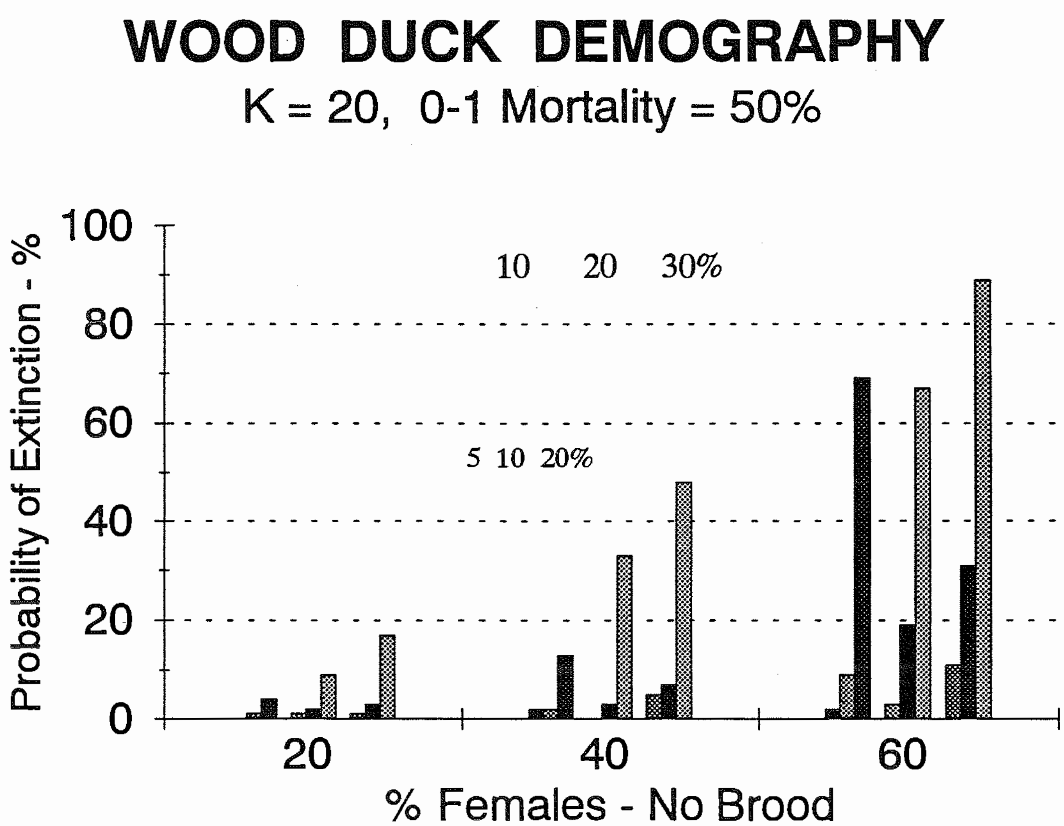
Catastrophe & Inbreeding




WOOD DUCK DEMOGRAPHY
First Year Mortality
N=60
%F0=60
50%
70%
90%
Probability of Extinction - %
0
20
40
60
80
100
5
10
15
20
25
30
35
40
45
50
Projected Years

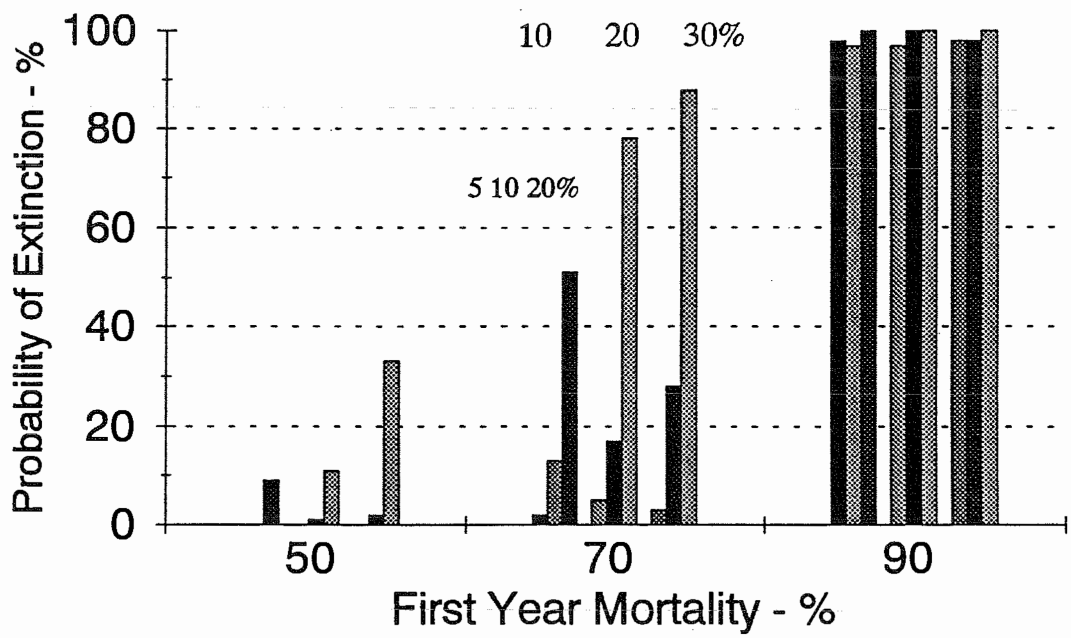

WOOD DUCK DEMOGRAPHY
First Year Mortality
N=60
%F0=60
LE=3.14
50%
70%
90%
Probability of Extinction - %
0
20
40
60
80
100
5
10
15
20
25
30
35
40
45
50
Projected Years


WOOD DUCK DEMOGRAPHY
%F 0 = 60, 0-1 Mortality = 50%
100
80
60
40
20
0
10 20 30 %
5 10 20 %
Probability of Extinction - %
20
60
180
Maximum Population Size


WOOD DUCK DEMOGRAPHY
K = 20, 0-1 Mortality = 50%
100
80
60
40
20
0
10 20 30%
5 10 20%
Probability of Extinction - %
20
40
60
% Females - No Brood

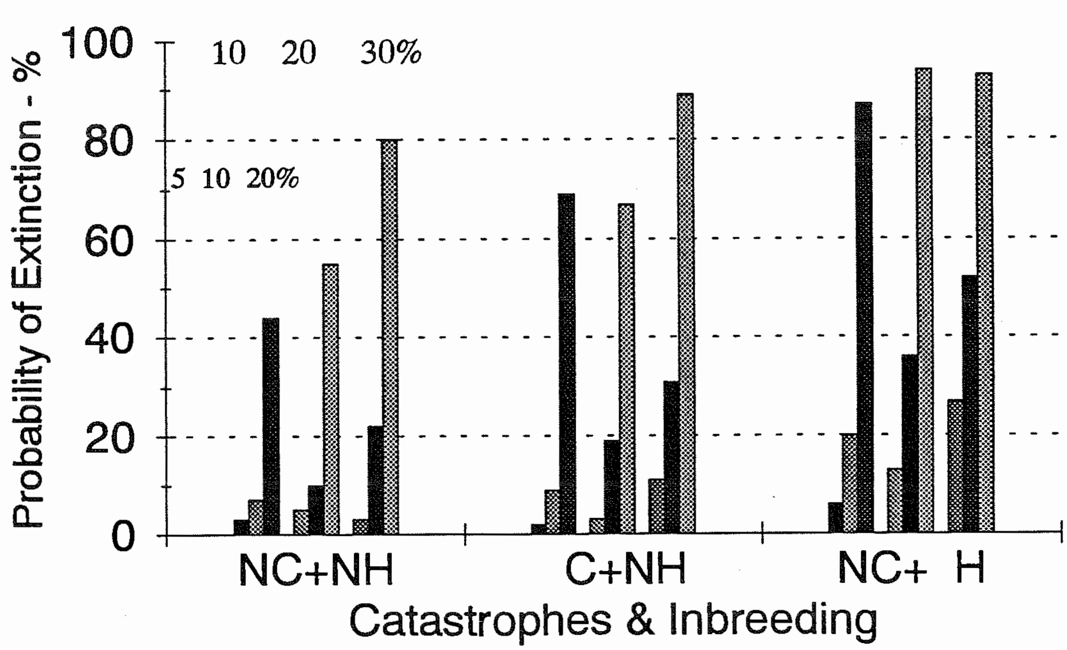
WOOD DUCK DEMOGRAPHY

K = 60, %F 0 = 60



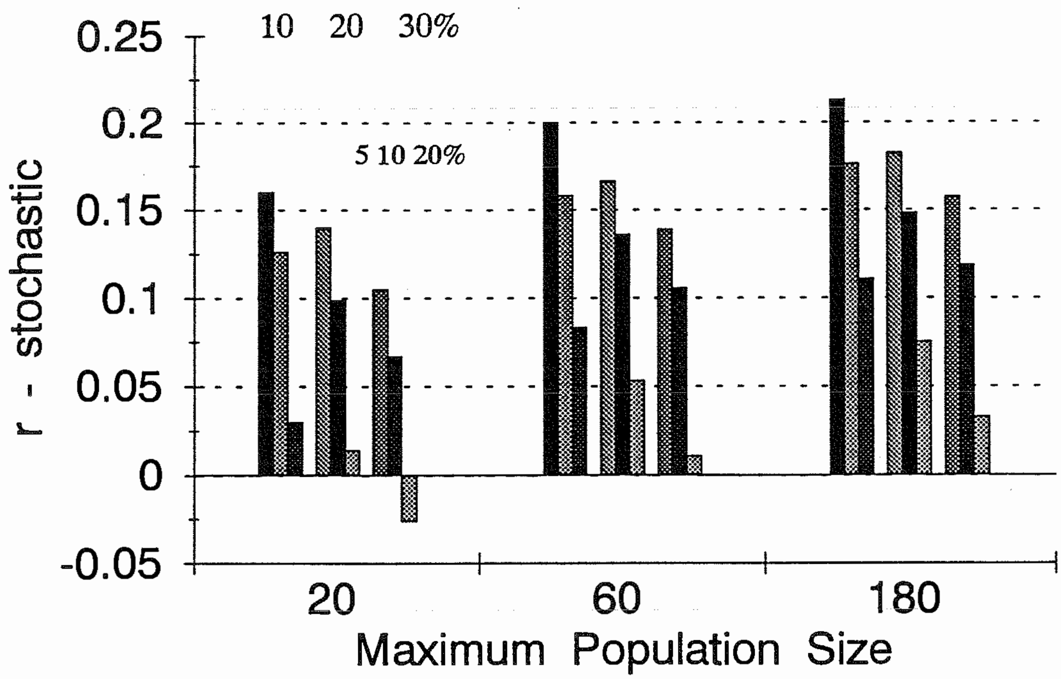
WOOD DUCK DEMOGRAPHY

K = 20, %F 0 = 60



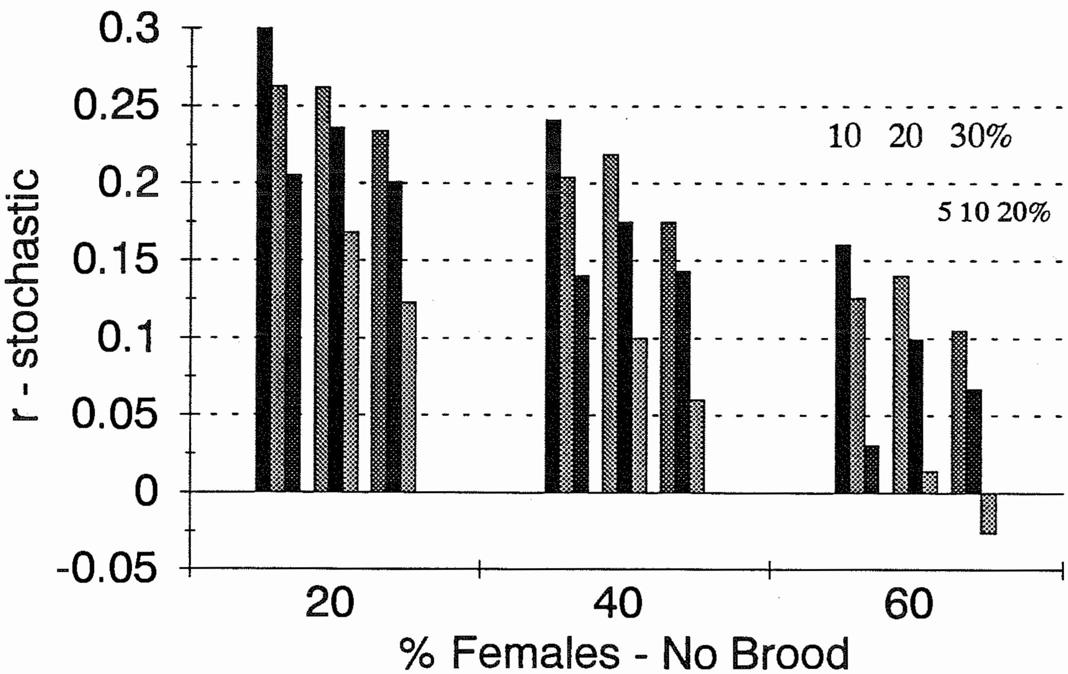
WOOD DUCK DEMOGRAPHY

%F 0 = 60, 0-1 Mortality = 50%



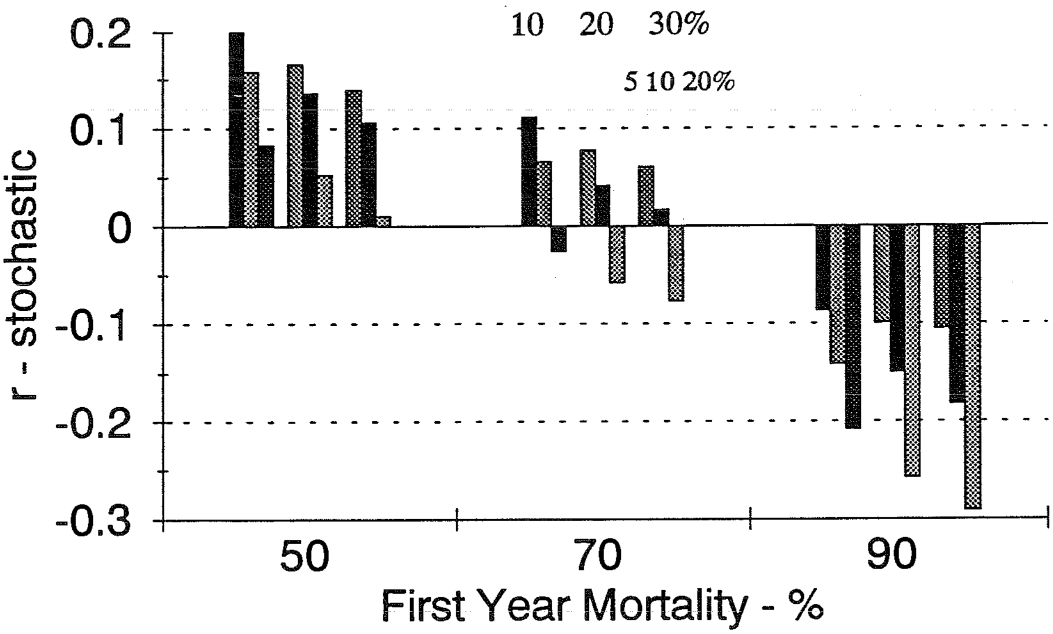
WOOD DUCK DEMOGRAPHY

K = 20, 0-1 Mortality = 50%



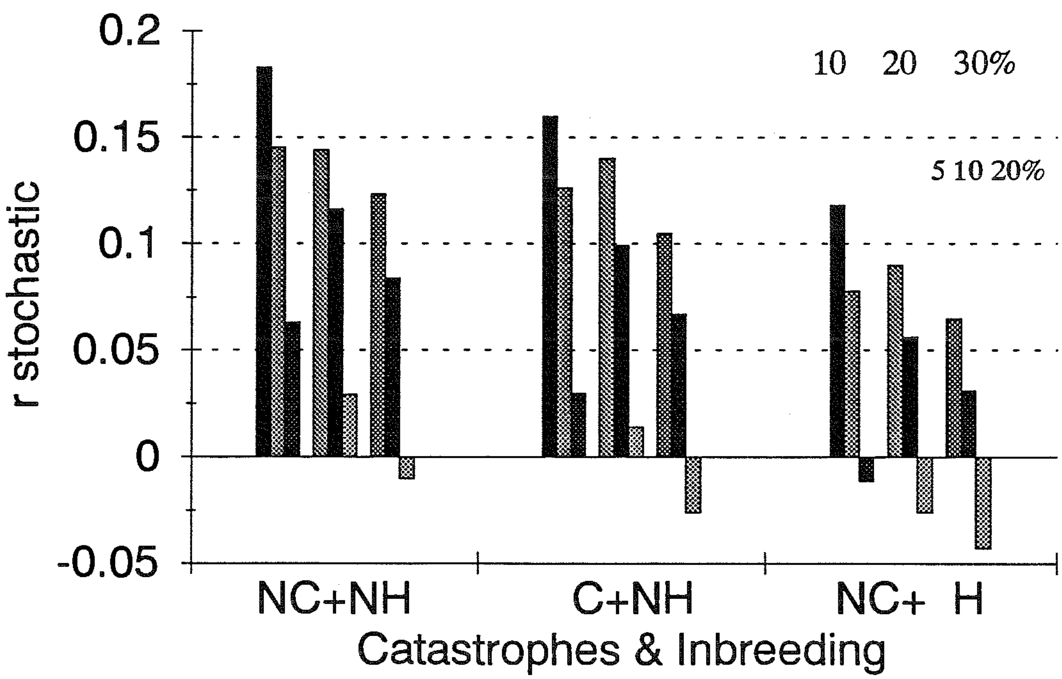
WOOD DUCK DEMOGRAPHY

K = 60, %F 0 = 60



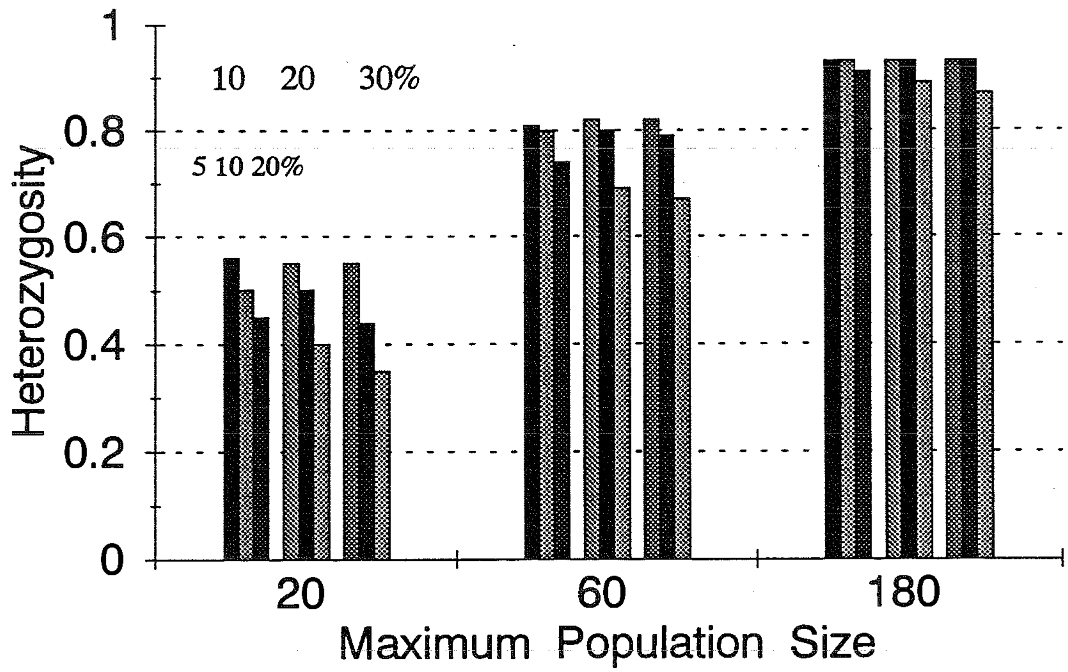
WOOD DUCK DEMOGRAPHY

K = 20, %F 0 = 60



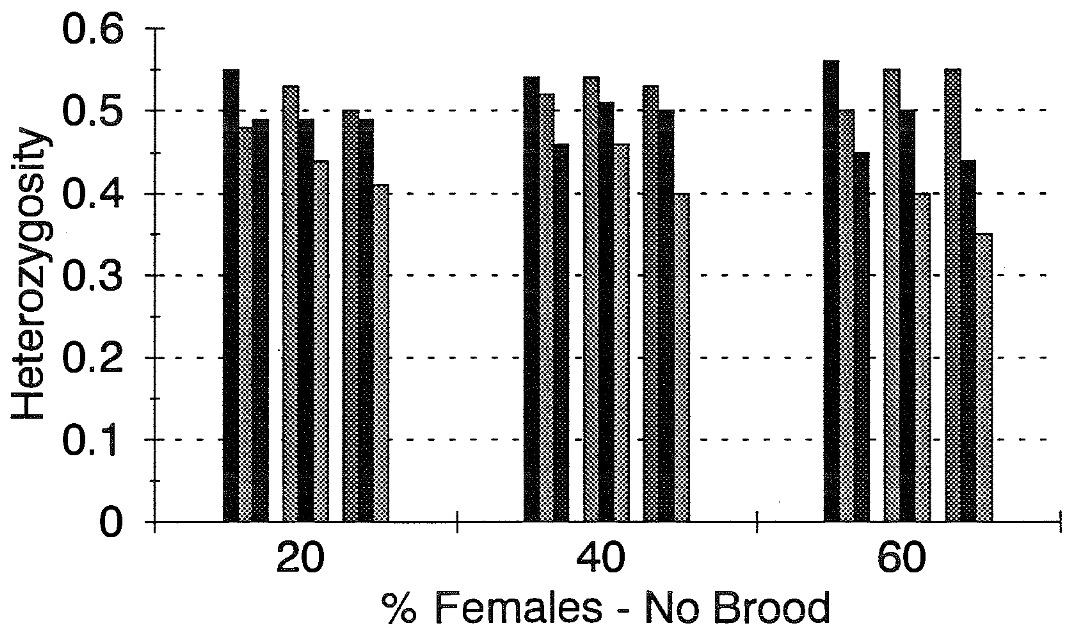
WOOD DUCK DEMOGRAPHY

%F 0 = 60, 0-1 Mortality = 50%



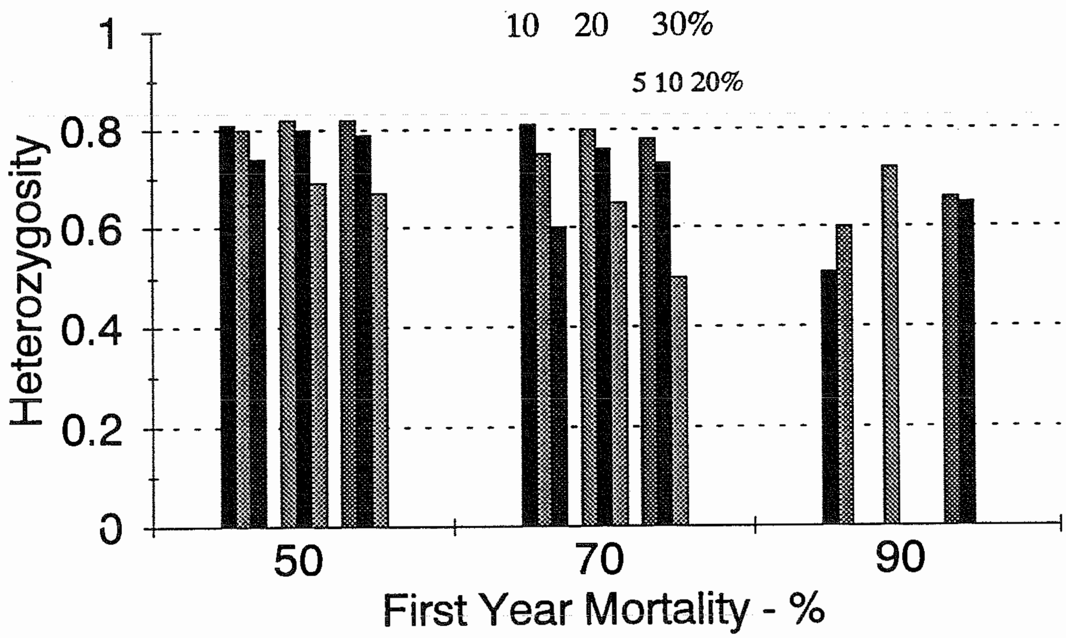
WOOD DUCK DEMOGRAPHY

K = 20, 0-1 Mortality = 50%



WOOD DUCK DEMOGRAPHY

K = 60, %F 0 = 60



WOOD DUCK DEMOGRAPHY

K = 20, %F 0 = 60

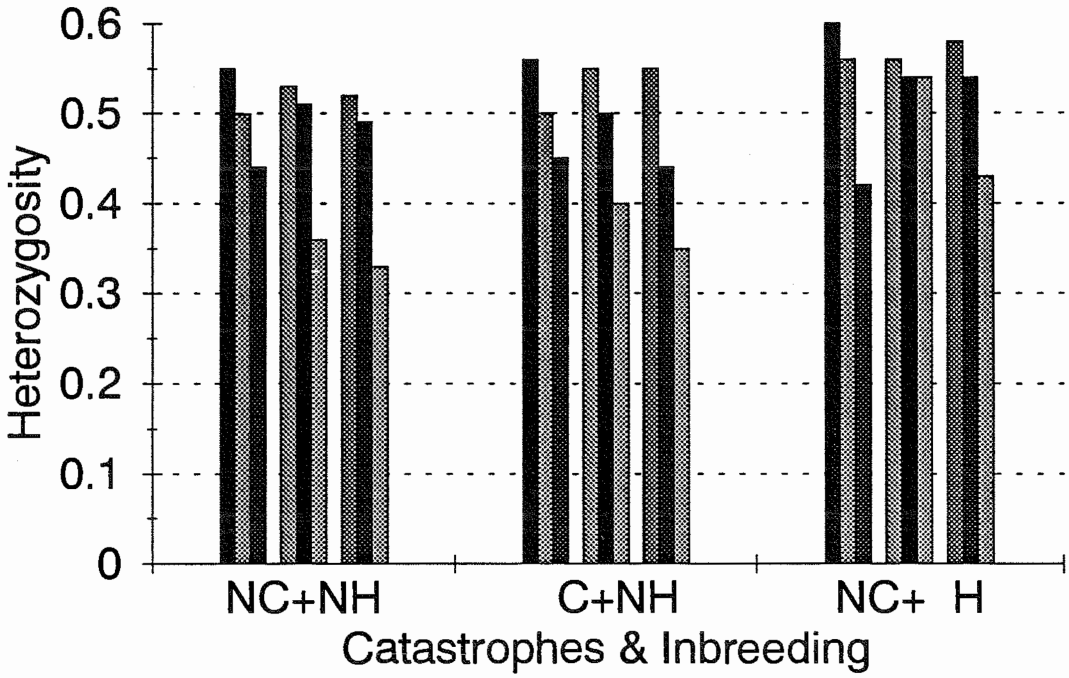


Table 1. WHITE-WINGED WOOD DUCK - N=20, 60%=0 Brood, Catastrophe												
File	Mortality-Age			Results								
	0 %	1 %	Adult %	Population Growth			50 Years					Te
				Deter r	Stochastic r	SD	Pe	N	SD	He		
001	50	10	5	.207	.160	.264	.02	18	3	.56		12
002			10	.177	.126	.278	.09	17	4	.50		22
003			20	.114	.030	.347	.69	16	5	.45		28
004		20	5	.182	.140	.281	.03	17	5	.55		24
005			10	.151	.099	.307	.19	17	4	.50		27
006			20	.086	.014	.355	.67	14	5.5	.40		28
007		30	5	.154	.105	.303	.11	17	4	.55		33
008			10	.122	.067	.323	.31	15	5	.44		25
009			20	.056	-.026	.386	.89	9	6	.35		24
010	70	10	5	.103	.070	.285	.23	15	6	.54		31
011			10	.070	.038	.309	.51	14	5	.43		31
012			20	-.000	-.061	.358	.91	10	4	.26		21
013		20	5	.081	.055	.303	.30	15	5	.49		33
014			10	.047	.019	.329	.59	13	5	.49		29
015			20	-.025	-.065	.384	.94	9	3	.46		20
016	70	30	5	.057	.019	.315	.52	13	5	.48		25
017			10	.022	-.019	.337	.75	9	6	.46		29
018			20	-0.051	-.112	.398	1.0	-	-	-		17
019	90	10	5	-0.080	-.085	.348	.97	9	3	.73		17
020			10	-0.118	-.139	.360	1.0	-	-	-		14
021			20	-.199	-.266	.400	1.0	-	-	-		9
022		20	5	-.098	-.087	.365	1.0	-	-	-		16
023			10	-.136	-.151	.367	1.0	-	-	-		13
024			20	-.218	-.251	.412	1.0	-	-	-		9
025		30	5	-.117	-.131	.354	.99	14	-	.50		14
026			10	-.155	-.189	.369	1.0	-	-	-		12
027			20	-.238	-.278	.415	1.0	-	-	-		8

Table 2. WHITE-WINGED WOOD DUCK - N=60, 60% = 0 Brood, Catastrophe

File	Mortalities			Results							
	0	1	>2	Population Growth			100 years				TE
				Deter r	Stochastic r	SD	PE	N	SD	H	
082	50	10	5	.207	.200	.241	0	59	5	.81	-
083			10	.177	.158	.246	0	56	6	.80	-
084			20	.114	.083	.285	.09	47	14	.74	38
085		20	5	.182	.166	.250	0	57	7	.82	-
086			10	.151	.136	.265	.01	54	10	.80	40
087			20	.086	.053	.304	.11	41	17	.69	34
088		30	5	.154	.139	.267	0	57	7	.82	0
089			10	.122	.106	.286	.02	54	9	.79	17
090			20	.056	.011	.337	.33	32	18	.67	33
091	70	10	5	.103	.111	.267	.02	52	13	.81	24
092			10	.070	.066	.277	.13	45	16	.75	34
093			20	-0	-0.026	.331	.51	25	16	.60	31
094		20	5	0.081	.078	.276	.05	48	14	.80	36
095			10	0.047	.042	.287	.17	42	17	.76	31
096			20	-0.025	-0.058	.358	.78	25	19	.65	29
097		30	5	.057	.061	.293	.03	44	15	.78	37
098			10	0.022	.017	.322	.28	33	17	.73	33
099			20	-0.051	-0.077	.372	.88	19	18	.50	29
100	90	10	5	-0.08	-0.087	.357	.98	36	0	.51	19
101			10	-0.118	-0.141	.350	.97	19	11	.60	17
102			20	-0.199	-0.208	.396	1.0	-	-	-	15
103		20	5	-0.098	-0.099	.342	.97	20	22	.72	18
104			10	-0.136	-0.149	.355	1	-	-	-	17
105			20	-0.218	-0.258	.404	1	-	-	-	13
106		30	5	-0.117	-0.105	.354	0.98	21	14	.66	19
107			10	-0.155	-.182	.384	.98	6	0	.65	15
108			20	-.238	-.291	.393	1	-	-	-	12

Table 3. WHITE-WINGED WOOD DUCK - N = 180, 60% = 0 Brood, Catastrophe

File	Mortality-Age			Results							
				Population Growth			100 Years				Te
	0 %	1 %	Adult %	Deter r	Stochastic r	SD	Pe	N	SD	He	
163	50	10	5	.207	.213	.234	0	177	9	.93	-
164			10	.177	.176	.241	0	174	13	.93	-
165			20	.114	.111	.274	0	159	30	.91	-
166		20	5	.182	.182	.223	0	174	30	.93	-
167			10	.151	.148	.253	0	166	22	.93	-
168			20	.086	.075	.287	0	137	45	.89	-
169		30	5	.154	.157	.265	0	169	17	.93	-
170			10	.122	.119	.272	0	163	25	.93	-
171			20	.056	.033	.314	.11	112	56	.87	38
172	70	10	5	.103	.128	.261	0	166	22	.94	-
173			10	.070	.086	.265	.01	147	41	.93	49
174			20	-0	-0.018	.311	.34	73	57	.82	36
175		20	5	.081	.010	.266	.01	158	31	.93	48
176			10	.047	.062	.278	.01	137	44	.91	23
177			20	-.025	-.031	.334	.40	70	57	.80	36
178		30	5	.057	.072	.286	0	140	40	.92	-
179	70	30	10	.022	.027	.297	.03	106	56	.89	42
180			20	-.051	-.067	.351	.58	51	45	.78	32
181	90	10	5	-.080	-.051	.343	.95	79	38	.91	21
182			10	-.118	-.121	.333	.95	46	28	.71	20
183			20	-.199	-.234	.399	1	-	-	-	17
184		20	5	-.098	-.062	.350	.93	76	47	.89	21
185			10	-.136	-.146	.349	.98	48	50	.80	19
186			20	-.218	-.258	.402	1	-	-	-	16
187		30	5	-.117	-.087	.352	.92	39	30	.77	19
188			10	-.155	-.164	.364	1	-	-	-	19
189			20	-.238	-.288	.399	1	-	-	-	15

Table 4. WHITE-WINGED WOOD DUCK - N = 20, 40% = 0 Brood, Catastrophe

File	Mortality-Age			Results							
	0 %	1 %	Adult %	Population Growth			50 Years				Te
				Deter r	Stochastic r	SD	Pe	N	SD	He	
028	50	10	5	.301	.241	.259	.02	20	2	.54	46
029			10	.274	.204	.269	.02	18	3	.52	32
030			20	.218	.140	.306	.13	18	4	.46	27
031		20	5	.273	.219	.276	0	19	3	.54	-
032			10	.245	.175	.286	.03	18	3	.51	31
033			20	.187	.100	.332	.33	16	5	.46	31
034		30	5	.242	.175	.293	.05	18	3	.53	31
035			10	.213	.143	.303	.07	18	4	.50	29
036			20	.152	.060	.366	.48	15	6	.40	27
037	70	10	5	.184	.135	.281	.09	18	4	.54	36
038			10	.154	.089	.307	.34	17	4	.54	30
039			20	.089	.001	.357	.73	14	6	.40	25
040		20	5	.160	.104	.300	.09	16	5	.57	37
041			10	.128	.065	.321	.30	14	5	.53	29
042			20	.062	-.019	.380	.85	13	6	.41	23
043	70	30	5	.133	.077	.327	.24	16	5	.56	30
044			10	.101	.038	.337	.50	14	6	.53	30
045			20	.032	-.076	.416	.98	6	.7	.47	17
046	90	10	5	-.018	-.074	.340	.98	9	0	.29	16
047			10	-.054	-.118	.374	1	-	-	-	15
048			20	-.132	-.208	.412	1	-	-	-	11
049		20	5	-.036	-.092	.364	.99	7	0	.13	16
050			10	-.073	-.131	.373	1	-	-	-	14
051			20	-.152	-.245	.412	1	-	-	-	10
052		30	5	-.057	-.102	.369	1	-	-	-	17
053			10	-.094	-.157	.397	.99	8	0	.30	13
054			20	-.175	-.245	.439	1	-	-	-	9

Table 5. WHITE-WINGED WOOD DUCK - N = 20, 20% = 0 Brood, Catastrophe												
File	Mortality-Age			Results								
	0 %	1 %	Adult %	Population Growth			50 Years					Te
				Deter r	Stochastic r	SD	Pe	N	SD	He		
055	50	10	5	.375	.300	.245	0	20	3	.55		-
056			10	.350	.263	.255	.01	19	3	.48		25
057			20	.300	.205	.276	.04	18	3	.49		18
058		20	5	.344	.262	.263	.01	20	3	.53		25
059			10	.318	.236	.272	.02	19	3	.49		36
060			20	.266	.168	.308	.09	18	4	.44		35
061		30	5	.310	.234	.282	.01	19	3	.50		33
062			10	.283	.201	.293	.03	19	3	.49		29
063			20	.228	.123	.336	.17	16	5	.41		26
064	70	10	5	.248	.172	.291	.02	19	3	.57		18
065			10	.219	.134	.307	.11	17	4	.53		27
066			20	.159	.047	.366	.64	14	6	.42		28
067		20	5	.221	.143	.306	.07	17	3	.55		24
068			10	.192	.111	.324	.22	17	5	.51		31
069			20	.130	.002	.388	.83	15	5	.46		24
070	70	30	5	.192	.111	.326	.10	16	4	.55		29
071			10	.162	.063	.350	.33	16	5	.51		27
072			20	.098	-.013	.404	.79	11	5	.42		21
073	90	10	5	.030	-.063	.360	.98	9	0	.32		18
074			10	-.005	-.122	.354	.98	9.5	8	.54		14
075			20	-.080	-.217	.425	1.0	-	-	-		11
076		20	5	.010	-.063	.380	.97	6	3	.51		19
077			10	-.026	-.134	.371	1	-	-	-		14
078			20	-.102	-.222	.425	1	-	-	-		10
079		30	5	-.012	-.107	.366	1	-	-	-		16
080			10	-.048	-.139	.388	1	-	-	-		14
081			20	-.126	-.223	.416	1					10

Table 6. WHITE-WINGED WOOD DUCK - N = 20, 60% = 0 Brood

File	Mortality-Age			Results							
	0	1	Adult	Population Growth			50 Years				Te
	%	%	%	Deter r	Stochastic r	SD	Pe	N	SD	He	
244	50	10	5	.225	.183	.267	.03	19	3	.55	34
245			10	.196	.145	.286	.07	18	4	.49	26
246			20	.135	.063	.334	.44	15	5	.44	37
247		20	5	.200	.144	.280	.05	18	3	.53	25
248			10	.169	.116	.300	.10	17	5	.51	35
249			20	.106	.029	.353	.55	14	6	.36	27
250		30	5	.171	.123	.304	.03	16	4	.52	25
251			10	.140	.084	.330	.22	16	5	.49	25
252			20	.075	-.010	-.403	.80	10	7	.33	27
253	70	10	5	.119	.094	.288	.21	16	4	.56	32
254			10	.086	.056	.303	.37	14	5	.57	29
255			20	.017	-.035	.371	.85	12	7	.34	21
256		20	5	.097	.065	.304	.34	16	5	.56	30
257			10	.063	.028	.323	.52	14	5	.47	29
258			20	-.008	.050	.379	.94	9	6	.32	23
259	70	30	5	.072	.044	.321	.41	40	5	.54	28
260			10	.038	-.008	.342	.70	11	6	.49	29
261			20	-.035	-.105	.903	.98	13	10	.48	16
262	90	10	5	-.068	-.073	.350	.98	12	1	.08	17
263			10	-.105	-.125	.364	.99	4	0	.53	14
264			20	-.186	-.210	.423	1	-	-	-	10
265		20	5	-.085	-.092	.364	.95	9	4	.92	15
266			10	-.123	-.136	.390	1	-	-	-	15
267			20	-.205	-.229	.418	1	-	-	-	10
268	90	30	5	-.105	-.142	.362	1	-	-	-	14
269			10	-.143	-.164	.395	1	-	-	-	12
270			20	-.226	-.246	.448	1	-	-	-	9

Table 7. WHITE-WINGED WOOD DUCK - N = 0, 60% = 0 Brood, Inbreeding

File	Mortality-Age			Results							
	0 %	1 %	Adult %	Population Growth			50 Years				Te
				Deter r	Stochastic r	SD	Pe	N	SD	He	
325	50	10	5	.225	.118	.240	.06	17	4	.60	44
326			10	.196	.078	.261	.20	14	5	.56	35
327			20	.135	-.011	.339	.87	8	6	.42	29
328		20	5	.200	.090	.252	.13	15	5	.56	39
329			10	.169	.056	.278	.36	13	5	.54	35
330			20	.106	-.026	.351	.94	10	5	.54	25
331		30	5	.171	.065	.283	.27	13	6	.58	35
332			10	.140	.031	.308	.52	12	6	.54	33
333			20	.075	-.043	.370	.93	6	4	.43	22
334	70	10	5	.119	.047	.265	.33	13	6	.58	37
335			10	.086	.007	.290	.63	10	5	.51	31
336			20	.017	-.082	.364	.98	5	3	.63	18
337		20	5	.097	.019	.284	.52	10	5	.58	31
338			10	.063	-.014	.306	.81	12	6	.55	29
339			20	-.008	-.078	.363	1	-	-	-	20
340		30	5	.072	-.001	.309	.75	10	5	.50	33
341			10	.038	-.043	.326	.96	6	3	.49	27
342			20	-.035	-.123	.397	1	-	-	-	16
343	90	10	5	-.068	-.099	.338	.99	12	0	.75	16
344			10	-.105	-.141	.350	1	-	-	-	14
345			20	-.186	-.202	.418	1	-	-	-	11
346		20	5	-.085	-.116	.341	1	-	-	-	15
347			10	-.123	-.159	.355	1	-	-	-	14
348			20	-.205	-.223	.431	1	-	-	-	10
349		30	5	-.105	-.150	.348	1	-	-	-	14
350			10	-.143	-.177	.391	1	-	-	-	12
351			20	-.226	-.260	.443	1	-	-	-	9

Table 8. WHITE-WINGED WOOD DUCK - N = 20, 60% = 0 Brood, Inbreeding												
File	Mortality-Age			Results								
	0 %	1 %	Adult %	Population Growth			50 Years					Te
				Deter r	Stochastic r	SD	Pe	N	SD	He		
568	50	10	5	.207	.101	.237	.09	16	5	.57		42
569			10	.177	.056	.261	.34	13	5	.52		31
570			20	.114	-.013	.314	.86	9	5	.49		30
571		20	5	.182	.077	.252	.17	15	5	.56		32
572			10	.151	.028	.286	.56	12	6	.50		34
573			20	.086	-.035	.356	.93	7	4	.42		24
574		30	5	.154	.043	.281	.38	15	5	.54		35
575			10	.122	.010	.310	.68	10	6	.54		31
576			20	.056	-.058	.375	.97	8	3	.54		23
577	70	10	5	.103	-.034	.267	.45	12	6	.55		32
578			10	.070	-.018	.304	.85	7	4	.48		29
579			20	-.000	-.079	.358	.99	1	-	.24		18
580		20	5	.081	.006	.282	.67	10	6	.60		33
581			10	.047	-.028	.307	.88	8	5	.50		30
582			20	-.025	-.110	.378	.99	2	-	.38		19
583		30	5	.057	-.019	.303	.81	11	6	.50		27
584			10	.022	-0.59	.329	.96	7	3	.48		25
585			20	-.051	-.120	.378	1	-	-	-		16
586	90	10	5	-.080	-.098	.343	1	-	-	-		17
587			10	-.118	-.151	.349	1	-	-	-		14
588			20	-.199	-.251	.414	1	-	-	-		9
589		20	5	-.098	-.124	.337	.99	3	-	-		15
590			10	-.136	-.168	.361	1	-	-	-		13
591			20	-.218	-.262	.396	1	-	-	-		9
592		30	5	-.117	-.138	.354	1	-	-	-		14
593			10	-.155	-.177	.364	1	-	-	-		12
594			20	-.238	-.292	.410	1	-	-	-		8

Table 9. WHITE-WINGED WOOD DUCK - N = 60, 40% 0 Brood, Catastrophe												
File	Mortality-Age			Results								
				Population Growth			50 Years				Te
	0 %	1 %	Adu lt %	Deter r	Stochastic r	SD	Pe	N	SD	He	
109	50	10	5	.301	.275	.228	0	59	4	.80	-
110			10	.274	.247	.239	0	58	4	.80	-
111			20	.218	.174	.263	0	56	7	.77	-
112		20	5	.273	.245	.242	0	58	5	.81	-
113			10	.245	.210	.253	0	58	6	.80	-
114			20	.187	.143	.280	0	54	9	.75	-
115		30	5	.242	.216	.270	0	57	6	.80	-
116			10	.213	.185	.269	0	56	7	.80	-
117			20	.152	.107	.302	.01	49	14	.76	38
118	70	10	5	.184	.158	.275	.02	57	7	.82	28
119			10	.154	.128	.283	.02	51	13	.81	42
120			20	.089	.032	.327	.29	38	19	.72	28
121		20	5	.160	.136	.288	.01	54	10	.82	29
122			10	.128	.101	.300	.02	50	13	.79	40
123			20	.062	.011	.350	.37	35	18	.69	32
124		30	5	.133	.102	.308	.01	52	10	.81	41
125			10	.101	.070	.319	.07	45	15	.78	35
126			20	.032	-.025	.375	.52	22	20	.66	32
127	90	10	5	-.018	-.056	.348	.94	33	17	.72	20
128			10	-.054	-.125	.358	.96	10	13	.34	17
129			20	-.132	-.218	.403	1	-	-	-	14
130		20	5	-.036	-.080	.358	.96	26	19	.57	18
131			10	-.073	-.119	.375	.96	14	17	.68	19
132			20	-.152	-.211	.422	1	-	-	-	15
133		30	5	-.057	-.098	.383	.98	35	6	.80	18
134			10	-.094	-.114	.389	1	-	-	-	18
135			20	-.175	-.225	.434	1	-	-	-	14

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

WWWD568
Sun Nov 21 22:39:11 1993


  1 population(s) simulated for 50 years, 100 runs

  HETEROSIS model of inbreeding depression
    with 3.14000 lethal equivalents per diploid genome

  First age of reproduction for females: 2   for males: 2
  Age of senescence (death): 11
  Sex ratio at birth (proportion males): 0.50000


Population 1:
  Monogamous mating; all adult males in the breeding pool. 100.00
percent of adult males in the breeding pool.

  Reproduction is assumed to be density independent.

    60.00 (EV = 20.00 SD) percent of adult females produce
litters of size 0
     2.00 percent of adult females produce litters of size 1
     3.00 percent of adult females produce litters of size 2
     5.00 percent of adult females produce litters of size 3
    10.00 percent of adult females produce litters of size 4
    10.00 percent of adult females produce litters of size 5
     5.00 percent of adult females produce litters of size 6
     3.00 percent of adult females produce litters of size 7
     2.00 percent of adult females produce litters of size 8

   50.00 (EV = 20.41 SD) percent mortality of females between
ages 0 and 1
   10.00 (EV = 3.00 SD) percent mortality of females between ages
1 and 2
    5.00 (EV = 2.00 SD) percent annual mortality of adult females
(2<=age<=11)
   50.00 (EV = 20.41 SD) percent mortality of males between ages
0 and 1
   10.00 (EV = 3.00 SD) percent mortality of males between ages 1
and 2
    5.00 (EV = 2.00 SD) percent annual mortality of adult males
(2<=age<=11)
    EVs may have been adjusted to closest values
        possible for binomial distribution.
    EV in reproduction and mortality will be correlated.

  Frequency of type 1 catastrophes: 20.000 percent
    with 0.600 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    Total
     3     1     2     1     1     0     1     0     1     0
0      10  Males
     3     1     2     1     1     0     1     0     1     0
0      10  Females

  Carrying capacity = 20 (EV = 0.00 SD)

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

     r =  0.207     lambda = 1.230     R0 =     2.990
   Generation time for:  females = 5.29    males = 5.29

Stable age distribution:  Age class    females     males
                              0         0.191      0.191
                              1         0.078      0.078
                              2         0.057      0.057
                              3         0.044      0.044
                              4         0.034      0.034
                              5         0.026      0.026
                              6         0.020      0.020
                              7         0.016      0.016
                              8         0.012      0.012
                              9         0.009      0.009
                             10         0.007      0.007
                             11         0.006      0.006

Ratio of adult (>= 2) males to adult (>= 2) females: 1.000


Population1

Year 5
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   100, P[S] = 1.000
     Population size =            18.83 (   0.25 SE,    2.47 SD)
     Expected heterozygosity =    0.924 (  0.002 SE,   0.018 SD)
     Observed heterozygosity =    0.992 (  0.003 SE,   0.027 SD)
     Number of extant alleles =   18.95 (   0.31 SE,    3.10 SD)

Year 10
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   100, P[S] = 1.000
     Population size =            18.20 (   0.32 SE,    3.22 SD)
     Expected heterozygosity =    0.884 (  0.003 SE,   0.027 SD)
     Observed heterozygosity =    0.967 (  0.004 SE,   0.043 SD)
     Number of extant alleles =   12.80 (   0.21 SE,    2.12 SD)

Year 15
```

```
        N[Extinct] =        0, P[E] = 0.000
        N[Surviving] =    100, P[S] = 1.000
        Population size =           17.69 (   0.37 SE,    3.74 SD)
        Expected heterozygosity =   0.837 (  0.004 SE,   0.044 SD)
        Observed heterozygosity =   0.933 (  0.007 SE,   0.066 SD)
        Number of extant alleles =   9.57 (   0.20 SE,    1.97 SD)

   Year 20
        N[Extinct] =        0, P[E] = 0.000
        N[Surviving] =    100, P[S] = 1.000
        Population size =           17.65 (   0.37 SE,    3.75 SD)
        Expected heterozygosity =   0.794 (  0.006 SE,   0.057 SD)
        Observed heterozygosity =   0.902 (  0.010 SE,   0.096 SD)
        Number of extant alleles =   7.77 (   0.18 SE,    1.81 SD)

   Year 25
        N[Extinct] =        0, P[E] = 0.000
        N[Surviving] =    100, P[S] = 1.000
        Population size =           17.87 (   0.33 SE,    3.34 SD)
        Expected heterozygosity =   0.749 (  0.008 SE,   0.078 SD)
        Observed heterozygosity =   0.820 (  0.012 SE,   0.116 SD)
        Number of extant alleles =   6.43 (   0.16 SE,    1.64 SD)

   Year 30
        N[Extinct] =        1, P[E] = 0.010
        N[Surviving] =     99, P[S] = 0.990
        Population size =           18.18 (   0.34 SE,    3.35 SD)
        Expected heterozygosity =   0.713 (  0.009 SE,   0.086 SD)
        Observed heterozygosity =   0.775 (  0.014 SE,   0.141 SD)
        Number of extant alleles =   5.53 (   0.13 SE,    1.30 SD)

   Year 35
        N[Extinct] =        1, P[E] = 0.010
        N[Surviving] =     99, P[S] = 0.990
        Population size =           17.32 (   0.36 SE,    3.58 SD)
        Expected heterozygosity =   0.675 (  0.011 SE,   0.106 SD)
        Observed heterozygosity =   0.735 (  0.016 SE,   0.161 SD)
        Number of extant alleles =   4.88 (   0.13 SE,    1.31 SD)

   Year 40
        N[Extinct] =        4, P[E] = 0.040
        N[Surviving] =     96, P[S] = 0.960
        Population size =           16.77 (   0.42 SE,    4.09 SD)
        Expected heterozygosity =   0.653 (  0.013 SE,   0.130 SD)
        Observed heterozygosity =   0.715 (  0.019 SE,   0.183 SD)
        Number of extant alleles =   4.44 (   0.12 SE,    1.15 SD)

   Year 45
        N[Extinct] =        5, P[E] = 0.050
        N[Surviving] =     95, P[S] = 0.950
        Population size =           16.48 (   0.47 SE,    4.59 SD)
        Expected heterozygosity =   0.606 (  0.014 SE,   0.140 SD)
        Observed heterozygosity =   0.662 (  0.020 SE,   0.194 SD)
        Number of extant alleles =   3.97 (   0.11 SE,    1.09 SD)
```

```
Year 50
     N[Extinct] =        9, P[E] = 0.090
     N[Surviving] =     91, P[S] = 0.910
     Population size =           16.33 (   0.52 SE,    4.97 SD)
     Expected heterozygosity =    0.569 (  0.016 SE,   0.155 SD)
     Observed heterozygosity =    0.633 (  0.022 SE,   0.210 SD)
     Number of extant alleles =    3.70 (   0.11 SE,    1.05 SD)
```

In 100 simulations of Population1 for 50 years:
  9 went extinct and 91 survived.

This gives a probability of extinction of 0.0900 (0.0286 SE),
  or a probability of success of   0.9100 (0.0286 SE).

9 simulations went extinct at least once.
Of those going extinct,
    mean time to first extinction was 42.11 years (2.11 SE, 6.33 SD).

No recolonizations.

Mean final population for successful cases was 16.33 (0.52 SE, 4.97 SD)

Age 1	Adults	Total	
1.30	6.65	7.95	Males
1.38	7.00	8.38	Females

Without harvest/supplementation, prior to carrying capacity truncation,
  mean growth rate (r) was 0.1013 (0.0034 SE, 0.2372 SD)

Final expected heterozygosity was   0.5691 (0.0163 SE, 0.1550 SD)
Final observed heterozygosity was   0.6326 (0.0221 SE, 0.2104 SD)
Final number of alleles was   3.70 (0.11 SE, 1.05 SD)
****

```
WWWD001     ***OutputFilename***
Y     ***PlotterFiles?***
N     ***EachRun?***
100     ***Simulations***
50     ***Years***
5     ***ReportingInterval***
1     ***Populations***
N     ***InbreedingDepression?***
Y     ***EVcorrelation?***
1     ***TypesOfCatastrophes***
M     ***MonogamousOrPolygynous***
2     ***FemaleBreedingAge***
2     ***MaleBreedingAge***
11     ***MaximumAge***
0.500000     ***SexRatio***
8     ***MaximumLitterSize***
N     ***DensityDependentBreeding?***
60.000000     ***Population1:PercentLitterSize0***
2.000000     ***Population1:PercentLitterSize1***
3.000000     ***Population1:PercentLitterSize2***
5.000000     ***Population1:PercentLitterSize3***
10.000000     ***Population1:PercentLitterSize4***
10.000000     ***Population1:PercentLitterSize5***
5.000000     ***Population1:PercentLitterSize6***
3.000000     ***Population1:PercentLitterSize7***
2.000000     ***Population1:PercentLitterSize8***
20.000000     ***EV--Reproduction***
50.000000     ***FemaleMortalityAtAge0***
20.412415     ***EV--FemaleMortality***
10.000000     ***FemaleMortalityAtAge1***
3.000000     ***EV--FemaleMortality***
5.000000     ***AdultFemaleMortality***
2.000000     ***EV--AdultFemaleMortality***
50.000000     ***MaleMortalityAtAge0***
20.412415     ***EV--MaleMortality***
10.000000     ***MaleMortalityAtAge1***
3.000000     ***EV--MaleMortality***
5.000000     ***AdultMaleMortality***
2.000000     ***EV--AdultMaleMortality***
20.000000     ***ProbabilityOfCatastrophe1***
0.600000     ***Severity--Reproduction***
1.000000     ***Severity--Survival***
Y     ***AllMalesBreeders?***
Y     ***StartAtStableAgeDistribution?***
20     ***InitialPopulationSize***
20     ***K***
0.000000     ***EV--K***
N     ***TrendInK?***
N     ***Harvest?***
N     ***Supplement?***
N     ***AnotherSimulation?***
```

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 5: Working Group WWWD Known Sites in Sumatra

Working Group Report:
White-Winged Wood Duck -- Known Sites in Sumatra

Members: Daniel Walter Sinaga, Djoko Setijono, Mualdaulay, Titus Muladi W., Siska Saskia Hendarin, Ucang Suparman, Prie Supriadi, Muniful Hamid, Widodo Sukohadi Ramono, A. Green, Rudyanto

The group made an analysis of the conservation status of all known sites with recently confirmed records of White-winged Wood Duck. Table 3 presents a complete list of the locations of sites in which the species has been recorded in Sumatra since 1980, with the minimum number of individuals recorded and the year when the last survey was conducted. In many cases, the actual population size at the time of the survey was likely to have been much higher.

The current land use in these sites is presented in the tables following analysis of land-use maps by PHPA staff at the workshop. It is important to note that ground-truthing suggests that the land-use information on these maps may be inaccurate in some cases. For example, the maps suggest that the forest in Padang Sugihan Wildlife Sanctuary is unchanged, while surveys show that the swamp forest has been severely degraded and the White-winged Wood Duck population has probably been eliminated. Nevertheless, this up-to-date land-use information permits an assessment of the conservation status of White-winged Wood Duck sites in Sumatra, a reassessment of the probable known number of individual ducks surviving in Sumatra, and an assessment of the rate of habitat destruction.

Only four sites where White-winged Wood Duck have been recorded since 1980 are conservation areas, one is protection forest and the remaining 17 are production forest or areas with other land use. Habitat loss through encroachment or conversion has occurred in all three classes of sites, including at least two of the protected areas.

The **known** number of individual White-winged Wood Ducks in Sumatra was assessed immediately prior to the workshop at 110. This figure assumes that any sites found to hold birds since 1980 still hold the same number of birds. However, the information in Table 3 suggests that, since these surveys, habitat loss has reduced the total minimum number of birds in these sites to 79. This reduction has been caused by habitat loss in formerly important sites such as Sungai Tulang Bawang (Lampung) and Kayu Agung (Sumatera Selatan).

In particular, of nine White-winged Wood Duck sites outside protected areas in Lampung and Sumatera Selatan that were identified in a 1988 survey as holding at least 53 birds (figures excluding Way Kambas National Park), five sites holding 64% of the total number of known birds have been destroyed in the past five years. Although the **actual**, total population size of White-winged Wood Duck in Sumatra may still exceed 1,000, this illustrates the high rate of population decline and the severe threat to the estimated 90% of remaining suitable habitat that is currently unprotected.

Table 3. Complete list of sites in Sumatra where the White-winged Wood Duck has been recorded since 1980.

3a) Sites shared with either Asian Elephant or Sumatran Rhino

Site and coordinates	Known numbers and year	Designation	Current Status
Lampung			
1. Way Kambas NP 5.01 S, 105.46 E	30 (1991)	National Park	16% encroached
2. Sungai Mesuji 3.44 S, 105.15 E	3 (1988)	Production forest	Converted
3. Sungai Terusan 4.31 S, 105.22 E	2 (1988)	Production forest	Converted
Sumatera Selatan			
4. Padang Sugihan WS 2.57 S, 105.10 E	4 (1988)	Game Reserve	100% degraded
Jambi			
5. Berbak NP 1.26 S, 103.43 E	7 present just outside in 1992	National Park	None
Aceh			
6. Singkil Barat 2.14 N, 97.53 E	2 present just outside in 1991	Production forest	20% converted
7. Kluet extension, Gunung Leuser NP 3.56 N, 96.33 E	5 (1993)	National Park	None

3b) Sites not shared with Asian Elephant or Sumatran Rhino

Site and coordinates	Known numbers and years	Designation	Current status/ threat
Lampung			
1. Sungai Tulang Bawang and backswamps 4.22-4.30 S, 105.14-105.51 E	18 (1988)	Other (non-forest)	100% converted-settlement
2. Cabang/Sungai Seputih 4.33-4.45 S, 105.27-105.48 E	9 (1988)	Permanent production forest	Part to be converted into sugar cane plantation (swampy area)
3. Jepara 5.12-5.22 S, 105.40-105.46 E	2 (1988)	Protected forest	50% encroached
Sumatera Selatan			
4. Kayu Agung 3.28-3.38 S 104.51-105.09 E	9 (1988)	Other (non-forest)	100% settled
5. Sungai Lalang 1.55-2.14 S, 103.55-104.08 E	4 (1988)	Conversion production forest	10% encroached
6. Sungai Lematan (Rawa Keleboran) 3.07 S, 104.14 E	4 (1988)	Conversion production forest/other (non-forest)	10% encroached
7. Banyuasin Musi River Delta 2.00-2.30 S, 104.30-105.15 E	1 (1986)	Conversion production forest/other (non-forest)	75% settled
8. Sungai Lumpur/ Sungai Selapan 3.18 S, 105.12 E	2 (1988)	Conversion production forests	20% encroached

Riau			
9. Kerumutan reserve 0.05 N, 101.25 E	4 (1992)	Wildlife Reserve	Insufficient information available
10. Rengat 0.25 S, 101.40 E	9 (1992)	Conversion production forest	20% encroached
Jambi			
11. Sungai Gelumpangkecil 1.08 S, 102.11 E	1 (1991)	Various	Insufficient information available
12. Kumpeh 1.27 S, 103.45 E	4 (1992)	National Park/other (non-forest)	None/ settlement
13. Air Hitam Dalam 1.20 S, 104.00 E	3 (1992)	National Park/other (non-forest)	None/ settlement
14. Sungai Berbak 1.04 S, 104.06 E	1 (1989)	Other (non-forest)	Insufficient information available
15. Muara Bulian 1.42 S, 103.16 E	2 (1976)	Other (non-forest)/ permanent conversion production forest	Insufficient information available
Sumatera Utara			
16. Rianiate 1.25 N, 98.55 E	2 (1990)	Protected forest/ limited production forest/other (non-forest)	None/none/settlement
17. Sungai Tapus 2.10 N, 98.11 E	1 (1990)	Other (non-forest)	25% encroached
Aceh			
18. Runding 2.40 N, 97.51 E	2 (1991)	Conservation Area/Game Reserve	None/none

Note: The presence of White-winged Wood Duck inside the boundary of Berbak National Park and Singkil Barat has not been confirmed. Data on threats to Padang Sugihan Wildlife Sanctuary come from Green (1992), not land-use maps.

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 6: Working Group
Tourism and Disturbance at Way Kambas National Park

Working Group Report:
Tourism and Disturbance at Way Kambas National Park

Members: Teguh Husodo, Hasudungan Pakpahan, Apriawan, C. McHenry, J. Reilly, G. Hill-Spedding, K. Wilson

The working group considered the problems of disturbance and tourism at Way Kambas, with particular reference Way Kanan. Whilst agreeing that tourist-related disturbance was a major problem at Way Kanan, group members proposed differing and conflicting solutions. The statements of the two sub-groups are given below.

Working Group: Tourism at Way Kambas - Visitors to Way Kanan

Sub-group Members: Teguh Husodo, Hasudungan Pakpahan, Apriawan

The number and access of tourists in Way Kanan should be limited as it is impossible for the officer to control them, and access to the swamps and ponds in that area should be restricted.

The current system of transporting tourists from the gate (Plang Ijo) to Way Kanan is the best way both economically and educationally because:

> Local people are able to take advantage of income from tourists who come to Way Kanan by their motorcycle transportation system (Ojeg). At the moment the volume of tourism is not sufficient to fill a bus on a regular basis; in order to fill a bus and make such a system viable, some tourists would have to wait for a long time.
>
> If the Ojeg system changed to another system which did not involve local people (coordinated by the National Park), many local people would lose their jobs and income. In order to gain another income in some other way, local people might turn to poaching within the park.
>
> It is also possible that local people who are aggrieved by having lost their income would cause trouble around the park. There is already an instance of the friends of a man caught poaching having set fires in retaliation when he was jailed.
>
> If tourists arrive together in a bus there is a problem of control. If a group arrives, and splits into smaller groups, it is extremely difficult for the officer to keep the groups under control. It is felt that the average tourist coming to Way Kanan at the moment, in particular the domestic tourist, is uneducated about wildlife and will not understand the need to behave appropriately in the National Park.

Working Group: Tourism at Way Kambas - Visitors to Way Kanan

Sub-group Members: C. McHenry, J. Reilly, G. Hill-Spedding, K. Wilson (Way Kambas '93 project)

The use of the track by park guards and tourists is currently uncontrolled and inefficient. Travel to and from Way Kanan post is by motorbike, which is noisy and can only carry two people at any one time. Additional travel occurs throughout the day, with no set times for travel. If a minibus were used to transport guards and tourists at specific times, less disturbance would be caused per person, and the times of travel could be such that they avoid peak times of White-winged Wood Duck activity.

The construction and use of the new track to Way Kanan has disturbed many of the ponds formerly used by the White-winged Wood Duck. This disturbance could be mitigated by growing vegetation between the ponds and the track to shield the ponds from the track.

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 7: White-Winged Wood Duck Action Plan

White-Winged Wood Duck Action Plan

Leaders: M. Ounsted, Rudyanto, A. Green, A. Choudhury and Workshop Participants

MAIN RECOMMENDATIONS

Recognising that:

The status of the White-winged Wood Duck is likely to qualify as `IUCN Critical' and that there appears to be a continuing steep global decline in the species's numbers;

Sumatra sustains a unique population of White-winged Wood Duck that is morphologically different from the continental *Cairina scutulata* and is likely to stem from a considerable genetic difference;

There are severe and compounding pressures on the Sumatran wetland rainforest, which is the White-winged Wood Duck's specific habitat;

For many parts of Sumatra accurate White-winged Wood Duck population assessments are still unavailable;

and that:

There is almost no knowledge of the life history of the White-winged Wood Duck in Sumatra,

the Working Group recommends that:

Every effort should be made to sustain and increase the population of White-winged Wood Duck in Sumatra through deliberate conservation planning and management;

A national White-winged Wood Duck Working Group should be established to monitor regularly the status of White-winged Wood Duck and the progress of these recommendations. The Group should undertake a specific reassessment of the population viability of the Sumatran White-winged Wood Duck in 1998;

The White-winged Wood Duck in Sumatra should be treated as a sub-species of *Cairina scutulata*, and that this should be substantiated by publication in an appropriate scientific journal;

Population surveys should be conducted in actual and potential White-winged Wood Duck habitats according to priorities prescribed in these recommendations;

Specific protection measures listed as essential in these recommendations should be carried out immediately;

In the compilation of management plans concerning actual or potential White-winged Wood Duck habitat, the White-winged Wood Duck should be given equal status with other endangered species considered in those management plans;

There should be satisfactory resourcing of manpower in order to control illegal fishing, logging and hunting both within and outside protected areas. This should be supported by an awareness programme for officials and the communities they serve;

and that:

White-winged Wood Duck research and management should be undertaken at Way Kambas National Park so that it can be used as the model for other sites on Sumatra.

NATIONAL & PROVINCIAL CONSIDERATIONS OF WHITE-WINGED WOOD DUCK

There should be a coordinated approach to land-use planning at a national level, encompassing the protection of sufficient natural habitat for the conservation of White-winged Wood Duck.

The regulation on `kawasan lindung' along rivers and swamps throughout Sumatra should be enforced. This regulation prevents the logging of forest within 100 m of the banks of waterways.

The results of surveys of White-winged Wood Duck and other species should be incorporated into RePPProT and LREP programmes in order to ensure that the nationwide data-base required for central land-use planning includes data on the species.

All development plans should be ratified by provincial planning authorities (BAPPEDAs) that answer to provincial Governors. Awareness of site-specific, White-winged Wood Duck conservation needs should be taken into account at this level.

The interests of local people should be carefully taken into account in White-winged Wood Duck conservation strategies.

RECOMMENDATIONS FOR SPECIFIC AREAS

Way Kambas National Park

Research

In view of the above-mentioned recommendations, a focused and continuous period of adequately-resourced research on White-winged Wood Duck should be undertaken in Way Kambas for a period of not less that three years, which should:

Provide accurate information on the life cycle of the White-winged Wood Duck - specifically food preference, reproduction, moult, predation and mortality;

Provide information on the movement of individual birds within and beyond the National Park boundaries;

Determine the density and nature of suitable nesting sites;

Identify accurately sites at which White-winged Wood Duck congregate in the dry season;

By means of a specific study, determine the trend in White-winged Wood Duck use of rice fields as foraging areas.

The goal of this research should be to identify management actions that will increase the size of White-winged Wood Duck populations.

This research should be coordinated by an experienced scientist, who must be resourced adequately.

Information and training

The White-winged Wood Duck should be promoted as a `flagship species' alongside the elephant in an education programme centred around Way Kambas National Park. Such a programme would concentrate initially on developing local public interest but could later be extended across Sumatra.

Workshops and training should be provided for managers and park staff so that they may contribute to and share information on White-winged Wood Duck in order to develop more effective management plans in Way Kambas and other areas known to be inhabited by White-winged Wood Duck. This particularly concerns the control of disturbance (see Disturbance Working Group statements, above).

Management

Way Kambas National Park should be managed so that its carrying capacity for White-winged Wood Duck is extended and maximised, with due regard for other endangered species in the ecosystem.

As part of the research programme recommended above, a number of management trials should be carried out in Way Kambas. For example, forest pools could be improved if they were trampled by domestic elephants; nest boxes suitable for White-winged Wood Duck could be provided on swamp trees in areas in which rengas trees do not occur, on a trial basis.

Illegal fishing and logging should be prevented in the reserve by increasing guard patrols, especially in the Way Kanan area.

In the areas surrounding the park, illegal fishing with poisons should be stopped and wise use of pesticides in the paddy fields should be ensured.

Kerumutan Wildlife Reserve (Riau) and surrounding area

The active logging inside the reserve at Potekait should be halted.

In order to protect White-winged Wood Duck habitat that lies outside the reserve, the boundary of the reserve should be extended to the west to include both sides of the Kerumutan River and also Sungai Peteloran. The boundary should also be extended to the south to include forest to the north and south of Sungai Indragiri in the Rengat area.

Berbak National Park

The boundary of the park should be extended to the west to include the White-winged Wood Duck habitat at Air Hitam Dalam and Desa Tanjung (Kumpeh).

Singkil Barat and surrounding area

The proposed Singkil Barat protected area should be gazetted as a Strict Nature Reserve.

Due to the fact that Rawa Singkil is a very important area for the White-winged Wood Duck and other endangered species which need to migrate between Gunung Leuser, Singkil Barat and Singkil Timur, a forested corridor should be constructed connecting Rawa Singkil and the Kluet of Gunung Leuser. An assessment of the mechanism for establishing such a corridor should be conducted as soon as possible by PHPA, related ministries and provincial government.

RECOMMENDATIONS FOR AREAS TO BE SURVEYED

The following unprotected areas are recommended as priorities for White-winged Wood Duck population surveys:

Aceh: Tripa river, Trumon river
Riau: Seberida, the Kuala Cinaku transmigration area
Sumatera Utara: Rianiate, Sungai Tapus, Sungai Batang Toru, Sungai Gadis, Sungai Natal
Sumatera Selatan: Proposed Sembilang Reserve
Sumatera Barat: Hulu Sungai Tapus

Surveys are recommended in the following protected areas to establish the status of their White-winged Wood Duck populations:

Aceh: Singkil Barat, Kluet
Riau: Kerumutan Baru (particularly Sungai Gaung)
Jambi: Berbak National Park
Lampung: Sungai Rasau, Sungai Wako, Way Penet, and ricefields in the areas immediately surrounding Way Kambas.

Conclusions for the Conservation of the White-Winged Wood Duck in Sumatra

The results of the VORTEX analysis show that isolated populations of White-winged Wood Duck that have a carrying capacity of 20 or below are not viable and have a high risk of extinction within 50 years. As the carrying capacity increases from 20 to 60 to 180, the risk of extinction is rapidly reduced and the associated problem of inbreeding depression is lessened. In the face of the rapid destruction of White-winged Wood Duck habitat in Sumatra and the resulting reduction in carrying capacity and size of the populations identified to date, these conclusions have very serious consequences for the conservation of the species.

They illustrate that the population in Way Kambas National Park is the only **known**, potentially viable population currently lying within a protected area. Data suggest that the majority of birds in the Berbak and Kerumutan populations may lie outside the existing protected area boundaries. The only existing protected area holding White-winged Wood Duck in Aceh is the Kluet extension, which has a carrying capacity that may be below 20. Action must be taken urgently at all four of the major populations identified.

Since, given the possibility of a catastrophe such as a forest fire or an epidemic, the conservation of only one wild population in Way Kambas National Park cannot be sufficient to guarantee the survival of the species, **urgent action** is required to ensure the conservation of more White-winged Wood Duck populations before their habitat is destroyed. In order to conserve viable populations, it is **essential** to make extensions to the protected area system without delay.

Such extensions are required in each of the Berbak, Kerumutan and Singkil Barat areas in order to conserve their populations. In addition, management action in Way Kambas National Park is urgently required to maximise the carrying capacity of the site for White-winged Wood Duck. The VORTEX models suggest that a carrying capacity of 60 may be too low to prevent extinction in the long term. The results of such management can be used as a model for similar actions in other sites in the future.

There is no guarantee at present that conservation action at these four sites will conserve four viable populations of White-winged Wood Duck. More surveys are required to clarify the sizes and distribution of these populations as an aid to their management. As other, potentially viable populations of White-winged Wood Duck still survive in unsurveyed areas of unprotected habitat, further surveys are **essential** in order to identify and protect further viable populations before their habitat is destroyed.

The total loss of more than half of unprotected White-winged Wood Duck populations identified in a 1988 survey illustrates the urgency of the recommendations made above; there is no time to be lost in implementing them.

White-Winged Wood Duck in Sumatra

Population and Habitat Viability Analysis Workshop

Final Report

Section 8: Bibliography

Bibliography

Information from the following publications was drawn upon during the workshop and in the production of this report:

Burn, J. & Brickle, N., eds. (1992) *Spirit of Sumatra 1992*. Preliminary Report. Unpublished report, held at The Wildfowl & Wetlands Trust.

Green, A.J. (1992) *The status and conservation of the White-winged Wood Duck Cairina scutulata. IWRB Special Publication No. 17*. IWRB, Slimbridge, Glos, UK. (Available from IWRB for UK£10.00 plus postage and packing - £2.50 UK, £3.00 overseas).

Green, A.J. (1993a) The status and habitat of the White-winged Duck *Cairina scutulata*. *Bird Conservational International* 3(2): 119-143.

Green, A.J. (1993b) The biology of the White-winged Duck *Cairina scutulata*. *Forktail* 8: 65-82.

Green, A.J. & Crosby, M.J. (1992) The historical range of the White-winged Wood Duck *Cairina scutulata* in Indonesia. *Kukila* 6: 1-7.

Holmes, D. A. (1977) A report on the White-winged Wood Duck in southern Sumatra. *Wildfowl* 28: 61-64.

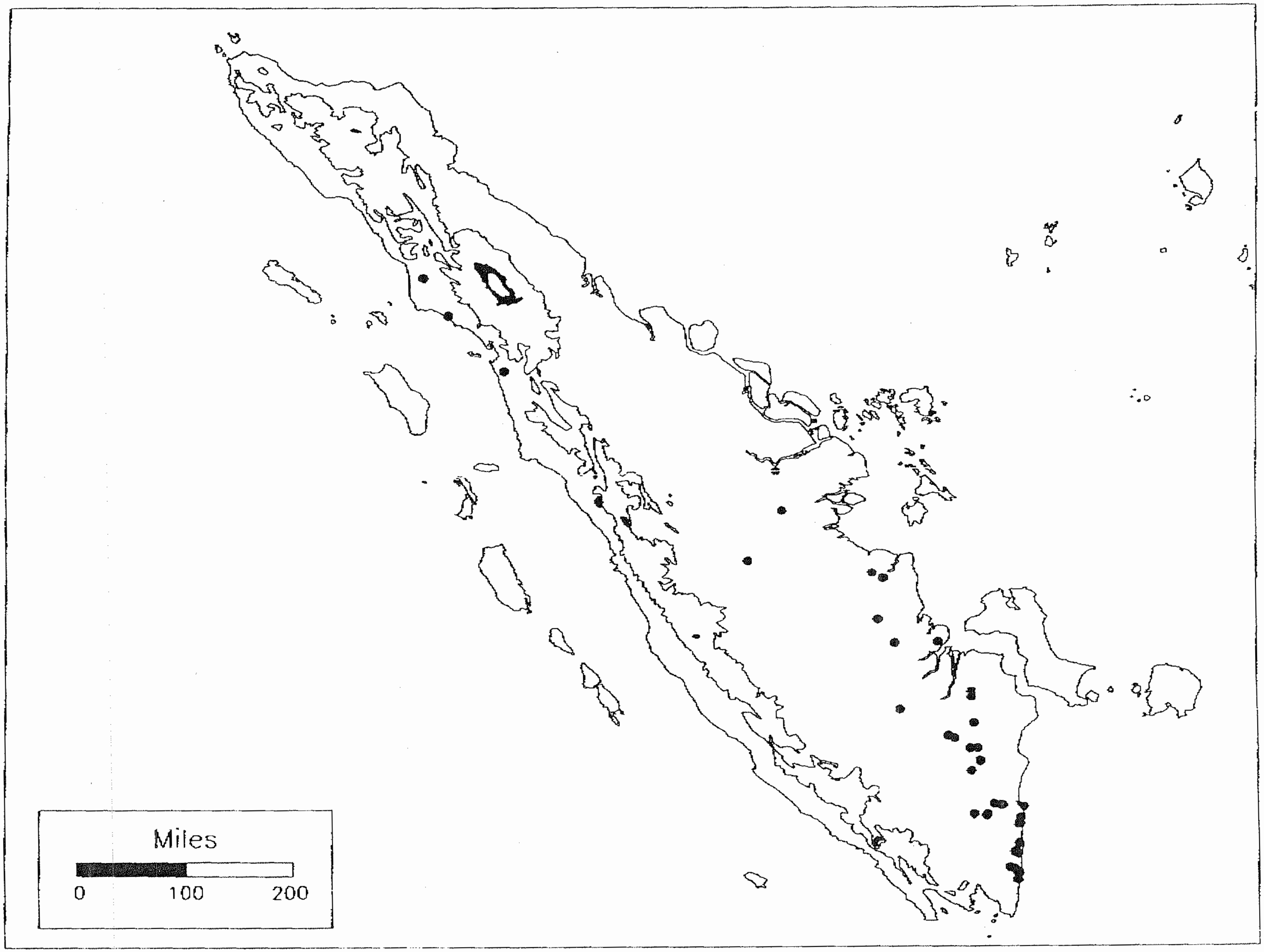
Holmes, D. A. (1990) Note on the occurrence of the White-winged Wood Duck *Cairina scutulata* on the west coast of North Sumatra. *Kukila* 5: 69-72.

Lambert, F. (1988) *The status of the White-winged Wood Duck in Sumatra, Indonesia. A preliminary assessment*. PHPA-AWB/INTERWADER Report No. 4.

Silvius,M.J. & Giesen,W. (1992) *Towards integrated management of Sumatran peat swamp forests*. AWB paper prepared for Workshop on Sumatera, Environment and Development. Bogor, September 1992.

Tim Ekspedisi (1991) *Bebek Hutan Bersayap Putih (Cairina scutulata) di Taman Nasional Way Kambas Propinsi Lampung, Sumatera, Indonesia*. Unpublished Report. Jatinangor: Himpunan Mahasiswa Biologi, Universitas Padjadjaran Bandung.

Verheugt, W.J.M., Skov, H., Danielsen, F., Purkowo, A., Kadarisman, R. & Kadarisman, U. (In press) The birds of the tidal lowlands and flood plains of South Sumatra Province, Indonesia; their status and conservation prospects. *Kukila*.



Records of White-winged Duck After 1980
in Indonesia