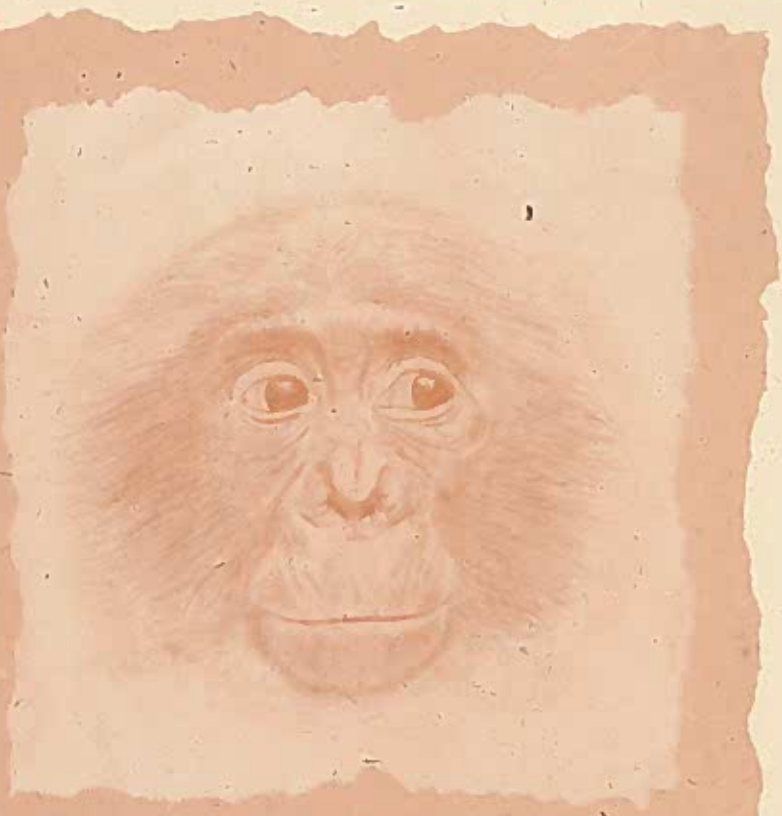

ACTION PLAN

FOR *Pan paniscus:*

Report on Free Ranging Populations and Proposals for their Preservation.

Zoological Society of Milwaukee County

• SUPPORT • EDUCATE • CONSERVE •

COMPILED AND WRITTEN BY:

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CONSERVATION INTERNATIONAL

Primate Conservation, Inc.

SPECIES SURVIVAL COMMISSION

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FOREWORD

This action plan for bonobos assesses the species' status in the wild and suggests strategies for future action on behalf of their conservation. It compiles all the information available that is pertinent to conservation of *Pan paniscus* through 1993. Because the document focuses on a single species that is endemic to only one country, the reader will find a greater concentration on intraspecific variation than is usual for an action plan. The site-to-site comparisons presented here are intended to facilitate the evaluation of the species' distribution, remaining numbers and habitat preferences in a wider context than has been heretofore available. We hope that this report will serve as a useful base of information to stimulate additional field studies, conservation efforts and management of remaining populations of bonobos.

Given the continuing uncertainty about the political and economic stability of Zaire, we have not estimated funding necessary to implement conservation action nor given a time frame. When the situation in Zaire improves, these elements should be added to future revisions. Much remains to be done and we envision the action plan for bonobos to evolve further as time, money and circumstances allow.

Acknowledgments: We are grateful to the Zoological Society of Milwaukee County for the long-term financial support they gave in compiling, publishing and distributing this document and the original draft. We would like to thank Dr. Gilbert Boese, President of the ZSMC, for his understanding of the needs of both *in situ* and *ex situ* conservation of *Pan paniscus* and also for the patience he has shown during the drawn out process of bringing this Action Plan to press. We also thank James Mills and Leta Flom of the Society's Conservation Department, who steadfastly helped edit, produce and distribute the Action Plan. Tricia Peterson of the Society's Graphics Department designed the cover around an original pencil drawing by Richard Malenky and also improved the figures.

Further financial support for the compilation of this document was given from the Sir Peter Scott Fund of the IUCN/SSC. These funds were administered through the Primate Specialist Group via Conservation International and we would like to thank George Rabb, Russell Mittermeier, Bill Konstant and Ella Outlaw of these organizations for their help. Noel Rowe of Primate Conservation Inc. provided funding for NTH to organize and attend a Bonobo Conservation Workshop at the XIVth Congress of the International Primatological Society in Strasbourg, France in 1992. We also thank the organizers of this Congress for their help in setting up the Workshop.

Geza Teleki of the Committee for the Conservation and Care of Chimpanzees and John Oates, compiler of the *Action Plan for African Primate Conservation,* were generous with their personal experience in preparing action plans and played an important role in determining the structure and content of this document. We gratefully acknowledge their groundbreaking work on primate conservation and thank them for the time they spent to make this a more comprehensive report.

This Action Plan represents a cooperative effort among all the researchers who have studied bonobos in the field and contributed their knowledge of *Pan paniscus* toward the preservation of the species. Much of this plan hinges on the long-term research at Wamba and the commitment of the Japanese researchers to bonobo conservation. Takayoshi Kano, Suehisa Kuroda, and Takeshi Furuichi were extremely generous in their help and in allowing us to use their published and unpublished data, especially in the preliminary population viability analysis section of this document. Any errors in the application or interpretation of these data, however, are the sole responsibility of the authors. We also thank the members of the Bonobo (Pygmy Chimpanzee) Protection Fund of Japan and the United States for their efforts to protect the bonobos of the Wamba area. Shigeo Uehara contributed his knowledge of the bonobos of Yalosidi and we are grateful for his update on the status of this population. Evelyn Ono Vineberg has also been very helpful in facilitating communication between Japanese and English-speaking researchers and has thus played an important role in contributing toward our understanding of and cooperative efforts in preserving *Pan paniscus.*

Long-term research in the Lomako Forest has benefitted from the efforts of Randall Susman, Diane Doran, Annette Lanjouw, Frances White and more recently from Gottfried Hohman and Barbara Fruth. We thank all of them for their contributions to this plan and their concern for the welfare of this research population and bonobos in general.

Data on more recently discovered bonobo populations was contributed by J-P Gautier and Annie Gautier-Hion, J-P d'Huart, Amy Parish and Angela Meder (Salonga National Park) and Carsten Bresch and Angela Meder (Beongo). Jorge Sabater-Pi served as our correspondent for research at Lilungu and we thank his team for their efforts at this site. We are very grateful to Jo Thompson for the efforts she has made to keep us updated on her very recent work in Yasa and Mimia. As the newest of the bonobo field researchers, Jo is deserving of special credit for undertaking a new project under very difficult conditions and we wish her continued success with this important research.

Information provided by Delfi Messinger (President, Societe Zoologique de Kinshasa) has proven very important in documenting the potential current distribution of *Pan paniscus.* Delfi's knowledge of Zaire is very valuable in

formulating strategies and she is an impressive source of new ideas for conservation outreach projects. We appreciate her generosity in sharing unpublished data and providing copies of maps and other material that were difficult to find outside of Zaire. We would also like to acknowledge Adrian Kortlandt's work on the distribution of *Pan paniscus,* which was very useful in determining promising areas for survey work.

We are especially grateful to our Zairian colleagues who have contributed to the preservation and understanding of bonobos. Mankoto ma Mbaelele, Delegue General for the Institute Zairois pour la Conservation de la Nature, has shown keen interest in preserving *Pan paniscus* in its natural environment and we have benefitted greatly by our discussions with him and Bihini Won wa Musiti who served as his representative at the San Diego Bonobo Conservation Workshop. As the director of the Centre de Recherche en Sciences Naturelles (CRSN), Dr. Zana Ndontoni has played an important role in fostering *in situ* research on *Pan paniscus.* Ekam Wina, Mbangi Mulavwi and Kabongo Ka Mubalamata of the CRSN have contributed toward our understanding of the bonobo population at the CRSN's research station in Mabali near Lac Tumba, as well as sharing in studies at Wamba, Lilungu and the Lomako Forest.

The preliminary population viability analysis would not have been possible without the help of Bob Lacy and the support of the Chicago Zoological Society and the Zoological Society of Milwaukee County . We are grateful to the Reinartz family and the University of Wisconsin-Milwaukee Field Station for providing the facilities that enabled us to work together under very pleasant circumstances. We would also like to acknowledge Tom Prinzi for additional work on the analysis undertaken at Slippery Rock University.

Help with maps came from various sources. Randy Downer of Applied Biomathematics generated the base map upon which figures 1 and 3 were based. Nadine Laporte shared satellite derived vegetation maps of the Central Basin with us and we benefitted greatly from discussions with both Nadine and Ned Horning while they were with NASA/Goddard Space Center.

Sharon Pitcairn of Conservation International was an enthusiastic supporter of our efforts and Chuck Hutchinson of this organization also helped us understand geographic information systems and their usefulness in formulating conservation strategies. We would also like to thank Armand Rioust de Largentaye and Chris Trapman of the World Bank for providing further information about Zaire. John and Teresa Hart of the Wildlife Conservation Society (WCS) also helped keep us up-to-date on Zaire and shared their experiences with creating a new protected area. We would also like to thank Bill Weber, Amy Vedder and Hilary Simons Moreland of WCS for their interest and readiness to answer questions. Similarly, Kate Newman

of the Biodiversity Support Group shared her expertise on Zaire and directed us to helpful documents and people. We also thank our friend Eric Lowenkron for his editorial efforts and advice.

Finally, we would like to acknowledge the San Diego Zoo and its sponsorship of the Bonobo Conservation Workshop which provided the initial impetus for this Action Plan, as well as much of the preliminary information.

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Introduction

INTRODUCTION

HISTORICAL BACKGROUND

The first ape imported to Europe (Tulp's ape, 1641) was probably a bonobo, also known as the pygmy chimpanzee (Reynolds 1967). Despite the bonobo's historical primacy, scientific recognition of the fourth great ape lagged for nearly 300 more years. Travelers' descriptions and collections of the other great apes--the orangutan (*Pongo pygmaeus*), the chimpanzee (*Pan troglodytes*) and the gorilla (*Gorilla gorilla*)--led to identification of these taxa during the eighteenth and nineteenth centuries. Hidden in the forests of Central Africa, the bonobo remained unproclaimed until colonization of the Belgian Congo (present day Zaire) was well advanced. A small sample of crania at a museum in Belgium provided evidence for the existence of an unexpected pongid from south of the Zaire (Congo) River. Schwarz (1929) described the skull of a small, aged female from this collection and proposed the type as a new subspecies of chimpanzee, *Pan satyrus paniscus.* Four years later, Coolidge (1933) published a more extensive treatise based on all information then available from museum collections. Coolidge found that this chimpanzee differed significantly from all others and proposed that it be classified as a full species, *Pan paniscus.*

Brief Description of the Species

Based on very limited material, primarily crania, both Schwarz and Coolidge estimated that the new variety represented a dwarf or pygmy version of the chimpanzee. Even today data on body weight and stature for wild bonobos are few: the information available, however, suggests that *Pan paniscus* largely overlaps in these characters with *Pan troglodytes schweinfurthii,* the eastern subspecies of chimpanzee (Jungers and Susman 1984). Where the bonobo differs significantly from the chimpanzee is in the size of its head. Comparatively, the bonobo has a smaller, rounded skull with an inflated forehead, small brow ridges and reduced facial prognathism: these features give the bonobo the appearance of a juvenile chimpanzee. Unlike the chimpanzee, its smaller teeth show sexual dimorphism only in the canines (Kinzey 1984). The bonobo's postcranial anatomy is more gracile than that of the chimpanzee and is proportioned differently (see Susman 1984 for detailed descriptions of bonobo anatomical features). *Pan paniscus* is also distinguished from the three subspecies of *P. troglodytes* by its distinctive pattern of head hair and cheek whiskers, its small ears and the frequent webbing between the second and third toes of the foot.

As evidence has accumulated verifying that *Pan paniscus* is not a dwarf variant of *Pan,* the common and historic name pygmy chimpanzee has been replaced in popular

use in the United States, Japan and Europe by "bonobo" or "bonobo chimpanzee." "Bonobo" is not an indigenous name for the species but rather a new genus proposed by Tratz and Heck in 1954. The word is probably a corruption of Bolobo, a town in Zaire from which specimens came (Susman 1984). The most commonly used term for the animal among the Mongo is *elya* or *edza*. Both species of chimpanzee occur in Zaire but are not sympatric. The two species are distinguished from each other in Zaire by referring to the bonobo as the black-faced chimpanzee and *P. troglodytes* as the white-faced chimpanzee since only *P. paniscus* is dark-faced from birth.

Early Field Research

The onset of modern field studies provided material for a large number of academic and popular articles, as well as television documentaries on the great apes. This information provoked wide interest in chimpanzees, gorillas and orangutans and alerted the public to threats that jeopardized their existence in the wild. In comparison to its better-known cousins, the bonobo has remained relatively obscure and virtually unprotected.

Since *Pan paniscus* exists only in Zaire, the politics of that country have played a critical role in limiting our understanding of the bonobo. When long-term field studies of the other great apes began in the 1960's, foreign scientists were reluctant to enter the bonobo's domain. After 85 years of colonial rule, Zaire became independent in 1960. The new nation harbored some 200 different tribes, and the first 10 years of independence were marked by bloodshed and civil strife. Research on wild bonobos was considered too risky until the early 1970's. Although Salonga National Park was established in 1970, in part to protect *Pan paniscus,* surveys by pioneer researchers did not locate any bonobos there. Additional surveys between 1972 and 1974 in other regions of the province of Equateur led to studies at Lac Tumba (Zone of Bikoro), Wamba (Zone of Djolu), Yalosidi (Zone of Ikela) and the Lomako Forest (Zone of Befale). Preliminary data from this research were published only toward the end of the 1970's.

Both long- and short-term research blossomed during the 1980's. Although the majority of publications focused on academic topics, researchers also conveyed their concern that the species was not abundant throughout its historic range, its distribution was patchy, and pressures from hunting, logging and competition for resources with growing and often transient human populations threatened the known populations of bonobos (e.g., Kano 1984; Susman et al. 1981). Documentation of the species' vulnerability led to discussion and action on several fronts.

Recent Conservation Actions

The *Action Plan for African Primate Conservation: 1986-1990* (Oates 1985) recommended three projects to increase protection of *Pan paniscus*. These were the development of a bonobo reserve in the Lomako Forest area, survey of the Wamba area for the establishment of a second bonobo reserve and survey of Salonga National Park to determine, in part, whether *Pan paniscus* is present. Malenky (Malenky et al. 1989) provided a summation of the conservation status of the species at the first *Understanding Chimpanzees Symposium* in 1986, the first international meeting devoted solely to *Pan*. Next, a meeting at the XIII Congress of the International Primatological Society in 1990 led to several roundtable discussions about conservation of *Pan paniscus*. An important outcome of this Congress was publication of the PP/B News (Pan paniscus/Bonobo News) edited by Evelyn Ono Vineberg. Thereafter, funding initiatives included the formation of the Bonobo Protection and Conservation Fund with separate Protection Committees in the US and Japan. In 1991, a Bonobo (Pygmy Chimpanzee) Conservation Workshop was sponsored by the San Diego Zoo. A bonobo task force spearheaded by Russell Mittermier, chairman of the IUCN/SSC Primate Specialist Group, was formed thereafter to facilitate strategic initiatives arising out of the workshop. The final impetus for compiling this *Action Plan for Pan paniscus: Report on Free-ranging Populations and Proposals for their Preservation* came during a meeting of the Committee for the Conservation and Care of Chimpanzees (CCCC) at the second *Understanding Chimpanzees Symposium* in 1991 during which Thompson-Handler and Malenky were asked to prepare a first draft.

During the late 1980's, managers of captive populations also became concerned with *in situ* and *ex situ* conservation of *Pan paniscus*. The captive breeding population is the smallest for any great ape: 103 animals in 1994 (Reinartz 1994). The AZA (American Zoo and Aquarium Association) initiated a Species Survival Plan (SSP) for bonobos in March 1988. The SSP is coordinated by Gay Reinartz of the Zoological Society of Milwaukee County. The Europaisches Erhaltungzucht Programm (EEP) was formed in the same month. The two organizations agreed to coordinate management of the North American and European populations at the SSP/EEP Master Plan Workshop: Bonobo in Antwerp in 1989. Two editions of the *Bonobo (Pan paniscus) Species Survival Plan Master Plans* have been published (Reinartz 1991, 1994) which deal primarily with captive propagation and management and how the captive population can contribute to species conservation. A global master plan is in progress.

CONSERVATION ISSUES

Despite obvious progress in conservation planning, major impediments to

implementing programs and research remain. In September 1991, civil disturbance once again erupted in the capital of Zaire and threatened to spread throughout the country. Runaway inflation and dissatisfaction with one-party rule led to increasing demands for change. Foreign governments began evacuation of their nationals despite continued efforts by the National Conference to pave the way toward democracy. Renewed rioting in the capital in 1993 led to further loss of foreign assistance. A complete transition in government has not yet taken place, and the economy and infrastructure continue to deteriorate.

Human Population Pressure

Since the onset of field studies, bonobos have disappeared from many parts of their range. Like other wild animals, the bonobo's habitat and future are jeopardized by human population increase and exploitation of natural resources, especially forest resources. Although the province of Equateur had a human density of only 8.4 inhabitants/km^2 during the last census in 1984, the population of Zaire as a whole showed an annual average growth rate of 3.2% over the preceding 14 years (Office for Official Publications of the EEC 1988). The majority of the human population is young (43% under 15 years of age and only 4% over 65 in 1985) and the population is expected to double in 22 years (Population Reference Bureau 1992). Forty percent of the population is urban, but the recent political and economic crisis has forced many urban immigrants to return to their rural home villages.

Social Changes

A rapidly growing, youth-dominated and recently urbanized human population foreshadows not only a crumbling of traditional values but also erosion of traditional relations with the rest of the natural world. Signs of this breakdown are already apparent. Tribal customs vary widely in the Central Basin with respect to killing bonobos. It was taboo in certain areas, and the study groups of Wamba, Lomako, Lilungu and Yasa survived because village elders perceived a special relationship between bonobos and humans.

Ethnic Conflict

In the past few years, large-scale tribal conflicts have been restricted to the Kivu region in the east and the region of Shaba in the south. Conflict in Shaba forced hundreds of thousands of refugees to flee into eastern and western Kasai. Since viable populations of bonobos are now confirmed to live in Kasai, the rapid influx of a large, destitute human population presents a grave risk to the bonobos there. If not shot for food, bonobos in the southern part of their range may be exposed to dysentery and other human diseases introduced by the transient human population.

Hunting

Recent immigrants to Wamba began shooting and capturing the bonobos there in 1984 (see **Site Reports**) and disturbance of this critical population has mounted during researcher absence as a result of the current political and economic crisis. The bonobos of the Lomako Forest, while more isolated from humans than are their counterparts at Wamba, face similar threats as deteriorating economic conditions draw other tribes to exploit this relatively undisturbed area. Studies by a team from the University of Barcelona at a study site in Lilungu documented the intensity of human predation on the fauna there (Sabater-Pi and Veá 1990). Bonobos in this area are protected by local religious beliefs and guns are rare, but during a two-month inventory researchers encountered a total of 1048 wire snares within the 72 km^2 of their study site. Thus, even traditional hunting methods for bushmeat pose a threat to bonobos. Both the Wamba and Lomako study populations contain individuals with hand and foot injuries that can only be trap-related. These are the animals that survived, and there is no way of knowing how many bonobos have been lost to non-selective hunting methods.

The degree to which bonobos are hunted for profit rather than food is not known. Correspondents from Kinshasa note that both species of *Pan* and African gray parrots continue to be openly sold in the animal markets. Demand for pets and "pity buying" from markets in the capital have been reduced greatly since the exodus of expatriates after the 1991 riots. However, the deterioration of law enforcement in the country may have opened the door wider for illegal export of bonobos, chimpanzees and other protected wildlife.

Deforestation

The Congo Basin (*Cuvette Centrale*) is part of the second largest block of rain forest remaining in the world. The best available figures estimate the amount of closed forest remaining in Zaire at 105,750,000 ha with 0.2% annual deforestation, although these rates are likely to be severely underestimated (McNeely et al. 1990, Table 3). Most of this forest is in the Central Basin, of which 87% is considered undisturbed (Mbaelele and Largentaye 1992). Mbaelele and Largentaye (1992) estimate that nearly 200,000 ha per year is lost to agricultural conversion and an equal amount to collection of firewood for home use and charcoal manufacture for sale in the urban regions. These authors state that industrial exploitation is less of a problem in Zaire because of the inaccessibility of the forests in the Central Basin, the weak infrastructure for extracting timber and the high cost of transporting it. They estimate that 100,000 ha of dense forest are cut each year for commercial purposes, of which 30% is exported.

Primate Species[1] (Conservation Status)

Perodictus potto (nt)
Galago demidovii (nt)
Cercocebus aterrimus (K)
Cercocebus galeritus pyrogaster (K)
Colobus angolensis (nt)
Procolobus (badius) rufomitratus tholloni (K)
Cercopithecus ascanius (nt)
Cercopithecus mitus (nt)
Cercopithecus neglectus (nt)
Cercopithecus salongo (V)
Cercopithecus p. wolfi (nt)
Allenopithecus nigroviridis (K)
Miopithecus talapoin (nt)

I.U.C.N. Categories of Threat[2]

E = Endangered (taxa in danger of extinction and whose survival is unlikely if the causal factors continue to operate). This category includes taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

V = Vulnerable (taxa believed to move into the "Endangered" category in the near future should the causal factors continue to operate). This category includes taxa whose populations are decreasing because of over-exploitation, extensive habitat destruction or other environmental disturbance; taxa with populations that have been seriously reduced and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

R = Rare (taxa with small world populations that are not at present "Endangered" or "Vulnerable," but at risk). These taxa tend to be localized within restricted geographic areas or habitats, or are thinly dispersed over a more extensive range.

K = Insufficiently Known (taxa that are *suspected* but not definitely known to belong to any of the above categories because of lack of information).

nt = Not threatened (taxa that are not considered to be threatened at the present time).

[1] Classification follows Oates (1985).
[2] From Lee, Thornback and Bennett (1988).

Box 1. Other Primates Associated with *Pan paniscus*

While commercial lumbering may not be considered a problem on a national scale, within Equateur, timber harvesting has already threatened or disrupted the habitat of the bonobos in the two major study sites, the Lomako Forest and Wamba. In the 1970's, concessions in both areas were leased to Karl Danzer Fernier-Werk, a veneer manufacturer headquartered in Germany (known by the acronym SIFORZAL in Zaire). Cutting began in the Lomako Forest in 1981. The concession was abandoned

in 1987, and the lease reverted to the state, making this area available for a reserve for the bonobos living there. SIFORZAL is now active in the Mentole area between the Yekokora and Lopori rivers. Smaller operations are also still active in Equateur. Even when selective logging is practiced, roads opened into the forest to extract timber serve as an invitation to hunters and others to exploit forest resources in a less systematic manner. After SIFORZAL's abandonment of the Lomako concession, hunters began to penetrate deeper into the forest and establish temporary camps (See **Site Reports** for further details).

Forest Preservation and Biodiversity

Because of its size, diversity of habitats and large blocks of undisturbed forest, Zaire harbors high levels of biodiversity (McNeely et al. 1990) Within Africa, Zaire ranks first in the number of species of mammals, primates, birds, amphibians, fish and swallowtail butterflies and second in plant diversity. The country ranks fourth in the world in the number of mammal species. Relatively low human population densities in the forested regions of the Congo Basin make this area particularly amenable to the implementation of proactive conservation efforts.

Preservation of habitats for bonobos therefore also protects a broad range of rare, endemic or threatened species that share its ecosystem (e.g., elephant, water chevrotain, golden cat, giant ground pangolin, Congo peacock). Box 1 lists primate species which are found in association with *Pan paniscus.*

Level of Protection

The bonobo is a protected species under Zairian and international law, listed on Class A of the African Convention and Appendix I of CITES (M-06-009-003-001 *Pan paniscus*) which bans any hunting, killing, capturing or trade in the species unless reviewed and licensed by the highest authority. The species is listed as Vulnerable by the International Union for the Conservation of Nature and as Endangered (both wild and captive populations) by the US Fish and Wildlife Service effective as of April 11, 1990 (*Federal Register* 55:(48), 1990). USFWS protective regulations for wildlife listed as "endangered" apply to any person subject to the jurisdiction of the United States and make it illegal to take or engage in any sort of commercial or import-export activity directly or to possess, sell, deliver, carry, transport or ship any wildlife that has been taken illegally. In fact, most Zairians are either unaware of the species' protected status or have little fear of the consequences of breaking the law. Moreover, bonobos can still be legally purchased under Ordonnance 86-114 of the Department of Environment, Conservation and Tourism. The purchase tax paid for a protected bonobo in 1986 was 3500 zaire ($117.00). This ordinance, with taxes adjusted for inflation, was still valid in April 1993 (Hohmann pers. comm.).

Box 2. IUCN Protected Area Standards[1]

I. **Strict Nature Reserve/Wilderness Area.** To maintain essential ecological processes and to preserve biological diversity in an undisturbed state, in order to have representative examples of the natural environment available for scientific study, environmental monitoring, education, and for the maintenance of genetic resources in a dynamic and evolutionary state. Research activities need to be planned and undertaken carefully to minimize disturbance.

II. **National Park.** To protect natural and scenic areas of national or international significance for spiritual, scientific, educational, recreational and tourism purposes. The areas should perpetuate, in a natural state, representative samples of physiographic regions, biotic communities, genetic resources, and species, and to provide ecological stability and diversity.

III. **Natural Monuments.** To protect and preserve outstanding natural features because of their special interest, unique or representative characteristics and to the extent consistent with this, provide opportunities for interpretation, education, research and public appreciation.

IV. **Habitat and Wildlife Management Areas.** To assure the natural conditions necessary to protect significant species, groups of species, biotic communities or physical features of the environment where these require specific human manipulation for their perpetuation. Scientific research, environmental monitoring, and education are the principal activities associated with management of this category.

V. **Protected Landscapes/Seascapes.** To maintain significant areas which are characteristic of the harmonious interaction of nature and culture, sites providing opportunities for public enjoyment through recreation and tourism and supporting the normal lifestyle and economic activities of the area.

[1] Hannah, L (1992) *African Peoples, African Parks.* Washington: Conservation International.

Erosion of traditional values, economic hardship and mixing of cultures through migration and human population expansion threaten even the few known havens of the bonobo. As Zairians adapt to rapid and traumatic change in the next few decades, survival of the bonobo will depend in great part on strong governmental leadership.

Governmental Infrastructure for Conservation

Zaire has a long history of protecting its wildlife. During the colonial period, elephant reserves were established in the 1880's and it was declared illegal to hunt mountain gorillas in 1912 (Lanjouw 1993). King Albert National Park (now Virunga National Park) was created in 1925, and the Garamba and Upemba National Parks were established in the 1930's. Today more than 7% of the country is protected as parks, reserves and hunting areas, with the stated governmental intent of reaching a level of protection of 12 to 15% by the end of the century (IUCN 1992).

Lanjouw (1993) offers a recent description of governmental structure relevant to conservation activities which is abstracted here. The major government organization responsible for the environment and the conservation and management of these protected areas is the Ministry of the Environment and the Conservation of Nature, which is under the financial control of the Ministry of the Portfolio. The IZCN (Zaire Institute for the Conservation of Nature) is "a parastatal and public institution which is the principal management and protection organization in charge of protected areas" (Lanjouw 1993:11). Management of the IZCN falls under a delegate who is nominated by the president of the republic and is the responsibility of the State Commission of the Environment, Nature Conservation and Tourism. Lanjouw notes that all forests outside national parks fall under the *domaine protégée* and belong to the state. The Centre de Recherches en Sciences Naturelles (CRSN) is responsible for research in the natural sciences; this organization is overseen by the Ministry of Education.

The government of Zaire has shown strong commitment to conservation at the highest levels; despite political conditions, a new wildlife reserve for okapi was created in the Ituri Forest in 1992. To realize national goals, however, greater financial resources must be made available for conservation. Actions within protected areas require the development and implementation of management plans, including improvement of administration, protection and management, increased training of staff, and purchase and maintenance of equipment. Improved law enforcement and especially commitment to antipoaching activities are important to protect threatened wildlife. Educational and other outreach programs to develop support for conservation activities among the local populace are also critical to both short- and long-term success.

At present, no reserve exists at the national level which provides adequate protection for bonobos. No sizable populations have been confirmed within Salonga National Park, although international aid has been given to develop the infrastructure to protect this vast and important area within the bonobo's range. Proposals for reserve developments at Wamba and the Lomako Forest are discussed under **Conservation**

Actions Proposed in the third section of this action plan. The IUCN has developed standards for protected areas (Box 2) which restrict activities depending on the level of protection. These standards should be taken into consideration in evaluating reserve development.

DISTRIBUTION

Pan paniscus occurs only in the Central Basin, south of the Zaire River. Its distribution is thought to be bounded on the north and west by the Zaire River, to the south by the Kasai/Sankuru Rivers and to the east by the Lomami River (Kano 1984; Coolidge 1933). Bonobos were collected in the area between the Lomami and the Lualaba Rivers during a 1955 expedition (van den Audenaerde 1984) but have not been observed there more recently. If the Lualaba is considered their eastern boundary and if their southern boundary is extended along the 5° latitude from the Sankuru River, their potential range covers an area of 840,400 km^2.

In the southeast, no large rivers serve as boundaries and distribution is thought to be inhibited by the change in vegetational cover from rain forest to savanna. Kortlandt (1991) argues that current vegetation maps indicate "large tracts of rain forest as far as 7° S. and muhul forests even further to the south." Currently there is no evidence that the bonobo ranges north of 2°, south of 4°, east of 18° and west of 24°.

Within this putative range, distribution is patchy. An extensive survey was made by Kano (1984) in 1973 in villages along roads stretching from Mbandaka to Kisangani from the west to the east and Lisala to Lomela from the north to the south, with side trips in the areas of Mbandaka and Boende. The area of the survey covered 13,500 km^2. Within this region Kano made inquiries in 200 villages and received positive responses from half of them. Positive responses to his inquiries were verified in 31 of 32 cases by direct or indirect evidence of bonobo habitation. Along many of the routes, no bonobos were reported (e.g., Boende-Mankoto, Boende-Bokungu, Djolu-Lisala and Ikela-Opala-Kisangani). Bonobos appeared to be most concentrated along the road from Bokungu to the village of Bokondo and from Ikela to Lomela.

Direct Evidence of Bonobo Populations: The Study Sites

Figure 1 illustrates the current distribution of *Pan paniscus* based on recent (within the last 25 years) direct and indirect evidence. Sites indicated by closed circles are areas where bonobos have been verified by direct observation and studied for periods of several hours to more than 20 years. The majority of known populations of bonobos were originally located for purposes of academic research and thus sites are strongly associated with either a particular university or the country from which the majority of researchers have been drawn. The best-known study sites are Wamba

(also known as the Scientific Reserve of the Luo) in the Zone of Djolu and the Lomako Forest in the Zone of Befale.

The first field study of free-ranging *Pan paniscus* was undertaken by Arthur Horn, Yale University, who began a two-year study in 1972 on the banks of Lac Tumba (Zone of Bikoro). His choice of study site was influenced by access to a former Belgian biological research station at Mabali. The Mabali Reserve is now under the direction of the Centre de Recherche en Sciences Naturelles (CRSN and Zairian primatologists such as Mbangi Mulavwa, Kabongo ka Mubulamata and Ekam Wina have pursued research at this site. Takayoshi Kano, Kyoto University, established the Wamba study site following his 1973 survey based on the high densities of bonobos he found there. He also established a second study site at Yalosidi (Zone of Lomela). Research at the Wamba and Yalosidi sites has been undertaken primarily by Japanese researchers under the direction of Kano. Inquiries north of Boende in 1974 led Noel and Alison Badrian to the Lomako Forest (Zone of Befale). Randall Susman of the State University of New York at Stony Brook joined forces with the Badrians in 1979 to establish a long-term study site in the Lomako. Gottfried Hohmann from the Max Planck Institute in Andechs, Germany began an independent research program at the Lomako Forest study site in 1990.

Research beginning in the late 1980's has led to further direct information about the location of bonobo populations. A two-year study in Lilungu (Zone of Ikela) begun in 1988 by a Spanish team under the direction of Jorge Sabater-Pi, University of Barcelona, confirmed the presence of a small population of bonobos. A survey team under the aegis of Carsten Bresch, University of Freiburg, Germany, sighted bonobos in two additional areas in 1988: Beongo (Zone of Befale) and near Lokata Station in Salonga National Park (Medder, Burgel and Bresch 1988). J-P Gautier and Annie Gautier-Hion of the Laboratory of Primatology, Biological Station of Paimpont, France, who began working in Salonga National Park in 1990, also report that bonobos are said to occur regularly several kilometers from their study site. This is probably the same population reported by the Bresch team. J-P d'Huart, Director of Conservation, World Wide Fund for Nature-Belgium, noted in a 1989 report that rangers in Salonga report five other locations in both the northern and southern sectors of Salonga National Park. In 1992, Jo Thompson, Oxford University, and Delfi Messinger, Zoological Society of Kinshasa, confirmed a population of bonobos at Yasa (Zone of Dekese, Kasai Occidental). Thompson began long-term field research there in 1994. The presence of bonobos at Yasa also extends the bonobo's ecological range since this is an area of woodland/savanna. During preliminary surveys in the southern half of the bonobos range, Thompson identified another population at Mimia to the west of Salonga National Park. All the sites providing direct evidence of the presence of bonobos are discussed in greater detail under Site Reports. Listings of historical sites may be found in Coolidge (1933), Kano (1984),

van den Audenaerde (1984) and Kortlandt (in prep.).

Indirect Evidence of Bonobo Populations

Messinger (pers. comm.) provides indirect evidence that bonobos may be more common in the southern part of their distribution than previously thought. By means of extensive interviewing of tourists, missionaries and other visitors to Kinshasa from the interior during 1990-1993, she has produced evidence that bonobos may still range in the region of Lac Mai Ndombe and along both the Lukenie and Kasai/Sankuru Rivers. These locations are listed as indirect evidence in Figure 1. Preliminary surveys by Jo Thompson at localities ○ 10-17 in the region of Lac Mai-Ndombe, Kwamouth, and the southern bank of the Lukenie River suggested that these localities were collection points along trade routes to Kinshasa rather than areas with a habitat suitable to bonobos. Nonetheless, indirect reports of bonobos stemming from this region suggest that there are likely other sources in the southern part of the bonobo's range or that bonobos are being poached from Salonga National Park. If more indirect evidence is verified, however, bonobos will be known from four provinces of Zaire: Equateur, Bandundu, Kasai Occidental and Kasai Oriental.

POPULATION

Estimating number of bonobos in the wild remains a major problem. Several attempts have been made. Kortlandt (1976, in IUCN 1988) estimated a total population of 100,000-200,000 by extrapolating chimpanzee densities to available habitat. Teleki and Baldwin (1979, in IUCN 1988) suggested a much lower estimate of 13,000 based on data then available from field sites and their estimation of available habitat. Kano (1992b, 1984) offers only the numbers based on survey work over a large area. From direct and indirect information gathered during his surveys of 1973, Kano estimated a population of 54,000 in the northern half of their distribution and a total population of less than 100,000. The estimate of 54,000 was calculated on a density of 0.4 bonobos/km^2 and an area of 135,000 km^2 (Kano 1992b, p. 59). A decimal error was made in the calculation of area since the region surveyed was actually 13,500 km^2 (Kano 1984, pp. 36, 42). This unfortunate slip led to an estimate that was off by an order of magnitude as noted by Tom Struhsaker at the Bonobo (Pygmy Chimpanzee) Conservation Workshop in San Diego. Thus, the number of bonobos estimated from the most ambitious survey to date is only 5400 animals and that research took place more than twenty years ago.

In the preface to the English translation of his treatise on bonobo behavior and ecology (Kano 1992b), Kano reviews the many factors which threatened the Wamba population during the 1980's, including killing by poachers and government-sanctioned capture of infants, habitat destruction from clearing primary forest to make coffee plantations, and the leasing of land as a timber concession. In its management plan, the Bonobo/Pygmy Chimpanzee Protection Fund (Japan) (1992) states that the bonobo habitat at Wamba was reduced by at least half between 1974 and 1990. The rapid and nearly total disappearance of bonobos in areas where they were once common, such as Yalosidi and Bokondo, has led this group to revise estimates downward to under 25,000 from 50,000 and probably between 10,000 and 20,000. If the recalculated number of 5400 in 1973 has been reduced by half in 16 years, bonobos are truly in peril.

The discovery of new populations in the south provides some reason for optimism, but it is doubtful that the addition of these populations will raise the total number to a sustainable level. Even in the early 1970's, bonobo distribution was patchy. The example above of what has happened to bonobos in an area where they were relatively abundant is cause for alarm. It also should be noted that numbers dropped at Wamba during a period of relative prosperity and political stability. The current politico-economic situation no doubt exacerbates many of the factors leading to a decline of bonobo populations.

Estimated Regional Densities

In this report we endeavor to provide as much information as possible from field research to guide strategic planning and actions to protect and manage wild bonobos. Aspects of the data we provide are unstandardized and inconsistent depending on the primary focus of the studies, visibility of bonobos within the habitat, level of habituation of the study animals, provisioning, duration and timing of the studies, and other factors. Therefore, site comparisons are difficult to make. However, these preliminary data do give us a starting point to further assess the conservation status of the bonobo in different regions of Zaire.

Table 1 lists estimated densities and/or numbers of bonobos thought to exist at several sites from which there are sufficient data. Sources for the data are identified in the footnote. Given the difficult nature of field studies and the disparate habitat of the study sites, methods for estimating numbers and determining range varied from site to site. These estimates were derived from both provisioned and nonprovisioned populations and in other instances were best guesses based on habitat quality. For example, densities estimated for the different areas of the Luo Special Protection Area (a proposed 6000 km^2 conservation zone surrounding the Wamba research site)

Table 1. Estimates of Numbers and Density from Study Sites

Study Site	Area (km^2)	Est. Numbers	Est. Density (bonobo/km^2)
Wamba[1]			
E group[2]	38* (58)**	65	1.71 (1.12)
B group		80	
P group		80	
K group		60	
S group		60	
Total	100	345	3.45
Luo Scientific Reserve	150	450	3.00
Luo Special Protection Area[3]			
N. Luo			
Befori to Yakili	800	1200	1.50
Wamba	100	400	4.00
S. Luo (E to W)	350	900	1.64
S. Wilembe Road	200		
Ilongo Forest	4000	500	0.125
Lomako[4]			
All Recognized Individuals	23.4***	81	3.46
Hedons	13.8***	44	3.19
Rangers	12.0***	26	2.17
Blobs	8.1***	9	1.10
Lilungu[5]	72	31	0.43
Yalosidi[6]	200	90	0.45

1 Kano 1987
2 Kano and Mulavwa 1984
3 Bonobo/Pygmy Chimpanzee Protection Fund (Japan)
4 Thompson-Handler 1990
5 Sabater-Pi and Veá 1990
6 Uehara 1988
* Exclusive core range.
** Range.
*** Minimum range.

are based on habitats which investigators believe would support very high (4.0), high (1.5) or low (0.5) densities of bonobos. These investigators feel that bonobos occur in the highest densities in areas of "mixed primary, secondary, and swamp forest, especially along roads or large rivers" [Bonobo Protection Committee (Japan) 1992] and that density is relatively low in the primary forest.

Table 1 has heuristic value in that it allows preliminary comparison of a range of density values from areas where bonobos have been studied for two years or longer. These estimates are provisional. One of the most important tasks before us is to develop survey methods that allow us to truly compare population densities across research sites and survey areas and reasons for their variation.

HABITAT

Vegetation maps generated from satellite data indicate that the Central Basin is dominated by dense moist forest with pockets of degraded forest [see Justice, Laporte and Horning (1993) Figure 3 for a recent example showing the whole Congo Basin]. Figure 2 is adapted from Justice, Laporte and Horning (1993) and contrasts vegetative differences between the two best-known bonobo study sites. The Lomako Forest appears to be the least disturbed. In contrast, the area north and west of Wamba shows a large block of degraded forest. Provisional estimates of densities (Table 1) of bonobos in the two areas are similar, suggesting flexibility in the species' response to habitat. Further long-term studies are necessary to confirm this observation, however.

Table 2 summarizes habitat differences among three areas where bonobos have been studied. Within the broad classification "dense moist forest," bonobos appear to be tolerant of a range of disturbance and show behavioral variation across sites in their exploitation of the available habitat. We do not yet know the limits. However, we would expect numbers to decline with the disappearance of forest cover and food sources. The presence of bonobos in woodland/savanna at Yasa further confirms that the species is more plastic in its habitat tolerances than was previously believed. One should note that on vegetation maps, the blocks of woodland/savanna between the Lukenie and Sankuru Rivers appear as islands in the middle of the prevailing moist forest of the region. It may be that the bonobos of Yasa are a remnant population or a group which has migrated because of loss of habitat or human pressure. Given the range of habitat exploited by other regional populations, however, bonobos may have historically lived within this transition zone. Identification of what constitutes "good" bonobo habitat, therefore, remains a critical factor in determining preservation and management strategies.

Table 2. Percentage of Habitat Types in Bonobo Study Areas

Habitat Type (%)	Wamba[1]	Lomako[1]	Lilungu[2]
Mixed semi-deciduous and evergreen	44.30	85.10	0.00
Old secondary	15.60	2.30	64.85
Swamp	21.90	12.60	5.52
Recently disturbed forest and cultivation	13.60	0.00	25.09

[1] White 1992b
[2] Sabater-Pi and Veá 1990

SUMMARY

It is apparent that the bonobo is extremely vulnerable in its present state and that urgent actions are necessary to prevent the species from becoming critically endangered or extinct in the near future.

Several interrelated factors contribute strongly to its vulnerability:

- The wild population may already number less than 5000;
- Known populations are fragmented and isolated from one another, thereby reducing gene flow;
- Rapid growth of the human population, changing values and politico-economic instability make the species increasingly vulnerable to predation and disease;
- The species is long-lived, matures slowly and produces few offspring in its lifetime, thus causing population growth rates to be easily disturbed by perturbations;
- The habitat is being degraded by agriculture, logging and competition with humans.

In the sections that follow, we present detailed data derived primarily from fieldwork conducted in Zaire. These data, encompassing the mid-1970's to the present, are meant to help assess the status of *Pan paniscus* in the wild and plan strategies for protecting and managing specific populations and their habitats. Such site-specific information is also intended, by extrapolation, to help guide attempts to locate "new"

populations as well as to coordinate conservation and research efforts between sites and on the national level. While the bulk of this document focuses on known populations and study sites, we also incorporate new field data that have not been widely disseminated. Much of this information provides indirect evidence for the continued existence of bonobos in areas of the Central Basin where information has been scant (e.g., in the southern and eastern part of the species' range) and where populations of bonobos were thought to be close to extinction or completely absent (Kano 1992a).

What follows is divided into three main sections:

Site Reports contain comparative, detailed information on known populations of bonobos, climate, habitat and specific threats to the well-being of each population.

Proposed Conservation Actions suggest survey work, urgent and long-term monitors and research, reserve development and other conservation-related activities and the rationale for each one. The proposals are prioritized using criteria parallel to those followed in the chimpanzee action plan prepared by the CCCC. However, since *Pan paniscus* is found only in Zaire, "sites" are examined here, not separate countries.

Population Viability Analysis employs a computer model using the program *Vortex* (Lacy and Kreeger 1992) to assess the potential impact of a variety of threats to existing populations and provide information useful to the future management of these populations. Population parameters employed are derived from the main study group at Wamba but are corroborated where possible with data from the Lomako Forest and from captive studies. By using this tool, we attempt to evaluate the effect of various factors thought to affect the long-term viability of the species. These analyses are most useful in providing guidelines for long-term planning and creating multiple strategies to insure the species' survival in the wild. While we realize the limitations of the current data, such an exercise also helps us pinpoint gaps in our research and underlines the importance of genetic and demographic information in conservation planning.

Critical to the preservation of bonobos is the identification of suitable habitats, i.e., areas of low human population density with substantial forest cover. Streamlining the identification of such areas for survey work and future conservation efforts, beyond information presented in this document, can be enhanced by the use of satellite images combined with groundtruthing by research/conservation teams. This work is in progress and we envision its inclusion in future drafts of the Action Plan.

Site Reports

SITE REPORTS

In the following chapter, we provide an overview of bonobos in their natural habitat as evidenced by reports and studies from nine areas where their presence has been directly confirmed and studied by experts for varying amounts of time from twenty years to several hours (●1-9, Figure 1). These are areas where bonobos presumably exist (or previously existed) in relatively high densities and, as such, merit special attention. The data are organized to facilitate comparison among sites and provide corroborating evidence where conclusions are tentative. These data provide a range of ecological parameters, as well as shed light on variation in the species' habitat preferences and behavioral ecology. Comparing data across study sites is useful in pointing out neglected areas of research and the need to standardize data collection methods. Although many of the studies were not designed to provide data on conservation biology, we have reported factors that are relevant to the preservation of the species.

These **Site Reports** also present in greater detail the data which were used for the relative rating in the third section of this report, **Conservation Actions Proposed**. Despite long-term studies, our knowledge of the demography and life history of *Pan paniscus* remains limited and based primarily on one study population from Wamba. Since data from the two subgroups of the E group of Wamba provide the basis of the preliminary **Population Viability Analysis** presented in Section IV, the reader can evaluate the results of this analysis in light of comparative data from other populations.

WAMBA (22.30E, 0.10N)

The study site, covering a 100 km^2 area surrounding the five hamlets of Wamba village, was established in 1974 following Kano's survey of the northern part of the bonobo's distribution in 1973. Research has continued on a yearly basis (excluding 1985) through 1991 under the direction of Takayoshi Kano, Kyoto University. Fieldwork resumed in 1994. Due to restrictions by the government of Japan, research is limited for the most part to the months from September to March (Kano 1992b). Artificial provisioning with sugarcane began in 1974 and members of one community (E group) began to regularly use the sugarcane field toward the end of 1975. Bonobos are studied at the artificial feeding site, under mobile provisioning, as well as in the natural habitat (Kano 1992b).

Bonobo Population

Size of communities

Five unit groups or communities have all or parts of their ranges within the study site. E group is the most studied. This community consisted of distinct southern (E1) and northern (E2) subunits that commingled on a regular basis until 1983 (Kano 1992b) but now may be separate communities. During the 1977-1978 field season, 58 individuals were individually recognized from both subunits of E group [18 in the southern group, 32 in the northern group plus 8 adolescent females of uncertain affiliation] (Kano 1987). The most recent census of E1 group in 1991 indicated that this group consists of 30 individuals (Furuichi pers. comm.; Kano 1992a). E2 group is now thought to number 55 individuals. Another frequently-encountered unit group, P group, was recently estimated to include 45 bonobos (Kano 1992a). The size of the lesser studied communities has been inferred from the average party size encountered (Kano 1987, 1992b). At the beginning of provisioning in 1974, researchers estimated the B group at 80-120 bonobos and K group at 100-150. The least frequently encountered community, S group, was estimated at 100-150 animals. Most recently, the population within the Luo Scientific Reserve [150 km^2 on either side of the Luo (Maringa) River including the Wamba study site] is estimated at 300-400 animals [Kano 1992a, Bonobo/Pygmy Chimpanzee Protection Fund (Japan) 1992].

Home Range

The total home range recorded for E group through 1982 covered 58 km^2, but 66% of this total overlapped with the ranges of three other communities (Kano and Mulavwa 1984). At that time, E group was estimated to contain 65 animals. (See Table 1 for densities derived from the overall range of 58 km^2 and the core range of 38 km^2).

Day Range

During four consecutive months in 1981 and 1982, the median day range of E group parties was calculated at 2.4 km (range 0.4 - 6.0 km, N = 91) [Kano and Mulavwa 1984]. These researchers did not find statistically significant differences in day range between seasons.

Density

The Bonobo/Pygmy Chimpanzee Protection Fund (Japan) (1992) breaks down their estimated numbers for a 6000 km^2 area to which they propose to extend protection

(see **Conservation Measures Taken and Proposed**) in the Upper Luo River region. They feel that this area, which includes the Scientific Reserve of the Luo (150 km^2) and the Kyoto University/Centre de Recherche en Sciences Naturelles (CRSN) Wamba study site (100 km^2), contains about 3000 bonobos overall (see also Table 1). These estimates are based primarily on extrapolations from habitat type rather than actual animal counts over large area. Density is thought to be particularly high within the study site of Wamba, perhaps due to the lack of competition with monkeys which have been largely hunted out by the local human population. About 400 bonobos live within this 100 km^2 area, an approximate density of 4.0 animals/ km^2. The Wamba study site is included within a 10 km wide strip extending 90 km from Befori to Yakili on the north side of the Luo River. The Protection Fund estimates a total of 1600 animals in the entire 900 km^2 northern Luo Zone. Deducting the 400 bonobos living in the vicinity of Wamba leaves 1200 bonobos in the remaining 800 km^2 outside the study site and yields a density of 1.5 animals/km^2 for the greater part of the northern Luo Zone.

The Japanese primatologists describe two areas on the southern side of the Luo River totalling 550 km^2 with similar high densities to the northern strip. They estimate that this area harbors 900 bonobos. On the other hand, The Bonobo Protection Fund suggests that numbers of bonobos drop dramatically in primary forest away from rivers and villages. Their estimate, therefore, for the total population of bonobos in the remaining 4000 km^2 of the Ilongo Forest is 500 apes (a density of 0.125). Factors influencing this low density in primary forest are thought to include competition from monkeys, low diversity of plant species and relative rarity of herbs in the family Marantaceae [Bonobo/Pygmy Chimpanzee Protection Fund (Japan) 1992].

Party Size

Based on data from the provisioned E group in 1981-1982, median party size at Wamba is large, 15 independent individuals (range 1 - 36, N = 147) [Kano and Mulavwa 1984]. Kano (1992b) notes that party membership in this community was relatively stable through 1979, commonly remaining unchanged for two to three weeks and sometimes remaining stable for more than a month. Kuroda (1979) found a similar mean of 16.9 animals (s.d. 11.6, n = 147) among non-provisioned groups at Wamba during 1974-1975. Mean party size varied widely from month to month during Kuroda's (1979) ten-month field season (range 8.5 - 32.5) in relation to changes in abundance and distribution of food resources.

Party Composition

Temporary parties of bonobos at Wamba are most commonly mixed in composition, comprised of adolescent and adult males and females and the females' offspring.

Kano (1992b) reports that 98% of his observations were of such mixed parties. Among non-provisioned bonobos at Wamba, Kuroda (1979) found that 74.2% of 163 parties were mixed in composition, 2.5% contained only adults, 4.9% were all female groups, 2.5% were all male groups. Lone individuals comprised 6.1% of his observations. Of the 9.8% of parties that could not be clearly classified as to composition, the majority were thought to also be mixed in composition.

Age Classification

Table 3 groups the Wamba bonobos by age range. Definitions are from Kano (1992b).

Table 3. Age Classification

Age Group	Age Range (Yrs.)
Infant 1	0 - 1
Infant II	1 - 2
Juvenile	
Early	2 - 4
Late	5 - 6
Adolescent	
Early	7 - 8
Middle	9 - 12
Late	13 - 14
Adult	
Early	15 - 19
Middle	20 - 30
Late	31 - +

Demographics and Life History (Based on E1 subgroup and E group 1976-1991)

Number of Births

Twenty-two infants were born in this subgroup from 1976 to 1991, equally divided between males and females. Based on the number of females over 14 years old, mean annual natality in this 16-year sample was 0.195 (s.d. = 0.169). For the entire E group from January 1976 to February 1985 (nine year sample), Kano (1992b)

recorded 17 births (8 males, 9 females) and calculated the average annual birth rate as 0.34.

Emigration and Immigration

Between 1976 and 1992, six females born into the E1 group emigrated. The percentage of the total group that emigrated each year was summed over the 16 year period and divided by 16 to yield an annual emigration rate of .0165 (s.d. 0.026) for E1 group as a whole. If a similar calculation is made for only those females between the ages of 6-9 (all natal females save one at Wamba have disappeared from the group between these ages), annual emigration rate for this subset of the population is 0.1613. All subadult males present in the E group at the beginning of studies and born subsequently have remained in the group.

From 1976 to 1991, four adolescent females immigrated into the E1 group, eventually gave birth and became permanent members. Calculated over 15 years, the annual increase due to immigration was .011.

Mortality

During the 1976-1991 period, 8 animals in the E1 group died (3 females, 5 males). These included 2 infant females < 1 year old, 1 juvenile male, 1 adolescent male, 2 young adult males, 1 old male and 1 old female. Ages of animals already present in the population in 1976 were estimated and sample size is small. Kano calculated a gross measure of annual mortality for this subgroup as a whole as 8 animals out of a sum of 407 animal years or 0.0197. Observed mortality for bonobos in their first year was thus 0.18 for females and 0.00 for males. For the entire E group between 1976 and 1985, Kano (1992b) calculated an average death rate of 0.004 per 100 individuals. This was based on the death of one infant female and the shooting of one young adult male.

All male mortality was due to poaching. Mortality in the E1 group due to hunting prior to 1992 can be calculated as 5/407 or .0123. Bonobos from the study population at Wamba began to be harassed by outsiders beginning in 1984. Twice, under direct orders from the regional government, bonobos have been captured there, resulting in the loss of 5-10 animals each time (Kano et al. 1990). Since the political/economic crisis of 1991, poaching in the vicinity of Wamba appears to be on the increase. During a short visit to Wamba in 1992, Kano (pers. comm.) was unable to locate several recognized individuals from the study group, although his stay in the study site was too short to confirm them missing.

Age at First Birth

One can only estimate the age of first birth for *Pan paniscus* in the wild since natal females emigrate. Table 4 shows estimated year of birth for the parous females of the E1 group (a middle value was used for older females whose birth years are bracketed), estimated year of birth for their first offspring and age at first birth. Older females who may have had female offspring who emigrated out of the E1 group prior to the beginning of studies at Wamba are more likely to show an older age at first birth. Our best estimate from these data is that females are most likely to give birth in their 14th year.

Table 4. Estimation of Age at First Birth

Female	Est. Birth Year	Est. Birth Year of Offspring	Age at First Birth
Kame	1948	IBO 1962	14
Sen*	1948	TEN 1970	22
Mitsu	1953	GORO 1968	15
Halu	1958	Iku 1971***	13
Shiro	1958	Junko 1971***	13
Bihi**	1964	Biko 1980***	16
Mayu**	1966	Mako 1981***	15
Nao**	1971	Naomi 1985	14
Miso**	1974	Miki 1986	12
Kiku**	1974	Kikuo 1988	14

x = 14 (*s.d.* = 1.225), median and mode = 14, n = 9

* Excluded from the calculation of the mean
** These females immigrated into the group as adolescents during the course of the study
*** These daughters disappeared during the course of study and are presumed to have immigrated to another group.

Birth Intervals

Birth intervals in the E1 group can be roughly calculated from the assigned birth years of successive infants born during or after 1976 when members of this group were well identified. Of the 11 intervals available for 6 females who gave birth in 1976 or thereafter, the mean interval was 4.55 years (s.d. 0.82), range 4 - 6 years.

The median birth interval was 4 years. One 2-year interval following the death of an offspring was not excluded from the mean.

Female Senescence

Kame, whose birthyear was estimated between 1946-1951, gave birth to the last of 5 infants in 1984 (between the ages of 33 and 38). She died in 1990. Sen, whose age is placed in the same age cohort as Kame's, last gave birth in 1980.

Age Structure of Population

Table 5 summarizes the mean percent (and standard deviation) for each age class for the E1 group over the 16-year period between 1976-1991. For comparative purposes, Table 6 provides a similar summary for the E2 group as calculated from Kano (1992; Table 9). The sex ratio in the E1 group was 0.505 (205 male years/406 animal years). In the E2 group, the sex ratio was 0.578 (107 male years/185 animal years). The composition of E2 group differed primarily in the larger number of adult males.

Table 5. Mean Composition of E Group Between 1976-1991 by Age Class (Source: Furuichi pers. comm.)

Age Class	Males	Females	Total
Adult ≥ 15 years	22.9 (2.9) **5.8 (1.0)**	28.8 (3.5) **7.4 (1.8)**	51.7
Adolescent 7 - 14 years	13.0 (3.4) **3.2 (0.7)**	5.7 (5.6) **1.4 (1.3)**	18.7
Juvenile 3 - 6 years	7.7 (3.1) **1.9 (0.9)**	7.5 (4.7) **2.0 (1.4)**	15.2
Infant 2 1 - 2 years	5.2 (2.7) **1.3 (0.7)**	4.0 (3.2) **1.1 (0.9)**	9.2
Infant 1	2.5 (3.3) **0.7 (0.9)**	2.7 (2.8) **0.7 (0.7)**	5.2
Grouped Juvenile 0 - 6	15.4 (3.8) **3.9 (1.4)**	14.2 (4.8) **3.8 (1.7)**	29.6

Mean Group Size = 25.4 (4.6), N = 16

Mean percent (standard deviation)
Mean Number (standard deviation)

Table 6. Mean Composition of E2 Group between 1978 - 1984 by Age Class (Source: Kano 1992b)

Age Class	Males	Females	Total
Adult	30.8 (3.2)	29.3 (1.6)	60.1
≥ 15 years	**11.4 (1.7)**	**10.8 (0.8)**	
Adolescent	10.3 (2.2)	-----	
7 - 14 years	**3.8 (0.8)**		
Juvenile	16.7 (2.4)	13.0 (3.0)	29.7
0 - 6 years	**6.2 (1.3)**	**4.8 (1.1)**	

Mean Group Size = 37.0 (3.3), N = 5

Mean Percent (standard deviation)
Mean Number (standard deviation)

Habitat Availability and Utilization

The habitat of the Wamba bonobo study population has been strongly influenced by human activity. The hamlet of Wamba, including five villages, falls within the 100 km^2 study site. Along the road connecting these villages, cultivated and fallow land extends on both sides. Three affluents and their branches (the Lokuli, Bokela and Kofala Rivers) flow into the Luo River, all of which are bordered by swamp forest. The rest of the habitat consists of mixed semi-deciduous and evergreen forest (44.3%), old secondary forest (15.6%), and young secondary forest (4.6%). Swamp forest accounts for 21.9% and secondary shrub and cultivated land 13.6% of the study site. Proportions above are based on White (1992). Herb species (*Sarcophrynium macrostachyum, Haumania liebrechstiana, Afromomum spp.*) important to the bonobos occur in different densities in the various forest types relating to the degree of light penetrating to the forest floor.

During the October 1981-February 1982 field season, Kano and Mulavwa (1984; Table 4) analyzed the proportion of utilization of four different forest types across food seasons. Proportion was determined by dividing the number of days bonobos were observed to exploit foods within four forest types (dry primary forest, swamp forest, aged secondary forest, young secondary forest and bush) by the duration in days for a given food season (e.g.., *Landolphia owariensis*, transitional, *Dialium spp.*) Overall, they found that the study population used the dry primary forest most frequently (93.5%, range 77.8 - 100), followed by aged secondary forest (47.2%, range 20.0 - 63.6), swamp forest (31.2%, range 11.1 - 50) and young secondary forest and bush (20.6%, range 0 - 45.5). They concluded the results indicate that although

bonobos are likely drawn to primary forest for many of their food plants and night nesting sites, other forest types also produce important food species for *Pan paniscus*. Although young secondary forest and bush was the habitat type least frequented, these authors observe that bonobos may visit these areas to supplement their diet with non-seasonal foods such as *Aframomum spp.* fruit and pith and *Musanga smithii* when there are shortages elsewhere in their habitat. The bonobos of Wamba appear to be flexible in their use of habitat.

Monkeys have been heavily hunted in the region and now occur in low densities. A species list of primates observed during the course of studies at Wamba in Kano (1992b) includes: *Cercopithecus ascanius, C. neglectus, C. mona (p. wolfi?), Cercocebus aterrimus, C. mitis (?)* and an unidentified guenon locally called tolu, *Allenopithecus nigroviridis, Colobus angolensis, Procolobus badius, Perodictus potto* and *Galago demidovi.* Of particular interest is the local endemic, *Cercopithecus salonga* which has not been reported from any other site in Africa.

Climate

Rainfall and temperature are assumed to be similar to Djolu, 80 km to the north. Rainfall in this center averaged 2005mm annually (range 1368-2310) from 1936 to 1959 (Vuanza and Crabbe 1975, in Kano and Mulavwa 1984) Rainfall is heaviest >200mm/month) from September to November and least (<100mm/month) from December to February. There are no months without rainfall. Absolute maximum monthly temperature ranged from 32.6-36°C. and absolute minimum ranged from 12.7-17.1°C between 1953-1963 (Vuanza and Crabbe 1975, in Kano and Mulavwa 1984).

Conservation Problems and Proposals

Hunting Pressure

Traditionally, the bonobos of Wamba have enjoyed a special status with the Ngandu people who have religious proscriptions against killing this species. Beginning in 1984, however, hunters from outside the area entered the Wamba study site and began killing bonobos. The first animal lost was a young adult male who was shot for meat in 1984. On two separate occasions, three infant bonobos have been collected in Wamba under direct authority of the Zairian government (Kano et al. 1990). In 1985, two females were shot and their infants captured (Kano 1987). A second incident occurred in 1987 (Linden 1992). Researchers estimate that 5-10 bonobos were lost while trying to protect the infants during each of these two incidents (Kano et al. 1992). Hunting continues to be a problem in Wamba and the Zone of Djolu. In 1991, two infants whose mothers had been killed in the Simba

Forest 70 km north of the study site were brought to researchers who tried to rehabilitate them (Idani 1991). Another poaching incident was noted in the Ilongo Forest in the southern part of the proposed Luo reserve (Okayasu 1991). During a recent visit, Kano (pers. comm. 1992) was unable to locate several members of the study population, although his stay was too short to definitely say that these animals had disappeared permanently. Local monkey populations have already been drastically reduced due to hunting in the region. The decline of other forest and river food resources coupled with extreme economic conditions may override cultural traditions which formerly safeguarded bonobos.

Habitat Loss

Kano (1992b) notes that the human population of Wamba numbers approximately 1000 people. Between 1974 and 1990, the bonobos' habitat there has been reduced by at least half (Kuroda et al. in press; in Bonobo/Pygmy Chimpanzee Protection Fund 1992). No plans for commercial logging exist at present in the area [Bonobo/Pygmy Chimpanzee Protection Fund (Japan) 1992].

Conservation Measures Undertaken and Proposed

Luo Scientific Reserve

Researchers at Wamba began talking to local inhabitants and officials about creating a protected area for the bonobos in 1984. Local bureaucrats surveyed the 150 km^2 of the proposed reserve and banned hunting in the area in 1986. The Commissioners of the Zones of Djolu and Ikela, the Centre de Recherche en Sciences Naturelles (CRSN) and the primatologists of the University of Kyoto jointly signed a document proposing the establishment of the reserve in 1987. The proposed reserve was visited by the Commissioner for the Tshuapa subregion who passed on his approval to the Regional Commissioner for Equateur. The proposal has not yet been approved on the national level. Once approval has been given, the reserve will be jointly administered by the CRSN. and the Japanese research team. Within the reserve, hunting of both bonobos and monkeys will be prohibited, as well as clearing of the forest.

Luo Special Protection Area

Figure 3 indicates the boundaries of the Luo Scientific Reserve and protection area. Surrounding the scientific reserve, the researchers propose to extend protection to an area of 6000 km^2 on either side of the Luo River containing some 50 villages. This area is estimated to harbor 3000 bonobos. Two protection stations are planned (one at Wamba and the other at Ilongo on the southern side of the Luo) which will serve as bases of operation for education and public relations programs, as well as training centers for rangers. In addition to employing rangers, leaders from each of the 50 villages will be asked to join a Protection Cooperation Council to help enforce hunting restrictions. Priority is currently given to 1) survey of hunting in the Luo region, 2) building protection stations and beginning patrols and public relations, 3) writing and distributing educational material, 4) requesting governmental cooperation on both regional and local levels and 5) undertaking an extensive survey of bonobos in the eastern part of their distribution.

LOMAKO FOREST (21.05E,00.50N)

The 35 km^2 study site was established in 1974 by Noel and Alison Badrian who spent six months in the area. A one-month study was undertaken by Noel Badrian and Randall Susman in 1979. The Lomako Forest Pygmy Chimpanzee Project (LFPCP) began in 1980 under the direction of Randall Susman, State University of New York at Stony Brook. Since then research has continued every year save 1988 and 1989. A three-year project on vocal communication and nest building began in 1990 under the direction of Gottfried Hohmann, Max Planck Institute.

The study site is an isolated block of undisturbed lowland mixed evergreen and semi-deciduous rain forest at an elevation of 390 m. The only permanent human inhabitants are the researchers and the project staff and their families. The bonobos of the Lomako Forest have never been provisioned with food. When long-term studies first began in 1980, researchers were reluctant to cut transects for fear of frightening the bonobos. Several major trails were thus developed along old hunting and animal trails which were associated with some of the larger streams (Bofua, Bakumba and Eyengo). Without causing a major disturbance to the study sites, this trail system facilitated movement through the forest, and plastic flagging at intervals of 50 m helped locate study animals. Secondary and tertiary trails branched off to interconnect major routes and led most directly to known food sources where the bonobos gathered. Marked trails covered about 23 km^2 of the 35 km^2 study site in 1986 (Thompson-Handler 1990).

Bonobo Population

Size of Communities

Not all individuals are recognized. Bonobos within the trail system associate primarily within two provisional communities, the Hedons (Bakumba group) and the Blackstone Rangers (Eyengo group). A small cohesive splinter group, the Blobs, containing no infants became apparent in 1984 and ranges closest to camp. Community association remains provisional since individuals assigned to all three groups have been noted to commingle peacefully and home ranges overlap extensively. While there is extensive overlap of range in the center of the study site, sightings in the west are exclusively of Hedons, in the east exclusively of Rangers, and in the south primarily Blobs. A third "community" is suspected in the northeast sector of the study area. Bonobos have also been observed north of the Bofua stream which serves as the northern boundary of the trail system.

During the 1984-1986 field season, 44 individuals were differentiated in the Hedon association, 26 in the Rangers, 9 in the Blobs and 1 recognized mother and her dependent infant who could not be associated with other recognized animals (Thompson-Handler 1990). German researchers working exclusively with the Rangers have identified 36 members through 1993 (Hohmann and Fruth pers. comm.).

Home Range

Home range of the Hedons was originally estimated at 22 km^2, based on direct and indirect evidence (Badrian and Badrian 1984). A later summary (Thompson-Handler 1990) of 300m blocks covering the trail system where members of each association were directly observed over four field seasons indicated a minimal home range for the Hedons of 13.8 km^2 (41% exclusive use), 12.0 km^2 (50% exclusive use) for the Rangers and 8.1 km^2 for the Blobs (30% exclusive use). The total area over which all identified animals were observed within the trail system totaled 23.4 km^2 (Thompson-Handler 1990). The Max Planck research team has observed Rangers primarily in a 16 km^2 area although they have followed them outside the trail system to both the north and east and conservatively estimate their range at 20 km^2 (Fruth pers. comm. 1992). Range and contact with known individuals varies greatly from field season to field season, apparently dependent on availability of food resources (Thompson-Handler and Malenky pers. obs.).

Day Range

Day ranges have not been measured in Lomako due to difficulty in following focal animals on the ground. Doran (1989) notes, however, one instance in which she followed a party for 12 hours during which they traveled 1200 m, never once descending to the ground. The longest recorded distance traveled terrestrially during Doran's study was 1700 m.

Density

With an underestimate of the numbers making up each "community" and using minimal estimates of home ranges, estimates of bonobo density within the Lomako Forest are likely to be inaccurate. Estimates based on the known individuals within the three study groups and the sum of the areas in which each group was observed over four field seasons provides a range of densities, however. Using the information above, Hedon density equaled 3.19 bonobos/km^2 (44/13.8). Densities for the Rangers using the same parameters equaled 2.17 (26/12) through 1987. Using more recent estimates from the German researchers, Ranger densities are slightly lower, 2.06 (33/16). Blobs occurred at the lowest densities, 1.11 (9/8.1). If the putative communities prove to be subgroups of one large community, one may roughly estimate density of the bonobos in the Lomako study site at 3.46 (81/23.4). Again, it should be emphasized that both total numbers and total home range are underestimated which may change these estimates to an undetermined degree.

Party Size

The largest sample of party sizes in the Lomako has been compiled from long-term LFPCP Project follow-records which record all bonobo sightings, indirect evidence of the presence of bonobos (vocalizations, food remains), time, locality, group size and composition, recognized individuals and foods eaten (in Thompson-Handler 1990). In these records, party size was determined from the first sighting of a bonobo until the last animal in its party was lost for more than 10 minutes and reflects the maximum number of bonobos recorded during an observation period since individuals or parties may have temporarily joined or separated from the animal/s first observed. Bonobos were primarily located by listening for vocalizations (often associated with feeding) or by monitoring fruit trees so these records primarily reflect arboreal feeding aggregations. Although temporary parties estimated at 50 animals have been occasionally observed in the Lomako Forest, parties with accurate counts numbered 1-26 independent animals. In a sample of 333 accurate counts made over 32 months of research (excluding the 1980 field season when bonobos were less habituated), mean party size in the Lomako was 6.37 $\pm$0.26 (standard error). During the 1982, 1984 and 1985 field seasons, median party size was 5 for all parties

observed. Modal group size was 2-5 bonobos, accounting for 44.14% of observations. Solitary animals accounted for 10.5% and parties >15 accounted for 5.9% of all observations. Median group size differed for each of the study groups with a median of 7 for the Hedons (N=120), 12 for the Rangers (N=31) and 5 for the Blobs (N=86).

Party Composition

Parties containing individuals of both sexes prevail in the Lomako. Bisexual groups accounted for 81.6% of all parties observed during the 1982, 1984 and 1985 field seasons when the study groups could be considered semi-habituated (Thompson-Handler 1990). Because the Blob splinter group contained no infants, sightings of all-adult parties were unusually high during this period (90% of all sightings of this study group). In the more typical Hedons and Rangers, mixed parties accounted for 77.7% and 90.6% of all parties observed, respectively. Over all 382 sightings where party composition was accurately determined, single sex parties and solitary animals observed were composed as follows: all females (7.6%), all males (1.31%), solitary males (3.9%), solitary mothers (2.6%), solitary females (1.6%) and solitary juveniles (1.3%).

Demographics and Life History

Identification of bonobos in the Lomako has been hampered by the long habituation period, time required to recognize animals, extended intervals between contact with known individuals, and 2-4 year gaps between field seasons for individual researchers at the study site. For these reasons, demographic and life history variables from this population are primarily anecdotal.

Births

Several parous Hedon females (Stitches, Pseu, Lobie, Rita) that were associated with juveniles during the beginning of studies in 1980-82 gave birth again prior to the 1985-1986 field season. Tasha, whose male infant was born in 1982, was observed carrying an infant daughter during the 1990-1991 field season. Phantom, a juvenile/adolescent female associated with the Hedons between 1981-1982, was seen on her own with an older infant daughter in 1985. Two adolescent females (Gypsy and Bobe) associated with the Rangers in 1984-1986 were carrying infants during the 1990-1991 field season.

Emigration and Immigration

Adolescents of both sexes are the least stable members of recognized associations. Two young nulliparous females very closely affiliated with the Blobs in 1985 associated at much lower frequencies during 1986. One recognized young adolescent male was not observed with other members of the Hedons for an entire field season but reappeared in the next. As mentioned above, two recognized adolescent females associated with the Rangers have given birth in that group.

Deaths

Between 1980 and 1986, only one death in the study site occurred. This was an adolescent male who was discovered soon after death beneath an emergent *Antiaris toxicaria* where the Rangers had been feeding. The nature of his injuries suggested that he had died from a fall.

Birth Intervals

Rough calculations based on infant development and the sexual activity of recognized mothers who have given birth more than once during the course of studies suggest that birth intervals in the Lomako are ≥4 years.

Female Senescence

One female (Stubbles) known since 1981 has never been associated with an infant or juvenile. She was no longer cycling during the 1985-1986 field season. Four other parous females (Miss Flagg, Connie, Helga and Donkey) also appear to be old and are also not associated with juveniles or infants. No old female was seen to copulate during the 1984-1986 field seasons and all appear to cycle irregularly if at all. From these data, it appears that female bonobos may survive well beyond their reproductive years.

Age/Sex Structure of Population

Based on the known individuals within the larger study groups, 50% of the Hedons are adult (≥ 15 years), 14% adolescent (7-14 years) and 36% immature (0-6 years). Identified Rangers were 50% adult, 19% adolescent and 31% immature during the 1984-1986 field seasons. For the recognized population as a whole, 52% were classified as adult, 22% adolescent and 31% immature. Table 7 analyzes population structure by summing counts for each age class over all parties: 63% of animals observed were adult, 12% adolescent and 25% immature. Females with infants

represented 18% of this sample. The adult sex ratio from party counts was 658 males/1610 adults = .41 (N=333).

Table 7. Age and Sex Composition of Completely Counted Parties, 1981-1982, 1984-1985, 1985-1986 Field Seasons (Source: Thompson-Handler 1990)

	Ad. M	Ad. F	Mother	Adol. M	Adol. F	Juv.	Inf.	Group
Min.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Mean	1.98	1.49	1.37	0.24	0.73	0.56	1.4	7.74
Sum	658	495	457	80	244	187	457	2578
% of Total	26	19	18	3	9	7	18	100

Habitat

As mentioned previously, the Lomako Forest study site is isolated, ~35 km from the nearest road. The study site can also be reached by river: there are no permanent dwellings along the Lomako River from where it flows into the Maringa to where it is joined by the Eyengo Stream (an eight-hour journey by *piroque* with a 25hp motor). Small temporary fishing camps on the edge of the river may be seasonally occupied, however. Camp Ndele is a 30-45 minute walk from the Lomako River.

Permanent habitation in the Lomako Forest was forbidden by the colonial government during the 1920's. Prior to the beginning of the long-term project, the study area was used by residents of the Befale-Mangania-Bokoli area who hunted primarily by traditional methods (snares, bows and arrows and nets) for monkeys, forest antelope, red forest hog and other game. The area was also previously exploited by European planters and prison guards from Ekafera who used rifles and ammunition to hunt larger game such as elephant, hippo and forest buffalo, all of which are now rare. In principle, access to the forest is regulated by the local chief and hunters are permitted to inhabit temporary hunting camps for only two weeks at a time. Hunting within the study site has been banned since 1984 and is enforced when researchers are present. Bonobos are traditionally viewed as relatives by Mongo of the area and are rarely hunted; they are, however, subject to snare injury from traps set for other terrestrial mammals.

Five other species of primate are common within the upland forest: *Cercopithecus ascanius, Cercopithecus p. wolfi, Cercocebus aterrimus, Colobus angolensis,* and *Galago demidovi. Cercopithecus neglectus* and *Allenopithecus nigroviridis* are found in the riverine forest. McGraw (1994) gives densities for *Cercocebus aterrimus* (73.1 ind/km^2), *Cercopithecus ascanius* (42.8 ind/km^2), *C. wolfi* (44 ind/km2) and *Colobus anoglensis* (5.8 ind/km^2). Elephant and leopard occur but are seen very rarely. Other protected wildlife are the endemic Congo Peacock, the golden cat, the giant pangolin, and the water chevrotain. Four species of duiker are encountered frequently.

The Lomako Forest study site is, thus, largely undisturbed and located within a much larger block of primary forest. Although forest to the west of the study site was lumbered during the 1980's, a 300,000 hectare block of vegetation surrounding the study site was not cut. Areas of old secondary forest (> 60 years) remain where habitations and clearings existed prior to colonial rule. Several fields outside the trail system were cut by project workers in the early 1980's to provide food for themselves and their families. The study site is dissected by five streams and their branches which flow into the Lomako. Seasonally inundated swamp forest and monospecific forest border these streams and their slopes. Within the study animals' range, White (1992) estimated 75.2% dry polyspecific primary forest, 9.9% primary evergreen forest dominated by *Gilbertiodendron dewevrei*, 2.3% old secondary and 12.6% swamp forest. Based on the percentage of 2-minute time points that focal animals were recorded in each forest type, the bonobos of the Lomako spent 93.4% of their time in primary forest, 4.5% in evergreen forest, 1.9% in secondary forest and .2% in swamp forest during her study from 1984-1985.

Climate

Like other areas in the northern Central Basin, the study site can be considered perpetually moist since rainfall in the driest month rarely falls below 60 mm. Two peaks of higher rainfall occur: mid-September-mid-November and March-April, the former peak showing a higher monthly average. There are also two peaks of lower rainfall: the more severe falling in January-February and the less severe occurring between the months of June-August. For 12 months between 1981-1982, total rainfall in camp equaled 1843.6 mm (Thompson-Handler 1990). During the same period, mean minimum monthly temperature ranged between 21.20 - 22.20° C. and mean maximum monthly temperature ranged between 26.8 - 30.85° C.

Conservation Problems and Proposals

Logging

From the beginning of studies in the Lomako, the area was suggested as an excellent site for creating a reserve (Kabala 1976; Badrian and Badrian 1977, 1978, 1980; McKinnon 1976; Susman et al. 1980, 1981; Lomako Forest Pygmy Chimpanzee Project 1986). When the long-term project began in 1980, however, a 99-year lease to the concession between the Lomako and Yekokora Rivers was held by Karl Danzer-Furnier Werk, a veneer manufacturer, headquartered in Germany. Cutting began in the western sector of the concession in 1981. In 1983, at the request of the Director of the Project, the corporation agreed to not disturb a 50,000 ha area surrounding the study site, this was later expanded to 300,000 ha by Danzer (Susman 1989). When the corporation abandoned the concession in 1987, this large area became available as a potential bonobo reserve. The Danzer camp at Beongo was also offered to WWF-Germany for the establishment of a research station there (Susman 1989). A brief survey in 1988 (Bresch pers. comm.) indicated that bonobos are still to be found along the lumber roads in Beongo and were also spotted along the Tofili Stream to the east of the proposed reserve.

Bonobos of the Lomako Reserve

A proposal to create a reserve of 3800 km^2 within the former concession was submitted to the Institute Zairois pour la Conservation de la Nature by WWF-International in 1990. By May 1991, the proposal had reached the level of the Ministry (Mbaelele pers. comm.) but since that time we assume that no further action has been taken. The proposal is intended to protect the reserve from human interference but will allow the continuation of scientific research. Within the proposed reserve, hunting and fishing; industrial, commercial, agricultural, pastoral or lumbering activity; the extraction of concessible or non-concessible material; the use of water; public access or any action that might harm the natural development of the flora or fauna or alter the features of the area will be prohibited.

Infrastructure for Research and Conservation

Research in the Lomako has been hampered by logistical difficulties in getting researchers and supplies into the study site and protecting equipment against the tropical climate. At present, the wives and younger children of the hired staff live in the camp since their permanent homes in Bokoli are a day's walk away. To lessen the impact of human numbers, the LFPCP proposes to establish a new camp for families outside of the proposed reserve. Bondolo, an abandoned village in the forest south of the Lomako River, is the proposed location. The project also proposes to

build a school for the workers' children. This school could serve as a pilot project for conservation education efforts. The pilot school would be restricted only to workers' children to discourage further immigration into the area surrounding the reserve.

Survey

Distribution of bonobos within the Lomako Forest outside of the study site is largely unknown. Members of the Max Planck team conducted a survey to the north of the plantation of Bohua, approximately three hours walking distance from the Ndele study site (Fruth and Hohmann pers. comm.) for one week in 1993. Inhabitants of Bohua, a small hamlet of two families, state that there are no villages to the north between their village and the Yekokora River. Direct observations, nest counts and feeding remains indicate that bonobos regularly inhabit this area.

Recent Threats

During 1992, Michael Chambers (pers. comm.) walked from Beongo to Ndele and upriver east. He reports that hunters are entering the Lomako Forest from the west along abandoned lumber roads. One hunting camp exists just outside the proposed reserve and another is within it. Upriver from Ndele are several large encampments occupied by Kitiwalists, a religious sect that continues to live in the forest against government regulations. Aside from cutting agricultural fields, the Kitiwalists take large amounts of bushmeat from the Lomako Forest and transport it to markets downriver as far as Basankusu. The government remains opposed to their presence in the forest. During 1991, increasing numbers of fisherman from Basankusu fished in the Lomako River. The Ngombe tribe from that region do not have religious proscriptions against killing bonobos. If Ngombe begin to permanently colonize the area, the bonobos of the Lomako will be under far greater threat. More recently, Hohmann and Fruth report that while extending the trail system to the east of Ndele, they found that certain areas such as the banks of the Yirte River showed indisputable evidence of recent hunting activity. Two study animals from the Eyengo group were seen with trap injuries.

LILUNGU (23.01E, 01.07S)

Systematic research at Lilungu in the Zone of Ikela began only recently. A team from the University of Barcelona under the direction of Jorge Sabater-Pi undertook studies from October 1988 - May 1990. The study population was not artificially provisioned with food. The study site of 72 km^2 has a high human population density for the region (19.51/km^2).

Bonobo Population

Size of the Population

The total population size as estimated from nest counts in a sample of 50 km of transect within an area totaling 72.83 km^2 was 31 bonobos (Sabater-Pi and Veà 1990). The researchers believe this is likely an underestimation of bonobos in the area since bonobos also exist in the forests to the north of the study area. One habituated group contained 2 adult, 2 young and 2 infant males and 2 adult females with infants, 2 adult females and 1 young female. A second group occasionally interacting with Group I contained at least 1 adult female with infant, 1 adult male and an infant female (Bermejo, Illera and Sabater-Pi in prep.).

Density

Density extrapolated from the nest census was calculated as 0.4293 bonobos/km^2 (Sabater-Pi and Veá 1990).

Habitat

Judging by the lack of primary forest within the study site, this area represents a highly disturbed study site. Old secondary forest occupied 64.65% of the study site, early successional forest 9.08%, cultivated areas 7.17%, swamp forest 5.52%, young secondary forest 4.63%, *Hevea brasilensis* 4.17, *Beluccia aubletii* 2.85% and oil palm (1.82%). Sabater-Pi and Veà (1990) report that night nests were located primarily in the young secondary forest (41.3%), old secondary forest (28.26%), *Beluccia* forest (26.09%), and in the early successional forest (4.35%).

Five other primates are found within the study site: *Colobus angolensis, Cercopithecus p. wolfi, C. ascanius, C. neglectus* and *Cercocebus aterrimus.* Other large mammals include forest elephant, bongo, red forest hog, Peter's duiker and the red-flanked duiker (Sabater-Pi and Veá 1990).

Climate

Sabater-Pi and Veá (1990) report that rainfall between November 1988-December 1989 totaled 1984.7 mm with the least rain (<100 mm) falling in the months of January, February, May and June. Temperatures varied from an absolute minimum of 19.5° C. (mean = 22.78) to an absolute maximum of 39° C. (mean = 32.66).

Conservation Problems

The Barcelona team notes that bonobos are not hunted or captured by the Mongo-Boyela people in the Lokofe-Lilungu-Ikomaloki region due to their magico-religious beliefs, although these beliefs are becoming less entrenched. The study area is extensively settled (24 villages) and the human population makes use of the forest for hunting as well as for collecting fruit, firewood and other materials. The results of a study of the effect of human predation in this area (Sabater-Pi and Veà 1990) characterized human predation on the fauna as very intense and indiscriminate. During a two-month period, 1048 traps were inventoried, preferentially set in the degraded forest near villages. Fifteen species of mammal (including four primates), four reptiles and three birds were ensnared. Brush-tailed porcupine was the most frequent catch, followed by small and large duikers, and giant rats.

YALOSIDI (23.14E, 02.00S)

Formerly the southernmost of the study sites, Yalosidi was chosen by Kano following his 1973 survey as an area with high densities of bonobos. The study site covers 200 km^2 with the majority of studies focused within a 70 km^2 area. Research on the Yalosidi bonobos was undertaken in 1973, 1974-1975, 1976-1977 and discontinued after 1977 (Kano 1992b). Bonobos have almost disappeared from the area since that time [Bonobo/Pygmy Chimpanzee Protection Fund (Japan) 1992]. Bonobos at the Yalosidi study site were not provisioned.

Bonobo Population

Between 1975-1976, Uehara (1988) estimated two communities totaling 80-90 individuals within the study site.

Party Size and Composition

During one five-month study, modal party size in an area of marsh grassland (Iyoko) where bonobos could be clearly observed was 2-5 animals, with a mean of 9.6 , range 1-32, N = 90 (Uehara 1988). The majority (76.0%) of 96 such parties were mixed in composition. Bisexual parties containing only adult animals accounted for 5.2%, all female parties 1.0%, all male parties 1.0%, and solitaries of both sexes 10.4% (op. cit.) The sex ratio in 64 parties characterized with confidence equaled .48 (140 males/290 bonobos).

Habitat

Like the other sites where *Pan paniscus* has been studied, the Yalosidi study area contains mixed primary forest, swamp forest, aged and young secondary forest and recently disturbed forest. The bonobos of Yalosidi differ, however, in their use of a 5 ha swamp grassland (known locally as yoku or iyoko) where they feed on several species of aquatic and amphibious plants (most commonly *Hydrocharis* spp.).

Six species of monkey are present: *Cercocebus aterrimus, Cercopithecus ascanius, Cercopithecus mona (p. wolfi?), Colobus angolensis, Allenopithecus nigroviridis* and *Cercopithecus neglectus*. During the 1970's, other large mammals such as western bongo *(Boocerus euryceros euryceros)* and dwarf forest buffalos (*Syncerus caffer nanus*) were observed. Indirect evidence indicated that elephants and leopards also passed through the study area (Kano 1983; Uehara 1988).

Climate

Records from Lomela (23.17E, 02.18S) indicate an annual rainfall of 1941.5 mm with the driest season occurring in June and July (Vuanza and Grabbe 1975, in Kano 1992b). During one study period (Kano 1983), average daily temperature ranged between 17.5 - 21.5° C.

Conservation Problems

Bonobos have "virtually disappeared" from the area of Yalosidi [Idani pers. comm.; in Bonobo/Pygmy Chimpanzee Protection Fund (Japan) 1992]. During the 1970's, the degree of human predation on bonobos was classified as "rare but exists" (Uehara 1988). One bonobo seen during Kano's (1983) study had a snare wire around his wrist and other bonobos were seen who had lost a hand, probably due to the same cause. Kano (1983) also mentions that shifting agriculture is widely practiced in the region.

LAC TUMBA (17.58E, 00.53S)

The first study of wild *Pan paniscus* was undertaken by Art Horn between November 1972-September 1974. His small study site (~1 km^2) was situated on the south-western part of Lac Tumba. Bonobos were directly observed 24 times during the study, totaling just over six hours of observation. Another 15 hours of contact were made when the bonobos were on the ground but could not be seen (Horn 1980). The west bank of Lac Tumba was also briefly surveyed by Nishida (1972) who felt that the bonobos remaining there were critically threatened by the human population.

Bonobos are still occasionally seen within the research station at Mabali on the southeastern shore of Lac Tumba (Ekam Wina pers. comm.)

Bonobo Population

Bonobos were totally absent from the study site for long periods of time during Horn's (1980) study and it is likely that the area represented only a very small portion of their range. Parties encountered included one with an adult male, an adult female and a juvenile male and another with an adult male, an adult female with a 2-year old infant and a juvenile female. An adult male was seen as a solitary, as well as in the company of an adolescent male.

Habitat

Horn's study site consisted primarily of old secondary forest penetrated by small cocoa plantations on the northern and western edges. Bordering the study site on the northeast was an extensive swamp and the rest of the study site was surrounded by periodically inundated swamp forest or the lake itself.

Other primates included: *Cercocebus aterrimus, Cercopithecus ascanius, C. p. wolfi, C. neglectus, Colobus angolenis* and *Procolobus [badius]* and *Allenopithecus nigroviridis*. Either observation or indirect evidence suggested that elephant, bongo and duiker frequented the area. Hippopotamus were observed in the lake and red forest hog were seen in the swamp forest.

The Mabali Reserve (managed by the Centre de Recherche en Sciences Naturelles) offers a protected area of 982 ha on the southeast side of Lac Tumba. The habitat of the research station is described by Mpolo and Kibungu (1978). Two peninsulas (Mabali and Bwalanga) are separated by the Bay of Bwalanga and covered primarily with heterogeneous terra firma forest. Bordering the two peninsulas on the east is a large area of esobe grassland which is being colonized by species from the dry forest, as well as swamp forest to the east. Further inland swamp forest prevails, although another island of terra firma forest exists along the road leading to Bikoro.

Climate

Records from the research station at Mabali during 1972 and 1973 indicated that rainfall was lighter in this area than at other sites, 1318mm and 1476mm respectively. The long dry season in this area extends from June through August. The shorter dry season occurs during February to early April. Horn (1980) reports minimum temperatures at the Mabali station ranged between 22-25° C. and the maximum between 29-31° C.

Conservation Problems

An investigation by Kabongo (1984) in 1981 in the zone of Bikoro indicated that hunting for bonobos was driven by the need for food, for magico-religious purposes and for commercial exploitation. He noted that illegal trade was rapidly growing in the Lac Tumba area, promoted among the Ntomba people by middlemen from Bandundu and neighboring countries. Horn (1980) notes that both the Ntomba and Tua pygmies kill forest primates using bows and poisoned arrows. Shotguns were used rarely but were growing more common in the early 1970's.

SALONGA NATIONAL PARK (20.00-22.30E, 01.00-3.20S)

Although Salonga was established in 1970 for the protection of *Pan paniscus* (and rainforest), until recently bonobos were thought to be absent or only marginally present (MacKinnon and MacKinnon 1986). This World Heritage Site represents the largest potential area of protection if viable populations of bonobos are confirmed; a total of 36,560 km^2 divided into two sectors of approximately equal size separated by about 45 km. A research station of 250 ha has been established at Botsina (22.00E, 01.05S) under the auspices of the European Economic Community (EEC). Primate research was undertaken between November 1989 - October 1991 by a team from the University of Remmes directed by J-P Gautier and Annie Gautier-Hion.

Bonobo Populations

Researchers at the Botsina station report only one encounter with bonobos during their year's study (Gautier-Hion pers. comm.) Bonobos are said to occur regularly several kilometers from the study area. In 1987 a survey team under the direction of Carsten Bresch, University of Freiburg, encountered a group of ~ 20 bonobos within two day's walk of the nearby Lokata Station (21.58E, 01.20S) [Meder, Burgel and Bresch 1988]. The Freiburg team also report that Park rangers report populations of bonobos north of Anga (21.34E, 03.07S) and north of Monkoto (20.40E, 01.35S). A map prepared by J-P d'Huart of WWF indicated bonobo sightings in Salonga Nord: 1) near the Lokata Station, 2) along the only branch of the Salonga River occurring southeast of the village of Bamata, and 3) in the northernmost sector of Salonga Nord east of the village of Nongo. Bonobo sightings were also reported from Salonga Sud: 1) southeast of Monkoto, 2) on the northeastern border of the park in the vicinity of the village of Tumba, in the south central sector south of the village of Ila. Outside the southern border of Salonga National Park, d'Huart indicates an additional sighting to the northeast of Dekese (pers. comm. from J-P d'Huart to Parish 1991). In a report to the EEP (1989), d'Huart states that from one station (presumably Lokata), bonobos are easy to find and respond to guards' whistles and calls. Alers et al. 1989, (in East

1990) report that *Pan paniscus* occurs throughout the Park but is only very locally common.

Habitat

The following description is taken from the IUCN Directory of Afrotropical Protected Areas (1987). Salonga National Park encompasses low plateaux covered by swamp forests, river terraces with an associated riverine forest and high plateaux with dry forest cover. In the northern sector, a type of grassland known as elephant's bath or "botaka-djoku" (probably similar to the yoku of Yalosidi) occurs. The southern part of the Park has esobe clearings. The total area of grassland within the park is estimated at <.5%.

Monkey species include *Colobus angolensis* and *Procolous badius*, *Cercopithecus p. wolfi* and *C. ascanius* and *Cercocebus aterrimus*. Both subspecies of African elephant are reported, although large-scale poaching has led to a decline in numbers. Other large mammals include the yellow-backed duiker, water chevrotain, sitatunga, bushbuck, bongo and pygmy Cape buffalo.

Climate

Mean annual precipitation is 1300 mm with a drier season from June to August. Mean variation in temperature ranges from 20°-32° C. (IUCN 1987).

Conservation Problems and Proposals

Salonga National Park is the only protected area for the bonobo on the national level. East (1990) reports that Salonga is currently under the control of heavily armed gangs of poachers. Although these gangs have decimated populations of elephants and hippos, they have had very little impact on other wildlife. Antelopes are also caught with snares by local villagers living both inside and along the park's borders. Due to the huge size of the park, however, large areas in the interior remain relatively undisturbed.

D'Huart (1989) reports that the EEC plans a large program for Salonga as part of the forestry program for Central Africa. The program within Zaire will focus on research. Other plans include improving infrastructure (roads and bridges) within and outside the park to improve communication. Family wildlife husbandry projects, such as raising forest porcupines, are under consideration for villages surrounding the park.

BEONGO (20.36E, 01.01N)

Beongo is the site of the former Danzer (SIFORZAL) lumber camp and airstrip which was occupied from 1981 through 1987. The camp with its permanent buildings was offered to WWF-Germany for use as a research station (Susman 1989). Through 1990, the camp remained guarded by employees of SIFORZAL (Ongaro pers. comm.). The camp lies outside the boundary of the proposed Lomako Reserve.

Bonobo Population

The following is excerpted from conversations with Bresch and Meder. A brief survey by Meder and Burgel at the end of 1987 located bonobos 6 km from the camp. Many nests were observed 20 to 30 km offroad. These surveyors found knuckleprints in Tofili Stream as well as feeding remains. SIFORZAL workers reported that bonobos were common and not shy. They noted that bonobos played on the company's machinery and drank from puddles in the road while the company was cutting. These informants also reported that bonobos were not eaten locally, but were occasionally captured as pets.

Conservation Problems

See under Lomako.

YASA (21.24E, 03.42S)

Confirmation of a population of bonobos at Yasa (Zone of Dekese, Kasai Occidental Region) has greatly changed recent conceptions of both species' distribution and ecological range. This new study site lies between the Lukenie and Sankuru Rivers, an area outside recent estimates of the species' distribution but within the historical range. Unlike other sites which all include some dense forest, the Yasa habitat is a hilly area of forest-savanna. The site was identified in 1992 by Thompson, Messinger and Mandungu. Jo Thompson of Oxford University began long-term research on the ecology and behavior of the Yasa bonobo population and their habitat in 1994.

Bonobo Population

During initial surveys, presence of bonobos was confirmed by nests, vocalizations and direct observation. Local missionaries report that bonobos have been abundant for many years in the area. Thompson (pers. comm.) reports the study population as already semi-habituated due to frequent non-threatening contact with the human population who traditionally do not hunt this species (but see Conservation

Problems). The study will include census along transects and will also try to determine the degree to which the population is isolated.

Thompson reports that bonobos occur as far south as Bolombo/Longa (04.00S, 21.24E). To date this is the southernmost extent of confirmed distribution for the species. This researcher (pers. comm.) notes that bonobo distribution in the region between the Lukenie and Sankuru Rivers appears to follow along forested corridors.

Habitat

Thompson (pers. comm.) offers the following description of the Yasa area:

> The vegetation in this region is known to be a mosaic of tropical rain forest and grassland where the intermediate transitional vegetation has difficulty growing (Kano 1992 and pers. obs.). The hilly terrain includes a ridge which is formed north to south and is a drainage divide shedding water east or west. The village of Yasa falls within the study area along a main dirt road coinciding with the north-south ridge.

Direct observation of other primates include: *Cercopithecus ascanius, Cercocebus aterrimus, Procolobus badius, Colobus angolensis, Galago demidovi,* and *Perodictus potto. Cercopithecus neglectus* is also possibly present. Monkeys are heavily hunted for food. Other mammalian species which are hunted include three species of duiker (*Cephalophus monticola, C. nigrifrons* and *C. silvicultor*), *Loxodonta africana, Potamochoerus porcus, Tragelaphus scriptus, Felis serval, Nandinia binotata* and *Viverra civetts.*

Climate

Meteorological data from this study are not yet available.

Conservation Problems

As noted above, hunting pressure for bushmeat is heavy. Formerly, bonobos received local protection from traditional religious beliefs. The influx of a transient population of young hunters is undermining these customs and a large male bonobo was killed for meat in the fall of 1992.

Ethnic conflicts as Shaba Province attempts secession from Zaire have led to an acute refugee crisis. Hundreds of thousands of people have fled north into the Kasai and

starvation and dysentery are epidemic. With such a huge incursion of desperate people, bonobos in this area may be at very high risk.

Thompson (pers. comm.) also notes that preliminary surveys in the region of Lac Mai-Ndombe and along the Lukenie River west of Yasa (see numbers 10-17 of Fig. 1) indicate that these provisional sites do not harbor bonobo populations. She feels that the habitat in many of these areas cannot support large mammals and also notes that other primate species are limited in number. These indirect sites which were identified from a survey in Kinshasa are most likely population centers along commercial routes in which bonobos are exchanged on their way to the capital.

MIMIA (20.00E, 2.29 S)

The presence of bonobos in this area was also directly confirmed by Jo Thompson during surveys in 1994 (pers. comm.). The site lies to the west of the southern sector of Salonga National Park and north of the Lokoro River. Mimia is described as flat and wet with areas of swamp forest. Relative to Yasa, the ground vegetation in this area is much more dense. Other primates noted at Mimia include: *Cercocebus aterrimus, Cercocebus galeritus chrysogaster, Colobus angolensis, Procolobus badius, Cercopithecus ascanius, Cercopithecus nictitans,* and *Miopithecus talapoin.* Three of these species *(C. g. chrysogaster, C. nictitans and M. talapoin)* are not reported from any other bonobo study site.

Recommended Conservation Actions

RECOMMENDED CONSERVATION ACTIONS

The previous chapter summarized current knowledge of bonobo ecology, distribution, demography and existing threats. From these collaborative efforts, a number of suggestions for future projects to determine the conservation status of the species, as well as to protect and manage known populations of *Pan paniscus* have emerged. Where options are many but funding and personnel limited, a system of priorities is useful in determining which actions will produce the greatest results. The categories and rating system used in this chapter are adapted from drafts for *Action Plan I. Conservation of Chimpanzees in Africa: A Species Survival Strategy for Pan troglodytes* compiled by the Committee for Conservation and Care of Chimpanzees, which this volume is designed to complement. Since ratings are subjective, data are presented or summarized from the previous chapter to clarify why these choices were made. These recommendations might be altered when new or more precise data become available.

TYPES OF ACTIONS PROPOSED

Because availability of information differs from area to area, several types of conservation projects are considered: survey, urgent research/monitor, long-term research/monitor (monitoring is assumed to be a critical component of any research program) and research development. We also include a section on conservation education and ecotourism projects, but these are not prioritized.

Survey

In areas where little information is available as to distribution or abundance but indirect evidence or habitat quality suggest that bonobos might exist, a survey team should be sent to collect relevant information quickly.

Urgent Research/Monitor

Where a few relict bonobos are on the verge of extinction, immediate 1-2 year research studies coupled with initiation of local conservation education are encouraged. Further support will stem from results. There will be a continuing dependence on researchers to ensure the survival of these populations. Sites of particular interest are those where bonobos show interesting cultural differences, and/or are present in marginal habitats that are likely to be of ecological interest.

Recommended Actions

Long-term Research/Monitor

In areas of little natural disturbance with larger populations but potential human threat, establishment of long-term research studies and local conservation education programs are suggested until more systematic conservation can be accomplished. Tourism development and coordination with local and national government agencies for protective management should be considered.

Reserve Development

A goal of the preceding conservation action categories is to identify unprotected areas where initial steps should be taken to obtain legal protection. For the purpose of this document, reserve development refers to conservation activities within areas that are a) already designated as protected areas, b) in the process of upgrading their legal status, or c) have been previously identified as warranting increased protection. For example, in areas such as Salonga where formal protection has been granted but where animals are still being poached, financial and technical support to the government is encouraged to achieve the goals of long-term species conservation.

Education

Where populations exist outside protected areas, projects need to be developed to strengthen anti-poaching laws and to educate citizens to better appreciate wildlife, understand the pressures on wildlife and protect Zaire's natural heritage.

PROJECT PRIORITIES

To effectively distribute monetary and human resources, prioritization of recommended projects are weighted by the following considerations.

1. Conservation value of an area is to some extent a function of its size: ecological importance usually increases with size.

2. Protection of other endangered or threatened species. If an area harbors high levels of biodiversity or locally endemic species, the area should be given higher priority.

3. Priority rating should be based on different criteria for the different types of actions proposed (e.g., survey, research/monitor, reserve development), as well as on

the nature and quality of data available.[1]

RATINGS FOR SURVEY PROJECTS

a. Imminence of threat to the ecosystem under consideration, scored on a 1 to 3 scale:
   1) low to moderate degree of threat
   2) degree unknown
   3) highly threatened, or degree of threat unknown

b. Presence of bonobos, scored on a 1 to 3 scale:
   1) confirmed by experts
   2) confirmed by local people
   3) unknown, but very probable in view of the ecosystem

c. Overall primate species richness in project area, scored on a 1 to 3 scale:
   1) 5 or fewer species
   2) 6-9 species
   3) 10 or more species, or unknown

d. Population size, scored on a 1 to 3 scale:
   1) less than 100
   2) more than 100
   3) unknown

e. Area to be surveyed, scored on a 1 to 3 scale:
   1) less than 100 km^2
   2) 100-1000 km^2
   3) greater than 1000 km^2 or unknown

f. Availability of qualified biologists. In some areas young students or scholars have been studying bonobos, often with poor financial support. In view of the urgency of our actions, availability of experts should be taken into consideration.
   - : Candidates not available
   +: Candidates available, without enough financial support
   #: Long-term research in progress

g. Area has high level of biodiversity:
   1) unknown
   2) other threatened, endangered or locally endemic species known to be present

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[1] Some factors are weighted differently for different categories of proposed actions. Under Surveys, "unknown" factors are weighted more heavily. Under Urgent Research/Monitor, small or marginal populations have highest priority, in contrast to Long-Term Research/Monitor and Reserve Development, where larger populations receive higher priority. Moreover, if an area harboring bonobos is already legally designated as a reserve or national park, a "reserve development" scheme should, in principle, be implemented in this area. However, if the reserve is not worthy of the name, "research/ monitors" or even "survey measures" may be more relevant.

RATINGS FOR URGENT RESEARCH/MONITOR PROJECTS

a. General environmental conditions, scored on a 1 to 3 scale:
   1) very good
   2) good
   3) poor

b. Imminence of threat to bonobos by hunting, trapping, etc:
   1) low degree of threat at present
   2) moderately threatened
   3) highly threatened

c. Overall primate species richness in project area, rated on a 1 to 3 scale:
   1) <5 species
   2) 6-9 species
   3) 10 or more species

d. Population size of bonobos, scored on a 1 to 3 scale:
   1) more than 500
   2) 100-500, or unknown
   3) less than 100

e. Geographic or ecological uniqueness:
   1) part of a continuous distribution
   2) isolated from other populations or marginal habitat
   3) ecologically important habitat

f. Availability of qualified biologists:
   - : Candidates not available
   +: Candidates available, without enough financial support
   #: Long-term research in progress

RATINGS FOR LONG-TERM RESEARCH/MONITOR PROJECTS

a. Presence or absence of other top-priority wildlife such as okapi, elephant or local endemics:
   1) absent
   2) present

b. General environmental conditions and habitat quality, scored on a 1 to 3 scale:
   1) poor
   2) good
   3) very good

c. Overall primate species diversity in project area:
   1) ≤ 5
   2) 6-9
   3) ≥ 10

d. Population size:
   1) < 100
   2) 100-500, or unknown
   3) > 500

e. Tourism potential, scored on a 0 to 3 scale:
   0) difficult access, and no good (i.e., lake or riverside) campsite available
   1) difficult access, but good campsite available
   2) easy access, but no good campsite available
   3) easy access, and a good campsite available

f. Attitude of the government to conservation tourism:
   0) not positive
   1) positive

RATINGS FOR RESERVE DEVELOPMENT PROJECTS

a. Presence or absence of other top priority wildlife such as okapi, elephant, or local endemics:
   1) absent
   2) present

b. General environmental conditions and habitat quality, scored on a 1 to 3 scale:
   1) poor
   2) good
   3) very good

c. Imminence of threat to bonobos by hunting, trapping, etc:
   1) low degree of threat at present
   2) moderately threatened
   3) highly threatened

d. Overall primate species diversity in project area:
   1) ≤ 5
   2) 6-9
   3) ≥ 10

e. Population size of bonobos, scored on a 1 to 3 scale:
   1) < 100
   2) 100-500, or unknown
   3) > 500

f. Tourism potential, scored on a 0 to 3 scale:
   0) difficult access, and no good (i.e., lake or riverside) campsite available
   1) difficult access, but good campsite available
   2) easy access, but no good campsite available
   3) easy access, and a good campsite available

g. Attitude of the government to conservation tourism:
   0) not positive
   1) positive

RECOMMENDED CONSERVATION ACTIONS

Surveys

Undertaking surveys can be both arduous and expensive. Without further exploration, however, we cannot realistically assess the status of the species in the wild, estimate numbers remaining and population status, determine species range and formulate future policy. The discussion below lists eight areas that have been previously identified as likely to harbor bonobos. For the purposes of initial efforts, boundaries are indicated by crude blocks to facilitate estimation of area to be covered (see Figure 4). This is certainly an overestimation of the total area. For each survey, we note who has proposed the survey and if potential surveyors have been identified. After the regions to be surveyed have been identified and prioritized, survey goals and methods must be comparable.

1. Between the Lomami and the Lualaba Rivers East of Wamba

This survey was recommended in the IUCN/SSC Primate Specialist Group *Action Plan for African Primate Conservation* (1986-1990), as well as in the preliminary *Chimpanzee Action Plan* and the San Diego Bonobo Workshop. From locality records in Kano (1984) and Kortlandt (in prep.), *Pan paniscus* was present in the area between the Lomami and Lualaba Rivers to about 1 degree south prior to the 1980's. In fact, the northern sector of this area was a focus of Vanderbroek's 1955 expedition (van den Audenaerde 1984). Two road trips made by Kano (1984) in 1973 between Ikela and Kisangani produced no evidence of bonobos, however. Based on Colyn (pers. comm.), the Bonobo/Pygmy Chimpanzee Protection Fund includes the middle regions of the Zaire and Lomami Rivers as an area with relatively high densities of bonobos. Satellite photography indicates disturbance along the road linking Opala and Kisangani, but south and east of this road the vegetation appears largely undisturbed. Below 3 degrees south, a forest/savanna mosaic prevails and further south true savanna vegetation predominates (Colyn and Verheyen 1988). The same authors also note that a very large zone of swampy forest appears to separate the two subspecies of *Cercopithecus wolfi* that occur between the Lomami and Lualaba Rivers to the west of the town of Lowa. Few villages are found in the central core of this region. Other primate species within this region include two new subspecies *Cercopithecus mitis heymansi* (Colyn & Verheyen 1987b) and *Colobus rufomitratus parmentieri* (Colyn and Verheyen 1987a). Colyn (1988) also places *C. ascanius whitesidei*, *C. wolfi wolfi*, *C. neglectus*, and *Cercocebus aterrimus aterrimus* in the northern part of the area. As a postulated fluvial refuge (Colyn 1988), the area is of particular importance and confirmation of the presence of bonobos in the area would extend the species' range eastward from more recent distribution maps. Figure 4 divides the potential area for survey into two blocks with

a total area of 46,720 km^2. Potential surveyors for this area have been identified (Kano pers. comm.).

2. South of Lukenie River

This area was identified in both the preliminary *Chimpanzee Action Plan* and the San Diego Workshop as of great interest. It was also included in the *Action Plan for African Primate Conservation* as important in assessing the status of *Cercocebus galeritus chrysogaster*. A number of locality records (e.g., Coolidge 1933, Kano 1984, Van den Audenaerde 1984, Kortlandt in prep.) indicate that *P. paniscus* was formerly present and the indirect evidence communicated by Messinger certainly call for more intensive investigation. Thompson's confirmation of the presence of bonobos south of Lukenie extends the current species' distribution to the south. Reports of bonobos at Yasa in an area of mixed forest/savanna vegetation also extend our knowledge of the ecological range of *Pan paniscus*. At present, the block defined by 19.00E, 3.10S (northwest corner) and 22.40E, 4.20S (southeast corner) includes areas with both direct and indirect evidence of bonobos, covering an area of 53,193 km^2. Thompson's preliminary surveys of sites with indirect evidence of bonobo populations within this block indicate that bonobos are unlikely to be present at sites 13-17 (see Figure 1) and that monkeys are present only in low densities. Thompson and Messinger began survey work in 1992 and plan to continue at a future time (Thompson pers. comm.). Additional surveyors may be available (Idani pers. comm.).

3. Lomako Forest

Prior to developing a reserve in the Lomako, more surveys are urgently needed between the Lomako and Yekokora Rivers to confirm presence of bonobos outside the area of the field station of the Lomako Forest Pygmy Chimpanzee Project (LFPCP) and to assess forest quality. Hohmann and Fruth have verified the presence of bonobos north of Bohua, about a three hour walk from the LFPCP base camp. Proposed boundaries of the reserve fall roughly into a block between 20.52E, 1.12N (northwest) and 21.38E, 0.45N (southeast): the area of the proposed reserve is 3800 km^2. This forest has been recognized as a priority in the *Action Plan for African Primate Conservation* (1986-1990) and the San Diego Workshop. A survey between Ndele and Beongo has been proposed by Thompson-Handler and Malenky, and Hohman and Fruth propose further surveys. The major threat to the bonobo population comes from hunters who enter along former lumber roads to the west of the proposed reserve and also from the Kitiwalists, a religious sect that has illegally established villages within the forest upriver from the study site.

4. Salonga National Park

The presence of bonobos is now confirmed by experts in both northern and southern sectors. Although the Park is protected from commercial ventures, poaching and habitat destruction are difficult to control due to a low staffing level relative to the huge area to be patrolled. Gautier and Gautier-Hion (pers. comm.) suggest that surveys within the northern sector would be relatively easy along a pre-existing trail running roughly southwest between 1.10S, 21.55E (above Botsina) and 1.36S, 20.40E (Mankoto). The need for surveys within Salonga has been stressed by the *Action Plan for African Primate Conservation* (1986-1990) and the San Diego Bonobo Workshop. Potential surveyors may be available (Parish pers. comm.).

5. Headwaters between the Tshuapa and the Lomela Rivers

This location was proposed as potentially important during the San Diego Bonobo Conservation Workshop. A rectangle encompassing most of the headwaters of the Tshuapa and a part of those of the Lomela is bounded on the northwest at 3.00S, 23.45E and on the southeast at 3.30S, 24.45E, covering an area of approximately 6200 km^2. By comparing historical records to recent interviews, Kortlandt (in prep.) obtained four independent reports that bonobos are not currently present in this area. These reports are in contrast to several museum and site reports recorded prior to the 1960's. Most of the area is now covered by a network of secondary roads, tracks and trail which would facilitate ground surveys. Confirmation of the presence of bonobos in this region would extend the current range to the southeast. No surveyors have been identified to date.

6. Between the Lopori and Lomami Rivers

Kuroda (pers. comm.) suggests that the area between these two rivers northwest of the Wamba study site may have high densities of bonobos. The northwest corner of a rectangle encompassing much of this area would fall at 22.45E, 0.45N and the southeast corner at 24.15E, 0.00N. The area of this block equals 5668 km^2. An NOAA-AVHRR Vegetation Map (See Figure 2) of the area shows large blocks of degraded forest occurring primarily in the northeast quadrant of this block, with smaller blocks following roads, while large areas of forest in the southern half are largely undisturbed to the east and west (Justice et al. 1983). Kortlandt's (in prep.) distribution map indicates that bonobos are not currently present in the area where the Lomami and the Zaire Rivers converge, but shows two reports prior to 1960 within the boundaries proposed above. Kortlandt provides abundant evidence of bonobos in the block between 0-1° N and 22-23° E. This proposed area presents an excellent opportunity to examine the effect of rivers as potential barriers to bonobo distribution, as well as the chance to sample both degraded and undisturbed forest for

the presence of bonobos. Inclusion of a survey between the Lopori and Lomami Rivers will also extend our knowledge of the bonobo's range in the north of the *Cuvette Centrale*. No surveyors have been identified to date.

7. The Lac Mai Ndombe Region

Suggested at the San Diego Workshop, the necessity for this survey is given additional weight by the indirect evidence presented by Kortlandt (in prep.) and Messinger (pers. comm.). Five new (> 1990) indirect reports fall within the block surrounding Lac Mai Ndombe bounded by 18.00E, 1.20S on the northwest corner and 18.40E, 3.00S on the southeast. From preliminary surveys, Thompson (pers. comm.) believes that viable populations of bonobos are not present (see indirect evidence 10-12, Fig. 1). This area covers some 13,861 km^2. The western border of the lake appears swampy. Potential surveyors have been identified (Messinger pers. comm.).

8. Between the Lulonga and Ikelemba Rivers

Inclusion of this survey is based on observations made during Kano's survey and a personal communication to Thompson-Handler and Malenky from a priest who was stationed at a remote mission within the region in 1990. Father Deen reported that his informants reported many bonobos in the forest between the Lulonga and Ikelemba Rivers. He compared the forest to that found between the Maringa and Lopori Rivers and also noted that the human population of the area was very thinly settled. Corners of the block suggested for survey are 18.20E, 1.00N (northwest) and 19.15E, 0.20N (southeast): an area covering roughly 7637 km^2. Within the proposed survey block, degraded forest is associated with settlements along rivers and roads (especially the road running north from Bolomba) but the forest in the center of the block appears to be undisturbed (based on satellite imagery). Proximity to the regional capital of Mbandaka may increase the level of threat to bonobos from hunting for meat or trade. Potential surveyors have been identified (Messinger pers. comm.).

Urgent Research /Monitor Projects

As a first (and relatively inexpensive) line of defense, immediate short-term research projects are encouraged in areas where small populations of bonobos have been identified. The presence of researchers has been shown to be an effective deterrent to poaching. Such short-term projects are also important in contributing to overall understanding of variation in bonobo ecology and behavior. Researchers would be expected to initiate local programs to increase conservation awareness.

1. Yalosidi

The precipitous decline of the bonobo population in Yalosidi since research was abandoned in 1977 underscores the importance of researcher presence. Yalosidi is of special ecological importance due to the presence of swamp marshland (iyoku) and the incorporation of this habitat into the bonobo's behavioral repertoire.

Table 8. Yalosidi

Summary of Relative Data Used for Priority Ratings for Urgent Research/Monitor

Environ. Conditions	Threat	Primate Species Richness	Popula-tion Size	Unique-ness	Qualified Candidates
relatively good, but shifting agriculture widely practiced	highly threatened	7	> 100 in 1976, virtually disappeared by 1991	iyoko swamp	Bonobo Protection Committee - Japan

2. Lilungu

Although survey results suggest that the study population at the Lilungu site numbers approximately 31 animals, this site offers the potential to study *Pan paniscus* in a disturbed habitat with high human densities. Since the traditional local attitude toward *Pan paniscus* is one of protection, research coupled with conservation education programs should be implemented to foster this predisposition.

Table 9. Lilungu

Summary of Relative Data Used for Priority Ratings for Urgent Research/Monitor

Environ. Conditions	Threat	Primate Species Richness	Popula-tion Size	Unique-ness	Qualified Candidates
highly dis-turbed forest, relatively high human density	moderately threatened by trapping of other species	6	31+	marginal habitat	University of Barcelona?

3. Lac Tumba

Although *Pan paniscus* has been heavily exploited in this area, bonobos occasionally pass through the Mabali Research Station. Mabali is headquarters for several Zairian primatologists who, if properly equipped, might be able to track these individuals over a larger area. The availability of local expertise in an area where bonobos are threatened on so many fronts should be cultivated not only to protect the remnant population of Lac Tumba but also to develop conservation education campaigns to deter exploitation of the species elsewhere.

Table 10. Lac Tumba

Summary of Relative Data Used for Priority Ratings for Urgent Research/Monitor

Environ. Conditions	Threat	Primate Species Richness	Popula-tion Size	Unique-ness	Qualified Candidates
relatively good within Mabali Reserve but high human density in area	highly threatened by hunting and loss of habitat	8	<10 likely transient	isolated from other populations	Centre de Recherche en Sciences Naturelles

4. Mimia

This is a new site where bonobos have been directly confirmed (See Fig.1). Any short-term research that will expand our knowledge of these unassessed areas deserves support. Primary goals should be to affirm the presence or absence of bonobos in little known areas of their potential range, to estimate local population densities and degree of isolation from other populations, to describe the available habitat and quantify habitat use by the study population, and to provide further insight into intraspecific variation in this species.

Table 11. Mimia

Summary of Relative Data Used for Priority Ratings for Urgent Research/Monitor

Environ. Conditions	Threat	Primate Species Richness	Popula-tion Size	Unique-ness	Qualified Candidates
assumed good	assumed moderate	8 including C. galeritus chryso-gaster, C. nictitans, M. talapoin	unknown	previously unknown population	?

Long-term Research/Monitor Projects

Both the Wamba and the Lomako Forest study populations contain significant numbers of bonobos which have the possibility of being self-sustaining populations. Until further legal protection can be obtained for these populations, continuation of the long-term research that has proceeded intermittently since the mid-1970's is imperative. While reserves are further developed, research pertinent to conservation and management of these and other populations of *Pan paniscus* (e.g., censusing, demographic studies, documentation of community range and overlap with other communities, habitat preference, feeding ecology, and genetic studies) should be encouraged. Continuous researcher presence is strongly recommended in these sites.

Although research has only recently begun in Yasa, the very unusual habitat demands intensive and longer-term study. Further, bonobos in the area are described as abundant by local missionaries. As more information becomes available to confirm population size, habitat quality and level of threat, Yasa might then be considered for development as a reserve.

Since these projects are discussed at length under Site Reports, the data pertinent to prioritizing these study sites for Long-term Research activities is summarized in tabular form below.

Recommended Actions

Table 12. Wamba

Summary of Relative Data Used for Priority Ratings for Long-term Research/Monitor Projects

Top Priority Wildlife	Environ.- Conditions	Primate Species Diversity	Popu- lation Size	Tourism	Gov't Attitude
absent ?	good but heavy human disturbance	12 including C. salonga but in low density	300-400	relatively difficult access, good campsite	positive

Table 13. Lomako Forest

Summary of Relative Data Used for Priority Ratings for Long-term Research/Monitor Projects

Top Priority Wildlife	Environ. Conditions	Primate Species Diversity	Popu- lation Size	Tourism	Gov't. Attitude
elephant in low density	very good, largely undisturbed	8, high density	> 100	difficult access, good campsites	positive

Table 14. Yasa

Summary of Relative Data Used for Priority Ratings for Long-term Research/Monitor Projects

Top Priority Wildlife	Environ. Conditions	Primate Species Diversity	Popu- lation Size	Tourism	Gov't. Attitude
elephant	good	7-8	unknown	unevaluated	positive

Reserve Development

In all cases, legal protection must be implemented in consultation and collaboration with the inhabitants of villages surrounding the reserves. Conservation and local

community development should be integrated. Ecotourism might offer a potential financial incentive for the local populace to conserve natural environments, but within the interior of Zaire, development of such enterprises will require extensive funding for improvement of infrastructure (landing strips, roads, bridges, communication facilities, lodging) to accommodate short-term visitors. Because the impact of ecotourism on great ape populations is largely undocumented, research to assess potential ecological effects should coincide with ecotourism development.

1. Scientific Reserve of the Luo (Level IV. Habitat and Wildlife Management Area)

At present, 150 km^2 surrounding the Wamba study site are protected as a scientific reserve with government approval on the local level (Tshuapa subregion). Approval is still pending at the regional and national level. Within this reserve, no hunting of primates or clearing of the forest is permitted. The reserve is to be administered jointly through the Centre de Recherche en Sciences Naturelles (CRSN) and the research team from Kyoto University, Japan.

Proposals have been made to extend protection and management to a much larger area (6000 km^2), encompassing forest on both sides of the Luo River under the aegis of the Bonobo Protection Committee (see Fig. 3). Under this plan, two protection centers will be constructed in Wamba and Ilongo. These centers will serve as bases of operations and training centers for rangers. Under the proposal, ten rangers will be employed and work cooperatively with members from the Bonobo Protection Committee and the CRSN. Rangers will patrol the 6000 km^2, as well as participate in public relations/conservation education and survey work. To enhance conservation efforts among the local people, a Protection Cooperation Council made

Table 15. Scientific Reserve of the Luo

Summary of Relative Data Used for Priority Ratings for Reserve Development

Top Priority Wildlife	Environ. Conditions	Threat	Primate Species Diversity	Popu-lation Size	Tourism	Gov't. Attitude
absent	good but includes permanent human settlements	highly threatened	12	6000	relatively difficult access, good campsite	positive on the regional level

up of the village leaders from the ~50 villages in the region will be formed to help enforce the taboo against hunting. In 1991, a budget of $185,000 was estimated for the construction of the centers, the purchase of a vehicle for each center and a boat with outboard motor. This figure also includes funding for public relations and education. Management and maintenance of the two stations was estimated at $60,100 annually.

Beyond these measures for immediate protection, the Bonobo Protection Committee also proposes a six month survey of distribution and habitat conditions in the eastern part of Equateur. Over the long-term, this committee stresses the need for further study of sustainable utilization of tropical rainforests, development of the local economy and strengthened enforcement of forest protection policies in Zaire.

2. Bonobos of Lomako Reserve (Level I. Strict Nature Reserve/Wilderness Area)

Following completion of SIFORZAL'S lumbering operations in the western sector of Concession 4, a proposal was submitted in 1990 to the Institute Zairois pour la Conservation de la Nature (IZCN) by Worldwide Fund for Nature to protect 3800 km^2 of forest bounded by the Lomako and Yekokora Rivers and their affluents (see Figure 5). This proposal was being considered by the Ministry in 1991 but has not been approved to date. Should the Reserve receive national level approval, the IZCN would accept responsibility for prohibiting "hunting and fishing; industrial, commercial, agricultural, pastoral, or lumbering activity; the execution of public or private works; the extraction of concessible or nonconcessible material; the use of water; public access by whatever means; all action capable of harming the natural development of the fauna and flora and more generally of altering the features of the area. The IZCN is authorized to levy certain of the above-enumerated prohibitions for the benefit of persons designated and under the conditions that it determines," (Translation of Proposed Edict).

Although the Reserve would be administered by the IZCN, the study area would continue to operate in conjunction with the Centre de Recherche en Sciences Naturelles, assuring the continuance of long-term biological research. The IZCN and the CRSN agree that cooperation between these agencies is complementary to overall conservation efforts.

Success of the Reserve is dependent on both top-down and bottom-up strategies. On the local level, consultation with the surrounding communities is necessary to design a site-specific management plan and integrate conservation efforts with local needs as expressed by the people most affected by changes in forest management.

Table 16. Bonobos of the Lomako Reserve

Summary of Relative Data Used for Priority Ratings for Reserve Development

Top Priority Wildlife	Environ. Conditions	Threat	Primate Species Diversity	Population Size	Tourism	Gov't. Attitude
elephant	very good, no permanent legal settlements	moderately threatened	8 high density	unk. but est. > 500	difficult access, good camp site	positive national level

A prospectus for an ecotourism venture within the Lomako Reserve has been proposed by Zaire River Tours. The company proposes to bring small groups (maximum six) of tourists into the Lomako Reserve for wildlife viewing (particularly bonobos and elephant) on a weekly basis.

The infrastructure for the venture would consist of an office in Kinshasa, a support station in Ekafera, a main lodge along the headwaters of the Lomomo River, and up to 10 shelter camps, blinds and canopy platforms. A naturalist would be permanently stationed at the main lodge and be responsible for habituating a population of bonobos. Groups of trackers will be employed to monitor the movements of the habituated bonobo group, as well as monitor the blinds and canopy stations for the presence of bonobos and other wildlife. Additionally, the project proposes to hire patrols who will be stationed along the periphery of the reserve to discourage hunting in the area. In total, Zaire River Tours proposes to employ 60 local villagers. Extreme care must be taken in hiring these workers so that jobs are distributed equitably among the villages surrounding the reserve and that human population pressure within the Reserve and in the peripheral zone is not increased by hiring practices. The ecotourism project would also provide further infrastructure for research and conservation in the Lomako Forest.

(Level II. National Park)

Salonga's importance to bonobo conservation remains dependent on surveys to confirm the status of *Pan paniscus* within the Park. Although already protected on paper, if Salonga is to provide a sanctuary for bonobos, funding to the IZCN will be necessary to improve Park infrastructure. At present, wildlife poaching, illegal timber cutting and plant collection, as well as edge effects stemming from expansion of the human population living along the boundaries are difficult to control due to insufficient personnel to control this huge area.

Table 17. Salonga National Park

Summary of Relative Data Used for Priority Ratings for Reserve Development

Top Priority Wildlife	Environ. Conditions	Threat	Primate Species Diversity	Popu-lation Size	Tourism	Gov't. Attitude
elephant	very good	moderately threatened	6	unk.	difficult access, good camping sites	positive

Education and Conservation Awareness Programs

Kinshasa

Illegal Trade

The capital of Zaire is the hub for trade in living bonobos. Results of a market study made prior to 1992 suggested that trade in the capital was relatively unorganized and unprofitable: casual buyers purchased bonobos in the interior and transported them to the capital, believing they would make a large profit. For the most part, these one-time traders were unaware of the fragility of the species and many animals perished during transport.

Potential purchasers actually living in Kinshasa are few. Infant bonobos are often available for sale in the downtown market. Some of these are purchased by persons, most often expatriates, who feel sorry for the dying infant and want to save it from death. This "pity buying" had at one time created a substantial market. As the wealthy expatriate population has dwindled, "pity buying" is much less of a force in

death. This "pity buying" had at one time created a substantial market. As the wealthy expatriate population has dwindled, "pity buying" is much less of a force in creating a market for infant bonobos. During 1994, however, local conservationists note that blatant animal trade has markedly increased as judged by the rapid turnover of parrots and *Pan* in the downtown animal market. Although unconfirmed at this time, these informants suspect that animals are being purchased for illegal export.

The majority of Zairians, both in the capital and in the interior, are unaware that *Pan paniscus* is protected under national and international law and that trade in the species is illegal. There is also little sense of identification with the bonobo as a national symbol, especially relative to the okapi which has high recognition value (e.g., Okapi cigarettes, Hotel Okapi) as an emblem of the country's unique wild heritage. An educational campaign using social marketing methods (i.e. employing television and radio, street theater, popular music) to reach a broad but relatively unsophisticated audience has a good chance of making Zairians aware of the species and the critical role they play in assuring its survival in the wild.

Zoo Exhibits and Social Marketing

A zoological society has been formed in Kinshasa to familiarize the Kinoise with the fauna of their country and to promote conservation in Zaire. A plan for a bonobo exhibit at the Kinshasa Zoo was studied but has not been implemented. Delfi Messinger, who has played a key role in the formation of the Society, has also developed conservation education material with a local artist in the form of comic books geared toward Zairian sensibilities. One such pamphlet, financed by the Wildlife Conservation Society, has already been distributed in Eastern Zaire in conjunction with survey work on gorillas and elephants. Messinger (pers. comm.) anticipates that a subsidized version of these comics can be sold through zoos and other sponsors of conservation activities and the income generated fed back into projects. These and other educational pamphlets can also be distributed through regular market channels to spread awareness. One social marketing tool that has been successful in Zaire in the past is the "tombola", a drawing in which completed answers to quizzes in the back of pamphlets are submitted to win prizes such as t-shirts. It should be noted that such social marketing techniques were very successful while Project SIDA (the francophone acronym for AIDS) was active in Zaire.

Government Programs

Joint projects between the Ministry of Education and a conservation NGO in conjunction with the IZCN and the CRSN are necessary to develop a national conservation education curriculum and teacher training program. Although targeted to a specialized audience, one such USAID/Biodiversity Support Group project is

currently active in Zaire and other regions of Africa. PARCS (Protected Area Conservation Strategy) is currently being implemented in Zaire by the Wildlife Conservation Society in coordination with the IZCN (Lanjouw 1993). The PARCS project is designed to facilitate the process of developing and implementing training programs for protected area managers. One outcome of the needs assessment during Phase I in Zaire was interest and enthusiasm for the development of in-service training programs. These programs would be designed to educate a broad base of conservation professionals in a relatively inexpensive manner. Materials and methods developed for in-service training might later be adapted to reach a broader audience.

Despite the chaos of the 1990's in Zaire, progress in protecting wildlife has been made. In 1992 the Okapi Wildlife Reserve (1,372,625 hectares) was gazetted in the Ituri Forest of Eastern Zaire. A training center (CEFRECOF) for biological and socioeconomic monitoring has also been constructed in Epulu which offers unparalleled opportunities for training in tropical rainforest. With such training available at home, the pool of qualified Zairian researchers will grow much larger and greatly facilitate the work of identifying and protecting viable populations of *Pan paniscus.*

Projects in the Interior

Conservation outreach within the Central Basin is more problematic than in the capital due to the logistical difficulties of traveling and distributing educational materials in the interior. It remains imperative, however, to reach the local people in areas where bonobos survive in the wild.

Conservation Outreach Linked to Research

For maximum efficiency, material should be furnished to researchers to distribute in villages and cities close to their research sites. T-shirts furnished by WWF, the Zoological Society of Milwaukee County, and The Bonobo Protection Society with illustrations of bonobos and a conservation message have already been distributed on a limited basis in Kinshasa and in the areas of Wamba, the Lomako Forest and Yasa. An inexpensive school notebook containing conservation messages is also being produced and distributed in Zaire (Messinger pers. comm.). The notebooks should be disseminated through school districts in areas where bonobos occur in the wild, as well as through the regular markets. Reading and writing material is generally scarce in the interior. School notebooks are shared with the family and thus conservation sensitization can be extended to both an immature and mature audience. Another highly prized and frequently traded commodity is soap. Soap conveying a conservation message is employed as a conservation technique at Yasa. Engaging

local people in conservation awareness through use of their own folklore is an approach that might be particularly effective where people cannot read. A number of Mongo folktales about bonobos are available in G. Hulstaert's Mongo history.

Educational programs are also being developed for local elementary and secondary schools in the villages surrounding the long-term research/conservation projects. These would also include teacher training for follow-up work.

Professional Development for Zairian Colleagues

The four major projects sponsored by the CRSN (Wamba, Lomako, Lilungu, Yasa) have all benefitted from working with Zairian primatologists. Field methods courses at the CRSN headquarters in Bukavu will be made available to CRSN personnel and applied studies then undertaken at the various field sites. Funding would underwrite course development and implementation in addition to providing current literature, equipment and logistical support to facilitate cooperation between the CRSN and the research projects. CRSN personnel would also benefit from training at CEFRECOF.

Riverboat Program

Riverboats are the basic infrastructure linking the capital to cities and villages in the interior. Vendors who live and ply their trade on these boats are a major connection in the commercial trade in bonobos and other protected species. Since the captains of these riverboats are the ultimate authority on what is transported on their vessels, they should be specifically targeted for education and cooperative effort to stop the trade in endangered species. Riverboats can also play an important role in the distribution system for conservation education material upcountry.

Wildlife Films

As the bonobo has received more publicity, professional filmmakers are eager for footage of this rare great ape under natural conditions. As a condition of working in any established research site or for working incountry, these companies could be required to pay a "conservation tax" to feed back into protecting the wild population. Secondly, copies of any resulting films should be made available (and dubbed in Lingala and/or French) to be shown on local television and in conservation outreach programs.

Recommendations for Methods

The foregoing text documents and prioritizes a number of actions that have been suggested to achieve bonobo conservation objectives. Unfortunately, they come at a time when many in-situ research and conservation programs have been suspended. Action can be taken, however, that will facilitate our long-term efforts even during the hiatus of activity in Zaire.

Although a great deal of information has been compiled for this document, the quality of certain types of data must be improved and standardized if we are to use them to conserve the bonobo. Different standards among sites in estimating population size and range and describing habitat quality make it difficult to compare ecological data and make inferences about the metapopulation. Field researchers, conservation biologists and managers must work more closely, coordinate efforts, and collect standardized baseline data on densities and distributions of extant populations. Such an accord is critically important before any major surveys are undertaken. Even while political conditions in Zaire remain unstable, small-scale surveys are feasible within existing study areas to pretest methods, calculate time necessary to cover a given area, determine personnel, obtain baseline data and establish a range of variation. Such small-scale and relatively inexpensive projects will be valuable in developing budgets and timetables for larger efforts. Large-scale surveys are essential to assess the present conservation status of *Pan paniscus* throughout its range. The information presented in this report strongly implies that the species is in trouble. Efforts to conserve bonobos can only be strengthened by solid objective data.

Demography and life history variables play an important role in assuring the preservation of the species through informed management practices. Collection of these data require long-term commitment as such information is very difficult to collect under field conditions in Zaire. The study populations of Wamba are invaluable in this regard, and all efforts must be made to further protect them. Those life history variables which best reflect demographic parameters and population dynamics must be identified in consultation with conservation biologists.

The following questions stand out: what ecological and social factors limit bonobo distribution? The presence of bonobos in savanna/woodland suggests that the species is more flexible in its requirements than previously thought. Since research in this habitat is so recent, the stability of the Yasa bonobo population has not been fully assessed. The Yasa population may have been historically present at the margin of the species' range, or it may have been driven into marginal habitat by such factors as habitat loss or human predation. Research should be directed toward defining optimal or minimally acceptable habitat for the species and toward developing

methods for large-scale identification of such habitat via satellite and aerial photography. Field researchers can supply vital ground-truth data for interpreting satellite imagery. It should be emphasized that Zaire represents a critical area in the preservation of rain forests and tropical ecology. Interdisciplinary collaboration in this realm would be invaluable. Information about areas where bonobos are absent is as important as knowing where they are present. Further studies on bonobo/human interactions are needed in order to develop education initiatives which foster positive human attitudes toward preserving bonobos in their natural habitat. Given the dire economic conditions in Zaire, collaboration with cultural anthropologists and community development specialists will help identify plausible incentives for rain forest conservation.

In time, more precise data on community ranges will be essential as we begin to establish reserves for remaining populations. Radio telemetry is proving increasingly successful in heavily forested areas and could be very useful in the collection of these data. Reserves need to be sufficiently large to sustain several populations, permit gene flow and population growth and stabilization. Adequate reserve size can only be determined by accurate measures of ranging behavior and intercommunity interactions.

Although a loose network exists between established field workers, there is a need to integrate the expertise and skills of conservation biologists and forest resource experts. Far broader institutional support is required to expand networks and provide infrastructure for bonobo conservation and research efforts. Zoos represent one potential source of support. They can provide financial assistance, expertise in conservation outreach and education, and resources for ecotourism. However, zoos can be but only part of the solution to the daunting issues facing the Zairians, the bonobo and the conservation community in Zaire.

Our mission is now more clearly defined, but much work remains to be done. The information contained herein should both raise a flag of warning and spur wider interest in assuring the survival of this fascinating great ape. A new agenda for research and conservation within Zaire must be formulated, funded and initiated.

SUMMARY OF PRIORITY RATINGS

Numerical results of the priority ratings for Surveys, Urgent Research/Monitors, Long-term Research/Monitor and Reserve Development projects are presented in Tables 16 through 19 which follow.

Table 18. Priority Ratings for Suggested Survey Sites

Site	Imminence of Threat to Bonobos	Confirmation of Bonobo Distribution	Overall Primate Species Richness	Estimated Bonobo Population Size	Size of Area to be Surveyed	Availability of Qualified Candidates	Level of Biodiversity	Total Score
South of Lukenie	3	1	3	3	3	+#	2	15+#
Between Tshuapa and Lomela	2	3	3	3	3	-	1	15-
Salonga National Park	2	1	3	3	3	+#?	2	14+#
Between Lulonga and Ikelemba	2	2	3	3	3	+	1	14+
Between Lomami and Lualaba	1	1	3	3	3	+	2	13+
Between Lopori and Lomami	2	1	3	3	3	-	1	13-
Lac Mai Ndombe	2	1	3	3	3	-	1	13-
Lomako Forest	1	1	2	3	3	+#	2	12+#

Table 19. Priority Ratings for Urgent Research/Monitor Projects

Site	General Environmental Conditions	Imminence of Threat to Bonobos	Overall Primate Species Richness	Estimated Bonobo Population Size	Geographic or Ecological Uniqueness	Availability of Qualified Candidates	Total Score
Yalosidi	2	3	2	3	3	+	13+
Lac Tumba	2	3	2	3	2	+	12+
Mimia	3	2	2	2	2	-	11-
Lilungu	1	2	2	3	2	+	10+

Table 20. Priority Ratings for Long-term Research/Monitor Projects

Site	Other Top-Priority Wildlife	General Environmental Conditions	Overall Primate Species Richness	Estimated Bonobo Population Size	Tourism Potential	Attitude of Government to Tourism	Total Score
Lomako	1	3	2	2	1	1	10+
Wamba	0	2	3	2	1	1	9+
Yasa	0	2	3	2	1	1	7+

Table 21. Priority Ratings for Reserve Development Projects

Site	Other Top-Priority Wildlife	General Environmental Conditions	Imminence of Threat to Bonobos	Overall Primate Species Richness	Estimated Bonobo Population Size	Tourism Potential	Attitude of Government to Tourism	Total Score
Scientific Reserve of the Luo	0	2	3	3	3	1	1	13
Lomako Reserve	1	3	2	2	3	1	1	13
Salonga National Park	1	3	2	2	2	1	1	12

Population Viability Analysis

POPULATION VIABILITY ANALYSIS

We used *Vortex*, a computer simulation program (Lacy and Kreeger 1992), to predict the effect of a variety of factors on the long-term (200 years) viability of *Pan paniscus*. Tables summarizing the results of the analysis and an explanation of the assumptions involved are presented in Appendix I. We ran a number of simulations experimenting with varying levels of the following parameters: unit group size, hunting pressure, number of unit groups, carrying capacity, infant mortality, the presence or absence of catastrophes and initial population size. Parameter levels were set based on available data from field workers and then varied to examine the effect of extreme situations and/or if data from captive studies (e.g., infant mortality) suggested that estimates from field data were low.

A few important results are summarized here. Based on recent data from Wamba, current levels of hunting pressure (5% of adults) can barely be sustained by isolated communities (a single Unit Group with no migration) even if there are no further losses due to catastrophe (habitat loss or crop failure), or even if the population has 300 animals. Under such circumstances, population size begins to decline or mean growth rate nears zero, and there is loss of genetic variation. Since, in the long run, catastrophes are likely to occur, this is clearly not sustainable. As modelled here, all populations suffer to some extent (lower growth rates and/or loss of some genetic diversity). Even if hunting levels are low (i.e., 3%), no population can sustain hunting pressure indefinitely (>200 years), especially if catastrophe is included.

Data collected at Wamba (Kano pers. comm.) suggested that infant mortality there was about 9%. We increased infant mortality (to 15 and 20%) based on data from captive populations, assuming that the captive situation increases the chance for infant survival and that loss of infants is a more cryptic event in the field. These increased rates of infant mortality raised sensitivity to harmful factors in the model; i.e., it made populations more vulnerable to hunting pressure, catastrophes and the effects of initial population size. For example, single populations modeled with 15-20% levels of infant mortality suffered a lowered growth rate (and ability to rebound from any disturbance) and were unable to withstand hunting pressure as well as populations where loss of infants was lower.

With multiple unit groups and migration between them, the population is somewhat more robust. However, the number of unit groups has to be greater than two (perhaps as many as 5) to improve resistance to the negative effects of hunting and catastrophe for an extended period of time. This suggests that it is critical for a healthy reserve to include numerous unit groups with safe corridors for migration between them or

an area large enough to accommodate multiple subunits. An isolated population, no matter how large, will not survive in the long run. Recent declines in the stability and infrastructure of Zaire will likely increase pressure from hunting on remaining ecosystems–making the situation increasingly critical.

The simulations showed that the number of alleles (NA) in a population is more sensitive to negative forces than are levels of heterozygosity. That is, NA decreases markedly while heterozygosity remains at higher levels. Thus, future management plans might be advised to use allelic diversity as an indicator of genetic health.

Most of the levels at which parameters were fixed in this simulation were based on small sample sizes. Thus, while it seems clear that areas should contain multiple populations and adequate territory (food resources, etc.), accurate estimates of these parameters are needed to establish realistic and successful reserves. Some key parameters necessary to improve future management efforts include:

1. Home range size for unit groups to be able to assess minimum area required by metapopulation.

2. Mean Unit Group size.

3. Identification of areas that contain multiple communities with migration corridors and/or those that could sustain larger numbers of animals.

APPENDIX I: RESULTS FROM PVA ANALYSIS ON *Pan paniscus*

Assumptions and parameter levels:

1. When there is more than one subpopulation (making up one metapopulation), there is migration between the subpopulations and only adolescent females from ages 6 to 13 years migrate. The rate of migration is set at .017, based on long-term census data from Wamba and is assumed to be the same between all subpopulations.

2. Hunting pressure varies from 0% to 7% . Recent reports from Wamba suggest that 5% of adults among known animals disappeared for no apparent reason, or are known to have been killed. This pressure appears to be equal on males and females, which we take to mean that hunting is for meat and not for the sale of young. When a test run was done on a single population (no subpopulations), hunting pressure (adult mortality) of 5% resulted in an insignificant decrease in population size, but a growth rate of about 0. Thus, we assumed that this was the limit of tolerance for a population with no other outside pressures such as habitat destruction or major food crop failures.

3. K is the carrying capacity. It is generally set at 60 (for each subpopulation) since that is the average unit group size so far reported. Above K, the program increases mortality rates until K is reached. The effect of doubling K is examined in a few simulations.

4. Catastrophe. This is modeled as half of the population being wiped out, the event taking place at a random interval once every hundred years. All age/sex classes are vulnerable. This event is intended to simulate major food shortages, habitat destruction or an epidemic. Since nothing like this has been recorded in either the Lomako or Wamba since 1976, we assumed that the frequency of such catastrophes is low and arbitrarily chose the one hundred year interval.

5. Mortality rates. Long-term census data from Wamba show an infant mortality rate of 9%. We raised this to 15% and 20% in some cases since data on captive animals and other wild populations suggests that 9% may be an underestimate. For individuals older than one year, we used 1.25% since there were 5 deaths in 406 animal-years for all animals above one year and there was insufficient data to calculate mortality for each age/sex class individually. Thus, we assumed that the mortality rate for adults was evenly spread out over all age-sex classes. This parameter was set higher than 1.25 to simulate hunting pressure on adult animals and a higher death rate is imposed on all classes to simulate catastrophe.

6. We made the assumption that wild bonobos are panmictic, that any male can mate with any female and vice versa.

7. All of the data in the tables below are means based on 50 runs, each lasting 200 years. The figures in the tables are means for the entire 200 years. Results for smaller intervals of time are available on request.

8. Genetic structure and inbreeding. In Vortex (Heterosis option), heterozygotes are accorded greater viability than homozygotes. The relatedness of each individual to all others is tracked and the degree of inbreeding for each mating is calculated. Inbreeding (producing higher frequencies of homozygosity) is disadvantageous resulting in lower viability (survival). (See *Vortex* manual for details).

9. Explanations of column headings:

IM = Infant Mortality Rate

IPS = Initial Population Size

K = Carrying capacity for each unit group

HP = Hunting Pressure, as a % of the adult population

C = Catastrophe, yes/no

PE = Probability of Extinction

FS = Final Population Size

OH = Observed Heterozygosity

NA = Number of alleles left in the population

MGR = Mean Growth Rate

MTE = Mean Time to Extinction

META = Number of Unit Groups (subpopulations) in the metapopulation

MTFE = Mean Time to first extinction

Table 22. Single Populations

A. Average Single Population

1. Without Catastrophe/ HP = 3%

I M	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
9	60	60	3	N	0	54.9	0.89	13	0.011	-
15	60	60	3	N	0	53.9	0.9	13.3	0.009	-
20	60	60	3	N	0	47.8	0.9	12.6	0.005	-
15	20	60	3	N	0.06	41.6	0.84	8.89	0.005	121
15	30	60	3	N	0	50.7	0.86	11.1	0.007	-

2. With Catastrophe/ HP = 3%

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
15	60	60	3	Y	0.20	36.2	0.87	9.88	.0005	122.9
15	30	60	3	Y	0.22	34.5	0.83	8.49	-.0012	130.6
20	60	60	3	Y	0.16	31.4	0.88	9.19	-.0020	130.6

3. Without Catastrophe/ HP = 5%

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
9	60	60	5	N	0.00	37.9	0.87	10.36	.0017	-
15	60	60	5	N	0.00	27.3	0.89	8.96	-.022	-
20	60	60	5	N	0.12	29.5	0.86	9.14	-.0039	161

4. With Catastrophe/ HP = 5%

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
15	60	60	5	Y	0.42	21.7	0.83	6.83	-.0097	156.8
20	60	60	5	Y	0.52	19.9	0.87	7.71	-.0124	150.1
15	60	120	5	Y	0.44	38.0	0.91	11.43	-.0130	144.1
20	60	120	5	Y	0.50	23.4	0.83	8.64	-.0141	187.0

5. Without Catastrophe/ HP = 7%

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
9	60	60	7	N	0.40	15.4	0.79	5.73	-.0107	165.0
15	60	60	7	N	0.46	12.6	0.79	5.67	-.0131	163.6
20	60	60	7	N	0.78	8.4	0.75	4.27	-.0183	147.5

6. With Catastrophe/ HP = 7%

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
20	60	60	7	Y	0.96	5.5	0.92	4.00	-.0272	118.2
20	60	120	7	Y	0.96	3.5	0.83	3.50	-.0257	127.5
15	60	120	7	Y	0.80	9.6	0.85	5.40	-.0221	138.0

7. Diminished K

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
15	60	20	3	N	0.42	10.6	0.66	3.52	-.0009	144.0
15	60	20	5	N	0.88	7.7	0.82	3.00	-.0136	117.3
15	60	20	7	N	1.00	0.0	0.00	0.00	-.0209	91.6

8. Larger K

IM	IPS	K	HP	C	PE	FS	OH	NA	MGR	MTE
15	60	120	3	N	0.00	114.6	0.94	23.66	.0102	-
15	60	120	5	N	0.04	70.7	0.91	15.63	-.0001	173.0
15	60	120	7	N	0.60	14.5	0.80	6.35	-.0143	165.0
20	60	120	3	N	0.00	110.1	0.94	23.02	.0068	-
20	60	120	5	N	0.02	45.9	0.89	12.27	-.0029	144.0
20	60	120	7	N	0.56	10.6	0.84	5.64	-.0162	146.5

Table 23. Multiple Populations [K = 60/ pop. ; IPS = 60]

META	HP	C	IM	PE	FS	OH	NA	MGR	MTFE
2	3	N	9	0.00	108	0.94	26.58	.0177	-
2	3	N	20	0.00	101	0.93	25.48	.0067	-
2	3	Y	9	0.03	78	0.91	19.50	.0050	-
2	3	Y	20	0.06	56	0.89	15.87	-.0022	150
2	5	N	9	0.00	80	0.92	21.28	.0027	-
2	5	N	20	0.02	54	0.89	17.37	-.0025	145
2	5	Y	9	0.27	44	0.89	13.00	-.0073	165
2	5	Y	20	0.42	20	0.84	9.10	-.0146	155
2	7	N	9	0.07	31	0.86	11.45	-.0077	191
2	7	N	20	0.58	11	0.86	6.52	-.0183	170
2	7	Y	9	0.65	13	0.78	6.40	-.0163	158
2	7	Y	20	0.92	10	0.91	4.75	-.0260	150
5	3	N	9	0.00	280	0.97	64.20	.0131	-
5	3	N	20	0.00	267	0.97	64.14	.0083	-
5	3	Y	9	0.00	232	0.96	52.98	.0083	-
5	3	Y	20	0.00	195	0.96	48.84	.0031	-

Table 23. (continued)

META	HP	C	IM	PE	FS	OH	NA	MGR	MTFE
5	5	N	9	0.00	242	0.96	55.36	.0046	-
5	5	N	20	0.00	173	0.95	46.68	-.0005	-
5	5	Y	9	0.00	126	0.94	38.18	-.0020	-
5	5	Y	20	0.00	51	0.91	20.32	-.0089	-
5	7	N	9	0.00	115	0.94	33.64	-.0041	-
5	7	N	20	0.10	35	0.90	16.47	-.0128	190
5	7	Y	9	0.20	29	0.84	12.95	-.0153	184
5	7	Y	20	0.66	7	0.82	5.82	-.0255	180

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