
白鱀豚
Baiji
Population
& Habitat Viability Assessment

白鱀豚
BAIJI

(*Lipotes vexillifer*)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Report

17 November 1994

Compiled and Edited by

Zhou Kaiya, Sue Ellis, Stephen Leatherwood, Mike Bruford, and Ulysses Seal

Produced by

Participants of the
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A Collaborative Workshop

Mammalogical Society of China
IUCN/SSC Cetacean Specialist Group
IUCN/SSC Captive Breeding Specialist Group

Sponsored by Sea World, Inc.

Hosted by:
Bureau of Fisheries Management and Fishing
Port Superintendence of China
and
Nanjing Normal University

SPECIES SURVIVAL COMMISSION

A contribution of the IUCN/SSC Conservation Breeding Specialist Group, the IUCN/SSC Cetacean Specialist Group, and the Mammalogical Society of China.

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Speedwell Bird Sanctuary

1 November 1994

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BAIJI

(*Lipotes vexillifer*)

POPULATION AND HABITAT VIABILITY ASSESSMENT

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OPENING TALKS

欢 迎 词

屠国华教授
南京师范大学副校长

女士们、先生们:

白暨豚保护评估研讨会今天开幕了，我代表南京师范大学向出席会议的国际自然保护联盟物种生存委员会饲养下繁殖专家组的主席西尔博士和委员们，鲸类专家组的主席莱瑟伍德先生和委员们，农业部渔政渔港监督管理局刘身利副局长和渔政专家们表示热烈欢迎。向来自美国、日本、英国和香港地区，来自中国科学院水生生物研究所，湖北、安徽、江苏水产局,东海区渔政分局以及铜陵、 天鹅洲和新螺的白暨豚自然保护区和养护场的专家们表示热烈欢迎。

自然生态环境遭到破坏和物种大量灭绝是一个紧迫的世界性问题。为子孙后代保存宝贵的物种资源，是我们这一代人的历史责任。在长江流域经济的高速发展中，白暨豚的数量在急剧减少。现在白暨豚已经是世界上数量最少的海豚之一，为了拯救这一珍稀的淡水豚物种，中国政府已经采取了一系列保护措施，中国科学家和技术人员进行了长期的研究工作。国际自然保护联盟物种生存委员会及其鲸类专家组和饲养下繁殖专家组、世界自然基金会(WWF International)、香港海洋公园、 日本淡水豚研究会白暨基金，江之岛水族馆，鲸和海豚保护学会，世界自然协会，荷兰国际自然保护基金会等许多组织和个人支持或参与了白暨豚的研究和保护工作。今天在这里召开的学术会议是上述努力的继续和发展。这次会议将制定保护白暨豚的策略以及紧急的和长期的保护措施，增进国际学术界与中国科学家和政府官员的工作联系，并制定国际性的资金和技术援助的策略。

这次会议由中国兽类学会、IUCN/SSC 鲸类专家组、IUCN/SSC 饲养下繁殖专家组共同组织，农业部渔政渔港监督管理局和南京师范大学联合主办，美国海洋世界提供了资助，我借此机会向所有这些组织表示衷心感谢。

最后，祝会议圆满成功，祝各位专家身体健康，在南京生活愉快。

谢谢大家。

Welcome address

Professor Tu Guohua
Vice President, Nanjing Normal University
Nanjing 210024, P.R. China

Ladies and Gentlemen,

Good morning. Now I declare the opening of the Baiji Conservation Assessment Workshop. On behalf of Nanjing Normal University, I would like to extend our warm welcome to Dr. Seal, chairman of Captive Breeding Specialist Group and other members from this organization, Mr. Leatherwood, the chairman of Cetacean Specialist Group and other members of CSG, to Mr. Liu Shenli, the Deputy Director of the Bureau of Fisheries Management and Fishing Port Superintendence of the Ministry of Agriculture and other specialists from this bureau, to specialists from the United States, Japan, Britain and Hong Kong region, and to specialists representing the Institute of Hydrobiology of the Chinese Academy of Sciences, the Fisheries Bureau of Hubei, Anhui, and Jiangsu provinces, the Fisheries Management Bureau of East China Sea, and specialists from the baiji reserves in Tongling, Tian'ezhou and Xinluo.

The destruction of natural habitat and extinction of many species are the two major environmental problems around the world. It is the historical responsibility for our generation to protect and preserve the precious species. Along the Yangtze River, a fast economic growth is experienced, but the number of baiji dolphins is decreasing rapidly. Baiji becomes one of the rarest dolphin species. In order to save this precious and rare dolphin species, the Chinese government has adopted a series of strategies and policies to provide protection. Chinese scientists and technicians have long been engaged in the research work. IUCN Species Survival Commission, IUCN/SSC CSG, IUCN/SSC CBSG, WWF International, Ocean Park in Hong Kong, Baiji Conservation Fund of Platanistoids Research Association of Japan, Enosima Aquarium, Whale and Dolphin Conservation Society, World Nature Association, Netherlands Foundation for International Nature Preservation, and many other organizations and individuals have supported and involved in the research and conservation of the baiji. The workshop held today is a continued effort in which both long term and short term conservation strategies and policies will be decided upon. It is also the attempt of this workshop to bring international experts to work together with the Chinese specialists and government officials and discuss the policies of international funding and technical support in baiji conservation.

This workshop is organized by the Mammalogical Society of China, CSG and CBSG of IUCN/SSC. The workshop is under the auspices of the Bureau of Fisheries Management and Fishing Port Superintendence of the Ministry of Agriculture and Nanjing Normal University. The sponsor of the workshop is the Sea World, Inc. I would like to express my appreciation to the afore-mentioned organizations.

Now I look forward to a successful completion of the workshop and wish all of you have a pleasant stay in Nanjing.

Thank you all.

欢 迎 词

刘身利
农业部渔政渔港监督管理局副局长

尊敬的各位代表,各位朋友:

白暨豚保护评估研讨会今天在这里召开了.首先,我代表农业部渔政渔港监督管理局,对这次会议的召开表示祝贺,并对出席这次会议的中外专家、代表和朋友们表示热烈的欢迎!

白暨豚是中国特有的珍稀水生哺乳动物,素有"水中大熊猫"之称,它分布在我国的长江中下游江段,具有极高的学术研究价值,历来视为中国的国宝。但长期以来,随着长江中下游地区社会经济的发展及自然环境的变迁,白暨豚栖息环境受多种因素影响,致使白暨豚种群数量逐年减少。据我国有关专家调查,长江白暨豚现存数量已不足２００头。 我国政府已将其列为国家一级重点保护野生动物。有关的一些国际组织也将白暨豚列为世界最濒危的物种之一。

我国政府对白暨豚的保护工作一直很重视,近两年,国务院曾多次开会专门研究白暨豚的保护工作,１９９２年１０月,国务院还批准在湖北省建立两处国家级自然保护区。目前,这两处保护区已由国家有关主管部门和地方政府共同投资兴建。近十多年来,我国有关专家、学者在白暨豚研究和保护方面做了大量的工作,取得了很大的成就,为我们主管部门制订白暨豚保护规划,提供了科学依据。

白暨豚属于珍贵、濒危的物种,为了更有效地保护好白暨豚,我们需要国际间的合作与支持。这次会议的召开,为中外专家、学者进行学术交流提供了一次机会。我们作为国家水生野生动物主管部门,希望通过这次交流,能够为我国今后白暨豚的保护管理工作提出一些好的建议。我们欢迎中外专家、学者今后更广泛地开展交流和合作,促进我国白暨豚研究保护工作的开展。同时,我们还原意进一步加强同有关国际组织、各国政府和民间团体在白暨豚及其它水生动物保护方面的联系,通过共同努力,达到保护好白暨豚的目的,共同为人类进步做出有益贡献。

最后,预祝这次会议取得圆满成功!

谢谢!

Opening Adress

Liu Shenli
Deputy Director
Bureau of Fisheries Management and Fishing Port Superintendence,
Ministry of Agriculture, Beijing 100026, P.R. China

Representatives and Friends,

On behalf of the Bureau of Fisheries Management and Fishing Port Superintendence of the Ministry of Agriculture, I would like to take this opportunity to extend our congratulation to the Baiji Conservation Assessment Workshop, and my welcome to specialists, representatives and friends present.

Baiji, renowned as the Panda in the waters, is a precious and rare aquatic mammal unique to China. It lives in the middle and lower reaches of the Yangtze River and cherished as a national treasure of high academic research value. Over the years, due to economic development and consequent ecological changes, the habitats for baiji degraded and the number of baiji decreased rapidly. According to specialists, there are less than 200 Baiji left. Baiji is now enlisted as one of the first grade national protected wild animals by the Chinese government and as the most endangered species by some international organizations.

Chinese government has shown concern to the conservation of baiji. The State Council held several conferences to promote research on conserving baiji in the past two years. In October, 1992, the State Council approved the plan to set up two national natural reserves in Hubei Province. Together with the local government departments, the State Council gave financial support to set up these two sites. In the recent ten years, Chinese specialists have achieved a great deal in the research and conservation of baiji, and provided consultation to the relevant government departments in their decision-making for preserving the baiji.

We look forward to international cooperation to effectively protect the precious and endangered species--baiji. This workshop provides the specialists both from China and other countries an opportunity to exchange experiences and ideas. As the government department responsible for baiji conservation, we welcome this type of exchanges and suggestions and proposals for the research and conservation of baiji. We also welcome similar exchanges in a wider scope in the future among the specialists. We are willing to strengthen cooperation with international organizations, governments and non-governmental organizations to work towards conservation of baiji and contribute to human progress.

Now I wish a successful workshop to you. Thank you.

开 幕 词

周开亚
（中国兽类学会代表，国际自然保护联盟物种生存委员会区域委员）

我谨代表中国兽类学会，向国际自然保护联盟物种生存委员会饲养下繁殖专家组和鲸类专家组的同事们以及到会的中外代表表示衷心的欢迎。今天，来自中国的和飞越大洋而来的专家在些集会，为了一个共同的目标，拯救白暨豚。作为鲸类专家组、饲养下繁殖专家组和物种生存委员会成员，我有机会在本次研讨会中和各个国际组织的成员及这么多代表一同工作，深感荣幸。我也为出席本次会议的中国专家们的广泛组成而高兴。代表中国专业队伍的是国家渔政渔港监督管理局刘身利副局长，水生生物研究所刘仁俊副教授以及三个白暨豚保护区、养护场的许多代表。

白暨豚是一个自然遗产物种。它的未来命运对中国和全世界都非常重要。随着中国经济的发展，白暨豚的自然栖息地正继续恶化，我的中国同行和我认为，拯救白暨豚不仅需要我们自己的努力工作，还必须与外国同行携手合作。事实上，从佩林博士的时期开始，我们就一直由于同鲸类专家组的经常的学术和意见交流而获益非浅。这种合作精神在莱瑟伍德的领导下继续保持和发扬。

在国际水生动物医学协会自然保护主席史罗德博士的敦促下，饲养下繁殖专家组、鲸类专家组和中国动物学会兽类学分会在过去一年中为准备这次会议多次交换了意见。在研讨会召开的今天，我要向为此作出贡献的许多组织和个人表示感谢，要提到的的人很多，我必须持别感谢海洋世界的安德鲁斯博士，他所提供的资助使会议得以召开。我也感谢饲养下繁殖专家组主席西尔博士，他将在未来几天内带着我们使用“旋涡”程序。

这是首次由饲养下繁殖专家组、鲸类专家组和中国兽类学会在保护濒危物种的努力中在中国联合召开正式会议。会议的成功将会促进在中国的自然保护事业的国际合作。我个人对会议的期待有三。首先，充分交流现有知识以形成保护白暨豚的策略以及短期的和长期的行动计划。第二，深入探讨行动计划中提到的每一种方法以保证这些努力获得成功。第三，强烈呼吁对紧迫的保护行动的资助，使我们拟定的计划能立即实施。

感谢各位代表来参加会议，我期待着和你们一同工作，拯救白暨豚。

Opening Remarks: Zhou Kaiya.

Member, Mammalogical Society of China. Member, IUCN Species Survival Commission, IUCN/SSC Cetacean Specialist Group, IUCN/SSC Captive Breeding Specialist Group. Nanjing Normal University, Nanjing 210024, P.R. China

On behalf of the Mammalogical Society of China, a heartfelt welcome to our colleagues from CBSG and CSG, and Chinese and foreign participants. We have a tremendous contingent of experts from China and across the ocean gathered here to save the baiji dolphin. As a member of CSG, CBSG, and IUCN/SSC, I am honored to have the opportunity to work with members of these international organizations and so many participants during the workshop. I am also pleased with the broad spectrum of Chinese experts present at this workshop. Representing Chinese expertise are Mr. Liu Shenli, Deputy Director of the Bureau of Fisheries management & Fishing Port Superintendence, Professor Liu Renjun of the Institute of Hydrobiology, and many staff representatives of three Baiji reserves.

Baiji is regarded as a natural heritage species. The future of the baiji is of paramount importance to China as well as to the world. As China progresses economically, baiji's natural habitat continues to degrade. My Chinese colleagues and I recognize that, to save the baiji requires not only diligence from ourselves, we must form partnerships with many foreign colleagues. In fact, we have benefited from frequent exchanges of ideas with CSG since Dr. Perrin's era. That collaborative spirit continues to thrive under Steve Leatherwood's leadership.

At the urging of Dr. Pete Schroeder, Conservation Chairman of IAAAM (International Association for Aquatic Animal Medicine), CBSG, CSG and MSC spent the past year exchanging ideas to prepare for this workshop. As we begin the workshop today, I want to acknowledge the contribution of many organizations and individuals. Although there are too many people to name individually, I must especially thank Brad Andrews of the Sea World for providing financial support which made the workshop possible. I also thank Dr. Ulie Seal, Chairman of CBSG who will be instrumental in guiding us through the VORTEX process in the coming days.

In China, this is the first official meeting to join CBSG, CSG and MSC in an effort to protect an endangered species. Success of this meeting will further advance international collaboration for conservation efforts in China. My personal expectations are three: First, we exchange current knowledge sufficient to formulate strategies for short- and long-term action plans for baiji conservation. Second, we thoroughly assess the feasibility of each approach mentioned in the action plan to ensure the success of these endeavors. Third, we aggressively address financial needs for urgent conservation actions so that what we formulate may be implemented immediately. Thank you for your participation. I look forward to working to save the baiji.

开 幕 词

斯蒂文·莱瑟伍德
主席，世界自然保护联盟物种生存委员会鲸类专家组
邮政信箱　１０９０号，索拉纳滩，CA　９２０７５　美国

在我今天简要发言的开始，我想首先感谢中国主人在这美丽的城市和校园里给我们的热情款待. 感谢美国海洋世界公司提供给研讨会的资助. 感谢周开亚教授和他的同事们以及IUCN/SSC饲养下繁殖专家组成员们为筹备会议所做的巨大努力。以及所有与会代表在百忙之中安排时间来参加这次重要会议。

我们鲸类专家组的成员，在过去十年中，以各种方式参与了中国为保护白暨豚所做的重大努力。在本次会议上我们很高兴有机会重申我们鲸类专家组对这一复杂工作的支持。

鲸类专家组是由来自３８个国家的７０名成员组成的志愿者的组织。大家为了阻止世界范围内鲸和海豚的物种或群体的灭绝在一起工作。目前我们面临的两个最艰巨的任务就是分布于墨西哥加利福尼亚湾最里面的一种小型的海豚即湾鼠海豚和中国的白暨豚的保护。它们都只见于一个国家的水域内，种群的数量不超过数百头而且令人担忧的是数量还在下降。如果不下决心立即行动，这两个物种很可能在几十年内就要灭绝了。

我高兴地报告大家一个消息，墨西哥政府最近已成立了一个特别工作组，集中力量保护残存的湾鼠海豚。今年6月4日墨西哥总统将宣布在加里福尼亚湾北部建立一个湾鼠海豚保护区。由于这些行动和来自外国的一些感兴趣组织的继续支持，湾鼠海豚通过我们的艰苦努力或许还有生存的机会。

在中国正在进行着类似的工作，由于政府的远见卓识和你们中的许多人的献身和艰苦的工作，我们在近几年了解到了关于白暨豚及其所面临威胁的大量资料。现在已有了国际协议、全国性组织、自然保护区、半自然保护区、饲养池、训练有素的工作人员以及正在酝酿或已在实施的挽救白暨豚以免遭灭绝的详细计划。我们需要所有以上这些行动以及更多的行动来完成这一严峻的任务。

在座各位及世界各地正密切注视着白暨豚保护工作的人们都深深地为白暨豚的生存而忧虑。白暨豚和其它海豚一样，其境况是反映人类在地球水体管理工作中的正确和错误的标志。接下来的四天，我们面临的艰巨任务就是对迄今为止我们集体努力所获得的结果，无论是成功的还是失败的，进行坦诚的讨论。以及利用这些讨论的结果来优化我们的计划和策略并为未来提出具体的建议。这次会议后我们面临的挑战是用新的献身和协作精神努力把这些建议付诸实施。

白暨豚，实际上还有墨西哥的湾鼠海豚、巴基斯坦的印河豚及其它一些还末达如此濒危境地的海豚，它们面临如此巨大的威胁，以至尽管我们做了最大的努力，仍可能将会消失。但不要因为我们没有尽力去挽救这些小型海豚，而使它们灭绝。它们是我们人类所依赖的健康的水域生态系统的关键组成部分。

谢谢。

WORKSHOP ON BAIJI CONSERVATION

Nanjing, China
1-4 JUNE 1993

Stephen Leatherwood, Chairman, IUCN/SSC Cetacean Specialist Group, P. O. Box 1090, Solana Beach, CA 92075 USA

I would like to begin my brief remarks this morning by thanking: our Chinese hosts for the warm hospitality they have shown us in this beautiful city and campus; Sea World, USA, for providing the funding to make this workshop possible; Dr. Zhou Kaiya and his staff and the staff of the IUCN/SSC Captive Breeding Specialist Group for their considerable efforts in making all the arrangements; and all of you for making the time in your busy schedules for these important deliberations.

Those of us associated with the Cetacean Specialist Group have been involved in various ways for over a decade with China's substantial efforts to protect the baiji, and we welcome the opportunity at this meeting to reaffirm our group's commitment to this complex process.

The Cetacean Specialist Group is an all-volunteer coalition of 70 members from 38 different countries working together to help prevent the extirpation of stocks and extinction of species of whales and dolphins worldwide. Our two greatest challenges at present are the vaquita, a small marine porpoise restricted to the upper end of the Gulf of California, Mexico, and China's baiji. Each of these species is found exclusively within the waters of one country, and populations of each are thought to number no more than a few hundred and are feared to be declining rapidly. In both cases, there is growing concern that without prompt and decisive action the species might well become extinct within a few decades.

I am happy to report that the Government of Mexico has recently formed a task force to concentrate on protecting the remaining vaquita and that on the 4th of June this year the President of Mexico will announce the establishment of the northern Gulf of California as a protection area for the vaquita. With these actions and continuing support from interested organizations outside Mexico, the vaquita may now have a fighting chance of survival.

In China, similar actions are underway. Thanks to the foresight of the Government and the dedication and hard work of many of you in this room, we have learned an enormous amount during the last few years about the baiji and the threats it faces. There are now international agreements, national organizations, natural reserves, semi-natural reserves, holding pools, trained staff and detailed plans developing or in place to be used to save the baiji from extinction. All these actions, and more, will be required to accomplish this daunting task.

Those of us here, and many around the world who are monitoring baiji conservation efforts, care deeply about whether or not the baiji survives. Baiji, and other dolphins, are resonant symbols of what is right and wrong about humankind's stewardship of or watery planet. Our challenge for the next four days is to candidly discuss the results of all our collective efforts to date, successes and failures alike, and to use those discussions to refine our plans and strategies and to develop specific recommendations for the future. Our challenge after this meeting is to vigorously implement those recommendations in a renewed spirit of dedication and cooperation.

The baiji, indeed the vaquita of Mexico, or the bhulan of Pakistan, or other dolphins not yet so endangered, may well disappear despite our best efforts, so great are the challenges they face. But let it not be because we have failed to do our best to save these little dolphins as vital parts of healthy aquatic ecosystems on which we humans also depend.

Thank you.

种群和栖息地生存力估测

尤里塞斯. S. 西尔
世界自然保护联盟物种生存委员会饲养下繁殖专家组主席

世界自然保护联盟物种生存委员会饲养下繁殖专家组感谢中国兽类学会和中国渔政渔港监督管理局邀请我们参加这个保护白暨豚的研讨会.

物种生存委员会的使命：通过建立并实施有关的项目，以保护、恢复及管理物种及它们的栖息地，以保护物种多样性。

饲养下繁殖专家组是世界自然保护联盟物种生存委员会的一部分，致力于帮助拯救动物物种。

饲养下繁殖专家组应各主办国的邀请已在22个国家举办了涉及50多个物种的**种群和栖息地生存力估测(PHVA)研讨会**。

研讨会的价值在于:

集中承担物种保护和管理的单位和团体，建立该物种的复壮所需的各项行动的共识。

集中有专门学识可帮助拯救该物种的专家们。

汇集现有的关于该物种的现状和对其生存的各种威胁的知识。

根据现有的资料，对该物种灭绝的风险作客观的估测。

应用各种模拟模型测试拯救和复壮该物种的各种管理行动。

提出一个客观的报告，作为拯救该物种所需的策略和实施行动的基础。

这些研讨会已帮助制定了拯救许多物种的一些方案。我们希望本次研讨会将有助于我们的同事们的拯救白暨豚的工作。

POPULATION AND HABITAT VIABILITY ASSESSMENT

U. S. Seal, Chairman IUCN/SSC Conservation Breeding Specialist Group, 12101 Johnny Cake Road, Apple Valley, Minnesota 55124, USA.

- CBSG/SSC/IUCN thanks the Mammalogical Society of China and Bureau of Fisheries Management and Fishing Port Superintendence of China for the invitation to participate in this Workshop on the conservation of the baiji, *Lipotes vexillifer*.

- SSC MISSION: To preserve biological diversity by developing and executing programs to save, restore and wisely manage species and their habitats.

- Captive Breeding Specialist Group (CBSG) works as a part of the IUCN Species Survival Commission (SSC) to assist rescue of species.

- CBSG has conducted **Population and Habitat Viability Assessment** (PHVA) workshops for >50 species in 22 countries at the request of host countries.

- **Values of the Workshops** are in:

* bringing together all groups responsible for the saving and management of the species to build a consensus on actions needed for the recovery of the species;

* bringing together experts whose knowledge may assist rescue of the species;

* assembling current information on status of the species and the threats to its survival;

* providing an objective assessment of the risk of extinction of the species based upon current information;

* using simulation models to test alternative management actions for rescue of the species and its recovery;

* producing an objective report which can be used as a basis for the policy and implementation actions that are needed to save the species.

- These Workshops have helped chart a course for saving of many species; we hope that this Workshop will be a help to our colleagues in their work to save the baiji.

BAIJI

(*Lipotes vexillifer*)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Section 2

EXECUTIVE SUMMARY AND RECOMMENDATIONS

会议纪要

将近二千年前，中国的作者记述了一种海兽一白暨豚，它栖居在长江中。在那时，长江水清澈并且从它的高居于青藏高原的源头不受阻挡地流向富饶的，展开在东海和黄海之滨的长江三角洲。今日，长江两岸的土地是全世界50亿人口中几乎12％的人的家园。为满足增长中的需求，他们越来越多地转向长江一捕捉江中丰富的鱼和无脊椎动物，砌筑江岸以控制洪水，在主流和许多支流上建造多用途的闸坝为各城市和农村供水，疏浚并取直河道供船舶和驳船通航，建起了多座跨江的大桥，并且长江两岸增长中的人类社会全都依赖长江来承受他们的各种废弃物。

长江和长江中的生活在过去二千年中发生了很大的变化。也许看得到的受这些变化影响最剧烈的是白暨豚(*Lipotes vexillifer*)，一种小型的淡水豚。没有估算过有多少头白暨豚曾经生活在长江及与其相通的支流和湖泊（最明显的是洞庭湖和鄱阳湖）。但以生活在未遭经济发展损害的地区的其他淡水豚类的密度为模型，有理由推测曾经有几千头白暨豚生活在长江中下游从三峡到长江口约1600公里长的江中。渔民和其他在江上生活的人可能经常见到这些豚。

然而现今的白暨豚是罕见之物。据报道，在过去的15年中白暨豚种群从1979—80年的约400头下降到1986年的200头左右，以及1993年的150头或更少。尽管对估算的可靠性有不同意见。已看到的白暨豚分布区的缩小以及在中国最近几次考察中极低的见到率，使我们有理由对白暨豚的种群小且不断下降深表关切。

1986年，关于淡水豚生物学和保护的国际专家们在中华人民共和国武汉集会，回顾了当时的关于白暨豚生物学和保护的知识，制订了紧急行动的方针。该研讨会建议：减少和排除白暨豚在滚钩渔业中的死亡；建立自然保护区保护野生种群；在牛轭湖等部分江段建立“半自然”保护区；初步研究饲养下繁殖在阻止和或许扭转白暨豚数量的灾难性的急剧下降中可能起的作用。

中国政府主管部门，科学家和保护学家很重视这些建议。自1986年以后，中国在白暨豚保护中作了巨大的努力。正在武汉的中国科学院水生生物研究所进行的一个稳重的项目迅速扩大，1992年11月一座现代化的耗资200万美元的用于研究和繁殖海豚的海洋生物馆正式落成启用。一个与之相联系的2X22公里的保护区在武汉上游的石首建立。南京师范大学的科学家的研究得到扩大，并且在靠近南京的铜陵帮助建立了一个半自然保护区。还制订了在长江的不同地点建立一系列五个白暨豚保护站的计划。

尽管作了这些努力，白暨豚的种群在继续下降。人们忧虑它将很快消失，这一前景不仅使献身于拯救白暨豚的中国人不安，也使国际社会不安，他们希望从中国的活动找到广泛适用于其它现有的和正在出现的海豚危机的范例。

因此，1993年6月1日至4日，在南京师范大学召开了一个研讨会。再一次回顾现有的关于白暨豚的知识，举行关于此物种的种群和栖息地生存力估测研讨会。研讨会由中国兽类学会、世界自然保护联盟物种生存委员会(IUCN/SSC)鲸类专家组和IUCN/SSC饲养下繁殖专家组组织。美国的海洋世界有限公司慷慨提供了支持。

研讨会的报告包括下列六部分：1）开幕词；2）本会议纪要及建议；3）关于种群数量和现状的报告；4）关于一般生物学、种群生物学和种群模拟模型制作的报告；5）关于栖息地、威胁和灾难的报告；6)关于采捕、运输、饲养和设施的报告；和 7）附录，内有会议参加者名单及参考文献目录。

种群和栖息地生存力分析研讨会

研讨会的目的是用现有的生物学资料和专家知识估测中国特有的极危的白暨豚种群的灭绝的风险。白暨豚现仅分布于中国长江中下游的主流中。使用了配有上述资料的随机模拟模型以估测灭绝的风险，以通过灵敏度分析确定关键因子，以检查所建议的管理方案对减少风险的有效性。此外，确定了可促进国际合作和援助的特定的项目，以帮助那些防止白暨豚灭绝的努力。

研讨会参加者的第一项任务是汇集和评价分析该物种所需的生物学和生态学资料。注意力集中在估测未来50—200年内灭绝风险所需的资料。

使用**漩涡程序**(VORTEX)作出了四种模拟方案以提出白暨豚在下列环境的和管理的方案中灭绝的概率。

1） 野生种群在100年中，没有任何豚被移到海洋生物馆或半自然保护区。
2） 野生种群在100年中，有实际数量的豚移出给繁殖项目。
3） 在半自然保护区和自然保护区建立的种群在100年中。
4） 在完全饲养的条件下建立的种群。

现有的关于此物种的资料中有一些是不确定的，如各年龄组的死亡率、散布能力、近亲交配的作用，以及异常或灾难事件的远期作用。用上述的基线方案探索了集中于减少白暨豚最近的灭绝危险的替代的或扩大的管理方案。所用的这些模型制作方案的更详细的内容和结果概括于模型制作工作组报告。

建议的摘要

研讨会参加者一致认为白暨豚在未来的25至100年内有很高的灭绝危险。此危险和我们对它的关切使得为保护白暨豚制订各种详细的计划及募集资金成为十分重要的事项。在研讨会中对白暨豚的保护有很强的国际兴趣，从这么多的人士，组织和国家到会就反映了这一点。在整个会议中，每个工作组都表达了援助此物种的保护项目的意愿。为完成各工作组拟订

的各项目标，需要很强的国际的和中国的合作，特别是中国的各单位十分密切地为这些项目共同工作。为保证使研讨会制订的这些计划成为现实，拟定了可在未来几个月中实施的专项建议如下:

1. 建议立即成立常设的“白暨豚保护协调委员会”以检查各项行动的进程并就保护此物种的 轻重缓急向中国政府提出意见。

    A. 白暨豚保护协调委员会将由下列单位和团体的成员组成：农业部渔港渔政监督管理局，他的代表任委员会主席；湖北省渔政局和安徽省渔政局；中国科学院水生生物研究所；南京师范大学；IUCN/SSC鲸类专家组；IUCN/SSC饲养下繁殖专家组；海洋公园保护基金会；（日本）淡水豚保护协会和白暨豚保护基金。农业部可在对白暨豚保护事业做出显著贡献的其他单位和团体中增补委员会委员。

    B. 建议该委员会将通过电话、传真和信函开展业务，必要时召开会议。对政府认为有必要的会议，将由农业部安排对中国参加者的资助。中国以外的参加者将由成员单位和团体提供资助。

2. 建议成立一些临时工作组以提出与设施的初步论证、捕捉、调查及训练等有关的事项和问题，直到白暨豚保护协调委员会能采取行动。

3. 建议所有计划收养白暨豚的设施在捕捉白暨豚之前应符合本文集中捕捉、运输和饲养工作组报告提出的标准化的饲养和设施的要求。

4. 中国的各饲养设施正在准备捕豚考察。建议在秋季考察前应获得快艇、对讲机和水衣。在捕豚时，建议遵循本文集中捕捉、运输和饲养工作组报告提出的步骤。

5. 建议对所有未捕到的豚作照相识别。在捕豚考察中须开展关于社会集群和行为的观察。如豚群带有幼豚，则不应捕捉。采捕的只应是有 3 头或 3 头以上大小相似个体的群体。捕到后立即收集形态测量资料、血样、以及遗传学标本。在捕捉和运输时均应有兽医在场。

6. 建议白暨豚的捕捉和运输应按照本文集中捕捉、运输和饲养工作组报告所提出的条件尽可能快速并且温和。

7. 建议在石首半自然保护区应如地方政府所规定的不准捕鱼或船只航行。建议认为此保护区获得成功的最佳条件是建成一个不准渔涝的，只以白暨豚为保护对象的单物种保护区。

8. 建议在铜陵半自然保护区的夹江，立即开始持续的对淤积的监测。建议在捕捉白暨豚并移入夹江前，有一群江豚(*Neophocaena*)在夹江中成功地生活一年并经白暨豚保护协调委员会确认。建议认为铜陵半自然保护区在满足上述条件后，获得成功的最佳条件是建成一个不准渔捞的，只以白暨豚为保护对象的单物种保护区。

9. 建议高度优先地进行一次全长江的考察。本文集中种群数量和现状工作组报告已详细列出关于此考察的科学建议和经费估算。

10. 建议集中、归档和查看所有野生白暨豚的照片。评定是否适用于个体识别。建立日期和地点的档案。还建议继续收集适用于个体识别的照片。

11. 建议扩大野外和饲养下死亡尸体的回收，获得关于死因、生活史、寄生虫和疾病以及受污染程度的知识。

Executive Summary

Nearly 2,000 years ago, Chinese authors wrote about a dolphin - the baiji - which lived in the Yangtze River. At the time, the Yangtze flowed clean and largely unencumbered from its source, high on the Qinghai and Tibetan Plateau, to the rich, sprawling Yangtze Delta, in the western Yellow Sea and East China Sea. Today, the land along the Yangtze is home to nearly 12 percent of the world's 5.5 billion people. To meet their growing needs, these people increasingly have turned to the Yangtze - harvesting its abundant fish and invertebrates, shoring its banks to control flooding, building multi-purpose dams on the main river and its tributaries to provide water for cities and rural agricultural communities, dredging and straightening its channels for boat and barge traffic, crossing it with bridges, and, all along its course counting on the river's disappearance around the next downstream bend to bear the diverse refuse of a growing human society.

The Yangtze and the life within it are much changed in the past 2,000 years. Perhaps nothing is more dramatically and visibly affected by these changes than the baiji (*Lipotes vexillifer*), a small, freshwater Platanistoid dolphin. There are no estimates of how many baiji once lived in the Yangtze and its associated tributaries and lakes (most notably Dongting and Poyang), but using densities of other Platanistoids, in areas uncompromised by development, as a model, it is reasonable to speculate that there were a few thousand living in the about 1,800 km long stretch of the middle and lower reaches from eastern Three Gorges to the mouth. These dolphins were probably seen often by fishermen and other river-dwelling people.

Today, however, the baiji is a rare sight. In the past 15 years, the baiji population is reported to have declined from about 400 animals in 1979-80 to 200 or so in 1986 and to perhaps 150 or fewer in 1993. Despite disagreements over validity of estimates, an observed constriction in the baiji's range and dramatically low rates of sightings during recent Chinese expeditions have lent credence to concern that the baiji population is small and declining.

In 1986, a committee of international experts on river dolphin biology and conservation was assembled in Wuhan, P. R. China, to review what was then known about the baiji's biology and conservation and to chart a course for urgent action. That workshop recommended: reduction or elimination of deaths of baiji in rolling-hook fisheries; establishment of natural reserves where wild populations could find sanctuary; establishment and stocking of "semi-natural" reserves in portions of the river such as ox-bows; and preliminary investigation of the role captive breeding might play in arresting and hopefully reversing the tragic and precipitous decline in baiji numbers.

Chinese authorities, scientists, and conservationists took these recommendations seriously. Since 1986, China has made enormous efforts in baiji conservation. A modest program, already underway, at the Institute of Hydrobiology (Chinese Academy of Sciences) at Wuhan was rapidly expanded, culminating in November 1992 with the formal opening of a modern $ 2 million (US) oceanarium facility to be used to study and breed dolphins. An associated 2 x 22 km reserve was established upstream from Wuhan at Shishou. Research efforts by scientists at Nanjing Normal University were expanded and a semi-natural reserve was established at Tongling, near Nanjing. Plans were also developed for a series (5) of baiji conservation stations at various sites along the river.

Despite these efforts, however, the baiji population has continued to decline. It is feared that it could soon disappear, a prospect that troubles not only the Chinese who have dedicated themselves to saving the baiji, but also the international community which has searched in China's activities for a model broadly applicable in other dolphin crises, existing and emerging.

Accordingly, from 1-4 June, 1993, a workshop was convened at Nanjing Normal University, Nanjing, China, to again review the available information on baiji and to conduct a Population and Habitat Viability Assessment Workshop on the species. The Workshop was collaboratively organized by the Mammalogical Society of China, the IUCN Species Survival Commission's (SSC) Cetacean Specialist Group, and the IUCN/SSC Captive Breeding Specialist Group. Support for the meeting was generously provided by Sea World, Inc. (USA).

The following report from the workshop includes: 1) the text of the introductory talks; 2) this executive summary and recommendations; 3) a report on population numbers and status; 4) a report on general biology, population biology and simulation modelling of the population; 5) a report on habitat, threats, and catastrophes; 6) a report on collection, transport, husbandry and facilities; and 7) an appendix with a list of participants; and a list of references.

THE PHVA WORKSHOP

The purpose of the Workshop was to use available biological data and expert knowledge to assess the risks of extinction of the critically endangered endemic population of baiji, which is now limited in distribution to the lower and middle reaches of the mainstream Yangtze River in China. Stochastic simulation models incorporating this information have been used to assess the risk of extinction, to identify critical factors through sensitivity analysis, and to examine the effectiveness of suggested management scenarios in reducing the risk of extinction. Additionally, specific projects, whereby international cooperation and assistance can be mobilized to assist in the efforts to prevent the extinction of the baiji, have been identified.

The initial task of the participants in the Workshop was to assemble and evaluate the biological and ecological data needed for the analyses of the species. The focus was on data needed to estimate the risk of extinction over the next 50-200 years.

Four simulation scenarios were carried out using VORTEX to address the extinction probabilities for baiji in the following environmental and management scenarios:

1) The wild population over 100 years, without the removal of any animals for oceanariums or semi-natural reserves.

2) The wild population over 100 years, with the removal of realistic numbers of animals for breeding programs.

3) Populations established in both semi-natural and fully natural reserves over 100 years.

4) Populations established under fully captive conditions.

There were uncertainties in the data available for this species on mortality rates for all age classes, dispersal capability, effects of inbreeding, and the long-term effects of unusual or catastrophic events. The baseline scenarios described above were used to explore alternative or expanded management scenarios intended to reduce the immediate risk of extinction of the baiji. Further details and results of the modelling scenarios used are outlined in the Modelling Working Group Report.

SUMMARY OF RECOMMENDATIONS

There was general agreement among the Workshop participants that the baiji is at a very high risk of extinction in the next 25 to 100 years. This risk and our concern for it makes it very important to develop detailed plans and allocation of resources for the preservation of the baiji. During the course of the workshop, there was clearly a strong international interest in the conservation of the baiji, as reflected by the presence of so many people from so many organizations and countries. Throughout the meeting, each of these groups expressed the desire to assist in the conservation projects for this species. To accomplish the goals laid out within the Working Groups, there is a need for very strong international and Chinese cooperation, and, in particular, for Chinese organizations to work very closely together on these projects. In order to ensure that the plans resulting from this workshop develop into reality, specific recommendations, to be implemented during the coming months, were developed. These recommendations follow.

1. It is RECOMMENDED that a standing "*Baiji Conservation Coordinating Committee*" be established *immediately* to monitor progress of all efforts and to advise the Chinese government on preferred status for conserving this species.

A. The Baiji Conservation Coordinating Committee will consist of members from: the Bureau of Fisheries Management and Fishing Port Superintendence, the Ministry of Agriculture, a representative of which will chair the group; the Fisheries Bureaus of Hubei and Anhui provinces; the Institute of Hydrobiology, the Chinese Academy of Sciences, Nanjing Normal University, IUCN/SSC Cetacean Specialist Group, IUCN/SSC Captive Breeding Specialist Group; the Ocean Park Conservation Foundation, the Platanistidae Conservation Association, and the Baiji Conservation Fund (Japan). The Ministry of Agriculture may add other members from organizations that make significant contributions to the baiji conservation efforts.

B. It is recommended that business of the committee will be conducted by telephone, fax, mail and, as necessary, by meeting. For any meetings deemed necessary, support for Chinese participants will be arranged by the Ministry of Agriculture. Support for participants from outside China will be provided by the member organization.

2. It is RECOMMENDED that temporary groups be established to address issues and problems associated with preliminary certification of facilities, capture, surveys, and training until the time the *Baiji Conservation Coordinating Committee* is ready to take action.

3. It is RECOMMENDED that all facilities planning to house baiji should meet the standardized husbandry and facility requirements, as outlined in the Report of the Working Group on Collection, Transport, and Husbandry in this document before additional baiji are collected.

4. Collection expeditions are planned by the Chinese facilities. It is RECOMMENDED that speedboats, radios, and wetsuits should be obtained prior to the fall collection. It is RECOMMENDED that procedures outlined in the Report of the Working Group on Collection, Transport, and Husbandry in this document be followed for this collection effort.

5. It is RECOMMENDED that all animals be photo-identified if not collected. Observations regarding social groupings and behavior need to be carried out during collection expeditions. If groupings contain calves, capture should be avoided.

Collect only groupings with the same size of animals and with 3 or more animals. Collect morphometric data, blood samplings, and genetic samples immediately upon capture. Veterinarians should be present during capture as well as transport.

6. It is RECOMMENDED that transport of collected baiji take place as quickly and humanely as possible, following transport conditions outlined in the Report of the Working Group on Collection, Transport, and Husbandry in this document.

7. It is RECOMMENDED that for the Shishou Semi-natural Reserve, no fishing or boat traffic be allowed, as already outlined by the regional government. Further, it is RECOMMENDED that the optimal conditions for success for this reserve are that it be a single-species reserve, without nets, for baiji alone.

8. It is RECOMMENDED that for the Tongling Semi-natural Reserve Channel, siltation be monitored on a continuing basis beginning immediately. It is RECOMMENDED that a group of *Neophocaena* be successfully maintained, as determined by the *Baiji Conservation Coordinating Committee*, in the channel for a one year period before baiji are collected or moved to the channel. It is Recommended that the optimal conditions for success for the Tongling Semi-natural Reserve are that it be a single-species reserve, without nets, for baiji alone, once the above conditions have been met.

9. It is RECOMMENDED that high priority be placed on conducting a survey of the entire Yangtze River. Specific recommendations and cost estimates regarding this survey are detailed in the Report of the Working Group on Population Numbers and Status in this document.

10. It is RECOMMENDED that all photographs of wild baiji be assembled, catalogued and examined. They need to be evaluated for usefulness for individual identification and documented with information on date and location. It is also RECOMMENDED that collection of photographs suitable for individual identification continue.

11. It is RECOMMENDED that efforts are expanded to retrieve carcasses (from mortalities in the wild and captivity) for information on cause of death, life history, parasites and disease, and contaminant loads.

BAIJI

(Lipotes vexillifer)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Section 3

BAIJI POPULATION NUMBERS AND STATUS

种群数量和现状工作组报告

参加者：高安利(主持人)，张先锋(主持人)，斯蒂文·莱瑟伍德(报告人)，常青，徐信荣，章贤，粕谷俊雄，小罗伯特·L·布朗内尔，威廉·F·佩林

背景和目的

白暨豚以前广泛分布于自三峡下端至河口的长江中，并偶尔进入洞庭湖，鄱阳湖和长江支流。还分布在南面的富春江。其现在的分布仅限于由宜昌至河口附近大约1700公里的长江干流中。

种群数量和现状工作组回顾现有的任何江段白暨豚数量（和发现率）的估测的所有论文，查明这些估计是如何得到的，评估其可靠性，并为监测种群数量和趋势推荐新的方法。

现有估测的总结

1979年8月，1980年2月和3月，以及1981年3月和7月，对南京至贵池江段250公里江段做了考察。2-3名观察者乘一条船沿近岸航行，在上行和下行都进行计数。在观察所发现的所有白暨豚群时，搜索航行暂停。在评价观察记录时，假设白暨豚群活动地点比较稳定。所以，只有当在新的地点记录到豚群时，才能增加栖息在该段的估测的白暨豚群数。总的来说，该考察区域有30－60头豚（3－6群，每群6－10头个体）（周开亚　1982；周开亚等　1979，1982）。周开亚（1982）使用这两个估计的发现率(0.12-0.24头个体/公里）的高值估计在1700公里江段中的种群数量约为400头。

1979年5月，5位考察者使用一条考察船考察了武汉至城陵矶230公里长的江段，在上行流考察中发现了两群白暨豚（分别为2和17头），在下行时仅发现一群（17头）。作者认为这一区域至少有两群19头白暨豚。根据这一资料估计的发现率为每公里0.08头白暨豚(陈佩薰等　1980)。

从1978年到1983年，在宜昌至南京江段(总长1574公里)，包括洞庭湖和鄱阳湖，作了9次考察。每次只考察该江段的一部分，有些江段则考察了一次以上。2-4名考察者在一条时速为10-12公里的船上，用肉眼和望远镜观察白暨豚。一旦发现白暨豚，船速减慢，以便统计数量。核对了17个江段中每一江段的资料（湖中未发现白暨豚）。把每一段的数量加起来，得到该研究区域内估测的白暨豚总数为156头。对那些考察一次以上的江段，作者取该江段的计数的最高值，对其它长而豚数少的江段，他们取所有较短江段中计数的平均值估得较高的值(林克杰等 1985)。

1979年至1986年间，在下游770公里(约白暨豚分布区的一半)进行了多次考察。考察者使用一条船，在2-5公里宽的长江中的约400米宽的区带中观察白暨豚，并尽可能多地访问已知或推测豚的密度较高的所有区域。在这一区域统计到的白暨豚数(48)只有在同一区域内使用6-8条船统计到的豚数(79-81)的60%(Chen and Hua 1989)。作者估计该区域内有约100头豚。这一结果是通过使用南京附近250公里发现率的早期估计(0.125-0.25)的下限值(周开亚 1982)乘以该研究区域的总长(770公里)得到的(Chen and Hua 1989)。

1985和1986年冬以及1986年春，对白暨豚分布区的大部分(宜昌至江阴-共1512公里)作了几次考察。6-8条船排成一横行，每条船上有几位观察者，考察长江的不同部分。发现白暨豚后，船靠拢并环绕该豚群，统计数量，并根据大小分组。春天统计的数量(176)比冬天的(243-247)少；所以，种群总数的估测是通过下列方法对冬天的计数结果进行校正而得到的：对冬天考察不完全的九江至南京段，1985和1986年冬天的计数59-61)用前一次考察的计数(92-93)代替。同样，由于1985和1986年冬未考察江阴至河口段，作者根据前一次的考察结果为这一段增加了5-7头豚。作了以上两项校对后，种群数量被估计为约283-285头。因为他们同时认为考察中也漏计了一些个体，作者估计种群数量为约300头。六个考察江段白暨豚的发现率为每公里0.06-0.22(平均值=0.18)头豚(Chen and Hua 1989)。

除了以上这些用视觉观察计数和估测从尝试外，最近也在部分江段使用照相识别和标记-重捕技术估测白暨豚数量。考察中航速为每小时7-8公里，在南京和黄石矶（1989年5月），南京和湖口(1990年3月)以及镇江和湖口之间(1990年4-5月)作上行和下行两个方向的考察。每次均使用7-8条船，17-24个观察者。发现白暨豚后，统计豚数，船跟踪所发现的豚群并为个体识别拍摄尽可能多的个体。三次考察中分别确认该区域有9、7和11头个体。通过照相识别了7头个体。根据已识别个体的重复发现率，估测此420公里江段中种群数量约30头。尽管需要对其它江段豚密度作一些未经证实的假设，由这一数据推估白暨豚总数为120头。使用这些考察中的数据， 估计在一次往返考察中该区域中的豚有2/3被漏计(周开亚等 1993)。

评价和建议

对整个分布区中白暨豚的种群总数没有一个合理可靠的估计。对大部分江段（1512公里)现有的最有用的资料似乎来自1985和1986冬天的未经校正的数据(243)，此数据可作为当时的最小种群(Chen and Hua 1989)。长江中有两段总长约420公里， 未被充分考察过，因此，所计数的豚数量偏低。显然，没有对未考察区段的豚数的偏差进行校正，使计数向下偏移了一个未知的程度。所以也低估了在考察中未被观察到的豚的概率。生活在这一区域的豚中相当大一部分被漏计了。

通过对哺乳类一些种小种群的研究，现在已经明白：即使在最佳的条件下，确定具有统计学置信度的种群数量变化趋势是非常困难的，除非数量发生了很大的变化。另外，考察中使用的方法不同，所以没有产生可比的结果。

工作组一致认为，继续做下列两种工作是没有价值的：(1) 根据对部分江段的考察推测种群总数，(2)把不同季节，甚至不同年份的局部考察的估测拼凑在一起。 因为这样的做法会被豚的移动。江面和有效栖息地随江水的季节性涨落而发生的变化，以及栖息地质量在较长时间内的漂移和豚分布的类型等因素所破坏。

相反，最优先的应是进行一次全长江的考察。工作组认为，这样一次考察应该是：

—尽快组成若干个考察队，进行一次白暨豚全部分布范围的考察，每队包括由来自不同白暨豚研究单位的工作者混合组成；

—使用最小的合理的搜索速度；

—在所有的江段，在同样很短的时期内进行考察；

—充分作好文件记录，以便进行结果分析并有利于在以后的考察中重复；

—每5-10年重复一次(在较短时间内数量的任何变化可能是难以检出的)。

小组进一步敦促：如果经费允许，在全江段的考察结束后，紧接着在一个或多个选择的江段进行重复考察，使得能够估算方差。这些重复必须在考察全过程中使用同样的工作者和考察方法。

在所有考察中发现的江豚应常规加以记录。

进行野外实验以检验观察者发现豚的能力和准确估算群中个体数的能力是有用的。但是，在白暨豚的密度如此低的情况下，还不清楚这样的实验应该如何实施。

照相识别和标记重捕技术现已被广泛应用于鲸类种群的研究(Hammond et al. 1990)，它们在研究白暨豚中的有限应用已证明是可行的(周开亚等，1993)。根据这一情况，小组特别建议：

—应该继续收集适合个体识别的照片；并

—所有可能适用个体识别并有时间和地点记录的野生白暨豚照片应该集中，归档和查看。

最后，小组认为，加倍努力收集野外和饲养下死亡的个体，已了解其死亡原因，生活史，寄生虫和疾病，以及污染负载等资料。

全长江种群考察所需的设备和人员

建议的全长江种群考察提纲:

1. 把考察的长江分成接近等长的两段。
2. 每段将配备7条船（一条较大马力的船和6条较小的渔船）。每条船上至少有2名受过训练的观察员，两个考察队将由武汉和南京研究组的人员共同组成。
3. 每段的考察将在同一天在各自的上游端开始。各条船横向排开，以约6公里/时的航速向下游行驶。相互间用报话机和/或信号旗保持联系。
4. 每当见到白暨豚时，这些船向豚群靠拢以得到尽可能好的计数， 并在条件适宜时，拍摄个体照片。
5. 当上述活动完成时，所有船只将恢复平行的搜索航线。
6. 到达各自江段的下端时，每个船队将以 6 公里/时的航速（或能达到的任何速度）驶向上游考察。
7. 考察将在其中的一个考察区重复，以作为计算方差的基础（上游段和下游段可作不同安排）。

人员和费用估算(外币兑换券)

类目	费用
工作人员: 14名观察员（共1344工作人员日，包括旅行时间）	0*
生活费: 1344工作人员日X30/日	40,320
大船: 第1江段 64日 @ 450/日 + 20吨柴油 @ 2,600	80,800
第2江段 32日 @ 450/日 + 10吨柴油 @ 2,600	40,400
小船: 第1江段 6 X 64 日 @ 50/日 + 7吨柴油 @ 2,600	37,400
第2江段 6 X 32 日 @ 50/日 + 3.5吨柴油 @ 2,600	18,700
旅行: 武汉至南京，14个往返 @ 400	5,600
北京至南京或武汉，3个往返 @ 600	1,800
设备和供应品: 胶卷和冲洗，135卷 @ 2 X 20	5,400
录相带，5盒 @ 40; 15盒 @ 100	2,100
记录本，14 @ 6	84

资料记录表，6,000 @ 0.5	3,000
数字电子表，14 @ 70	980
报话机，14 @ 1,500	0**
总计	236,584
	（约50,000美元）

脚注:

* 工资由聘用单位付给。

** 将使用已有的及根据捕豚合同购买的报话机。

Population Numbers and Status

Participants: Gao Anli (Cochairperson), Zhang Xianfeng (Cochairperson), Chang Qing, Xu Xinrong, Zhang Xian, Sun Jiang, Toshio Kasuya and Stephen Leatherwood (Rapporteur), Robert L. Brownell, Jr., and William F. Perrin.

Background and Objectives

The baiji was formerly widely distributed in waters of the Yangtze River and occasionally in associated lakes (Dongting and Poyang) and tributaries from the lower end of Three Gorges to near the river mouth, as well as in the Fuchun River to the south. It now has a more restricted distribution in the mainstream of the Yangtze from Zhicheng to near the mouth, a distance of about 1,600 km.

The working group on population numbers and status reviewed all available papers which report estimates of baiji numbers (and encounter rates) for any portion(s) of the current range to determine explicitly how those estimates were obtained, to evaluate their reliability, and to recommend future approaches towards monitoring population size and trends.

Summary of Available Estimates

In August 1979, February and March 1980, and March and July 1981, surveys were made of the 250-km stretch of river between Nanjing and Guichi. Two to three observers counted dolphins from a single vessel during both upstream and downstream transects conducted near the banks. Searching was interrupted to observe all groups of dolphins detected. In evaluating the sightings data, it was assumed that dolphin groups showed site fidelity. So, the number of groups estimated to be inhabiting the area was only increased when a group was encountered at a new location. Overall, it was reported that there were 30-60 dolphins (3-6 groups, each containing 6-10 individuals) in the surveyed area (Zhou, 1982; Zhou et al., 1979, 1982). Zhou (1982) used the higher of these two estimated encounter rates (0.12-0.24 individuals/km) to estimate a total population of about 400 baiji in 1,700 km of the river.

In May 1979, five observers aboard a single survey vessel located two groups of dolphins (2 and 17 individuals) during an upstream survey and only one group (17 individuals) during the downstream survey of the 230 km stretch of river between Wuhan and Cheng Ling Ji. The authors concluded that there were at least two groups and 19 individuals in the area. These data yield an estimated encounter rate of 0.08 baiji/km (Chen et al., 1980).

From 1978 through 1983, nine surveys were made in the river between Yichang and Nantong (a total length of 1,574 km), including Dongting and Poyang lakes.

Each survey covered only a portion of that range, and some areas were surveyed more than once. Two to four observers searched for dolphins, with naked eye and binoculars, from a single vessel traveling at 10-12 km/hr. Whenever dolphins were seen, the vessel was slowed to permit counts of numbers present. Data were tallied for each of 17 sections of river (No dolphins were seen in either of the lakes.). The total number of dolphins in the study area was estimated to be 156 by adding the numbers for each section. For some sections surveyed more than once, the authors used the highest number counted in that section; for others which were long but contained few dolphins, they used a higher value derived as the average of all counts in all shorter sections (Lin et al., 1985).

Between 1979 and 1986, various surveys were made of 770 km (about half the baiji's range) of the lower river. Observers aboard a single vessel searched for dolphins in an approximately 400 m strip of the 2-5 km-wide river but also diverted to visit as many as possible of the areas known or suspected to have high dolphin concentrations. The number of dolphins counted was only about 60% of the number reportedly counted during previous surveys of the same area using 6 to 8 vessels (48 vs. 79-81) (Chen and Hua, 1989). These authors estimated that there were about 100 dolphins in this area. They did so by multiplying the lower range of a previous estimate of encounter rate (0.125-0.25) from a 250 km stretch near Nanjing (Zhou, 1982) by the total length of the study area (770 km) (Chen & Hua, 1989).

In winter 1985-86 and Spring 1986, surveys were conducted of most of the baiji's range (Yichang to Jiangyin - a total of 1,512 km). Six to eight vessels, each containing multiple observers, traveled abeam, searching different portions of the river. Whenever pods of dolphins were located, the vessels converged and encircled the animals to count them and classify them by size class. Fewer animals were encountered in spring (176) than in winter (243-247); so, the winter counts were corrected as follows to produce an estimate of the total population: For the area between Jiujiang and Nanjing, incompletely surveyed in winter, the winter 1985-1986 count (59-61) was replaced with a count from a previous survey (92-93). Similarly, as the area between Jiangyin and the mouth was not surveyed in winter 1985-1986, the authors added the 5-7 dolphins seen in that area during a previous survey. With these two corrections, the population would be estimated to contain approximately 283-287 individuals. Because they also believed some animals were missed during the surveys, the authors estimated the population at about 300. Dolphins were encountered in the six survey segments at a rate of 0.06-0.22 (mean = 0.18) dolphins/km (Chen & Hua, 1989).

In addition to these attempts to count or estimate dolphin numbers using strictly visual surveys, there have been recent efforts to estimate numbers in portions of the river by using photo-identification and mark-recapture techniques. Surveys were conducted at 7-8 km/hr. both upstream and downstream between Nanjing and Huangshiji (May 1989), Nanjing and Hukou (March 1990) and Zhenjiang and Hukou (April-May 1990). All surveys employed 7-8 boats with 17 to 24 observers. Dolphins were counted, and the vessel lingered with each group encountered to photograph as many individuals as possible for individual identification. The expeditions confirmed the presence in the areas of 9, 7 and 11 individuals on the three expeditions, respectively. Seven individuals were photo-identified. Based on the frequency of resighting of these identified dolphins, the population in the 420 km portion of the river between Nanjing and Hukou was estimated to number about 30 individuals. Extrapolation of this number to the baiji's entire current range would yield a total estimate of 120 individuals, although this requires some untested assumptions about densities elsewhere in the river. Using data from the same expeditions, it was estimated that as many as 2/3 of the dolphins present within the area might have been missed by observers during a given round-trip survey (Zhou et al., 1993).

Evaluation and Recommendations

There is no adequately reliable estimate of the total population of baiji throughout its range. The most useful information available for a large portion of the river (1,512,km) appears to be the uncorrected count (243) from the surveys in winter 1985-1986, which can be taken as the minimum population size at that time (Chen & Hua, 1989). Two parts of the river, totaling some 420 km, were not fully surveyed; so, they are under-represented in the count. Clearly, not applying corrections for animals in the unsurveyed areas biases this count downwards to an unknown degree. So also does the probability that animals, perhaps a substantial proportion of those present, are missed during surveys.

It is now clear from research with small populations of mammal species that it is extremely difficult, even under the best of circumstances, to detect trends in population numbers with statistical reliability, unless a major change in numbers occurs. In addition, methods in baiji surveys have been diverse and therefore have not yielded comparable results.

The group agreed that there is little value in continuing to (1) extrapolate to total population size from surveys of only portions of the river or (2) assemble estimates from partial surveys conducted in different seasons or even different years and perhaps with different methods. Such efforts are compromised by such factors as dolphin movements, changes in surface area and available dolphin habitat with the seasonal rise and fall of the river, and longer-term shifts in habitat quality and dolphin distribution patterns.

Highest priority should be placed on conducting a survey of the entire river. The group agreed that such a survey should be:

1. **Conducted along the entire range of the baiji as soon as possible** by teams each representing a mix of workers from the various institutions studying the baiji;

2. **Conducted at the slowest reasonable search speeds;**

3. **Conducted in all sections of the river within the same very short time period;**

4. **Fully documented** to facilitate analysis of results and replication in future surveys;

5. **Repeated every 5-10 years** (Any change in abundance over shorter intervals is likely to be undetectable).

6. The group further urged that **if resources permit, immediately following completion of the survey of the full river, replicate surveys be conducted in one or more selected sections of the river to permit calculation of estimates of variance.** These replicates should be employ staff and methods identical to those used in the full survey.

Sightings of finless porpoises should be routinely recorded during all surveys and analyzed to produce estimates of population sizes.

There is also value in conducting field experiments to calibrate observers' ability to detect dolphins present and accurately enumerate animals in the group(s). However, it was not clear how such experiments could be conducted given the low density of the baiji.

Photo-identification and mark-recapture techniques are now widely used in studies of cetacean populations (Hammond et al., 1990), and their limited application to date in studies of baiji have been promising (Zhou et al. 1993). Accordingly, the group Recommended that:

1. **All photographs of wild baiji which are potentially adequate for individual identification and documented by information on date and location be assembled, catalogued and examined.** Some photographs can be taken during the coordinated surveys of the entire river, but it will be necessary to conduct some dedicated photo-identification surveys at other times as well.

2. **Collection of photographs suitable for individual identification should continue.**

Finally, the working group recognized the potential importance of expanding efforts to retrieve carcasses (from mortalities in the wild and captivity) for information on cause of death, life history, parasites and disease, and contaminant loads.

EQUIPMENT AND PERSONNEL NEEDED FOR RIVER-WIDE POPULATION SURVEYS

Outline for the proposed river-wide population surveys:

1. The river will be divided into two sections of approximately equal length.

2. Seven boats (one larger power vessel and 6 smaller fishing boats) with at least two trained observers per boat will be assigned to each section. Both teams will be composed of representatives from both the Wuhan and Nanjing groups.

3. Surveys of each section will begin on the same day at the upstream end of the section. Vessels will travel downstream, abeam, at about 6 km/hr and will maintain contact by radio and/or flag signals.

4. Whenever dolphins are seen, the boats will converge on the group to obtain the best possible estimate of numbers and, as appropriate, photograph individuals.

5. When the above activities are completed, all vessels will resume their parallel search paths.

6. Upon reaching the lower end of their sections, each fleet of vessels will survey upstream at 6 km/hr (or whatever speed is attainable).

7. In one of the areas, the surveys will be repeated over all of the section as a basis for estimating variance. (Upstream and downstream segments may be treated separately.)

Estimate of Personnel and Costs (in FEC).

Category	COST
Staff: 14 observers (1344 staff days, including travel time)	0*
Subsistence: 1344 staff days X 30/day	40,320

Boat Charter:

Large Vessels	
Section 1, 64 days @ 450/day + 20 tons diesel @ 2,600	80,800
2, 32 days @ 450/day + 10 tons diesel @ 2,600	40,400
Small Vessels	
Section 1, 6 X 64 days @ 50/day + 7 tons @ 2,600	37,400
2, 6 X 32 days @ 50/day + 3.5 tons @ 2,600	18,700

Travel:

Wuhan to Nanjing, 14 RT @ 400	5,600
Beijing to Nanjing or Wuhan, 3 RT @ 600	1,800

Equipment and Supplies:

Film and processing, 135 rolls @ 2 X 20	5,400
Videotapes, 15 rolls @ 40 & 15 rolls @ 100	2,100
Journals, 14 @ 6	84
Data forms, 6000 @ 0.5	3,000
Digital watches 14 @ 70	980
Radios, 14 @ 1,500	0**
TOTAL	236,584
	(APX $50,000 US)

Footnotes:

* Salaries paid by employing institutions

** Radios already on hand or purchased under capture contract will be used

白暨豚自然群体数量及其锐减原因的分析

华元渝　高四新　张建
南京师范大学生物系，南京，210024，中国

随着人类经济活动的迅速发展，淡水豚(Platanistidae)普遍面临巨大威胁，诸如水堰、堤坝的建设，水体污染、渔业和航运等的影响，国内外已有这方面的报导[1],[2],[3],[4],[5],[6],[7],[8]。但有关我国白暨豚(*Lipotes vexillifer*)受上述影响而致使其自然群体数量急剧减少的状况及其原因分析则未见报导。

作者1984——1991年间，先后29次，在宜昌至江阴(1512公里)河段内开展了白暨豚生态考察，其中 9 次进行了水利工程对白暨豚栖息水域影响的调查；4 次组织了全江段考察[1985年冬(10-11月)，1986年春(4-6月)，1990年冬(10-11月)，1991年春(4-6月)]； 1987——1990年间，在白暨豚分布密集的湖北螺山——新滩口(180公里)、安徽官洲——黑沙洲(200公里)两大河段内对白暨豚的栖息水域进行了16次季节观察。考察时除采用多船航行考察法观察、跟踪白暨豚之外[1]，还用带有300×300mm长焦镜头的相机摄影[9]，用 LS2r-1型旋桨式流速仪测流速，用SKIPPER-ED162回声探测仪测水深和床形，用改进的皮尔森挖泥器取底泥，获得了大量的观察资料和数据。综合分析时，参考了作者自1962 年以来收集的长江鱼类种群数量变动资料，长江流域规划办公室水文局(1989)水文资料， 南京环境保护科学研究所(1983——1984)江水污染调查资料，据此估算白暨豚的自然种群数量， 并分析白暨豚群体数量减少的原因，本文是上述工作的总结。

一、自然群体数量的估算

表1　栖息地环境质量与白暨豚栖息活动的关系

河道特征	观察次数	静回水区 直径 (m)	静回水区 深度 (m)	静回水区 流速 (m/s)	夹堰水区 长度 (m)	夹堰水区 宽度 (m)	夹堰水区 深度 (m)	夹堰水区 流速 (m/s)	底质	白暨豚活动情况 发现情况	白暨豚活动情况 群体大小 (头/群)	白暨豚活动情况 活动时间 (hr)
弯曲河段									沙,砾石,小石块	无	—	——
	9	>50	>15	0.0-0.6	>300	>60	>10	0.6-1.4				
									泥沙,沙泥,硬泥	偶见	1-3	经过
	7	50-80	>15	0.0-0.6	>300	>60	>10	0.6-1.4	淤泥	有	2-5	0.5-2.0
	12	>80	>15	0.0-0.6	>300	>60	>10	0.6-1.2	淤泥	常见	3-7	>3
弯曲河分段汊									沙,砾石,小石块	无	—	——
	11	>30	>10	0.0-0.6	>1500	>30	>5	0.6-1.2				
									泥沙,沙泥,硬泥	偶见	1-3	经过
	8	30-60	>10	0.0-0.6	>1500	>30	>5	0.6-1.2	淤泥	有	3-5	1.0-2.5
	9	>60	>10	0.0-0.8	>1500	>30	>5	0.6-1.0	淤泥	常见	3-12以上	>4

白暨豚喜欢在水流缓慢、流态稳定的大回水区内栖息活动[8]。在弯曲、弯曲分汊河段内江心洲、边滩附近以及支流、湖泊入江处，往往具有这样的大回水区(华元渝，1992，水利工程对白暨豚生态环境的影响)。据作者多年观察，大回水区的地理位置和水文特征受床形、水深、水流等诸多因素的影响， 受制于上游来水量和来沙量及附近通江湖泊的江水的

调蓄能力。无论是自然的还是人为的原因，只要改变了河段内的水位，就会引起白暨豚赖以栖息活动的回水区的变化。如果大回水区内底部富含有机质，白暨豚则在内作较长时间的栖息活动；如果大回水区底部有机质为沙卵石所代替，白暨豚就会迁移。白暨豚的活动是随大回水区的这种变化而变化的(表1)。

由于用照相识别的方法初步证实了白暨豚可因环境恶化而进行200公里以上的长距离活动，因此存在重复观察的可能性。此外，还存在恶劣天气使观察遗漏的可能。为此，作者将1987——1991年间获得的资料与1984——1986年间获得的资料进行对比，对白暨豚自然群体数量进行估算。

表2 主要河段内白暨豚群体数量减少统计
(1985年冬、1986年春——1990年冬、1991年春)

河段命称	洲滩名称	公里数*(KM)	河型	白暨豚群体头数			
				1986年	1991年	减少数(头)	累积减少(头)
宜昌—城陵矶	南阳碛	1633	弯曲	2		2	
	关洲	1601	弯曲	2		2	
	姚港	1578	微弯	3		3	
	八亩滩	1563	微弯	2		2	
	二圣洲	1488	弯曲	3		3	
	南五洲	1473	微弯	5		5	
	天星洲	1453	弯曲	8		8	
	三合洲	1433	弯曲	8-9	7	1-2	
	无名洲	1406	弯曲	6		6	
	方家夹	1383	弯曲	8	2	6	
	大马洲	1345	弯曲	8		8	
	八仙洲	1290	弯曲	7		7	
	捉鱼洲	1275	弯曲	9	2	7	60-61
螺山—新滩口	长旺洲	1228	顺直分汊	13	9	4	
	复兴洲	1168	弯曲分汊	16	11	5	
	土地洲	1133	弯曲	7	7**	6	
	团洲	1123	弯曲分汊	6			15
官洲—黑沙洲	官洲	651	弯曲分汊	9	8	1	
	江心洲	620	弯曲分汊	6	5	1	
	玉板洲	602	弯曲分汊	10	10	—	
	杂水洲	578	顺直分汊	10	7	3	
	和悦洲	552	弯曲分汊	7	5	2	
	成德洲	530	弯曲分汊	9	9	—	
	黑沙洲	476	弯曲分汊	10	—	10	17
镇江	世业洲	278	弯曲分汊	16-17	4	12-13	12-13
							资源量1991年比1986年减少104-106(头)

* 公里数按河口为起点，向上游累计计算。

** 土地洲和团洲1991年共发现7头。

1985年、1986年调查时，白暨豚种群数量约有42个群体，约283-287头[1]。1990年、1991年再度调查时发现：在宜昌——沙市(160公里)河段中已看不到白暨豚的踪迹，在沙市

以下的其它河段也未发现新群体。沙市——城陵矶(240公里)河段内仅看到11头，比1986年时的观察数减少60-61头。湖北螺山——新滩口河段内观察到27头，比1986年时减少15头。安徽官洲——黑沙洲河段内观察到44头，比1986年减少17头，江苏镇江河段内观察到4头，比1986年减少12-13头。原来分布密集、活动很有规律的一些水域如湖北观音洲水域、江苏镇江水域也很难观察到白暨豚活动。从整个情况看来，白暨豚群体规模普遍减小，最大群体也只有7头，一般2-3头，有时仅见单个豚活动。根据以上调查资料综合分析，宜昌——城陵矶河段、螺新河段、官黑河段及镇江河段总共长约800余公里的分布区内，1991 年比1986年白暨豚种群数量减少约104-106头(表2)。

随着环境压力增大，近几年发现的死亡个体大多是在维系种群生存和繁衍中起关键作用的母豚和幼豚。由于缺乏很详细的资料，作者采用几何平均法求出上述河段内1986 年至1991年这五年内白暨豚自然群体数量递减比例为14.66-14.84%。若按此比例推算，1991 年全河段白暨豚自然群体数量为120-130头。作者认为目前我国白暨豚自然群体数量少于 150头。

二、自然群体数量锐减原因的分析

1、筑坝和裁弯对大回水区有破坏作用

白暨豚仅分布在长江三峡以下至长江口1690公里河段内，自在宜昌以上兴建了葛洲坝水利枢纽和在下荆洲实施了系统裁弯工程之后，荆江(枝江——城陵矶)长约401公里河段内的水文条件和水流情势发生了变化，受到影响的河段水流流速增大，河床下切，床面粗化，原有的大回水区遭到破坏。作者1985年冬和1986年春曾到该河段考察，当时坝下至云池 40公里河段内已无适合白暨豚栖息活动的大回水区，考察时反复搜索，证实白暨豚分布区域的上限当时已不在宜昌，而是在宜都，据坝下50公里处[8]。1990年10——11月和 1991年4——6月，作者再次对该河段考察时，冲刷已沿程向下影响到沙市河段。枝城——沙市(92公里)河段内，宜都清江河口南岸、白洋南岸、枝城魏家河南岸、洋溪关洲、松滋口南岸、姚港北岸、李家渡南岸、枝江南岸、江口南岸、涴市马羊洲、太平口南岸以及沙市野鸭洲南岸、金城洲等13处边滩和江心洲附近的大回水区遭到破坏，已观察不到白暨豚的活动。白暨豚分布区域的上限退缩到距坝下160公里的沙市河段内，生存空间已向下游压缩了10%。

沙市——城陵矶(309公里)河段内，曾有较多白暨豚分布，有多处适合白暨豚栖息活动的大回水区。中国科学院“水生一号”科学考察船航行日志记载，曾在荆江河段多处观察到白暨豚活动。渔民也曾多次观察到11——20 余头的白暨豚群体活动。该河段实施系统裁弯后，74公里长的河段(占白暨豚自然分布区的4.4%)被分割成三处无白暨豚分布的牛轭湖。裁弯段上游口门段，水流流速普遍增大，发生自下而上的冲刷。1991年调查时，冲刷已向上游发展，河段内南阳碛、关洲、姚港、八亩滩、二圣洲、南五洲、天星洲等洲滩处，大回水区遭到明显破坏，与1986年同期考察资料相比，白暨豚的数量大幅度减少(表2)。河段内白暨豚的平均分布密度也从3.67公里/头减低到10.36公里/头。另外，裁弯后长江三口入洞庭湖的口门处水位普遍降低，三口分水、分沙量逐年减少，相反，干流径流量却相应增大，江湖关系的这一改变和调整已使城陵矶以下的大兴洲——杨林岩河段流速增大，冲刷加剧；螺山——新滩口河段中陆溪口、中洲、排洲、团洲等处大回水区相对萎缩，白暨豚的数量亦相应减少(表2)。

2、湖泊入江处修建坝闸对白暨豚的影响

湖泊入江处受湖水顶托形成的大回水区历来是白暨豚良好的栖息活动场所。据渔民反映，湖泊入江处未建坝闸前，附近经常可观察到白暨豚活动，有时还发现20 头以上的白暨豚集群。自建坝闸之后，此处就看不到白暨豚活动了。近卅年来，人们在湖泊入江处广泛修建坝闸，仅中游地区，与干流隔开面积在10平方公里以上的湖泊就有 27 个，总面积达1793.5平方公里。在下游，仅安徽一省，用于造田、围垦的湖面就达500万亩以上。目前长江中下游仅剩鄱阳湖、洞庭湖等少数几个湖泊和荆江河道裁弯形成的牛轭湖以及个别蓄洪

区湖泊仍与长江相通以外，其余皆与干流隔开。 江湖连通的这种自然水生态系统遭到破坏后，其功能随之丧失，鱼群失去了许多辽阔的天然索饵肥育水域， 湖泊入江处的水文状况发生改变。作者在多年的考察中，除在鄱阳湖、 洞庭湖等仍与干流相通的入江处附近观察到白暨豚的活动外，未在修建坝闸的湖泊入江处附近观察到白暨豚的活动。

3、江水污染对白暨豚的影响

工业生产中直接排入干流的废水，造成了江水污染。据1985年统计， 长江沿岸废水排放量已达128亿吨，占全国污水排放量的37%[10]。这些废水量大、集中，成份复杂， 经常污染白暨豚的栖息生境。例如南京大厂镇河段，具有多处大回水区，当地渔民反映， 五十年代初还常在江中观察到大群白暨豚活动。自从这里建设成为拥有化工、冶金、 电力为主体的工业区后，南京钢铁厂、南京化学工业公司、 南京热电厂三大企业沿江排列，封闭了近十公里的江岸线，每年约有一万七千吨有毒物质如氨、氮、砷、酚、氰、 氟及重金属离子随废水排入干流，特别严重的是河床底质长期受高浓度金属离子的污染，在被检测的 10项指标中有9项超标，铜、锌、钴的超标率均已达 90%，其中铜的最大检出值超标达25.8倍(表3)。

表3 长江南京大厂镇河段底质污染情况(1983.3——1984.4)

项目 / 名称	As	Hg	Pb	Cr	Cd	Cu	Zn	Co	Ni
测点数(个)	10	10	10	10	10	10	10	10	10
实测值范围(PPM)	6.186-52.1	0.036-0.22	10.4-154.6	3.3-53.7	0.00-1.06	29.3-831.9	73.4-387.9	10.2-86.9	14.1-36.4
均值(PPM)	19.66	0.099	56.46	24.75	0.182	229.82	228.88	28.07	26.91
超标测点个数	5	1	7	—	2	9	9	9	1
超标率(%)	50	10	70	—	20	90	90	90	10
最大超标倍数	4.92	1.29	6.23	—	5.58	25.8	5.05	6.2	1.04

近几年来,大回水区的有毒成份有增无减，经常发现中毒死亡的鱼类，死鱼中既有上层的鲢、鳙、鲌、也有底层的鲤、鲫、鮠,小至幼虾,大至几十斤重的成鱼， 幸免不死的也头大体瘦或体内充满煤油味，有的水域甚至鱼虾绝迹。 考察中从未在受重度污染的水域内观察到过白暨豚。目前，长江中下游干流的污染带总长已达500公里，大回水区的环境质量普遍变差，生活在其中的白暨豚被迫进行长距离的迁移。1990年3月16日，在安庆市大渡口附近，作者观察到3头一群白暨豚在大回水区内作短暂活动后，旋即迁移上行，其中一头大豚背部有特殊斑痕，肉眼能区别。考察船尾随其后跟踪，5天后豚群抵达叶家洲附近大回水区并在内作长时间栖息活动。肉眼识别后又通过照片核对，证实该豚群至少上行迁移107公里。

4、噪声对白暨豚的危害

随着航运业的发展，长江中下游沿岸港口林立，江面上客货轮穿梭， 船只动力发出的噪声对白暨豚产生的危害日益严重。 作者多次观察到白暨豚对船舶动力发出的噪声表现出惊恐不安：或深潜水层中，或躲离声源[9]。生活在港口附近大回水区里的白暨豚，终日受

机械设施发出的噪声困扰，只得被迫迁移。如作者1984年3月14日——19日在湖北排洲搬运码头和1991年5月20日——22日在安徽安庆大渡口附近的大回水区进行观察，白天噪声不息，大回水区内见不到白暨豚的踪迹，但清晨和傍晚宁静时刻， 大回水区中却能观察到白暨豚活动。又如长约100公里的武汉河段内，码头密集噪声隆隆，江面上客货轮川流不息，作者自1984年开始，连续8年的考察中都未能在该河段的大回水区内观察到白暨豚的踪迹，也未听到有关白暨豚的报导。

噪声是一种感觉公害，被噪声严重干扰的白暨豚易被船只螺旋桨击伤、击毙。据统计，1955——1984年间，由噪声引起的以外死亡占死亡总数的14.12%(表4)。1979——1981年间，仅长江下游河段内至少有10头白暨豚罹难[7]。噪声对白暨豚生理、心理的潜在影响，还有待进一步研究。

表4 1955——1984年白暨豚死亡统计*

年份	死亡原因							死亡总数(头)	平均年死亡头数
	滚钩业	螺旋桨	搁滩	电击	爆炸	泵吸	其它		
1955-1964	9						2	11	1.1
1965-1974	13	2			6		2	23	2.3
1975-1984	19	10	7	1	8	1	5	51	5.1
1984	5		1	1	7		2	16	16.0
死亡总数(头)	41	12	7	1	14	1	9	85	
死亡率(%)	48.23	14.12	8.23	1.18	16.48	1.18	10.58	100	

* 资料来源于中国科学院水生所和南京师范大学1955 年以来所搜集到的白暨豚死亡个体资料以及1985年长江中下游五省白暨豚保护座谈会提供的资料。

5、食物鱼减少对白暨豚的影响

长江中下游鱼类资源丰富，在全国淡水渔业中占有重要地位，其中青、草、鲢、 鳙、鲤、鲫、鳜、鳊、鲌、鲚等种类，不仅组成水域的主体渔产量， 而且是白暨豚生活中不可缺少的食物鱼[9],[11]。

五十年代以来，随着长江渔业生产机械化水平不断提高，渔捞强度迅速增强， 作业面广量大，加之人们为了获取更大的利润，在渔政、公安人员管理不到之处，炸鱼、 毒鱼、电鱼等，极大地破坏了渔业资源，再加上江湖阻隔、湖区围垦、江水污染等多种原因， 长江鱼类资源已大幅度减少。以产量为例，洞庭湖渔产量1981年比1949年下降55%。从渔获物组成来看，青、草、鲢、鳙等半洄游性鱼类产量下降显著，江苏境内下降50%强，过河口的洄游性鱼类产量下降98%(长江江苏渔业史，1987，江苏省水产局编)。目前，整个长江中下游渔获物组成日趋小型化、低龄化。白暨豚食物鱼减少，摄食强度加大， 意外死亡增多。作者统计了1955——1984年30年间白暨豚死亡的档案资料(表4)，从表中可以看出，近卅年来，白暨豚年平均死亡数呈几何级数增加，其中渔业、 航运直接造成白暨豚死亡数占整个死亡统计数的62.35%。

人类大规模的生产活动已急剧地改变了白暨豚分布区的自然面貌， 对白暨豚的生存和繁衍产生了严重干扰。随着大回水区环境的逐渐恶化，白暨豚意外死亡增多，仅 1990年就

发现，河段内至少有10头白暨豚死于非命，其中湖北螺新河段死亡4头，安徽官黑河段死亡4头，江苏镇江河段死亡2头。

鉴于目前白暨豚自然种群数量已不足150头的高度濒危状况，作者认为，若不采取有效措施，几代之后物种可能灭绝。当前首要任务是要保存住自然条件下的白暨豚。作者建议：除湖北螺新自然保护河段外，增设安徽官黑河段为保护河段，抢先对野生白暨豚实施“就地保护”。其内容包括摸清白暨豚的取食区域、繁殖条件、求偶和迁徙通道，加强航运、渔业管理，禁止未经处理的工业废水直接排入栖息活动水域，满足白暨豚生息繁衍的基本要求等。从长远考虑，采用无伤害技术按一定的性比、年龄结构，选择健康的野生白暨豚20——25头[12]移入半自然保护区和人工饲养池进行保护和繁殖。但是白暨豚很难适应人工饲养环境，目前只有中国科学院水生所1头雄豚“淇淇”饲养成活。为此，在加强“就地保护”减缓灭绝速度的同时，应积极开展生殖机理及育幼研究，如应用现代高新科技探讨白暨豚的人工授精技术，采用低温技术离体保存白暨豚物种种质，建立白暨豚饲养种群等，积极开展白暨豚保护生物学研究，寻找防止物种灭绝的途径。

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The Status of Population Size of the Baiji, *Lipotes vexillifer* and the Analysis of Their Rapid Decrease and the Causes

Hua Yuanyu Gao Sixing Zhang Jian

Biology Department, Nanjing Normal University,
Nanjing, 210004, PRC.

With the rapid development of people's economical activities, the platanistidae is endangered by the constructions of weirs, dykes and dams, aquatic pollution, fishing and shipping, etc. Although some odd reports have been made both at home and abroad on the platanistidae's menace[1][2][3][4][5][6][7][8], there is not a single report ever made to analyze the causes of the rapid decreases of the Baiji's population size in China.

In the years from 1984 to 1991, the author made altogether 29 ecological surveys in the river sections between Yichang and Jiangyin (1512km). Among the 29 surveys, 9 were made to investigate the effects of the water conservancy projects upon the Baiji's habitats; 4 surveys organized along the whole length of the river sections [In winter of 1985 (Oct-Nov); spring of 1986 (Apr-Jun); winter of 1990 (Oct-Nov) and spring of 1991 (Apr-Jun)]; and 16 other seasonal expeditions fielded from 1987 to 1990 to observe the Baiji's habitats along the sections between Luoshan and Xintankou (180km) of Hubei Province, and between Guanzhou and Heishazhou (200km) of Anhui Province. The Baiji is densely distributed in these regions. An approach involving several vessels was used to observe the Baiji and follow its tracks[1]. Besides, cameras with 300x300mm long-focus lens were used to take photos[9]; LS2r-1 currentmeters of propeller model to measure the current velocity; SKIPPER-ED 162 echo sounders to determine the water depth and shapes of riverbed; and the improved Pealson dredge to get the riverbed mud. By these divergent means, the author collected a vast amount of data. While making final analysis, the author take the following as their reference: materials that the authors have gathered since 1962 of the fluctuations of the population size of the fishes living in the Yangtze; hydrological data of the

Hydrological Branch of Yangtze River Drainge Area Program Office (1989); and water-pollution data provided by Nanjing Environmental Protection Science Institute (1983-1984). Therefore, the author made an estimation of the population size of the Baiji and an analysis of the causes of its decreases in number. This paper makes a conclusion of the author's researches.

I. Estimation of the Status of the Baiji's Population Size

The Baiji prefers to live in the counter-current eddies which have stable current characteristics and a slow-current portion[8]. Such eddies exist near the islets and sandbars in the meandering or multi-branched sections of the river. They can also be found at the place where the river has channels or meets the lakes (Hua Y.Y, 1992, Water Conservancy Projects Showing Effects on the Baiji's Ecological Environment). As the authors have observed, the geographical positions and hydrological characteristics of the counter-current eddies are conditioned by the shapes of riverbed as well as water depth and current velocity, etc, and are also restricted by the amount of discharge and drift sand coming from the upper stream as well as the storing and regulating capacity of the nearby branch rivers and lakes. Regardless natural or artificial reasons, any change of the water level will cause the spontaneous change of the counter- current eddies where the Baiji inhabits. If there is large amount of organic material in the trough of an eddy, the Baiji, therefore, would remain there for a long period and if the eddy's bottom is composed of pebbles, the Baiji would then migrate. The Baiji's activity always varies with the change of the eddy's condition. (See Table 1). With the distinguishing method aided by taking pictures, the author tentatively concluded that the Baiji may move over 200Km to escape the worsened environment, so that there exists the possibility of repeated observations or slips of observation caused by bad weather. Hereby, the author did a comparison between the data obtained during 1987-1991 and 1984-1986 and made an estimation of the status of the Baiji's population size.

The Baiji totalled 42 groups. about 283-287 individuals[1] when observed in 1985 and 1986. But, When the observations were conducted in 1990 and 1991, the result was as following: no track of Baiji was observed in the river sections between Yichang and Shashi (160Km) and not a new group ever found in other sections of

Table 1 Relation between the Baiji's Activity and the Environmental Conditions of It's Habitats

Characteristics of the Riversection	Meandering Sections				Multi-channelled Meanders			
Survey Times	9		7	12	11		8	9
Still Areas								
Wid.(m)	>50		50-80	>80	>30		30-60	>60
Dep.(m)	>15		>15	>15	>10		>10	>10
V.(m/s)	0.0-0.6		0.0-0.6	0.0-0.6	0.0-0.6		0.0-0.6	0.0-0.6
Boundary Areas								
Len.(m)	>300		>300	>300	>1500		>1500	>1500
Wid.(m)	>60		>60	>60	>30		>30	>30
Dep.(m)	>10		>10	>10	>5		>5	>5
V.(m/s)	0.6-1.4		0.6-1.4	0.6-1.2	0.6-1.2		0.6-1.2	0.6-1.0
Materials on Riverbed[1]	Sa. Sl. Gr. Sm. Ss. Hm.		Si.	Si.	Sa. Sl. Gr. Sm. Ss. Hm.		Si.	Si.
Baiji's Act								
Sites[2]	No	+	++	+++	No	+	++	+++
Group-Size	--	1-3	2-5	3-7	--	1-3	3-5	>3-12
Stay-Time (hr)	--	<0.5	0.5-2	>3	--	<0.5	1.0-2.5	>4

1. Sa.: sand; Gr.: grand; Ss.: small stone; Sl.:slit; Sm.:sand and mud; Hm.: hard mud; Si.: silt.
2. The symbol "+" means that Baiji could be seen only by chance, "++" means it could be seen, and the "+++" means that it could be seen more often.

river in the lower reach of Shashi. 11 individuals were observed in the river sections between Shashi and Chenglingji (240Km) , the number of decrease totalled 60 -61 individuals, compared with the observed animals in 1986; 27 individuals between Luoshan and Xintankou, Hubei Province,decreased 15 individuals compared with 1986; 44 individuals between Guanzhou, and Heishazhou, Anhui Province, decreased 17 individuals, compared with 1986; 4 individuals in the river section of Zhenjiang, Jiangsu Province , decreased 12- 13 individuals, compared with 1986; Hardly any activity of baiji was observed in the river sections of Guanyinzhou, Hubei Province, and Zhenjiang, Jiangsu Province, where the baiji had once been densely contributed and used to regularly frequent. According to result of the observations, the Baiji's group size is decreasing. The largest group consists of 7 individuals, and the usual group of 2-3 individuals and even of a single animal. According to above data, in the 800Km river sections between Yichang and Chenglingji, Luoshan and Xintankou, Guanzhou and Heishazhou and of Zhenjiang, the number in 1991 decreased by 104 -106 compared with that in 1986 (Table 2).

The observed dead individuals in recent years are mainly the mother and baby dolphins which played important roles in maintaining the survival and reproduction of the species. These victims died because of the increasing environmental pressure. Owing to lack of detailed reference, the author used geometrical averaging method and calculated that the annul degrading percentage of the baiji's population size in the five years from 1986 to 1991 was 14.66- 14.84 %, accordingly , the number of the Baiji in 1991 totalled 127 -130 individuals in the whole length of the river sections. The author believes the population size of the Baiji in China numbers is less than 150 individuals.

II. Analysis of the cause of the Rapid decrease of Baiji's population size.

1. Construction of Dam and Cutting of Curve Bring Damages to the Counter-current eddies.

The Baiji is distributed in the Yangtze within the 1690Km river sections between the Three Gorges and the river mouth. Under the influence of the Gezhou Dam Key- Water Project in the upper reach of Yichang and the systematic curve- cutting project conducted in the lower reach of Jingjang river section, the hydrological conditions current characteristics in the 401Km river section of Jingjiang, between Zhicheng and Chenlingji, underwent such a great

Table 2 The decreased number of the Baiji in some major reaches (The winter of 1985 and the spring of 1986--the winter of 1990 and the spring of 1991)

River Section	Sandbar	Length[1] (Km)	River Type	The number of the Baiji			
				1986	1991	Decreased Number	Total Decreased
Yichang	Nanyangqi	1663	M.[2]	2		2	
|	Guanzhou	1601	M.	2		2	
|	Yaogang	1578	SM.[2]	3		3	
|	Bamutan	1563	SM.	2		2	
|	Ershengzhou	1488	M.	3		3	
|	Nanwuzhou	1473	SM.	5		5	
|	Tianxingzhou	1453	M.	8		8	
|	Sanhezhou	1433	M.	8-9	7	1-2	
|	Wumingzhou	1406	M.	6		6	
|	Fanjiajia	1383	M.	8	2	6	
	Damazhou	1345	M.	8		8	
Cheng-	Baxianzhou	1290	M.	7		7	
lingji	Zhuoyuzhou	1275	M.	9	2	7	60-61
Luoshan	Changwanzhou	1288	SMC.[2]	13	9	14	
|	Fuxingzhou	1168	MCM.[2]	16	11	5	
|	Tudizhou	1133	M.	7	7[3]	6	
Xintanko	Tuanzhou	1123	MCM.	6			15
Guanzhou	Guanzhou	651	MCM.	9	8	1	
	Jiangxinzhou	620	MCM.	6	5	1	
|	Yubanzhou	602	MCM.	10	10	--	
|	Cuanshuizhou	578	SMC.	10	7	3	
	Heyuezhou	552	MCM.	7	5	2	
Heisha-	Chengdezhou	530	MCM.	9	9	--	
zhou	Heishazhou	476	MCM.	10	--	10	17
Zhenjiang	Shiyezhou	278	MCM.	16-17	4	12-13	12-13
The number in 1991 decreased by 104-106 against 1986							

1. The length(Km) is accumulated from the Yangtze River mouth upto the sandbar.
2. M.: Meander; SM.: Slight Meanders; SMC.: Straight Multi-Channel; MCM.: Multi-Channel Meanders.
3. The number of 7 embraces both decreased numbers in Tudizhou and Tuanzhou.

change that the current velocity increased, riverbeds declined down, the surface of riverbeds coarsened and the original counter - current eddies were thus damaged. On the author's expeditions in the winter of 1985 and the spring of 1986, the author didn't find any counter current eddies which could be inhabited by the Baiji in the 50Km river sections between Gezhou downstream to Yidu[8]. After repeated researches, the author claimed that the upper extreme of the Baiji's distributing area had moved from Yichang to Yidu, 50 Km away from the Dam. The author surveyed Jingjiang section again in Oct and November of 1990 and from April to June 1991. Based on his investigations, the author believe the scouring influence has reached the river section of Shashi. The counter- current eddies near 13 sandbars and islets were damaged and therefore no activity of the Baiji can be sighted in the river sections between Zhicheng and Shashi (92 Km) at namely south bank of Qingjiang, south bank of Weijiahe in Zhicheng, Guanzhou of Yangxi south bank of Songzikou, North bank of Yaogang, south bank of Lijiadu south bank of Zhijiang, south bank of Jiangkou, Mayangzhou of Huanshi, south bank of Taipingkou, south bank of Yeyazhou in Shashi and Jinchengzhou. The upper extreme of the Baiji's distributing has withdrawn downstream to the Shashi section, 160 Km away from the Dam. Habitat of the Baiji has moved downstream and decreased by 10%.

There used to be several counter- current eddies and a dense distribution of dolphins in the river sections between Shashi and Chenglingji (309 Km). According to the navigation diaries of the investigation vessel " Shuisheng No 1 " of Academia Sinica, dolphins were sighted at several places in Jingjiang river section in the 1950's. The local fishermen also reported their frequent witnesses of Baiji's activity in groups consisting of about 11 or 20 individuals. After the systematic curve- cutting project in this section, 74 Km of river, totalling 4.4% of the Baiji's distributing areas, was divided into three Oxbow where no dolphin inhabited. At the section in the upper reach of the curve- cutting river section, the water underwent a general increase of current velocity and a scouring from downstream to upper. The result of investigation in 1991 shows that the scouring has developed to the upper stream,and the counter- current eddies in the Shashi - Chenglingji sections have been obviously damaged namely at Nanyangqi, Guanzhou, Yaogang, Bamutan Ershengzhou, Nanwuzhou, Tianxingzhou, etc. Compared with the data of the same period in 1986, the Baiji has decreased rapidly in number (See Table 2). The density of the dolphin's distribution has decreased to 10.36 Km/per individual from 3.67 Km/ per individual. Besides, after the curve - cutting, the water level at the 3 places where the Yangtze and Dongting lake meet lowered. The amount of discharge and drift sand that the lake shares decreases year by year. The run off the trunk stream correspondingly increases. Such change and regulation in the river lake relations lead to the increase of current velocity and the scouring in the sections between Daxingzhou and Yanglinyan of the lower reach of Chenglingji. The several eddies withered at Luxikou, Zhongzhou, Paizhou and Tuanzhou in the sections between Luoshan and Xintankou and, and as a result, the number of the dolpins correspondingly decreased. (See Table 2)

2.Dam constructions at the place where the river and lakes join cause effects onto the Baiji.

The eddies formed at the place where the lakes join the river provide ideal place of repose for the dolphins. According to the fishermen's reports, dolphins were frequently sighted, sometimes even 20 individuals appeared spontaneously near the lakes mouths before the dams were built. But, after the completion of the dams, no dolphin has ever been observed. In the recent 30 years, a large number of dams have been set up at the joint spots where the lakes and the Yangtze River meet. Simply in middle reach, there are 27 lakes which respectively covers more than 101km lakes separated by dams from the trunk stream. The total size of the isolated numbers 1793.5 Km^2. In Anhui Province, people built many dykes and claim land from the lakes, which makes a requisition of 500 million mu of lake. At present, almost all the lakes have been separated from the trunk stream in the middle and lower part of Yangtze except a small number of lakes still open into the river namely Poyang Lake, Dongting lake, several flood storage lake and the Oxbow, which come from curve- cutting project in Jingjiang river course. The natural hydrological systemic structure built by the joining of lakes and river was destroyed and thus its hydrological functions disappeared, the fish lost vast fertile area where they used to seek food, and the hydrological conditions at the river- lake joining spot varied. The author didn't witness any dolphin near the spot where dams were constructed. Except the dolphin that the author observed where the Poyang lake and Dongting lake open onto the river in his years of field investigations, no dolphin was ever

Table 3 Pollution of the River Bed of the Dachangzhen River Reaches in Nanjing. (1983,3--1984,4)

Elements	As	Hg	Pb	Cr	Cd	Cu	Zn	Co	Ni
Samples	10	10	10	10	10	10	10	10	10
Density (PPM)	6.186-52.1	0.036-0.22	10.4-154.6	3.3-53.7	0.00-1.06	29.3-831.9	73.4-387.9	10.2-86.9	14.1 36.4
Average (PPM)	19.66	0.099	56.46	24.75	0.182	229.8	228.9	28.07	26.9
Overdensty Samples	5	1	7	--	2	9	9	9	1
Multiples of Surpass	4.92	1.29	6.23	--	5.58	25.8	5.05	6.2	1.04

sighted at linking spot where a dam was built to separate a lake from the main river.

3. Effects of Water Pollution upon the Baiji.

Water pollution was caused by the waste water emitted directly by the factories. The statistics of 1985 shows that the emission of the waste water along the Yangtze totalled 128 billion tons, constituting 37% of China's total drainage. Such waste water emitted into the Yangtze consists of so various elements that it usually pollutes the Baiji's habitats. Take, for example, the Dachangzhen section where there are several counter- current eddies and large groups of dolphin were reported to be seen by the fishermen in the early 1950's. Since it turned into an industrial zone of chemical industry, metallurgical industry and power industry. Nanjing Steel Works, Nanjing Chemical Industry Company and Nanjing Heat and Power Plant stand along the river bank, covering nearly 10 Km of riverbank, deliver about 17,000 tons of noxious substances per year, such as ammonia nitrogen, arsenic, phenol, cyanogen fluorine and heavy metal ions. What matters seriously is the river bed has been polluted by high concentration of metal ions. Among the 10 tested items, 9 exceed the index. Cu, Zn and Co surpass the index by 90% and Cu goes beyond the index by 25.8 times of the index. (See Table 3).

In the recent years, the noxious elements keep increasing so that the poisoned dead fish can often be found ,which included *silver carp variegated carp*, *Hypophthalmichthys molitrix*, *Aristichthys nobilis*, *Culter alburnus*, frequenting the upper level of water, and also included *Cyprinuscarpio haematopterus*, *Leiocassis longirostris,* living in the depth of water. These survived were usually very slim, some send off a smell of kerosene and, in some areas, fishes and shrimps even disappeared. No dolphin was observed during the authors investigation. Nowadays, the polluted areas in the trunk stream of the middle and lower reaches of the Yangtze River have expanded to 500 Km, the aquatic environmental quality of the eddies worsened and then the Baiji living in these arras were forced to make long distance migration. On Mar 16, 1990, the author observed a group of 3 dolphins stay for a short time in the eddies near Dadukou, Anqing. One of the dolphins had on its back a special mark which can be distinguished by eyes. The vessels followed the group. 5 days later, they were found in the counter-current eddies near Yejiazhou. They stayed there for a long time. Based on eye identification and checked with photos, the author believed that the group had covered at least 107Km upstream.

4. Noise Hurt the BaiJi.

With the development of shipping, numbers of ports have been set up along the Yangtze River, and, passenger ships and cargo ships shuttle fro and to on the river. The noise sent off by the ships produces a more and more hurt to the Baiji. The author often observed the uneasy and frightening reactions of the Baiji. When a ship engine made a loud noise, they would dive deeply or tried to escape the noise[9]. The Baiji which used to frequent the eddies near the ports are forced to move away because of the noise produced by the mechanical equipment. The author once fielded a survey in Paizhou Docker of Hubei Province from Mar, 14 to 19 in 1984 and another one in the eddies near Dadukou of Anqing, Anhui Province in the period from May 20 to 22 in 1991. At day time, the eddies were filled with continual noise and there was no dolphin observed. But, at dawn and dusk when it was quiet in the eddies, the author could view the dolphins' activities. Here comes another example. Along The 100 Km or so river section of Wuhan, a dense distribution of ports makes a rumble of noise daily, passenger ships and cargo ships make a continuous shuttle. Since the author conducted his first in investigation in 1984, he had neither observed any dolphin in this in this river section nor heard of any report of the Baiji.

Noise is a kind of sense hazard. The dolphins which suffered serious noise disturbance are easily to be hurt or killed by ships' propellers. A statistics shows that, from 1955 to 1984, the accidental mortality caused by noise disturbance shared 14.12% of the total (See Table 4). From 1979 to 1981. at least 10 individuals of the Baiji were killed only in the lower reach of the Yangtze[7]. Further researches should be conducted to study the potential effects of the noise upon the Baiji's physiology and psychology.

Table 4 Mortality of the Baiji from 1955 to 1984

Year	Death Causes: Roll Hooks	Propp-eller	Strand	Elec-tron	Bomb	Pump	Others	Total Death	Ann Dea 1
1955-1964	9						2	11	1.1
1965-1974	13	2			6		2	23	2.3
1975-1984	19	10	7	1	8	1	5	51	5.1
(1984	5		1	1	7		2	16	16.0)
Total	41	12	7	1	14	1	9	85	
Percentage	48.23	14.12	8.23	1.18	16.48	1.18	10.58	100	

1. It represents the "Average Annual Mortality of Baiji", and the unit is "Individual / year".

5. Decrease of the fish amount Affect the Baiji.

There are rich fishery resources in the middle and lower Yangtze which play an important role in China's freshwater fishery business. Fishes that include *Mylopharyngodon piceus, Ctenopharyngodon idellus, Hypohthalmichthys molitrix, Aristichthys nobilis, Cyprinuscarpio haematopters, Carassius auratus, Siniperca,* *Parabramis and Coilia ectenes*, form a major output of the fishery in this area and provide the food that the BaiJi liver on.[9][11]

With the development of fishery mechanization in the Yangtze River since 1950's, fishing intensity increased and fishing areas broadened. Besides, some people used electronfishing, bombfishing and poisonfishing methods in order to gain more profits. All these brought tremendous damages to the fishery resources. Meanwhile, construction of dams between river and lakes, building decor to reclaim land from lakes as well as water pollution also cause the reduction of the Yangtze's fishery resources. Take, for example, the fact that the Dongting Lake fishery output in 1981 was reduced to 45% of that in 1949. As fishing catches are concerned, output of some fishes, namely, *Mylopharyngodon piceus, Ctenopharyngodon idellus, Hypohthalmichthys molitrix, Aristichthys nobilis*, have been reduced rapidly. Reduction rate in Jiangsu Province even reached 50% (History of Jiangsu Fishery, 1987, Fisheries Bureau of Jiangsu). At present, in the middle and lower Yangtze River, the catches tend to be smaller in size and younger in age. That the amount of fish decreased, leads to the increase of Baiji's hunting intensity and its accidental death. The author has made a calculation of Baiji's mortality during the 30 years from 1955 to 1984 (See Table 4) and therefore it has been clear that the average annual mortality of the Baiji increased with a geometrical progression in the last 30 years. Deaths caused directly by fishing or shipping amounts for 62.35% of the total.

The natural characteristics of the Baiji's distribution has been severely changed by the people's wide scope of production and ecological activities, which also seriously disturbs the Baiji's survival and reproduction. The Baiji's accidental morality increased along with the environments of the counter-current eddies is being gradually worsened. Only in 1990, at least 10 dolphins died accidentally in Luoxin section, Hubei Province, 4 in Guanhei section, Anhui Province, and 2 in Zhenjiang, Jiangsu Province.

At present, the status the Baiji's Population size amounts for less than 150 individuals. the Baiji is living under great dangers. The author thinks it imperious to adopt effective measures to prevent the Baiji, otherwise, it will become extinct in several generations. The main task at present is to save the Baiji which is still living in the nature. The author recommends that except the preservation section of Luoxin, Guanhei section should be established as another one, and people should try to protect the Baiji on spot, which means to know clearly the Baiji's feeding area, conditions, reproduction and route of its courtship and migration, to strengthen the fishing and shipping, prohibit the disposal of industrial sewage untreated into the Baiji habitats, so that the basic requirements of the Baiji's living may be satisfied.

For the sake of future, we'd better pick out a special average of sex and age according a certain amount of healthy dolphins, about 20 to 25 individuals[12], and keep them in the semi-natural preserves or feeding pools for reproduction and further protection. However, the Baiji is hard to adapt to the artificial feeding. So far, only in Institute of Hydrobiology Academia Sinica, a male dolphin "QiQi" has survived the artificial feeding. In view of these, the author recommends that more preserves be set up as soon as possible so as to slow down the Baiji's extinction. Meanwhile, we should conduct further study on the Baiji's breeding and suckling mechanism, apply high technology to the researches of the Baiji's artificial insemination, use hypothermic method to preserve the species substances and to develop hydrobiological study of the protection methods of the Baiji to seek more ways to prevent the dolphin's extinction.

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白暨豚种群现状及保护

张 先 锋

(中国科学院水生生物研究所，武汉，430072)

目前，有关白暨豚种群的生物学研究，可以说是不充分和不协调的。原因之一，同时也是最重要的原因是缺乏足够的研究经费。然而，国际、国内同行间的沟通不够和协作不力亦是重要原因。当然，白暨豚的种群数量也的确太少了，以致于难以运用有效的方法对其进行有效的观察、跟踪和监测。不过，无论如何，中国的和外国的专家们仍在尽最大努力，从不同的角度、用不同的方法来研究这一人们了解甚少、十分神秘、十分濒危的淡水豚。本文的资料来自于14篇公开发表和未发表的文献以及作者的最新研究结果。

一、白暨豚种群的动态与现状：

毫无疑问，白暨豚种群的现状，如白暨豚的种群数量、白暨豚的迁移规律等问题是白暨豚研究与保护工作的最大难点之一。1977年以来，先后有周开亚等(1977、1980、1982、1989、1993)，陈佩薰等(1980、1987、1989、1990、1992)，林克杰等(1985)，华元渝等(1989、1990、1991)，刘仁俊(1991)从不同的侧面报导了一些白暨豚种群生物学问题。根据上述报导，结合作者的研究作如下综述：

1.白暨豚的种群数量及其变动趋势

白暨豚的种群数量一直是人们关注的问题。周开亚(1982)根据长江下游南京至贵池 250公里江段的考察结果推测，白暨豚种群数量约为 400头。林克杰等(1985)根据1978—1983年长江中下游考察结果，用点估计的方法推算，白暨豚种群数量超过 156头。陈佩薰等(1987、1989)运用改进了的多船考察的方法，根据1985—1986年的考察结果，估计白暨豚种群数量约为 300头。周开亚等(1989)根据长江下游的考察结果，估计分布于长江下游的白暨豚数量约为 100头，与 300头的观点相吻合。陈佩薰等(1990、1992)根据1987年以后在长江中下游连续监测白暨豚种群数量的结果，估计白暨豚的种群数量已不足 200头。周开亚等(1993)根据在长江下游对白暨豚照相识别的结果，推测白暨豚的种群数量已不足 150头(图 1)。

上述数字跳跃较大，不大一致。实际上，白暨豚的种群数量仍是一个悬而未决的问题。目前，谁也无法用充分可靠的理由来说明白暨豚的种群数量现在到底还有多少。根据我们近年的考察，很可能白暨豚的种群数量比人们目前的估计还

要悲观得多。

尽管如此，从图 1不难看出，白暨豚的种群数量呈明显的下降趋势。关于这一点，作者从1985年以来中国科学院水生生物研究所开展的23次考察中，挑选10次方法相同、江段相近的考察结果进行比较。发现这10次考察的SPUE 值亦呈显著的下降趋势（表 1）。

表 1. 1985—1993年10次考察结果的SPUE 值统计比较

考察时间	工作天数	观察到的白暨豚数量	SPUE 值
1985.11.23-1986.02.02	71	243-247	3.45
1986.04.08-1986.06.04	58	176	3.03
1987.02.20-1987.04.02	40	32	0.80
1988.12.20-1989.01.07	19	17	0.90
1989.03.13-1989.04.11	30	7	0.23
1989.11.15-1989.12.04	20	1	0.05
1990.02.09-1990.04.07	58	6	0.10
1991.11.01-1991.11.18	18	1	0.05
1992.02.09-1992.02.28	28	1	0.05
1993.02.15-1993.04.16	61	7	0.11

2. 白暨豚的集群

白暨豚的典型栖息地为大洄水区（陈佩薰等1987，华元渝等1989）。一些洄水区被白暨豚群体所占据，而另一些却未被利用（陈佩薰等1990）。通常，白暨豚群体以2—4头最为常见。 迄今记录到的最大白暨豚群体为16—17头（陈佩薰等1987、1989）。分析1985年以来白暨豚群体资料可以看出，白暨豚的集群规模有明显缩小的趋势。1988年以后，从未观察到超过10头的群体， 8—10头的群体已非常罕见。图 2显示1985年以来，观察到的白暨豚的集群大小及变化。

3. 白暨豚的社群结构

陈佩薰等（1985， 1989），林克杰等（1985）根据白暨豚的体型（体长、体重）和年龄的关系，把白暨豚的发育分为三个阶段。幼年豚，0—4（♂）、5（♀）龄，体重小于80公斤，体长150厘米；成年豚，5—20（♂）、6—20（♀）龄，体重不超过150公斤，体长220厘米；老年豚，大于20龄，体重大于150公斤，体长大于220厘米。粗略统计各阶段所占的比例如下：42%，55%，3%。

刘仁俊（1991）根据 102头白暨豚标本资料，统计出白暨豚种群的性比约为1：1（♂：♀=48：52）。成熟雌体约占全部雌体的30%。成熟雌体的妊娠率亦

为30%。以白暨豚种群数量为 150头（周开亚等，1993）推算，每年仅有约 7头白暨豚会怀孕，新生的个体就更少得可怜了。

4.白暨豚的迁移

显然，由于在长江中下游没有天然或人为的障碍，白暨豚可以在不同的栖息地和不同的群体间迁移。因而可以认为，白暨豚种群是相互关联的种群（metapopulation）。就目前资料而言，很难推测白暨豚的家域范围。

自华元渝等（1990）首次报导运用照相识别技术研究白暨豚迁移的可能性后，近来有了可喜的进展。周开亚等（1992）通过照相识别确认，白暨豚的迁移距离至少达 204公里。另一方面，作者统计1987—1990年间， 108头白暨豚观察记录发现，其中 101头是逆水向上迁移的，占93.5%。这种上行迁移均是在清晨至下午 4时这段时间内观察到的。由此推测，白暨豚的上行迁移多发生在白天中的大多数时间内，向下迁移多发生在黄昏或夜间。

二、白暨豚保护工作的最新进展：

1.国家农业部公布《白暨豚保护总体规划》

1992年12月，农业部主持，在武汉召开了《白暨豚保护总体规划论证会》。该规划由中国科学院水生生物研究所代起草。主要内容包括：1)建立两个国家级白暨豚自然保护区，即“长江天鹅洲白暨豚自然保护区”和“湖北长江新螺段白暨豚自然保护区”。2)建立湖北监利、湖南城陵矶、江西湖口、安徽安庆、江苏镇江五个白暨豚保护站。3)完善安徽铜陵白暨豚养护场。4)利用这些区、站、场建立长江中下游白暨豚信息网。这个《白暨豚保护总体规划》已于1992年 4月由国家农业部批准实施。

2.长江天鹅洲白暨豚自然保护区

1986年10月，在武汉召开的首次“淡水豚类生物学与物种保护”国际学术讨论会上，中国科学院水生生物研究所提出了“建立长江天鹅洲白暨豚保护区”的设想。主要是针对长江干流日益恶化的环境，利用长江中游荆江江段的长江天鹅洲故道对白暨豚实行迁地保护。随后，在农业部的支持下，中国科学院水生生物研究所立即着手对天鹅洲故道进行本底调查。调查的项目包括，水质理、化和生物指标、污染物浓度、底质、鱼类资源、生物生产力等。1988年底完成该调查，结果理想（中国科学院水生生物研究所，1988；张先锋等，1990）。1990年3—4月，引 5头江豚进入故道试养。1993年 4月再次引入 5头江豚试养。目前，江豚在故道内生长良好，并在故道内妊娠和产下了新的一代小江豚。

长江天鹅洲白暨豚自然保护区已由国家投资开始兴建。主要建筑包括一个管理站及必要的研究设施，一个暂养池，故道上下口的防逃工程， 200亩精养鱼池（用于渔民转产安置）。另外，配备巡逻车船和通讯设备。捕捉白暨豚进入天鹅洲故道的准备工作亦在抓紧进行。

2.湖北长江新螺段白暨豚自然保护区

湖北长江新螺段白暨豚自然保护区位于长江中游的洪湖新滩口至螺山江段，是白暨豚分布相对密集的江段之一。该保护区于1987年被批准为省级保护区并开始筹建。1992年被批准为国家级保护区。经国家投资，该保护区已建造 150马力巡逻船一艘、75马力快艇一艘，已开始在该保护区内管理、巡逻和监测白暨豚群体活动。在该保护区两端各树起一座14米高的标牌。一个具管理和研究功能的保护区管理处已开始在洪湖市兴建。此外，该保护区还训练了一批渔民，经常协助科研部门考察白暨豚。

4.白暨豚馆落成

由中国科学院投资，得到日本国际协力事业团和江之岛水族馆的支持，一座较为现代化的白暨豚饲养繁殖系统——白暨豚馆，于1992年11月在武汉，中国科学院水生生物研究所内落成。该馆具有完备的白暨豚饲养、繁殖和研究功能。一头白暨豚和一头江豚目前在该馆内生长良好。在建设该馆的同时，中国科学院水生生物研究所还专门训练了白暨豚饲养、繁殖方面的研究人员。两年来，已有 7人次从国外学成归来（其中， 4人次赴日本、 2人次赴香港、 1人次赴美国）。这些为全面、深入进行白暨豚研究和保护打下了良好的基础。

5.安徽铜陵白暨豚养护场

安徽铜陵白暨豚养护场位于长江下游。该养护场于1985年经初步论证，1987年12月由国家投资开工兴建。四年之后，1991年10月，养护场工程通过了预验收。该工程包括，1500米长的夹江清淤工程，暂养池工程，水处理工程，研究和办公楼工程，通讯和道路工程等。1992年 3月，从长江捕捉江豚进入该养护场暂养池试养成功。1993年 1月，由农业部主持，对该养护场进行了全面考察和论证。

三、今后有关白暨豚研究和保护的几点推荐意见：

白暨豚的种群数量已非常稀少，这个物种已岌岌可危。现在迫切需要的是实实在在的行动而不仅仅是开会、讨论和写文章。为此，我们紧急呼吁，在尽快实施《白暨豚保护总体规划》的同时，迅速开始如下行动：

1. 中国的白暨豚研究者们真诚携起手来，共享信息、资料、设备、人力物力和有限的研究经费。既有分工，又有合作，最大可能地发挥各自的优势。共同解决白暨豚的种群数量监测、个体跟踪和识别和饲养条件下繁殖白暨豚等急待解决的问题。

2. 利用中国科学院水生生物研究所白暨豚馆的有利条件，建立一个饲养条件下白暨豚繁殖研究的中心。该中心向国内外开放，请国际国内的专家前来进行联合攻关。争取在短时间内建立白暨豚精子库、卵子库甚至胚胎库，最大限度地保护白暨豚的部分基因。同时，该中心也可办成白暨豚研究和保护人员的训练基地。

3. 组建一个全国性的和一个国际性的白暨豚保护委员会或协会。前者由农业部牵头，由国内的专家和有关的政府官员组成。其任务是统筹、协调全国的白暨豚保护工作。后者由 CSG 和／或CBSG 牵头，由国际上有名的专家、有关保护组织和机构的代表以及中国国内的专家和政府官员组成。其任务是向国内外募捐白暨豚研究和保护经费，监督该经费的使用，制订研究和保护计划，训练保护人员，协调政府与保护组织间、官员与专家间、中国与国际间的关系。

Population size

Fig. 1 Estimate population size

of baiji since 1982

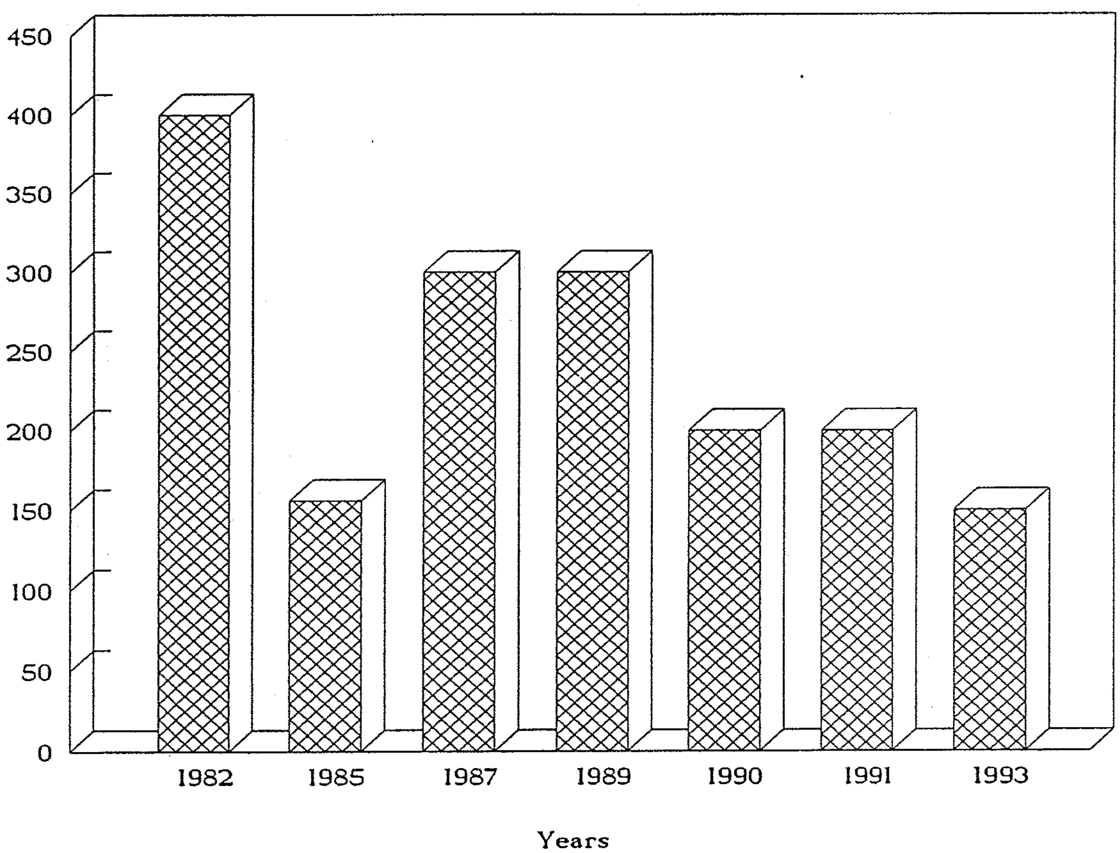
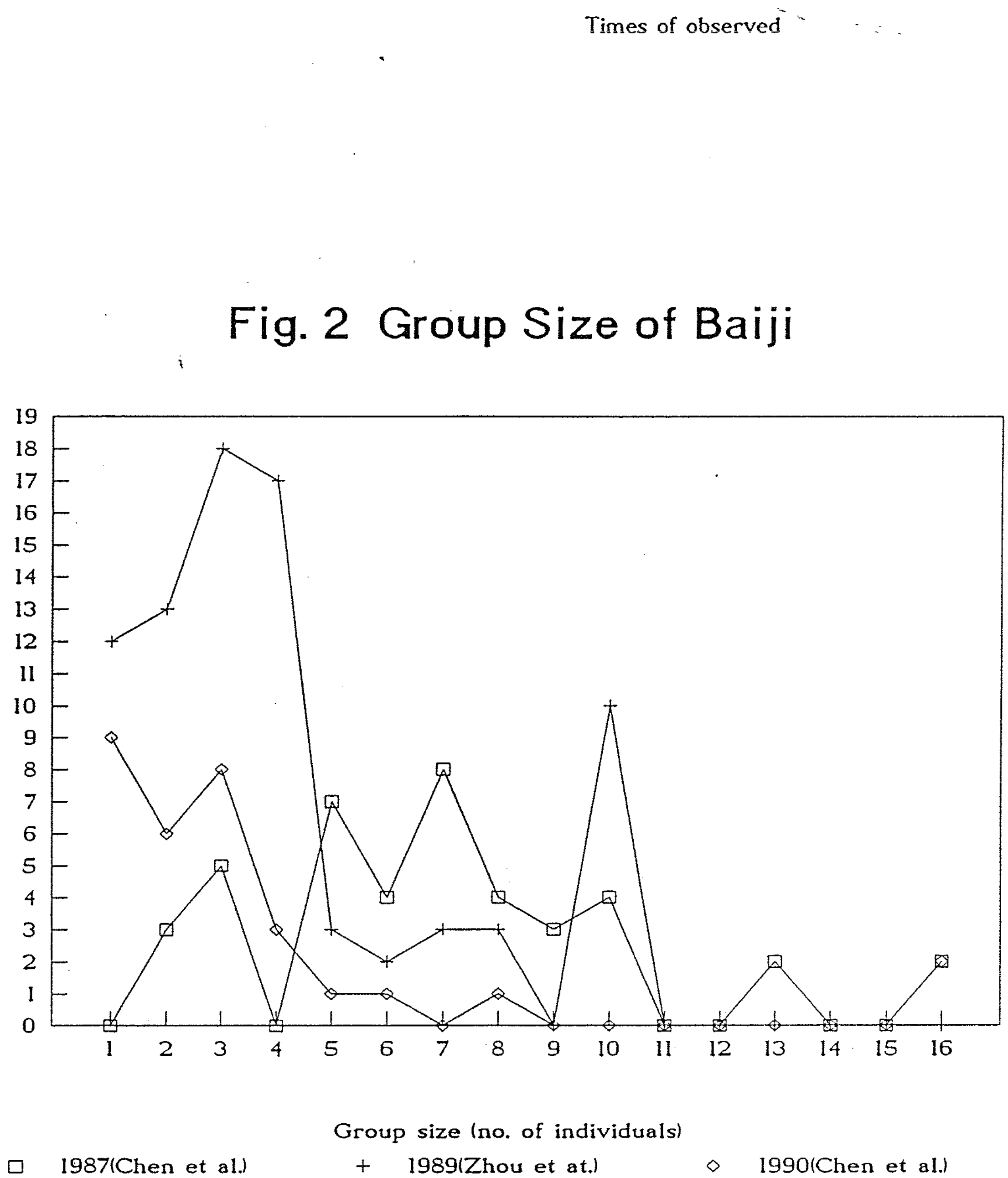
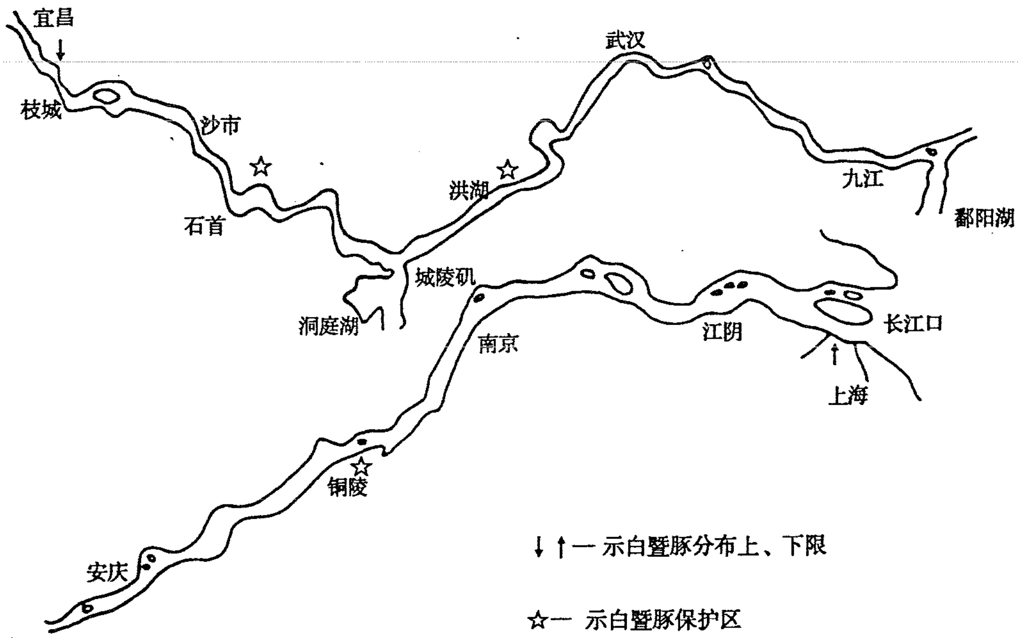
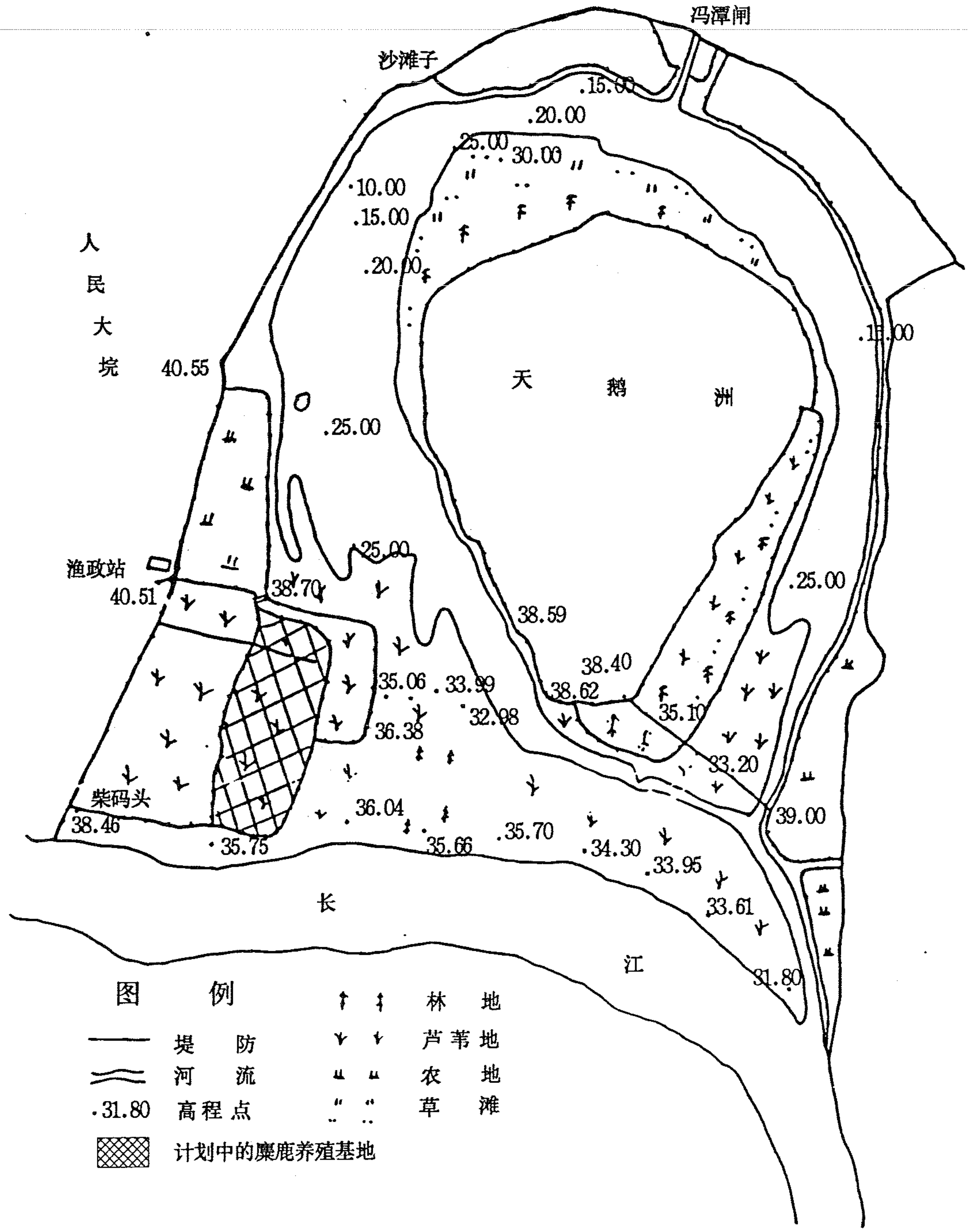


Fig. 2 Group Size of Baiji





白暨豚分布图（上：长江中游；下：长江下游）



天鹅洲故道平面图

(1:66667)

Working Paper for Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

POPULATION STATUS AND CONSERVATION OF THE BAIJI, *LIPOTES VEXILLIFER*

Zhang, Xianfeng
(Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan, Hubei 430072, P. R. China)

At present, the study of population biology of baiji, *Lipotes vexillifer,* in China is still in its early stage. One of the reason, also the most important reason is the lack of enough funds for research. However, the lack of cooperating among China's scientists and international experts as well is another reason. Of course, baiji's population is too small to observe, follow and monitor with effective methods. Nevertheless, we are still trying our best to study this very very endangered river dolphin from different angles with different ways. Data of this review are obtained from 19 published and unpublished sources as well as latest research of us.

POPULATION DEMOGRAPHICS AND STATUS

Population status of baiji, such as the population size, migration etc. are undoubtly the most important thing we need to know for its conservation. Zhou et al. (1977, 1980, 1982, 1989, 1993), Chen et al. (1980, 1987, 1989, 1990, 1992), Lin et al. (1985), Hua et al. (1989, 1990, 1991), Liu (1991) have reported successively some studies on those questions from different aspects since 1977. Based upon the above reports, we review some opinions with our latest research as follows.

1. Population size of baiji

Population size of baiji is always a problem concerned by people. Zhou et al. (1982) first reported the population was about 400 animals on the basis of data obtained between Nanjing and Guichi, a 250km section of the lower river. Later on, Lin et al. (1985) gave a estimation of over 156 according to surveys using the method of spot estimation to treat the data obtained during 1978 and 1983 in the middle and lower river. Chen et al. (1987, 1989) estimated that there were about 300 individuals depending on surveys carried between 1985 and 1986 in the middle and lower river using the improved investigating method searching for dolphins, which included using several boats at a time and making observation from both sides of the boat. At the same time, Zhou et al. (1989) estimated that the population size of the lower river was about 100, which was identical with the result of 300. After 1987, Chen et al. (1990) continued to monitor the population both in the middle and lower river and estimated that the population size then had fallen to less than 200. More recently, Zhou et al. (1993) reported that the population size was about 150 depending on the preliminary results of photo-identification of baiji in the lower river (Fig. 1).

It seems that the above numbers were fluctuated and out of accord with each other. In fact, population size of baiji is still an open question. No one is able to give a precise estimation with enough and reliable evidences today. It is considered that the population is possibly much more pessimistic than the above estimations.

Even so, it is not difficult to find that the population size obviously presented a tendency of decreasing from Fig. 1. We compared eight results of surveys which were carried out with same methods of searching for dolphin and in the similiar sections of the river, which were selected from 21 surveys carried by us from 1987 to 1993. From the results, it was also obviouse that the SPUE (Sightings Per Unit of Effort-no./day) presented the same tendency (Tab. 1).

Tab. 1 The SPUE(no./day) during 1987 and 1993

Survey date (mm/dd/yy)	Days of effort	No. of dolphin observed	SPUE
02/20/1987-04/02/1987	40	32	0.80
12/20/1988-01/07/1989	19	17	0.90
03/13/1989-04/11/1989	30	7	0.23
11/15/1989-12/04/1989	20	1	0.05
02/09/1990-04/07/1990	58	6	0.10
11/01/1991-11/18/1991	18	1	0.05
02/09/1992-02/28/1992	20	1	0.05
02/15/1993-04/16/1993	61	6	0.11

2. Aggregation of baiji

Tipical habitat of baiji is large counter-current area (Chen et al. 1987, Hua et al. 1989). Some habitats are being occupied by the dolphin's group, some others are not being utilized (Chen et al. 1990). Usually, the group of baiji consists 2-4 individuals. The biggest group recorded so far was consisted of 16-17 animals (Chen et al. 1987, 1989). It had also observed that the group size was going down since 1985. The group with more than ten individuals have never been observed after 1988. Even smaller groups with 8-10 animals were very few observed since then. Fig. 2 shows the group size and the corresponding frequencies.

3. Social structure of baiji

Growth of baiji was divided into three stages based upon the body type (body length and body weight) and the age (Chen et al. 1985, 1989; Lin et al. 1985). Newborn and young: age of 0-4 (male) or 6 (female) years, body length less than 150cm and weight less than 80kg; Adult: 5-20 (male) or 6-20 (female) years, length 220cm and weight 80-150kg; Old: over 20 years and more than 220cm and

150kg. A rough estimation of proportion of each stage was given respectively: 42%, 55% and 3%.

Sex ratio of the population was approximately 1:1 (male: female=48:52) depending on data obtained from 102 specimens (Liu, 1991). There were about 30% of adult females among whole females and the pregnant rate was also 30%. It is estimated that only about seven females may be in pregnancy per year according to the latest population size of 150 individuals estimated by Zhou (1993). And the newborn animals will be more pathetically few.

4. Migration of baiji

Obviously, the dolphin may migrate or move among different groups and habitats because there is no natural or artificial obstacle in the main stream of the middle and lower river. So, it is believed that baiji's population is metapopulation. But it is hard to estimate the dolphin's home range according to present information obtained so far.

However, some heartening results on photo-identification of baiji have been obtained after Hua et al. (1990) first reported the feasibility of using the technique to study baiji's migration. It was comfirmed that the movement distance of one baiji was at least 204km (Zhou et al., 1992). Meanwhile, 101 individuals were observed migrating against the current among 108 observations between 1987 and 1990, which made up 93.5% of the total records. All of the up stream movements were observed at the day time from early morning to 4 pm., which shows that the up stream movements happened at the most of the day time, the movements with the current might happen mainly in dusk and night.

LATEST PROGRESS ON THE CONSERVATION OF BAIJI

1. " An Overall Plan For Conservation of Baiji" promulgated by the Ministry of Agriculture

In December, 1991, a meeting called "expounding and proving the overall plan for conservation of baiji", convered by the Ministry of Agriculture, was held in Wuhan for discussing a nation wide comprehensive programme and immediate actions to save baiji. The plan, entrusted by the Ministry of Agriculture, was drafted by Institute of Hydrobiology in earlier time. Main contents of the plan are highlighted as follows: 1/ to establish two national natural reserves for baiji, namely, Tian-e-zhou semi-natural reserve for baiji and Xin-luo baiji natural reserve. 2/ to set up five protective stations, which are Jianli in Hubei, Chenglingji in Hunan, Hukou in Jiangxi, Anqing in Anhui and Zhengjiang in Jiangsu. 3/ to improve Tongling baiji reserve's rearing conditions. 4/ to set up an information network for baiji along the stations. The plan had been approved and enforced by the Ministry of Agriculture in April, 1992.

2. Progress on the Tian-e-zhou semi-natural reserve for baiji

The proposal of establishing a semi-natural reserve at Tian-e-zhou oxbow for baiji was first put forward at the workshop on the biology and conservation of river dolphins in Wuhan in October, 1986. It is planned to translocate the dolphin from main river to the oxbow where environment is very similar to that of baiji's habitat in the main river. In fact, some dolphins used to move around there before it separated from the main stream and even today, a group of four animals are usually found in the main stream where is just several kilometers away from the oxbow. We, the Institute of Hydrobiology, supported by the Ministry of Agriculture, made a baseline investigation at the oxbow, including examinations of physical, chemical and biological features of the water, levels of contaminants, bottom sediments and fish resources ect. (Institute of Hydrobiology, 1988; Zhang et al., 1990). In March and April of 1990, five finless porpoises, *Neophocaena phocaenoides*, were moved into the oxbow to test if this area was indeed suitable for baiji. In April of this year, another five finless porpoises were move once again into the oxbow. These porpoises have been living very well there. They could not only survial but also give birth as well as nurse calves there.

The reserve has been started construction invested by the state government. Project of the reserve mainly includes a management station with necessary facility for research, a pool for keeping dolphin temporarily, long fixed net at the both ends of the oxbow for preventing the escaping of baiji, 400 *mu* fish pounds for changing the job of the fishermen, who used to live on fishing in the oxbow, from fishing to cultivting. Patrol car and boat as well as communicating equipment are being also equiped in addition. Preparation for safely catching baiji and transporting them are also being carried on in time.

3. Progress on Xin-luo baiji natural reserve

Xin-luo section, located in the middle river from Xitankou to Luoshan of Honghu City with a total length of 135km, is one of the sections representing the main distribution of baiji. The reserve was approved as a provincial natural reserve in 1987 and started to prepare since then. It was upgraded as a national natural reserve in 1992. One patrol boat with 150h/p engine and one motorboat with 75h/p outboard engine are working in the section to patrol and monitor the population status. Two 14m high signboards, on which " Natural Reserve For Baiji" was highlighted, had been set up at both ends of researching and doing official work has been started construction in Honghu. On the other hand, a group of fishermen had been trained for observing dolphin, they usually assisted us to investigate baiji in the section.

4. Completion of the New Baiji Dolphin Aquarium

A new much improved rearing and breeding facility--the Baiji Dolphin Aquarium had been completed at the Institute of Hydrobiology in Wuhan in November of last year. The aquarium was invested by the Chinese Academy of Sciences with finacial help from Japan International Cooperation Agency and the Enoshima Aquarium in Japan. It possesses full function of rearing, breeding and researching. One baiji and one finless porpoise are living well here. Meanwhile, researchers of the institute have also gotten some special training on dolphin keeping, rearing and breeding. During last two years, there were seven person/times going to foreign countries or area for training or visiting (among them, four to Japan, two to Hongkong and one to United States). All of these have supplied a well basis for studying and protecting baiji widely and deeply.

5. Progress on Tongling Baiji Reserve

Tongling baiji reserve is located at the lower river in Anhui Province. The proposal was preliminary discussed in 1985 and started construction in December, 1987. Four years later, the project had been prechecked in October, 1991. Main projects of the reserve include digging and sweeping away bottom mud sediment in the strip, which is a channel between two ilands with 1500m in length, a pool for keeping baiji temporarily, water processing facility, two buildings for researching and doing official work, and communicating and transporting equipments ect. Seven finless porpoises were introduced into the reserve in 1992, three of them still living well in the pool. This reserve was reexaminated comprehansivly in January of this year.

RECOMMENDATIONS FOR FUTURE RESEARCH AND CONSERVATION

Population size of baiji is already very small, and this specise is faced with imminant extinction. The urgent need for saving baiji should be real, effective and exact actions, not just talking, discussing and publishing articls. For this purpose, we critically appeal here that the following actions should be done soon while carrying on the "Overall Plan For Conservation Of The Baiji."

1. We, the researchers of China, should join hands truly, sharing information, data, equipments, manpower and material resources and the very limited funds for reserach as well. Let us work together to solve the problems of monitoring baiji's population, tracking its movement, identifying the dolphin and breeding them in

2. It seems necessary to establish a captive breeding research center for baiji using the favourable conditions possessed already at the Baiji Dolphin Aquarium in the Institute of Hydrobiology. The center should be opened for both inside and outside of China. Scientists should be invited together to tackle problems of breeding the dolphin. In order to keep baiji's gene as far as possible, it is also necessary to establish banks for its sperm, ovum and even embryo here. Meanwhile, the center should also become a training base for researchers and conservators.

3. Two conservation committees /or societies for baiji should be composed, of which one is national and the other is international. The former should be orgnized by the Ministry of Agriculture and composed of scientists and officers of China. Duties of it are to coordinate and orgnize nationwide conservationwork. The latter should be orgnized by the CSG (Cetacean Specialist Group) and/or CBSG (Captive Breeding Specialist Group) and composed of worldwide experts, representatives of orgas and institutions concerned nature conservation, as well as scientists and officers of China. Duties of it are to serach for funds and work out plans for reaearch and conservation, supervise use of the funds, train conservators, coordinate relationships between governmant and protective orgas, officers and scientists , China and the world as well.

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Working Paper for Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

Population size

Fig. 1 Estimate population size

of baiji since 1982

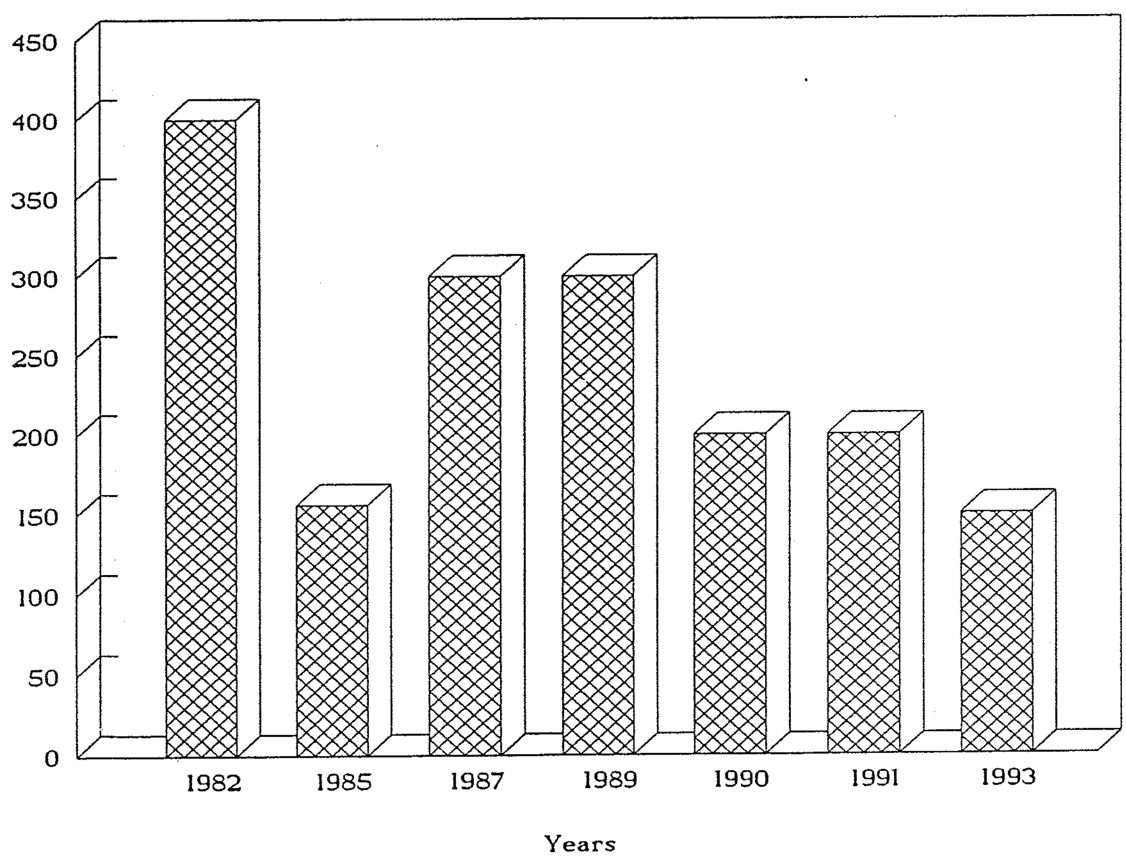
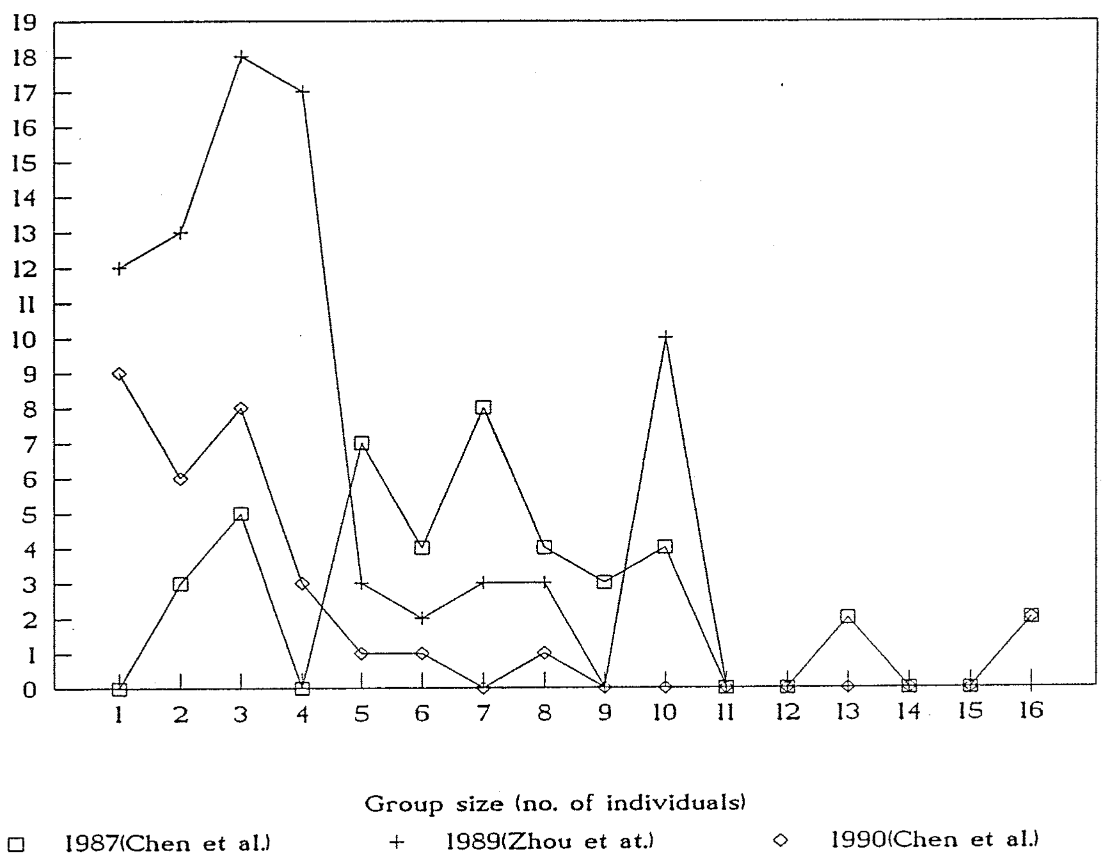


Fig. 2 Group Size of Baiji



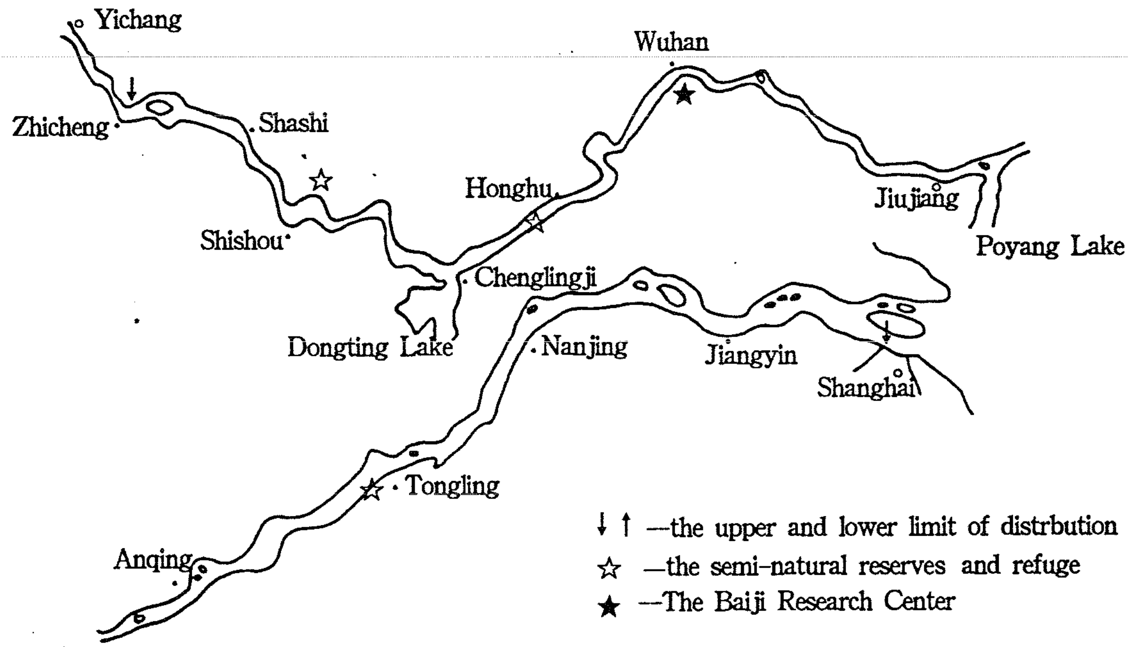


Figure 3. Map of the middle and lower reaches of the Yangtze River, showing distribution and protected areas of the baiji.

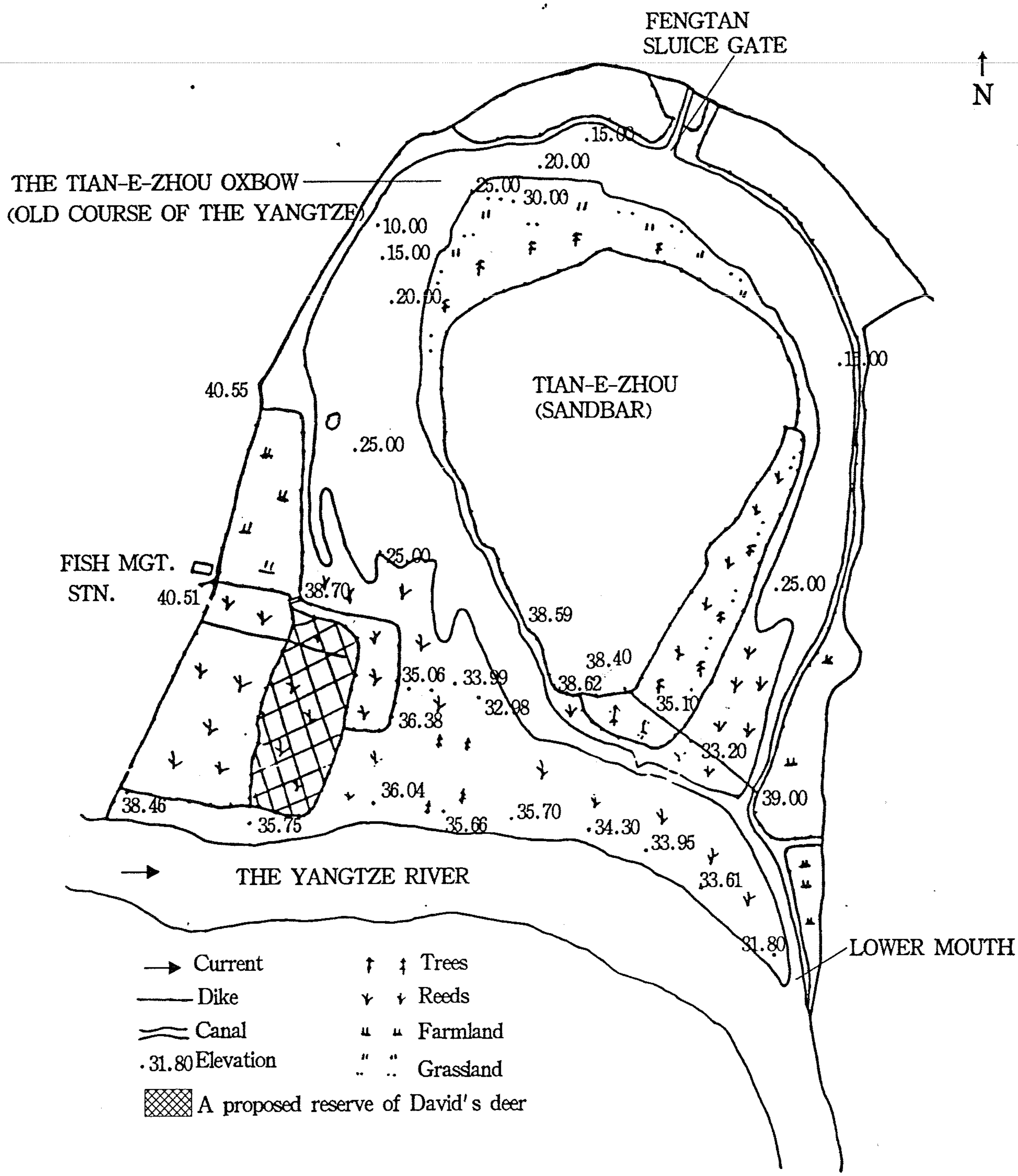


Figure 4. The map of proposed semi-natural reserve at Tian-e-zhou Oxbow (Swan Oxbow)

长江下游白暨豚的种群现状

周开亚　孙江　高安利
南京师范大学生物系，南京 210024，中国

白暨豚，Lipotes vexillifer，是单型科－白暨豚科的孑遗物种(周开亚等1979)。它已经在长江的这一适宜环境中生活繁衍了数千年。但是，由于栖息地的衰退，它在过去的几十年中逐渐变少，其种群还正在下降。

自然保护界对白暨豚危险处境的认识在八十年代迅速增长。鉴于白暨豚数量的严重下降和其面临的威胁，中国政府将其列入国家重点保护野生动物。国际自然保护联盟物种生存委员会(IUCN/SSC)在1986年将其作为世界上最濒危的12种动物之一，并在 1990 IUCN受胁动物红皮目录和IUCN 1991红皮书中列为濒危等级。国际捕鲸委员会(IWC) 的1991年会敦促立即采取进一步的行动帮助拯救白暨豚。关于白暨豚的研究已有简要综述(Zhou 1989，周开亚 1992)。

自1979年以来，在长江中游和下游已进行过多次考察，研究白暨豚的种群现状和行为(陈佩薰等，1980，1985；林克杰等 1985；周开亚 1982，周开亚等 1982；Chen & Hua，1989；Hua et al. 1989；Zhou 1986，Zhou & Li 1989，Zhou et al. 1979)。尽管这些研究已经推动了保护工作，仍然急需继续进行种群监测并了解白暨豚的移动和种群结构。

本文介绍了1989-1991年在长江下游对白暨豚种群现状和移动的研究结果。应用照相识别技术识别了白暨豚个体，报道了白暨豚个体的移动范围，做出了关于白暨豚种群数量的最新估计。

方　法

考察

1989-1991年在镇江(32° 2′ N，119° 4′ E)至湖口(29° 7′ N，116° 2′ E) 之间约500公里的江段中进行了5次航行考察。每次考察租用4-8条4-12马力的小型渔船。每条船由2个渔民驾驶。研究者在一些船上。其中一条船作为指挥船。船与船之间用无线对讲机或信号旗保持联系。平均航速每小时7-8公里。当发现白暨豚时，中断考察，观察白暨豚并照相。大多数照片用100彩色胶卷装入35毫米配有300毫米远摄镜头的佳能相机拍摄。

考察前，孙江于1989年3月8日至4月23日在玉板洲江段对白暨豚作过观察和照相识别。这些资料及照片也用在本研究中。

数据分析

可识别豚在该江段所有豚中所占比例(P) 由可识别豚占该江段所有记录到的豚的总数的平均百分比估计。后者用一次考察中识别的豚数除以计数的豚的总数，再对各次考察的结果取平均值。

[1]　　$P = \sum[(L_i+R_i)/2n_i]/E*100\%$

公式中:

L_i = 考察中由左侧识别的豚数　　R_i = 考察中由右侧识别的豚数

n_i = 在一次考察中计数的豚数

E = 考察的次数。

种群大由识别的豚数除以由公式[1]计算的百分数(P)估计。可识别豚数用两种方法计算。

1)根据概率原理，可识别豚数由解下列公式[2-1]到[2-3]得到。

[2-1]　$SQ_1 = D_1$

[2-2]　$SQ_2 = D_2$

[2-3]　$SQ_1Q_2 = D_{12}$

公式中:

S = 该江段内可识别豚数

Q_1 = 1989年5月识别的豚占可识别豚的概率

Q_2 = 1990年3月识别的豚占可识别豚的概率

D_1 = 1989年5月的考察识别的豚数

D_2 = 1990年3月的考察识别的豚数

D_{12} = 1989年5月和1990年3月的两次考察都识别的豚数。

2) 可识别豚数由Hammond (1986)推荐的Chapman修改的Petersen估算法计算。

[3]　$S = (D_1+1)(D_2+1)/(D_{12}+1)$

(S，D_1，D_2，D_{12}的定义与[2-1]至[2-3]同。)

种群大小(N)还简单地由标记-重捕模型估算:

[4]　$N/M = n/m$

公式中:

N = 种群大小

M = 标记豚数(1989年3月识别的豚数)

n = 重捕的豚数(1990年3月记录到的豚数)

m = 重捕个体中有标记的豚数(在1989年5月和1990年3月均被识别的豚数)。

结　果

考察工作时间共662小时，航行4763公里。1989年春和1990年春的3次考察有较满

意的结果，而1991年春因天气不好，考察效果很差(表1)。

分布

发现白暨豚的地点包括乌鱼洲(310公里)，小黄洲(400公里)，天然洲(475-490公里)，成德洲(540公里)，羊山矶(550公里)，余水洲(590公里)，玉板洲(600-603公里)，江心洲(安庆，640公里)，吉阳矶(670公里)和三号洲(740-747公里)。 上述地点按顺序由研究区域的下游端到上游端排列。括号内为该地点与吴淞口(31° 4′ N, 121° 5′ E)之间的距离。吴淞口在长江口上方大约100公里处。乌鱼洲在镇江上游40公里处， 三号洲在湖口下游约20公里处。

照相识别

各次考察共获得1178张照片。可用于个体识别的照片有84张，根据以下三条原则分类：体表的划痕，背鳍的缺刻和缺陷以及面部色斑。共识别了7头白暨豚个体(表2)。根据1989年和1990年的照片分别识别了6头和3头个体。但是，1991年只看到2 头白暨豚，由于风浪太大，没有拍摄到白暨豚的照片。在被识别的豚中，有3 头被识别了两次或两次以上(表2)。两头(#001和#003)被发现了3次。#001的发现间隔分别为373和3天，#003分别为10和344天。1989和1990年之间的年度间相合表明，划痕和背鳍的缺刻已保持了1年或更长时间。另一头豚(#007)在前一次看见后15天后又被见到。这是一头老个体，背鳍前半缺损。当该豚出水时，这一特征甚至可以用肉眼看到。表3 还列出了在发现时与该被识别的豚相伴的豚的数量。1989年5月4日，两头豚(#003和#004)在同一次发现中被照相识别。

白暨豚数量

1989年5月的考察有7次发现共12头白暨豚。减去3次重复发现记录后，共有9头豚。1990年3月的考察有4次发现共13头白暨豚。根据照相识别减去两次重复发现，共有7 头豚。1990年4月至5月考察中有6次发现共30头白暨豚。减去3次重复发现的19头豚，共有11头豚。1991年11月，只发现1次，有两头豚。

1989年5月根据天然标记识别了6头白暨豚。其中1头仅根据其左侧，2头根据其右侧(表2)。在1990年3月识别2头白暨豚，1990年4月至5月识别了1头。根据公式[1]， 可识别豚在所有记录到的豚中的比例(P)为28%。由于1991年考察期间不利的天气条件，这估算中没有使用1991年的考察结果。应用1989年5月和1990年3月的考察结果，根据联立方程[2-1]至[2-3]解得可识别豚数(S)约为9头，根据公式[3]约为7头。因而，估算得该研究区域的种群分别为32和26头。用标记－重捕公式[4]估算的种群大小为约30头。 这三个估算值的平均数为30。所以，南京－湖口江段白暨豚的种群数量约30头。如果我们考虑研究江段与其它江段之间的个体交换，30头将是对这一江段豚数的偏高估计。

移动

NJNUID #001 1989年3月9日在离吴凇口600公里的玉板洲发现一群6头白暨豚。其中之一，#001，是根据其照片上体表的划痕识别的(表3)。1990年3月 17 日在离吴凇口约640公里的江心洲(安庆)江段该豚再一次被识别。 同它在一起的还有一头成体和一头较小的豚。该群一直向上游移动。考察队跟踪了9小时50分钟。观察于下午5时30分当该群

豚到达安庆上游30公里的吉阳矶江段时结束。该群豚于3月20日在离吴淞口约740公里的周家湾被再一次发现，它在3天内向上游移动了100公里。移动速度平均每天约33公里。3月20日，该群豚时而向上游，时而向下游，在三号洲江段的周家湾和叶家洲之间约7公里范围内索食。考察队从上午11时10分至下午3时30分跟踪了6小时20分。该群豚的照片中看到有一头豚身上有这一弧形划痕。尽管其它两头豚的照片没有识别特征，它们的体形大小与3月17日发现的豚群没有差异。叶家洲至江心洲(安庆)的距离为107公里，叶家洲至1989年拍摄到这头带有划痕的豚的地点玉板洲之间的距离为147公里。

NJNUID #003　该豚于1989年5月4日在天然洲上游第一次被发现并照了相(表3)。它在一个由4头群组成的群内，它的标志是在背鳍后缘有一显著的缺刻。 它的同伴之一，#004，也是在这一天被拍摄到的。该群豚下午向下游旅行了15公里，穿过黑沙洲与天然洲之间的水道至后者的下游，考察队从下午2时30分到天黑，跟踪了5小时30分钟。10天以后，#003于前一次发现地点下游75公里的小黄洲江段被又一次照相，这次它在单独活动。1990年4月24日，#003再一次被发现时，他同其它4头豚一起在玉板洲江段活动。迄今，这是记录到的白暨豚移体运动的最长距离。

值得一提的是1992年4月，#003在铜陵白暨豚养护场附近第四次被识别时， 它同一头比他小一些的未识别的豚在一起。

又一次是在1993年春，当我们参加铜陵白暨豚养护场组织的考察时，#003被第五次识别。这次同它在一起的还有两头豚。

讨　论

种群监测考察是保护白暨豚的基础工作之一。已经就1986年举行的淡水豚生物学和保护学术讨论会论文集提出的任务做了许多工作。

基于1979至1981年在长江下游进行的6次考察的数据， 周开亚和同事们估算在长江下游从距吴淞口350公里处到距吴淞口600公里处250公里长的江段中有约30-60头白暨豚(周开亚 1982，周开亚等 1982，Zhou et al. 1979)。林克杰等(1985) 于 1979 年至1983年作了9次考察，在270公里长的江段中(距吴淞口370-640公里)统计到29头白暨豚。这一结果于周开亚和同事们所报道的几乎相同。林克杰等在458公里长的江段中(距吴淞口330-788公里)记录到47头个体，这一江段在地理上与本工作的研究江段相似。Chen & Hua (1989)在1985-1986年作过两次考察。他们在距吴淞口350-602 公里的江段中计数到26头豚，在278-772公里的江段中有82头豚，估算种群大小为约300头个体。因为没有减去重复计数的豚，这些作者所报道的数字可能偏高。另一方面，可能至少有一半的豚因为不良的天气情况和其它原因在考察中被漏计了。所以，这些材料的可靠性是有疑问的。尽管如此，这些数据和本研究结果的比较表明，在过去的10年中，在这一420 公里长的江段中有约一半的豚消失了。据本研究，研究区域内的种群密度为约14公里有1 头豚，或者每公里0.07头豚。假设白暨豚仍然栖息在1700公里长的江段中，而且整个栖息江段的种群密度相似，可能长江中尚存的白暨豚只有约120头。或者保守地说， 豚的数量已下降到不足150头。正如我们已经说过的， 如果考虑被考察江段与其它江段的个体交换，120头将是对白暨豚种群量的一个偏高的估计。

不管怎样，我们的样本量非常小。要更准确地估算种群大小，需要结合照相识别在

较长的江段作多次重复。

在野外见到白暨豚明显地一年比一年困难。自1989年4月以来， 我们研究组已经在我们考察的江段中记录到10头死亡的豚。

如果120是对1990年白暨豚种群量的合理估算，现有的种群大小可能已低于120。白暨豚已接近灭绝。这是一个非常时刻，当我们为拯救白暨豚而做许多其它方面工作的同时，我们必须密切注视白暨豚种群大小的变化。

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表1. 1989-1991年长江下游考察工作时间和白暨豚计数.

日期	江段	江段长 (公里)	考察路程 (公里)	考察时间 (小时)	白暨豚计数[1]
89/5/03-26	南京一黄石矶	330	892	116	9
90/3/04-31	南京一湖口	420	1030	164	7
90/4/22-5/18	镇江一湖口	500	1105	144	11
91/3/13-23	南京一湖口	420	642	87	0
91/11/23-12/21	镇江一湖口	500	1094	151	2

[1]重复计数已根据识别照片被减去

表2. 被识别个体的区别特征和与之相伴随的豚数。括号内为月份和日期.

ID#	照片张数	区别特征	与之相伴的豚数 1989	1990
001	36	背鳍前方背部左侧有弧形划痕	5(3/09)	2(3/17) 2(3/20)
002	2	背鳍前方背部右侧有弧形划痕	?(3/29)	
003	11	背鳍后缘有缺刻	3(5/04) 0(5/14)	4(4/24)
004	4	两条平行且直的划痕由背中部至背右侧肩部	3(5/04)	
005	8	面部色斑型	0(5/17)	
006	2	吻部明显上翘	2(5/18)	
007	21	背鳍前半缺损		2(3/14) 3(3/29)

表3. 1989-1990年在长江下游被识别的白暨豚个体

地点	距吴淞口距离[1] (公里)	NJNUID# 001	002	003	004	005	006	007
小黄洲	400			5/14 89				
天然洲	475-490			5/04 89	5/04 89			
黄石矶	550					5/17 89		
余水洲	590						5/18 89	
余水洲—玉板洲	594-604	3/09 89	3/29 89	4/24 90				3/14 90 3/29 90
江心洲—吉阳矶	640-670	3/17 90						
三号洲	740-747	3/20 90						

[1]指发现白暨豚的地点。

Population Status of the Baiji (Lipotes vexillifer) on the Lower Yangtze

Zhou Kaiya, Sun Jiang and Gao Anli
Department of Biology, Nanjing Normal University
Nanjing 210024, People's Republic of China

Baiji, Lipotes vexillifer, is a relict species belonging to the monotypic family Lipotidae (Zhou et al., 1979a). It has lived generation after generation and multiplied in number in the desirable environment of the Yangtze River for thousands of years. However, it was decreased in the past decades mainly due to habitat degradation, and the population is declining. Awareness of the critical situation of the baiji grew rapidly in the conservation community in the 1980s. In response to the serious decline and threat to the baiji, the Chinese authorities have included the species in the List of National Protected Major Wild Animals. It was also listed by IUCN/SSC as one of the 12 most endangered animals of the world in 1986 and under endangered category in the 1990 IUCN Red List of Threatened Animals and IUCN Red Data Book of 1991. The 1991 Meeting of IWC has urged immediate further action to help save the baiji. The studies on baiji have been briefly reviewed (Zhou, 1989a, 1992).

A number of surveys were conducted on the middle and lower reaches of the Yangtze River since 1979 to study the population status and behavior of the baiji (Chen et al., 1980, 1985; Chen & Hua, 1989; Hua et al., 1989; Lin et al., 1985; Zhou, 1982, 1986; Zhou et al., 1979b, 1982; Zhou & Li, 1989). Although the conservation efforts have been promoted by these studies, there is still an urgent need to continue the population monitoring and to determine the movement and population structure of the baiji.

This paper presents the results of a study of the population status and movement of baiji in the lower Yangtze in 1989-1991. Individual baijis were identified using photo-identification techniques. The estimation of population size was updated, information of the extent of movement of individual baiji was reported.

Methods

Surveys

A total of 5 boat surveys were conducted along a 500 km river section between Zhenjiang (32° 2′ N, 119° 4′ E) and Hukou (29° 7′ N, 116° 2′ E) in 1989, 1990 and 1991. Four to eight small fishing boats of 4-12 HP were chartered in each of the surveys. Each boat was operated by two fishermen. Researchers were on some of the boats. One of the boats was served as command vessel. The vessels kept in communication with radio telephone and signal flags. The average speed of the surveys was 7-8 km/hr. The surveys were interrupted to observe the dolphins and photograph them when baiji was sighted. Most of the photographs were taken with 100 color print films in 35 mm Canon cameras equipped with 300- mm telephoto lens.

Prior to the surveys, Sun Jiang made observations and photo-identifications of the baiji from March 8 through April 23 in the Yubanzhou river section. These data and photographs were included in the present study.

Data analysis

The percentage of identifiable animals (P) in the total count in the section was estimated by the mean percentage of identified animals in the total number counted in the section. The latter was calculated by dividing the total number of identifications obtained by the total number of dolphins counted in a survey, and averaging that proportion over all surveys in which photo-identification was attempted for animals encountered.

[1] $$P = \sum[(L_i+R_i)/2n_i]/E*100\%$$

where:

L_i = the number of left-side identifications in a survey
R_i = the number of right-side identifications in a survey
n_i = the number of dolphins counted in a survey
E = the number of surveys.

The population size was estimated by dividing the number of identifiable animals by the percentage (P) calculated using the equation [1]. Two methods were employed to calculate the number of identifiable animals (S).

1) According to the principles of probability, the number of the identifiable animals was calculated by resolving the following equations [2-1] to [2-3].

[2-1] $$SQ_1 = D_1$$
[2-2] $$SQ_2 = D_2$$
[2-3] $$SQ_1Q_2 = D_{12}$$

where:

S = the number of the identifiable animals in the section
Q_1 = the probability of the identification in the identifiable ones in May 1989
Q_2 = the probability of the identification in the identifiable ones in March 1990
D_1 = the number of animals identified during the survey in May 1989
D_2 = the number of animals identified during the survey in March 1990
D_{12} = the number of animals identified both in May 1989 and March 1990.

2) The number of the identifiable animals was calculated via Chapman's modified Petersen estimate as recommended by Hammond (1986):

[3] $$S = (D_1+1)(D_2+1)/(D_{12}+1)$$

where S, D_1, D_2, D_{12} were defined as those in [2-1] to [2-3].

The population size (N) was also estimated simply by the mark-recapture model:

[4] $$N/M = n/m$$

where:

N = population size
M = the number of marked animals (animals identified in May 1989)
n = the number of recaptured animals (animals counted in March 1990)
m = the number of marked animals in the recaptured ones

(animals identified in both May 1989 and March 1990).

Results

The surveys spent 662 hours and covered a distance of 4763 km. The 3 trips in the spring of 1989 and 1990 have yielded results, but the field expeditions in the spring of 1991 was compromised by poor weather conditions (Table 1).

Distribution

Sightings of baiji were made at Wuyuzhou (310 km), Xiaohuangzhou (400 km), Tianranzhou (475-490 km), Chengdezhou (540 km), Yangshanji (550 km), Cuanshuizhou (590 km), Yubanzhou (600-603 km), Jiangxinzhou (Anqing, 640 km), Jiyangji (670 km) and Sanhaozhou (740-747 km). The localities are listed in an ascending order from the lower end to the upper end of the study area. In the brackets is the distance between the locality and Wusongkou (31° 4′ N, 121° 5′ E) which is about 100 km up the mouth of the Yangtze. Wuyuzhou is 40 km up stream of Zhenjiang and Sanhaozhou is about 20 km down stream of Hukou.

Photo-identification

A total of 1,178 photographs of baiji were obtained in the surveys. Individual baijis were identified in 84 photographs and were classified by the three criteria: scratches on body, dorsal fin nick and deformity and facial pigment pattern. Seven different baiji dolphins were identified (Table 2). Six and three baiji dolphins were identified by the photographs taken in 1989 and 1990 respectively. But in 1991 only two baijis were sighted and no photographs of baiji were obtained because of poor weather conditions. Three of the identified animals were sighted more than once (Fig. 2). Two animals (#001 and #003) were seen three times. Time between the sightings was 373 and 3 days respectively for #001, 10 and 344 days respectively for #003. The interyear matches between 1989 and 1990 indicate that the scrape and dorsal fin notch have lasted about one year or more. Another animal (#007) was spotted 15 days after the previous sighting. It is an old animal distinguished by the absent of the anterior half of the dorsal fin. This character can even be seen with naked eye when the animal is surfacing. The number of associated individuals counted within an encounter with the identified baiji is presented in Table 3. On 4 May 1989, two animals (#003 and #004) within an encounter were identified by photographs.

Abundance

There were 7 sightings of 12 baijis during the surveys in May 1989. Three repeated records were subtracted and resulting in a total count of 9 animals. Four sightings with 13 individuals were recorded during the surveys in March 1990. Two sightings were subtracted according to the photographic identification and resulting in a total count of 7 animals. In April-May 1990, 30 individuals were sighted on 6 occasions during the surveys. Three repeated sightings with 19 baijis were subtracted and resulting in a total count of 11 animals. In 1991, only 1 sighting of 2 baijis were recorded in November.

Six baijis were identified by their natural marks in May 1989. Of them, 1 was recognized by the left and 2 were by the right side only (Table 2). Two and 1 baijis were identified in March 1990 and April-May 1990 respectively. According to formula [1], the percentage of identifiable animals in the total count was 28%. The results of the surveys in 1991 were not used in this estimation because of the unfavorable weather conditions during the surveys.

Using the data obtained during the surveys in May 1989 and March 1990, the number of the identifiable animals were calculated to be about 9 according to the simultaneous equations [2-1] to [2-3], and about 7 according to [3]. Consequently, the population size of the baiji in the study area was estimated to be about 32 and 26 respectively. In the estimation using mark-recapture formula [4], the population size was about 32. The three results averaged out to 30. Therefore, the population size of the baiji in the river section between Nanjing and Hukou was about 30. if we consider that the individuals exchange between the investigated section and the other ones, 30 would be an over-estimated number in this section.

Movement

NJNUID #001 A group of 6 baiji dolphins was sighted on 9 March 1989 at Yubanzhou river section which is about 600 km from Wusongkou. One of the animals, #001, was identified using photographs of body scrape (Table 3). The animal was recognized again by photographs taken on 17 March 1990 in Jiangxinzhou (Anqing) river section which is about 640 km from Wusongkou. It was in a group consisted of 2 adults and 1 smaller animal. The animals moved steadily in upstream direction and were followed by the research team for 9 hours and 50 minutes. The observations were finished at 5:30 p.m. when the animals reached Jiyangji river section 30 Km upstream of Anqing. The group was sighted again on 20 March at Zhoujiawan which is about 740 km from Wusongkou. It has moved 100 km upriver in 3 days. The travelling speed was about 33 km per day on an average. On that day the animals swam upstream and downstream and fed on fishes within a range of about 7 km between Zhoujiawan and Yijiazhou in Sanhaozhou river section, and were followed 6 hours and 20 minutes by the research team from 11:10 a.m. to 3:30 p.m. Photographs of the group revealed the arched scrape on one of the animals. Although no identification feature was found on the photographs of the other two, the size of the animals showing no difference with that of the group sighted on 17 March. The distance is 107 km from Yijiazhou to Jiangxinzhou (Anqing), and is 147 km between Yijiazhou and Yubanzhou where the scraped individual was photographed in 1989.

NJNUID #003 The animal was first sighted and photographed on 4 May 1989 at upstream of Tianranzhou (Table 3). It was in a group of 4 and was characterized by a conspicuous notch on the posterior edge of the dorsal fin. Photographs of one of its partners #004 were also taken on the same day. The group travelled 15 km downstream in the afternoon, passed through the channel between Heishazhou and Tianranzhou to the downstream of the latter, and was followed by the research team for 5 hours and 30 minutes from 2:30 p.m. until dark. Ten days later, #003 was photographed again at Xiaohuangzhou river section which is 75 km downstream of the previous sighting locality. This time the animal was alone. The baiji #003 was resighted together with about 4 partners on 24 April 1990 at Yubanzhou river section. The 1990 locality is over 200 km upstream of that of the 14 May locality in 1989. So far it is the largest distance recorded for individual movement of a baiji.

In April of 1992, #003 was recognized for the fourth time at the section by the Tongling Semi-nature Reserve when he was accompanied by a smaller un-identified dolphin.

Again, in the spring of 1993, #003 was recognized for the fifth time when he was accompanied by other 2 animals while we took part in the research team orgnized by the Tongling Semi-nature Reserve.

Discussion

The population monitoring surveys are one of the fundamental parts of the conservation biology of baiji. Much work has been done on many of the tasks outlined in the Proceedings of the Workshop on Biology and Conservation of the Platanistoid Dolphins held in 1986.

On the basis of the data obtained during 6 expeditions in the lower Yangtze in 1979 through 1981, Zhou and colleagues estimated about 30-60 individuals in a 250 km stretch of the lower Yangtze which is 350-600 km from Wusongkou (Zhou, 1982; Zhou et al., 1979b, 1982). Lin et al. (1985) made 9 expeditions between 1978 and 1983 and obtained a counting of 29 individuals in a 270 km stretch (370-640 km from Wusongkou) almost identical with that reported by Zhou and colleagues or 47 individuals in a 458 km section (330-788 km from Wusongkou) geographically similar to the present study. Chen & Hua (1989) made two surveys in 1985-1986, they counted 26 animals in the 350-602 km section or 82 animals in the 278-772 km section and estimated the total population at about 300 individuals. It was possible that the number reported by these authors was over counted because repeated sightings were not subtracted. It was also true that at least half of the animals might have been missed during the surveys because of unfavorable weather conditions and other reasons. Therefore, the reliability of these data is questionable. Nevertheless, a comparison between these data and the present results indicates that about half of the animals has disappeared in the 420 km river in the past 10 years. According to the present study, the population density in the study area was about 1 per 14 km, or 0.07 per km. Assuming that the baiji still inhabited 1,700 river stretch and that the population density was similar throughout the inhabited section, probably there were only about 120 individuals may be left in the Yangtze River. Or conservatively we may suggest that the dolphin's number have fallen to less than 150. As we have stated, if we consider the individuals exchange between the investigated section and the other ones, 120 would be an over-estimated number for the population size of the baiji.

Any way, our sample size is very small. To estimate the population size more precisely, surveys with photo-identification covered longer section in several repetitions are recommended.

It is obvious that sightings of the baiji in field become difficult year by year. Since April of 1989, 10 dead dolphins had been recorded by our research group in the river section we investigated.

If 120 was an reasonable estimate for the population size of the baiji in 1990. Present population size might be less than 120. The baiji is close to extinction. This is a special time, we should keep close to the change of the baiji's population size while we are working on many other aspects to save the baiji.

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Table 1. Efforts and counts of baiji in 1989-1991 survey seasons in the lower Yangtze.

Date	Section	Section length (km)	Survey distance (km)	Survey time (h)	Baiji counted[1]
89/5/03-26	Nanjing-Huangshiji	330	892	116	9
90/3/04-31	Nanjing-Hukou	420	1030	164	7
90/4/22-5/18	Zhenjiang-Hukou	500	1105	144	11
91/3/13-23	Nanjing-Hukou	420	642	87	0
91/11/23-12/21	Zhenjiang-Hukou	500	1094	151	2

[1]repeated counts were subtracted according to identification photographs

Table 2. Distinctive feature of the identified individuals and number of associated individuals counted. Month and dates in brackets.

NJNU ID#	Number of photographs	Distinctive features	Number of associated individuals 1989	Number of associated individuals 1990
001	36	Arched scrape on left side of back in front of dorsal fin	5(3/09)	2(3/17), 2(3/20)
002	2	Arched scrape on right side of back in front of dorsal fin	?(3/29)	
003	11	Notch on posterior edge of dorsal fin	3(5/04), 0(5/14)	4(4/24)
004	4	Two parallel straight scrapes from mid-back to shoulder on right side of back	3(5/04)	
005	8	Facial pigment pattern	0(5/17)	
006	2	Snout obviously bows upward	2(5/18)	
007	21	Anterior half of dorsal fin absent		2(3/14), 3(3/29)

Table 3. Individual baijis identified by photographs in the lower Yangtze in 1989-1990.

Locality	Distance from Wusongkou[1] (km)	NJNUID # 001	002	003	004	005	006	007
Xiaohuangzhou	400			5/14 89				
Tianranzhou	475-490			5/04 89	5/04 89			
Yangshanji	550					5/17 89		
Cuanshuizhou	590						5/18 89	
Cuanshuizhou -Yubanzhou	594-604	3/09 89	3/29 89	4/24 90				3/14 90 3/29 90
Jiangxinzhou -Jiyangji	640-670	3/17 90						
Sanhaozhou	740-747	3/20 90						

[1]referred to area where baiji was sighted.

BAIJI

(Lipotes vexillifer)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Section 4

POPULATION BIOLOGY AND MODELLING

白暨豚的普通生物学

周开亚和高安利
南京师范大学生物系，南京　２１００２４，中国

引言

对白暨豚的最早的记录见于约公元前２００年的中国古籍《尔雅》。在这本书里首次收载了“暨”字。在白暨豚的名字在中国得到广泛使用前，它曾被当地渔民称为白暨、青暨、白夹、江马等（周开亚、钱伟娟和李悦民，１９７７）。 其英文名称为 "baiji"。它是属于白暨豚科的孑遗物种（周开亚，钱伟娟和李悦民，１９７９）。对其颅后骨胳和消化道的详细研究揭示了白暨豚与其他淡水豚在这些器官中的重要区别。白暨豚已在长江中生息繁衍了千年万年。然而，主要是由于栖息地衰退，它的数量在过去几十年中急剧减少，现种群还在下降中。它是当今世界上最濒危的鲸类之一。

分布

白暨豚现只见于中国长江中、下游的主流中，分布的上限在长江中游的枝城。过去的分布区较广，包括富春江、长江中游上端及三峡下端，洞庭湖和鄱阳湖（周开亚，１９５８；周开亚、钱伟娟和李悦民，１９７７）。白暨豚是如何分布到富春江的？本文作者认为白暨豚的一些个体是经过河口迁到富春江的。河口在洪水期是淡水的。

性二型

雌性大于雄性。记录到的最大雌性体长达２５３厘米，雄性为２２９厘米（周开亚，１９８９ａ）。颅骨大小也呈性二型（周开亚，１９８９ａ；高安利和周开亚，１９９２）。雌性最大颅基长６５０毫米，属于一头体长２５０厘米的标本。雄性的颅基长小于雌性的。最大的雄性颅骨颅基长５３４毫米，属于一头２１龄的豚，其体长不明。用ｔ检验阐明了两性在外形比例的９个性状，及在颅骨测量的２９个性状呈显著差异。当用协方差分析消除体长的作用后，有８个颅骨测量性状呈二性差异。

结构和功能

已发表的白暨豚的解剖学和组织学研究有关于皮肤（周开亚和李悦民，1981a），骨胳（周开亚、钱伟娟和李悦民，1978,1979），肌肉（周开亚和钱伟娟，1981,1982），舌（李悦民，1983），胃（周开亚、李悦民和钱伟娟，1979），肠（周开亚和李悦民，1981b），鼻囊、气管和肺（陈佩薰、林克杰和刘仁俊，1980；刘仁俊和林克杰，1980），肾（刘仁俊、王丁、王小强和龚伟民，1986；倪健英和周开亚，1988a,b），卵巢和睾丸（陈佩薰、刘仁俊和林克杰，1982,1984），甲状腺、甲状旁腺和肾上腺（李钟杰，1985,1988）脑（陈宜瑜，1979），脊髓（吴葆孙、周开亚、华益民和刘玉杰，印刷中），耳蜗基膜（冯文慧和梁长林，1986），蜗神经纤维（高国富和周开亚，1991），螺旋神经节和前庭神经节（冯文慧、梁长林、王今拄撷王秀春和陈佩薰，1989），眼球（吴奇久和李俊凤，1984a），视神经（吴奇久，李俊凤和肖友芙，1982；吴奇久和李俊凤，1984b；高国富和周开亚，1992），视网膜（李俊凤、吴奇久和肖友芙，1983； 高安利和周开亚1987）。除近年发表的外，周开亚（1989a）已对上述研究作了综述。

声学

声速测量表明在额隆的右后下方有一个低速核（荆显英、肖友芙和景荣才，1982）。额隆超声衰减和声速研究发现在鼻道至头部前端之间有二条小的声路径（华明龙、周开亚、钱振德、王雨初和唐天雪，1989）。对饲养下的白暨豚进行了声信号和声行为的研究（荆显英，肖友芙和景荣才，1981；肖友芙和景荣才，1989；王丁、卢文祥和王治藩，1989；王丁、刘仁俊、陈佩薰、王治藩、卢文祥和杨叔子，1989）。白暨豚发出的声信号主要有二类。啸叫声为通讯信号，为持续时间约300毫秒的脉冲，其主频率基本稳定在６千赫，含有二、三、四次谐波。主频率随时间而变化。的答声是用于回声定位的信号，是由多个窄脉冲组成的一系列的脉冲串，其频率分布于８千赫－160千赫之间。

生理学和生物化学

除T波外，白暨豚的心电图各波、段和间期的正常范围与人的很相近（沈钧贤和关力，１９８１；刘仁俊、马建新、赵庆中和张永珍，１９９２）。人的T波与同导联的主波方向一致，而白暨豚的T波的方向却正好相反。P－R间期比人的长。

陆佩洪和杨利寿(1980)报道了油脂的成分。邹玉珍、蔡婉平和顾生明（1982），邹玉珍、周开亚和顾生明（1984）研究了额隆油、下颌油和体脂油的油脂组分。额隆和下颌油脂的主要组分为蜡酯和三甘油酯。在白暨豚的额隆油、下颌油及体脂油中不含异戊酸。因此白暨豚科与恒河豚科、亚河豚科、喙鲸科和抹香鲸科一样被列为无异戊酸的类群。官之梅（1985），官之梅和陈道权（1989）报道了白暨豚血红蛋白和血浆蛋白的电泳研究。血红蛋白的电泳图谱有清晰的两条带，没有发现非血红蛋白呆擒此结果表明白暨豚的血红蛋白与海西豚（ Pontoporia ）的相似而与亚河豚（ Inia ）及恒河豚（ Platanista）的不同。还报道了白暨豚血液的生化值及肌肉的生化成分（陈道权和官之梅，1985，1987；陈少莲和刘肖芳，1986；官之梅和陈道权，1989）。

重金属和有机氯

报道了白暨豚组织中某些重金属和有机氯化合物的含量水平（陆佩洪、夏娉娉和黄斌，１９８３；杨利寿、余多慰和陆佩洪１９８８）。已有的８种重金属（Cd、Cu、Fe、Mn、Ni、Pb、Zn和Hg）在白暨豚体内的浓度的数据是以采自３个标本的心脏、肾、肝、肌肉及皮肤等样品测定的。这些样品中重金属浓度相对较低。白暨豚体内DDT和HCH的浓度根据采自一头８.８龄雌豚的肾、肝、肌肉和卵巢样品，浓度比采自沿岸海域的江豚的高。在样品中未检出PCB。

遗传

陈敏容、陈道权和官之梅（１９８６）报道了白暨豚的核型。染色体的二倍体数为４４（２n＝４４），有７对中着丝点染色体，８对亚中着丝点染色体，２对亚端着丝点染色体及４对端着丝点染色体。

用一头年轻雄白暨豚的肝组织研究了线粒体DNA的限制性图谱（高安利和周开亚，未发表）。线粒体DNA由肝组织制备，被SacI，AccI，BamHI，BglII，HindIII，XbaI，EcoRI，StuI，和HpaII消化。其限

制性图谱与江豚的和虎鲸的作了比较，在相同的酶未发现同样的片段。线粒体DNA基因组的大小根据ＳａｃＩ和ＢｇｌＩＩ消化得到的限制性片段图估算为约２１７００ｂｐ或根据ＸｂａＩ产生的限制性片段图估算为大于１９５００ｂｐ。

生长和生殖

估计雄性和雌性的初生体长为91.5厘米。高安利和周开亚（1992）文中的图５显示了体长与年龄的关系。雄性的生长曲线在4GLGs 或小于此年龄时与雌性的曲线相一致。雄性的生长率在年龄约4GLGs时显著下降，根据陈佩薰、林克杰和华元渝（1985），这是雄性达到性成熟的年龄。雌性在约6GLGs时达到性成熟。最小的性成熟的雄性和雌性体长分别约为180厘米和200厘米，它们的体重分别为85公斤和100公斤。性成熟白暨豚的卵巢中，较小的卵巢重1.3－2.4克。较大的重2.7－16.0克。据年龄鉴定，最老的动物为体长242厘米年龄24GLGs的雌性及21GLGs的雄性，后者的体长不明，估计约为214厘米（高安利和周开亚，1992）。本作者认为有些个体可能生活到３０龄或更高。

白暨豚可能在上半年繁殖和产仔。产仔期的高峰似乎在２月至４月。

食性

胃含物的分析表明白暨豚捕食多种鲤形目鱼类（陈佩薰、林克杰和华元渝，１９８５）。它们中的多数是中下层鱼类，鲤鱼、草鱼、青鱼、三角鲂、赤眼鳟等，也有一些上层鱼类如鲢鱼及底栖鱼类如鲶和黄颡鱼。在胃含物中常发现渔钩（周开亚、钱伟娟和李悦民，１９７７；陈佩薰、林克杰和华元渝，１９８５）。据信有些渔钩是白暨豚摄食时从定置的滚钩渔具上拉下来并和所食的鱼一同吞入胃中的，在长江中游和下游发现的白暨豚尸体中，分别有约５７．１％和４２％是被滚钩或其他渔具误捕致死的。

出水和潜水

白暨豚在出水时通常不造成大水花，它在从容前游时呼吸。每次出水呼吸约１－２秒。几次较短的呼吸间隔（３２秒或更短）与一次较长的呼吸间隔相交替（周开亚和李悦民，１９８９；周开亚、孙江和高安利，未发表）。潜水时间从４秒至201秒，短潜与长潜之比在一个体约为4.5比1。在不同个体及在一天中的不同时间均略有不同。当机动船接近白暨豚时它们通常行长潜水，在水下改变方向，并在距该船５０米或更远处出水。

群的大小

白暨豚集小群生活。1985-1986年在世业洲观察到的16至17 头的群及在观音洲观察到的16头的群是已报道的最大的群（陈佩薰和华元渝，1989）。这些大群可能是几个小群集成的临时性的群聚。根据1982至1986年间的考察，长江下游白暨豚群的大小为１至10个体，最常见的大小是３至４个动物（周开亚和李悦民，1989）。据1989至1991年的考察，群的大小为１至７个体，而最常见的大小是１头和３头（周开亚、孙江和高安利，未发表）羖看来群的大小在近年减小了，群聚的大小也随着减小了。

移动

林克杰、陈佩薰和华元渝（１９８５）建议每个江段通常有一个白暨豚群栖居。然而，根据我们做的照相识别研究，每个白暨豚群不像是只限于一定的江段。照相识别及观察到的记录表明白暨豚群既就地移动也作长距离的移动（周开亚、孙江和高安利，未发表）。佘水洲江段在长江下游是白暨豚喜爱的地点，在这里观察到了就地移动。１９９０年研究组于３月１４日上行及３月２９日下行通过该江段时都观察到一群３－４头豚；于４月２４－２５日上行及５月３－４日下行通过该江段时则观察到一群７头豚。看来后者是由新来者和前者集成的临时性群聚。这些动物在约１０公里的范围内游泳。一个３头豚的群在１９９０年３月所作的旅行是长距离移动的例子。这个群三天移动了100公里。记录到的一头照了相的豚的最大范围是距初始照相地点２００公里以上。

行为方式

报道了４种行为方式（周开亚、孙江和高安利，未发表）。１）旅行，动物朝总方向稳定地移动， 如１９９０年３月１７日一个３头豚的群从江心洲上游到吉阳矶。２）摄食，动物在一定的栖息地搜索并捕捉猎物。１９９０年３月１４日和２９日，４月２４日和２５日，５月３日和４日，在玉板洲和佘水洲之间观察到一个约７头豚的群。这些动物在约１０公里的范围内，尤其是在支流进入长江的回水区上下索食。使用超声测深仪在１８米的江底发现一条１２米深的槽。相信在这个位于回水区下的槽内有很多鱼。３）示尾鳍，白暨豚偶而在潜入水下前把整个尾鳍竖出水面，当尾鳍入水时有时拍打水面溅起水花。１９９０年４月２５日傍晚在玉板洲见到陡直下潜的白暨豚的尾鳍。４）休息，动物缓慢移动，从容地上浮和下滑。１９８９年５月１７日黄昏见到这一行为，该豚在下午６：３０至７：３０天黑时保持休息状态。

与江豚的关系

白暨豚群和江豚群偶而短时间在一起摄食（周开亚、孙江和高安利，未发表）。１９９０年３月１７日，在安庆江段见４头江豚与３头白暨豚一同摄食。两个群在上午８：３０至９：３０混合约１小时。见到许多红嘴鸥（*Larus ridibundus*）在同一地点索食。红嘴鸥是长江下游鸟类的优势种，有时见到它在江豚摄食的地点捕鱼。同日下午３：１５至３：４５，在清节洲江段见到白暨豚群与一个５头江豚的群在一起摄食。１９９０年３月２０日，上述白暨豚群在三号洲江段与４头江豚混合在一起，上午１１：３０混合２０分钟，下午４：３０混合１小时。另一次记录在１９９０年３月１４日，２头白暨豚和３头江豚在玉板洲江段潭家沟附近于下午３：００在一起摄食。

人类活动对白暨豚的影响

河流栖息地极易衰退并处在人口增长和经济发展的沉重压力之下。将近三分之一的中国人或世界人口的十分之一居住在长江流域。长江流域的大规模的经济发展始于本世纪50年代。自那时开始的对白暨豚的威胁已有详细的讨论（周开亚，1982，1989b； 周开亚和李悦民，1989；林克杰、陈佩薰和华元渝，1985；陈佩薰和华元渝，1989）。

在长江中结构、网目和作业期不同的各种刺网捕捞不同的目标种，定置的滚钩和蔴箔很多。被滚钩和蔴箔误捕的白暨豚尸体已发现了数十具。白暨豚不仅受渔具误捕之害，

也遭江上交通增加、食物资源减少，闸坝的建设及水污染的伤害。富春江的白暨豚在１９５７年建造了新安江水电站以后消失了。在长江中游，自１９７０年葛洲坝建设工程开始后，在宜昌附近再也找不到白暨豚了（周开亚、钱伟娟和李悦民，１９７７）。沿长江修建了大中小型排水涵闸１８００余座以防洪、排涝和抗旱。然而沿江一带数以千计的水库、闸坝阻隔了江湖间洄游鱼类的通道。鱼类资源由于它们不能达到产卵场完成其生活史而衰退。白暨豚偶被轮船的螺旋桨打伤或击毙。这在长江下游尤为严重，因为下游的运输量比中游高得多。在过去三十年中，长江下游的江上运输几乎以每十年翻一番的速度增长，并将在新的经济发展规划中很快再翻一番。据新华社１９９２年8月１３日电讯，沿长江已有２２１个港口，其中的３７个的年吞吐量在百万吨以上。在南京、镇江、江阴、高港、杨州和张家港等港口已有４１座万吨级的码头投入使用。长江已具有年运输货物3亿吨，旅客5千万人次的能力，而且将在改革开放的政策下进一步扩大。在长江是已有7座大桥，4座正施工建造，6座将要开工，至少有8座大桥的可行性研究正在进行。长江流域的工农业产值约占全国的百分之四十。每年排放到长江的废水总量约１５６亿立米，其中的工业污水为１２３亿立米。约有百分之八十的废水末经处理即直接排放到环境中。１９８４年在长江下游发现的死亡白暨豚个体至少有１４头（周开亚和李悦民，1989），在中游和下游发现的尸体共１８头（周开亚，1989b）。

优先研究项目（不一定按此排序）

1. 长期的白暨豚种群监测及照相识别研究。
2. 白暨豚的行为和移动。
3. 白暨豚的生殖生物学，关于性成熟，生殖的老化、季节性、生殖周期延续时间，妊娠延续时间等。
4. 白暨豚种质的冷冻保存（精子、卵、细胞系、DNA等）
5. 白暨豚种群的遗传变异，线粒体DNA序列的多态性等。
6. 白暨豚及其主要猎食种体内有机氯和重金属含量水平的基础研究。
7. 误捕的监测及尸体的收集以供生物学研究。

参考文献（见本文英文稿）

General biology of the baiji, Lipotes vexillifer

Zhou Kaiya and Gao Anli

Department of Biology, Nanjing Normal University,
Nanjing 210024, P.R. China

Introduction

The earliest record of this dolphin was in <Er-Ya>, a Chinese classical book as early as 200 B. C. In which, the name `ji' was listed for the first time. Before the name baijitun was widely used for this species in China, it was known as baiji, qingji, baijia and jiangma by local fishermen (Zhou, Qian and Li, 1977). The English common name is the baiji. It is a relict species of the monotypic family Lipotidae (Zhou, Qian and Li, 1979) . Thorough studies on skull, post-cranial skeleton and digestive tract of the baiji have revealed substantial differences between the baiji and other platanistoid dolphins in these organs. It has lived generation after generation and multiplied in number in the desirable environment of the Yangtze River for thousands of years. However, it has decreased rapidly in the past decades mainly due to habitat degradation, and the population is declining. It is one of the most endangered cetaceans in the world today.

Distribution

The baiji is found only in the mainstream of the middle and lower reaches of the Yangtze River in China. The upper limit of the distribution of the baiji in the middle reaches is up to Zhicheng. The range was formerly broader, including Fuchun River and upper part of the middle Yangtze up to the lower end of the Three Gorges, and Dongting and Poyang Lakes (Zhou, 1958; Zhou, Qian and Li, 1977). By which way the baiji was distributed to the Fuchun River? The present authors consider that individuals of baiji were moved to the Fuchun River via the estuaries which were fresh during the flood season.

Sexual dimorphism

Females are larger than males. Maximum recorded body length for females is 253 cm and for males 229 cm (Zhou, 1989a). Skull size is also sexually dimorphic (Zhou, 1989a; Gao and Zhou, 1992). The maximum CBL for a female, 650 mm, is for a specimen with a body length of 250 cm. Condylobasal length was smaller in males than that in the females. The largest male skull is 534 mm long and is from a 21-GLG-old dolphin of unknown body length. Significant differences between the sexes in external proportions were demonstrated, using the *t*-test, in 9 characters, those in skull measurements in 29 characters. When the effect of body length was removed using covariance analysis, 8 skull measurements differed between the sexes.

Structure and function

Anatomical and histological studies of the baiji were published on skin (Zhou and Li, 1981a), skeleton (Zhou, Qian and Li, 1978, 1979), muscle (Zhou and Qian, 1981, 1982), tongue (Li, 1983), stomach (Zhou, Li and Qian, 1979), intestine (Zhou and Li, 1981b), nasal diverticula, trachea and lung (Chen, Lin and Liu, 1980; Liu and Lin, 1980), kidney (Liu, Wang, Wang and Gong, 1986; Ni and Zhou, 1988a,b), ovary and testis (Chen, Liu and Lin, 1982, 1984), thyroid, parathyroid and adrenal gland (Li, 1985, 1988), brain (Chen, 1979), spinal cord (Wu, Zhou, Hua and Liu, in press), cochlear basilar membrane (Feng and Liang, 1986), cochlear fiber (Gao and Zhou, 1991), spiral and vestibular ganglia (Feng, Liang, Wang, Wang and Chen, 1989), eye ball (Wu and Li, 1984a), optic nerve (Wu, Li and Xiao, 1982; Wu and Li, 1984b; Gao and Zhou, 1992) retina (Li, Wu and Xiao, 1983; Gao and Zhou, 1987). These studies except the recent ones have been reviewed thoroughly (Zhou, 1989a).

Acoustics

Sound velocity measurement indicates that there is a low velocity core at the right posterior-ventral part of the melon (Jing, Xiao and Jing, 1982). Studies on the ultrasonic attenuation and sound velocity in the melon found two sound paths looked like two small sound channels between the nasal tract and anterior end of the head (Hua, Zhou, Qian, Wang and Tang, 1989). Acoustic signals and acoustic behavior of captive baiji has been reported (Jing, Xiao and Jing, 1981; Xiao and Jing, 1989; Wang, Lu and Wang, 1989; Wang, Liu, Chen, Wang, Lu and Yang, 1989). The baiji emits mainly two types of acoustic signals. Whistles are communication signals. These are pulses with a duration of about 300 msec. They have a fundamental frequency around 6 kHz and contain 2nd, 3rd and 4th harmonics. In addition, the fundamental frequency varies with time. Clicks are signals used for echolocation and are a series of pulse trains composed of many single pulses. The frequencies of the clicks cover a range of 8-160 kHz.

Physiology and biochemistry

The normal range of waves, sections and durations of electrocardiogram of the baiji are very close to those of human, except for the wave T (Shen and Guan, 1981; Liu, Ma, Zhao and Zhang, 1992). The direction of wave T in human is in accordance with that of the main wave, but the direction of wave T in baiji is just opposite to that of the main wave. The duration of P-R is longer than that in Human.

Lipid components were reported by Lu and Yang (1980). Lipid class compositions of the melon, jaw and blubber fats were studied by Zou, Cai and Gu (1982), Zou, Zhou and Gu (1984). The wax esters and triglycerides are the major lipid components in the melon and jaw fats, while the subcutaneous fat is composed of triglycerides. No isovaleric acids are found in the melon, jaw and blubber fats of the baiji. Therefore, Lipotidae is referred to as nonisosvalerate family, the same as Platanistidae, Iniidae, Ziphiidae and Physeteridae are. Electrophoretic studies of the hemoglobin and plasmaprotein of the baiji were reported by Guan (1985), Guan and Chen (1989). Two obvious fractions were shown in the electrophoretogram of hemoglobin. Non-hemoglobinprotein has not been detected. The results indicate that the hemoglobin in the baiji is similar to that of Pontoporia and differs from those of Inia and Platanista. Biochemical values of blood and biochemical composition of muscle of the baiji were also reported (Chen and Guan, 1985, 1987; Chen and Liu, 1986; Guan and Chen, 1989).

Heavy metals and organochlorines

The levels of some metals and organochlorine compounds in the tissues in baiji were reported (Lu, Xia and Huang, 1983; Yang, Yu and Lu, 1988). Available data on eight heavy metals (Cd, Cu, Fe, Mn, Ni, Pb, Zn and Hg) in the baiji were based on samples of heart, kidney, liver, muscle and pancreas taken from 3 specimens. The concentrations of the metals in these samples were relatively low. Those of DDT and HCH were based on samples of kidney, liver, muscle and ovary taken from an adult female of 8.8 years old and were higher than those in the finless porpoise from the Chinese coastal waters. PCB has not been detected in these samples.

Genetics

The karyotype of the baiji was reported by Chen, Chen and Guan (1986). The diploids of chromosomes amount to 44 (2n=44). There are 7 pairs of metacentric chromosomes, 8 pairs of sub-metacentric chromosomes, 2 pairs of sub-acrocentric chromosomes and 4 pairs of acrocentric chromosomes.

The restriction pattern of mitochondrial DNA of the baiji was studied using liver tissue of a young male (Gao and Zhou, unpub.). The mtDNA was prepared from the liver tissue and digested by Sac I, Acc I, Bam II, Bgl II, Hind III, Xba I, Eco RI, Stu I and Hpa II. When the restriction patterns were compared with those of the finless porpoise and killer whale, no identical fragment was found in corresponding enzymes. The genome size of mtDNA might be estimated to be about 21700 bp by the restriction fragment patterns produced by Sac I and Bgl II or larger than 19500 by Xba I.

Growth and reproduction

Body length at birth was estimated to be 91.5 cm for both males and females. The relationship between body length and age was shown in Fig. 5 in a paper published by Gao and Zhou (1992). The curve for the males about 4 GLGs or less coincides with the curve for females. The growth rate in males seems to decrease sharply at the age of about 4 GLGs, which was the age at sexual maturation according Chen, Lin and Hua (1985). The females attained sexual maturation at about 6 GLGs. They continue to grow rapidly until about 8 GLGs. The smallest sexually mature male and female were about 180 cm and 200 cm long respectively. Their body weight were about 85 kg and 100 kg respectively. The weight of the smaller ovary was 1.3-2.4 g and the larger 2.7-16.0 g in ovaries from sexually mature baiji. The oldest animal according age determination was a 242 cm long female 24 GLGs in age and a 21 GLGs male of unknown body length and was estimated to be about 214 cm in body length (Gao and Zhou, 1992). The present authors consider that some individuals probably survived to 30 or more.

The baiji probably breeds and gives birth in the first half of the year. The peak calving season appears to be February to April.

Feeding habitats

Analyses of stomach contents indicate that baiji consume a wide variety of Cypriniform fishes (Chen, Lin and Hua, 1985). Most of them are middle and lower layer fishes, Cyprinus carpio, , Ctenopharyngodon idellùs, Mylopharyngodon piceus, Megalobrama terminalis, and Squaliobarbus curriculus, There were also upper layer fish such as Hypophthalmichthys molitrix and bottom-feeder Parasilurus asotus and Pseudobagrus fulvidraco.

Fishing hooks were commonly recovered from the stomach contents (Zhou, Qian and Li, 1977; Chen, Lin and Hua, 1985). It is believed that the hooks were pulled apart from rolling hook bottom set longlines and swallowed with the fish when feeding. About 57.1 % and 42 % of the dead bodies found in the middle and lower reaches of the Yangtze River respectively were killed incidentally by rolling hook bottom set longlines and other fishing gears.

Surfacing and diving

The baiji usually surfaces without causing white water and breathes while moving forward in a smooth manner. The duration of the blow is 1-2 sec. The dolphin has a sequence of several short breathing intervals (32 sec and shorter) alternating with one longer one (Zhou and Li, 1989; Zhou, Sun and Gao, unpub.). The dive times ranged from 4 to 201 sec. The ratio of short dives to longer ones was about 4.5 to 1 in one individual and 2.8 to 1 in another. It varied slightly in different individuals and in different hours of the day. When baiji were approached by a motor boat, they generally made long dives, changed direction under water, and surfaced about 50 m or more from the boat.

Group size

The baiji live in small groups. A group of 16 to 17 individuals observed in Shiyezhou and a group of 16 individuals observed in Guanyinzhou in 1985-1986 is the largest group reported (Chen and Hua, 1989). These larger groups were probably temporary aggregation of several groups. According to the surveys made between 1982 and 1986, estimates of group size in the lower reaches of the Yangtze River ranged from 1 to 10 individuals, the most common group size was three to four animals (Zhou and Li, 1989). In the surveys made between 1989 and 1991, the group size ranged from 1 to 7 individuals and the most common group size was single and three (Zhou, Sun and Gao, unpub.). It seems that the size of the group was reduced in recent years, and the size of the aggregation was reduced in turn.

Movement

Lin, Chen and Hua (1985) suggested that each river section was usually inhabited by a baiji group. However, it is unlikely that each baiji group is confined to certain river section according to our photographic identification studies. The photographic identifications and sighting records have shown that the baiji group made either local or long-range movement (Zhou, Sun and Gao, unpub.). Local movement has been observed in Cuanshuizhou-Yubanzhou Section which was a favorite site for baiji in the lower Yangtze. In 1990, a group of 3-4 animals was sighted in the section on March 14 when the research team passed up river and on March 29 when the team passed again down river; a group of 7 was seen on April 24-25 when the team passed up river and on May 3-4 when the team passed down river. It seems that the latter was probably a temporary aggregation formed by the joining of the new arrivals and the former. The animals swam within a range of about 10 km. The travel made by a group of three in March 1990 was an example of long-range movement. It covered a distance of 100 km in 3 days. The largest recorded range of a photographed baiji was over 200 km from the initial photographing site.

Behavior patterns

Four behavior patterns were reported (Zhou, Sun and Gao, unpub.). 1) Travelling, animal moves steadily in one general direction, such as a group of 3 moved upriver from Jiangxinzhou to Jiyangji on 17 March 1990. 2) Feeding, animal searches and captures prey items in certain habitat. A group of about 7 individuals was observed on 14 and 29 March, 24 and 25 April, 3 and 4 May 1990 between Yubanzhou and Cuanshuizhou. The animals forage downstream and upstream within a range of about 10 km, especially in the counter-current area where the tributary enters the river. The measurements made by the echo sounder revealed a trough about 12 m in depth below the 18 m deep river bottom. The trough extending under the counter-current water was believed to be rich of fishes. 3) Fluke show, occasionally the baiji erects whole or part of the fluke out of the water just before dive underwater, sometimes with a slap and splash when the fluke enters the water. In the late afternoon of 25 April 1990 at Yubanzhou, the fluke of a baiji was seen when the animal dived at a steep angle. 4) Resting, animal moves slowly, floats up and slips down gently. This behavior was observed in the dusk of 17 May 1989 in Yangshanji, the animal kept resting state from 6:30 p.m. to 7:30 pm when it is dark.

Relationship with finless porpoise

Occasionally baiji group and finless porpoise group feed together for a short time (Zhou, Sun and Gao, unpub.). On 17 March 1990, 4 finless porpoises were found feeding together with 3 baijis in Anqing section. The two groups mixed for about 1 hour between 8:30 a.m. and 9:30 a.m.. A number of black-headed gull, <u>Larus ridibundus</u>, was found feeding in the same locality. The black-headed gull is a dominant bird species on the lower Yangtze. Sometimes it was found feeding in the spot where the finless porpoise was feeding. The baiji group was found feeding together with a group of 5 finless porpoises at 3:15-3:45 p.m. in Qingjiezhou section in the same day. On 20 March 1990, the same baiji group was found mixed with 4 finless porpoise in Sanhaozhou river section at 11:30 a.m. for 20 minutes and at 4:30 p.m. for 1 hour. Another record was in the afternoon of 14 March 1990, 2 baijis and 3 finless porpoises feeding together at 3 p.m. near Tanjiagou in the Yubanzhou river section.

Impacts of human activities on baiji

The river habitat is highly vulnerable to degradation and is under heavy pressure as human population burgeon and as the economics expand. Nearly one-third of the population in China or almost ten percent of the entire world population live along the Yangtze valley. The large-scale economic development along the Yangtze valley started in the 1950s. The threats against the baiji thereafter have been discussed thoroughly (Zhou, 1982, 1989b; Zhou and Li, 1989; Lin, Chen and Hua, 1985; Chen and Hua, 1989).

In the Yangtze River, different kinds of gillnets varying in structure, mesh size and operating period for different target species, the rolling hook bottom set longlines and stake net traps are common. Dozens of dead bodies of the baiji have been found entangled or trapped in the rolling hook longlines and stake net traps. The baiji suffered not only from incidental kill in fishing gears but also from river traffic, reduction of food resources, dam construction and water pollution. In the Fuchun River the baiji disappeared after the construction of the Xin'anjiang Hydropower Station in 1957. In the middle reaches of the Yangtze, the baiji are no longer found near Yichang City after the construction of the dam at Gezhouba started in 1970 Zhou, Qian and Li, 1977). About 1800 floodgates and culverts, large and small, have been built along the Yangtze to control flood or water logging and drought. However, the thousands of dams, locks and reservoirs along the Yangtze blocked the route of fish trying to migrate between the lakes and the river. Fishes have decreased in great numbers because they are unable to reach the spawning ground to complete their life cycle. Occasionally the baiji were killed or injured by ship propellers, particularly in the lower reaches of the Yangtze where the freight volume is much higher than that in the middle reaches. In the past 30 years, the river traffic in the lower reaches has doubled every ten years and will soon doubled again under a new program of economic expansion. According to a Xinhua News Agency dispatch on 13 August 1992, there are 221 ports along the Yangtze River, 37 of which can handle over one million tons of cargo a year. Forty-one wharfs of ten thousand tons were put into operation at Nanjing, Zhenjiang, Jiangyin, Gaogang, Yangzhou and Zhangjiagang Ports. The Yangtze River already has a capacity of transport over 0.3 billion tons of cargo and fifty million passengers per year and it will be expanded more rapidly under the reform and open policy. There are already 7 bridges across the Yangtze river, 4 are under construction, 6 will be started to construct and the feasibility investigation of at least 8 is underway. The value of the industrial and agricultural output in the area is about forty percent of the nation. The total volume of the waste waters discharged into the Yangtze River is about 15.6 billion cubic meters per year, of which about 12.3 billion cubic meters are industrial polluted waters. About eighty percent of the waste waters are discharged directly to the environment without treatment. At least 14 baiji were found died in the lower Yangtze in 1984 (Zhou and Li, 1981), altogether 18 carcasses were recorded in the middle and lower reaches (Zhou, 1989b).

Research priorities (not necessarily in this order):

1. Long-term population monitoring surveys and photo-identification studies of the baiji on the Yangtze River.
2. Behavior and movement of the baiji.
3. Reproductive biology of the baiji, information on sexual maturity, reproductive senescence, seasonality, duration of the reproductive cycle, time of ovulation, duration of pregnancy, etc.
4. Cryopreservation of germ plasm (sperm, oocytes, cell lines, DNA, etc.) of the baiji.
5. Genetic variation, mitochondrial DNA sequence polymorphism, in the baiji population.
6. Baseline studies of organochlorine and heavy metal levels in baiji and the principal prey species.
7. Monitoring of incidental kill and collection of carcasses for biological studies.

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种群生物学和模型制作工作组报告

参加者：迈克尔·布鲁福德、王丁、高安利、刘晴、王亚明

前言

本报告综合了各种模拟产生的结果及本次研讨会建议的一些方案。被试验的模型有3种:

1. 野生种群在100年中的模型，假设没有任何豚为建立饲养种群或半自然保护区的种群而被移出。

2. 野生种群在100年中的模型，考虑到有实际数量的豚为建立饲养项目而被移出。

3. 保护区种群和饲养种群的模型，假设在各保护区和饲养单位有不同的建群率和基因流水平。

野生种群模型制作

野生种群的各参数

1. 这些模拟被投射100年。由于需要近期的紧急资料和行动以扭转此绝危物种的下降，使得本工作组必须把注意力完全集中在未来的100年，用频繁的报告来跟踪迅速的变化。

2. 在模拟中以10年为间隔取得种群和灭绝的报告。

3. 工作组内对在长江可能存在着一个或两个种群有不同看法。迄今测到的一头个体最长的散布距离（周教授和同事们用照相识别技术）为200公里。这两个假定的种群最密集的区域在长江的中游和下游。假如这两个种群确实存在，他们之间相隔约500公里（即安庆江段至洪湖江段）。然而，白暨豚的散布距离完全可能比目前已测得的200公里最大距离高得多，特别是因为已被照相识别的标本量小。因此，尽管开始时的模型集中在只存在一个种群，我们决定最终模拟两种可能性，包括在两种群间每年有较高(5%-记为0.05)的基因交换率。

4. 讨论了生殖和存活的方差间的可能的相关。从总体上，本工作组感到那些生殖成功的年份将与存活率较高的年份相关联，特别是因为按年龄/性别记录到的死亡率表明雌成体在人致的死亡率中占多数。

5. 本工作组与栖息地、威胁、灾难工作组的意见广泛一致，认为只有两类环境事件将对白暨豚的存活和生殖产生显著作用（大于正常的环境变量）。他们是: 1)爆炸的作用—炸鱼或江中建设工程的爆炸； 2)江中化学事故的作用。

6. 本工作组确定，最简约的策略将是用杂种优势模型把近交缺陷的作用包括在内，此模型中的每一个体携带3.14个致死性等价基因。在缺乏关于白暨豚的任何遗传学资料的情况下，这样做将可包含大多数可能发生的情况。

7. 在缺乏关于白暨豚的其他资料的情况下，我们假设此物种有多配偶性配偶系统的可能性。然而，已知此物种属性二型，雌性大于雄性，据此它完全有可能不是一雄多雌的(Ralls和Brownell,1986; Perrin,个人通信)。真实情况可能是一种在雄性和雌性间形成松散、临时、不稳定关系的随意交配。这样一种情况不能在现在的漩涡程序中模拟。但可能各雄性有相等的生殖成就，此种情况下可能产生有效的单配偶性。因此将进行关于单配偶性配偶系统的模型的作用的灵敏度分析。

8. 已有的证据(Liu等,1988; Chen等,1984)提示雌性在6至8龄间开始生殖(我们取最新的估算8龄)，雄性在4至6龄开始生殖(我们认为6龄可能更真实些)。

9. 记录到的年龄最大的白暨豚据估算约为24龄(Gao和Zhou,1992)。因此本工作组感到有些个体可能活30—40年，所以采用的保守的估算为30龄。

10. 白暨豚出生时的性比不详。然而，其他鲸类物种的证据表明可预测1:1的性比。

11. 虽然白暨豚的生殖可能是密度制约的，但因为野生白暨豚种群密度很低，本工作组认为此参数毫无意义。

12. 数据提示，在任何一个年份有30%的雌性成体产一头幼仔(Liu等,1988)。可是考虑到这一数字的标准差很高，所以我们选用20%。

13. 在野生白暨豚种群模型制作中最有问题的参数是特定年龄和性别的死亡率，包括自然的和人致的。得不到自然死亡率的数据。仅有的有死亡时年龄和性别的数据主要是人类引起的死亡率一意外事故，这些数据得自武汉（水生生物研究所，未发表资料）及南京(Gao和Zhou,1992;及未发表资料)，那儿的公众和科学家发现了搁浅在岸上的或漂浮的一些尸体。

与得自其他鲸类物种的已发表和未发表的数据相一致(如虎鲸在前6个月为40-50%，长鳍领航鲸在第一年为35%，灰鲸在第一年为35-36%，瓶鼻海豚在第一年为60%)。我们在自然死亡率的模型制作时，考虑了在第一年的死亡率为60%、50%、40%和30%，以及预期的亚成体的下降幅度和成体死亡率(见表1)。模型制作工作组认为50-60%的数字最符合白暨豚的实际。

另外，我们按下列方式分解了人类引起的死亡率的数据。在过去3年中，在南京研究组研究的长江下游调查得知了10头死亡个体。但仅获得了其中的2头(20%)，并在周教授的实验室鉴定了年龄和性别。王博士感到武汉得到的个体接近死亡数的40%。所以我们设置一个折中的数字，30%，作为被发现的由人类引起的死亡的比例。武汉和南京研究组在15年间采集了28头雌性和16头雄性。根据这一数字可推断为这15年期间有93头雌性和53头雄性死亡，或每年有6头雌性和4头雄性死亡。

表1. 野生种群各种死亡率情况（自然和自然+人类）的模型制作

死亡率 年　龄	高 + 人类	高	中 + 人　类	中	低 + 人　类	低	很　低 + 人　类	很　低
0-1	62.7	60.0	52.2	50.0	41.8	40.0	31.3	30.0
1-2	20.9	20.0	16.7	16.0	13.6	13.0	10.5	10.0
2-3	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
3-4	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
4-5	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
5-6	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
雄 成体	6.2	6.0	5.2	5.0	4.2	4.0	3.1	3.1
6-7	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
7-8	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
雌 成体	6.2	6.0	5.2	5.0	4.2	4.0	3.1	3.0

可以根据我们已经使用的（见前面）现实的年龄/性别结构来分配这些死亡率。在15年前约有400头动物，现在可能少到150头，所以我们取得平均值275头。 假设性比为1:1，则增加的人致死亡率对雌性为4.4%，对雄性为2.9%。把这些百分数分配到各年龄组（见表1）。必须注意到栖息地、威胁、灾难工作组感到人致死亡率可能高得多（每年5-10%），并且这些数字应该用于某些模型制作。进一步的模型制作将测试把人类引起的死亡率负担先加到幼体，再加到成体所产生的作用。此模型对成体可能比对幼体更灵敏（Seal，个人通信）。

14. 用下列方法配置了灾难的概率。

A. 爆炸（捕鱼或建筑）：1974年有6头白暨豚被与建筑有关的爆炸杀死，1985年有5头豚被捕鱼的爆炸杀死。这些事件（20年中两次）得出了10%的概率，种群中有高达2%的个体被杀死，对生存者的生殖能力未发生作用。

B. 化学事故：1989年一辆载有4吨磷的卡车沉人江中。江水被严重污染并导致许多鱼死亡。几天后，发现了3头没有明显外伤的白暨豚尸体。推测它们的死亡与此化学泄漏有关。由于很可能有另外的约6头豚因此死亡，但未被发现，本工作组决定这类灾难至少杀死

种群的3%。而且，随着长江流域继续工业化，这类事故的频率很可能随着时间而增加。因此本工作组把发生化学泄漏的概率设定为10%，即我们预测每10年将发生一次。可以料想这样的化学泄漏对靠近泄漏处的动物的生殖能力会有附带的作用。我们认为另有种群的3%会受到作用但未被杀死。因此，设定了3%的对生殖的负作用。

15. 在缺少关于白暨豚的资料的情况下，考虑了其他鲸类物种的资料，我们认定最慎重的方针是假定所有雄性成体都在生殖库中。

16. 有某些资料提示白暨豚种群的年龄分布略向5龄至13龄之间的年龄组倾斜(Lin等，1985)。然而该样本很小(33+3胎儿)并且是在10年期间得到的。因此这些资料对得出一个种群在某一时期的年龄结构可能并不可靠。在缺少实际资料的情况下，本工作组在认识到可对在亚成体年龄组记录到的可能的微小倾斜作模型进行更多的模拟的同时，采取了一个稳定的年龄分布。

17. 如种群数量和现状工作组所回顾的，考察的证据指出此种群的数量在240至150头个体之间。本工作组对现存种群大小的上、下两个估测数量都做了模型制作。

18. 本工作组和栖息地工作组都认为长江的容纳量比长江中下游现有种群大小大很多。因此很难估测在条件适合于此物种的情况下长江所能支持的种群的真实大小。我们任意选择了1,000这个数字，如果模拟表明此种群可在任何一点达到容纳量，我们将测量加大容纳量的作用。

19. 虽然本工作组的总的感觉是容纳量已以某种速率下降，鉴于容纳量比现有的种群大小大很多，并且不会在模型制作的时期内显著地冲击种群的生长，我们没有就容纳量的一个趋势作模型。可是此模型制作是在可中止的情况下做的，即如果此种群在任何一点达到容纳量，我们将就这一趋势试作模型。

20. 对野生种群的初始分析中未包括计划了的捕豚，也未包括个体的补充。

带有捕豚的野生种群模型制作

根据铜陵和武汉研究组的捕豚计划进行了模型制作：

武汉计划为武汉的设施和石首捕捉5头	3－4龄的雄性 2 头
	6－7龄的雌性 3 头
铜陵计划捕捉2或3头	雄性成体1头
	雌性成体1头
	雄性亚成体1头

还进行了另外一个模型制作。此模型加入了一个“大规模的行动”以捕捉足够的动物在30年内建立一个能自我维持的饲养种群。因此，按下列假设建立了2个模型：a)在模型的前

20年每年捕捉3头(2雌性，1雄性)； b)在前20年每年捕捉5头(3雌性，2雄性)。二十年被选定为捕豚的时间框架，因为我们最初的意见是应在第1—4年每年捕捉5头，在其后的15年每年捕3头。漩涡程序不允许有不同的捕捉率作模型，所以我们决定按前20年每年捕3头和5头分别作模型。

自然保护区种群的模型制作

湖北省新螺自然保护区

这是长江中一个135公里长的江段，按照计划它是一个开放的江段，捕鱼将被禁止，污染被严格控制，其他人类活动(如江上交通等)大大减少。

在1984年，这一江段支持了约42头半常住的白暨豚。现在约有20头豚常常使用这个区域。

为模型制作之目的，对在保护区内种群的假设的作用为：与人类有关的死亡率将在相当短的时期内被消除而达到反映了自然死亡率的阶段。

假设在历史上此135公里的江段可能曾支持比42头多得多的个体，我们做了容纳量为21(在前10年从K增长10%开始)、42、75和150头的模型制作。不建议主动地把任何豚移人这一江段。

半自然保护区和饲养建立的种群的模型制作

1. 湖北省天鹅洲牛轭湖半自然保护区

这是一个有可能封闭的，可充分管理的保护区，长21公里，宽约1公里。确切测量的鱼产量为年产184,000公斤。理论上这些鱼足够在任何一年喂养80头豚。然而实际上不像能支持这么多动物，故建议在此保护区放人25头豚。

为这个模型，我们假设强化管理可消除所有与人类有关的死亡率，并可把开始生殖的年龄在雄性提前一年，在雌性提前两年（如在其他被集中管理的鲸类物种中所观察到的）。

2. 安徽省铜陵半自然保护区

这个保护区是一条1.5公里长，100米宽的夹江，两端被闸坝封闭，在低水位时需抽水以保持夹江水位。夹江中无天然鱼产，现有的计划是把3头（2雌性，1雄性）至5头（3雌性，2雄性）放入保护区。

为了模型制作，我们决定去除人致死亡率的作用，保持初次生殖的年龄与野生种群的一样，并包括密度制约的生殖成就。

3. 武汉的饲养设施(水生生物研究所)

当前在武汉只打算有一个饲养种群，那里有4个不同大小的养豚池。远期的计划打算把10头豚(4雄性和6雌性)引入此设施，但在初期只引入4头。

为了模型制作，我们假设远期的死亡率可明显降低(30%幼体死亡率)，但在前10年则高得多(10%成体死亡率，50%幼体死亡率)。此外，我们包括了密度制约的生殖，2%概率的严重疾病爆发，后者有20%的死亡率而对生殖没有作用。

饲养和半饲养种群的模型制作把所有3个饲养的和半饲养的种群计算在内，假设在这些种群间有遗传的交换，它们是:

A. 天鹅洲牛轭湖: 2雄性，2雌性

B. 铜陵: 2雌性，1雄性

C. 武汉: 1雌性(+现有的雄性淇淇)

模拟结果

迄今这些模拟主要在野生种群进行，含捕豚和不含捕豚。因为很难预测在何时、何地以及有多少头豚将被捕获，作半自然保护区的和饲养的种群的模型困难得多。不管怎样，将为最后的报告作出半自然种群和饲养种群的全面分析。

野生种群

首先，我们在初步模拟中查明了采用不同死亡率水平（包括人致死亡率）的作用非常大。接着在240头的和150头的种群进一步研究了此作用的大小。所有其他参数均如“野生种群的参数”一节所述。改变死亡率在240头开始的种群的结果见表2，在150头开始的种群的结果见表3。

死亡率明显地对生长率(r)、种群大小(n)和存活概率(p)(及其必然的倒数，灭绝的概率P(E))有大的作用，增加的年人致死亡率根据年龄和性别对自然死亡率的分割而扩大，对所有参数都有小而显著的影响。然而，从这些数据还不清楚人致死亡率因子的微分负载将对结果有何作用。做了进一步的模拟，先把死亡率加到幼体，然后加到年龄分布的成体一端。结果表明，如所预测的一样，所取的起始种群的大小（在此例为150头或240头）对存活概率(P)及MTE(达到灭绝的平均时间)有某些作用。

这些数据的更突出的部分可用图表示，图1和图2示死亡率（不包括人类导致的）对种群大小（采用240头的上限作为初始大小）和灭绝概率的作用。可看到在100年中，**种群大小只在死亡率很低时**(即第一年幼体为30%，成体为3%) **增加**。不幸的是，这样的死亡率对野生种群可能是不切实际地低。

我们从这一证据得到的结论是：采用上述参数时，除非白暨豚的死亡率能保持在记录到的鲸类死亡率的最低的水平，在野外的白暨豚种群将稳定不变地继续下降。

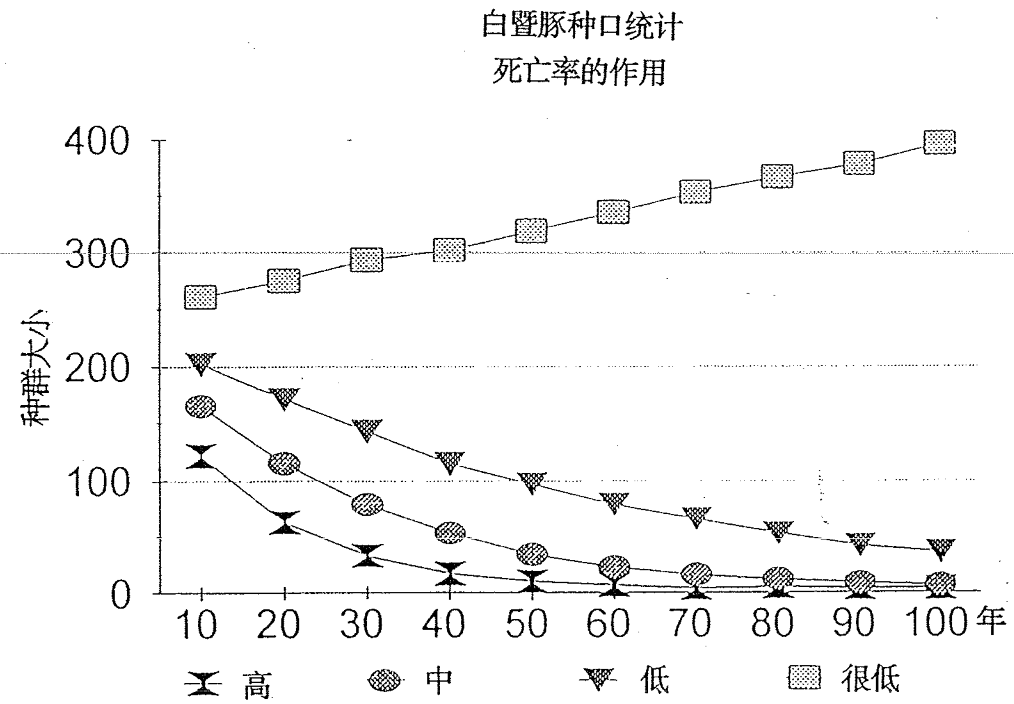


图1. 在100年中死亡率对白暨豚种群大小(240)的作用。

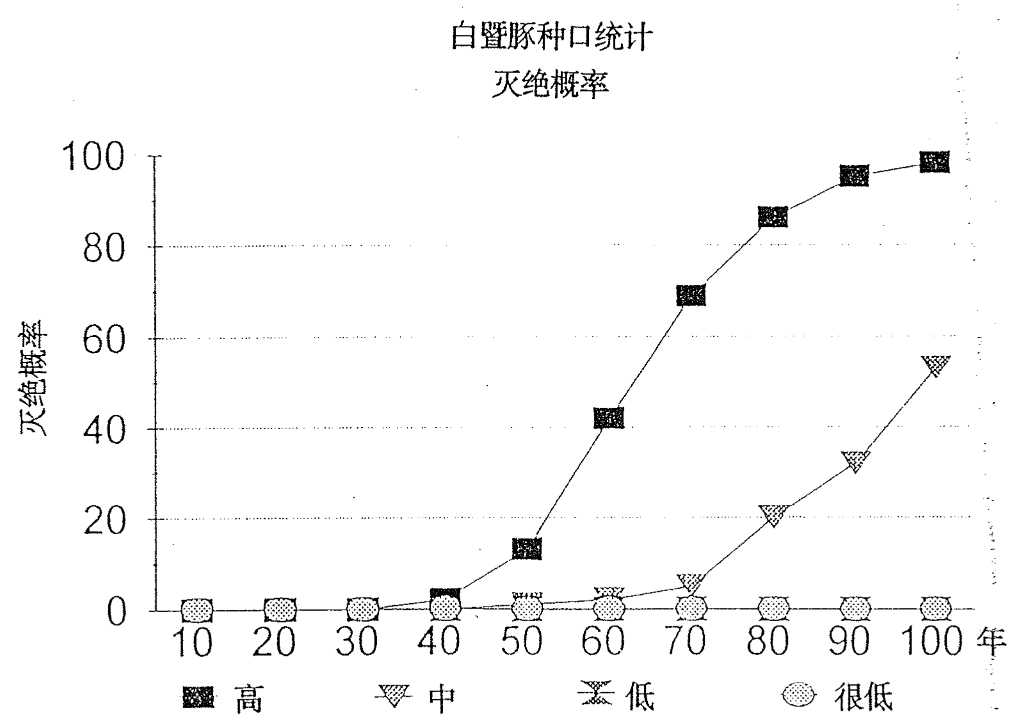


图2. 死亡率对白暨豚灭绝概率的作用。

另外，图 2 显示在高水平和中水平的死亡率时，此种群在未来100年内灭绝的概率在50%至100%之间。然而在低死亡率时（第一年幼体40%和成体4%），灭绝过程可长于100年，而在死亡率很低时，可能不会灭绝。

很清楚，除非种群的自然的和直接的人致死亡率的原因能被确定并得到控制，白暨豚在野外灭绝的概率很高。作了进一步的模拟以进一步准确界定死亡率模型灵敏度的临界值、生殖间隔、年龄结构以及在下面述及的其他参数.

进一步的一些模拟

如在"野生种群参数"中所述，对几种可供选择的参数进行了分析。

1. 做了两个种群(假定的"中游"和"下游"种群)的模型制作。

通过模拟测量了分成两个种群的作用，并与前述的假定死亡率为60%和40%的单个种群相比较。根据最近的观察我们感到，如果存在两个种群，下游种群的大小约为上游种群的2倍。假设种群总的大小为150，下游种群100头，上游种群50头，对每一个死亡率估算都作了100次模拟。

结果

采用60%死亡率估计时，种群1(下游，n=100)有99%的灭绝概率，至首次灭绝的平均时间为49.80年，种群大小年下降率为7.8%。种群2(上游，n=50)也有99%的灭绝概率，至首次灭绝的平均时间为52.13年，种群大小年下降率为6.4%。此联种群有98%的灭绝概率，至首次灭绝的平均时间为62.46年，存活种群的平均最终大小为3.5。此联种群的结果与单个种群作模型时(见表3中的高死亡率数据)相同的一些模拟的结果极为相似。

采用40%死亡率估计时，种群1(下游，n=100)有62%的灭绝概率，至首次灭绝的平均时间为83.29年，种群大小年下降率为4.1%。种群2(上游，n=50)也有64%的灭绝概率，至首次灭绝的平均时间为74.78年，种群大小年下降率为3.8%。此联种群有43%的灭绝概率，至首次灭绝的平均时间为85.84年，存活种群的平均最终大小为8.67。此联种群的结果与单个种群作模型时(见表3中的低死亡率数据)相同的一些模拟的结果显著不同。特别是单个种群分析表明灭绝概率很大地降低(6%)。

根据这些结果，模型制作工作组建议进一步开展观察研究以决定白暨豚有一个还是两个种群，这项努力应尽可能得到分子种群遗传学分析的支持。

2. 研究了按单配偶性配偶系统做模型制作的作用。

如在"野生种群的各参数"一节中所述，进行了包括单配偶性配偶系统做模型制作的作用在内的灵敏度分析。就死亡率(50%)及较低估测数的种群大小(150)做了模型制作。在100次模拟后，此种群有77%的灭绝概率，至首次灭绝的平均时间为81.09年，种群大小年下降率为4.8%，存活种群的平均最终大小为5.04。与多配偶性系统的相应的数据作了比较，后者为

80%的灭绝概率，至首次灭绝的平均时间为76.74年， 种群大小年下降率为4.0%及存活种群的平均最终大小为7.21(见表3)。因此，这个数据表明两者在灭绝概率P(E)，至灭绝的平均时间(MTE)以及种群平均最终大小几乎没有差别。虽然在种群大小年下降率r(LM)观察到一些差别，此差别没有在其它参数得到反映。

3. 评价了按每年有50%雌性生殖(相当于两年的生殖间隔)，作为与有33%雌性生殖相对的参数，做模型制作的作用。

改变这一参数对白暨豚种群的存活率有很大的正向作用。采用60%死亡率估计时，此种群有79%的灭绝概率，至首次灭绝的平均时间为78.28年，种群大小年下降率为4.9%，存活种群平均最终大小为5.19。作50%死亡率估计时，此种群只有1%的灭绝概率，种群大小年下降率为1.4%，存活种群的平均最终大小为44.59。另外，采用40%和30%两种幼体死亡率类型作模型时导致种群的正向增长，在30%的例子中，种群达到了容纳量。

两年的生殖间隔是不是白暨豚的自然状况尚有待查明。正确地确定此物种的这一生活史特性显然是十分必要的。如果有两年的生殖间隔，在当前致使它下降的各因素被消除的条件下，此物种从很可能是的低数量迅速复壮的能力是很大的。可是按这个相对高的生产力水平较难解释当前的数量急剧下降。

4. 首先只在幼体改变人致死亡率负载，其次只在成体改变。模拟了死亡率数据的这一改变的作用，以观察此模型对死亡率年龄波动的敏感程度.

A. 死亡率加到幼体的结果。

采用64%的幼体死亡率估计时，此种群有100%的灭绝概率，至首次灭绝的平均时间为61.02年，种群大小年下降率为7.3%。作54%幼体死亡率估计时，此种群仅有67%的灭绝概率，至首次灭绝的平均时间为81.40年，种群大小年下降率为4.4%，存活种群平均最终大小为5.97。作44%幼体死亡率时，此种群仅有1%的灭绝概率，种群大小年下降率为1.8%，存活种群平均最终大小为32.21。作34%幼体死亡率时，此种群在100年的模拟中达到容纳量。

这些结果看来可以指出，把人类导致的死亡率加到幼体年龄组中只有一个边缘效应。在幼体死亡率为64%的最高基线死亡率(60%)的模拟中的作用比死亡率扩展到全部年龄区模拟中的作用(见表3)边缘地较不剧烈。上述所有其它模拟的结果比死亡率扩展到全部年龄区显著地较不剧烈。因此是与已观察到的结果的相反趋势。不管怎样，极其重要的是收集分年龄的死亡率数据。

B. 人类导致的死亡率加到成体的结果。

归因于人类相关的因子的额外死亡率完全加到雄成体和雌成体的年龄组，模拟了全部四种基线死亡率水平。已知种群大小极小，虽然物种的最大年龄是30龄，根据对稳定年龄分布的预计，在年龄分布中实际包括8-19龄的雌性和6-17龄的雄性的所有成年个体，所以人类引起的死亡率被除以11。

把死亡率只加到成体的作用显著，且与多数与会代表认为是准确的预测相一致。

在60%基准水平的死亡率时，此种群有100%的灭绝概率，至首次灭绝的平均时间46.99年，种群大小年下降率9.3%。作50%幼体死亡率估计时，此种群只有99%的灭绝概率，至首次灭绝的平均时间64.49年，种群大小年下降率6.9%。作40%幼体死亡率估计时的结果，此种群有67%的灭绝概率，种群大小年下降率3.9%，至首次灭绝的平均时间83.51年，以及存活种群平均最终大小8.36。作30%幼体死亡率估计时，此种群只有2%的灭绝概率，种群大小年下降率0.9%，以及存活种群平均最终大小57.69。

这些结果指出，很可能影响白暨豚数量最近突然下降的主要因素是人类导致的成体死亡率。模型制作工作组建议对成体死亡率作紧急的进一步研究，以便迅速采取适当的行动。

5. 改变年龄分布以超代表Lin等(1985)所发现的5-13龄年龄组。

在这一模拟中没有假定此种群有稳定的年龄分布并对超代表青年成体的参数（40%在5-13年龄组）进行了模型制作。也察看了带有人类导致的死亡率的50%幼体死亡率被加到白暨豚成体的模型。采用的种群大小是150头。

结果

采用60%幼体死亡率估计时，此种群有100%的灭绝概率，至首次灭绝的平均时间为57.65年。种群大小年下降率为7.6%。作50%幼体死亡率估计时，此种群有82%的灭绝概率，至首次灭绝的平均时间为81.51年，种群大小年下降率为4.9%，存活种群平均最终大小为5.00。作40%幼体死亡率估计的结果，此种群只有8%的灭绝概率，种群大小年下降率为2.55%，存活种群平均最终大小为16.74。最后，把带有人类导致的作用的50%幼体死亡率加到成体的结果，此种群有100%的灭绝概率，至首次灭绝的平均时间为55.72年，种群大小年下降率为7.9%。

因此可以断定，偏向青年成体的种群年龄分布增加了灭绝概率，且当与人类导致的死亡率相结合加到成体时，导致有灭绝紧随其后的种群大小的迅速下降。最后的模拟研究了加人60%幼体死亡率和把人类导致的死亡率加到成体的结果作为一个“更差的方案”。在这些参数下，此种群有100%的灭绝概率，至首次灭绝的平均时间39.87年，以及种群大小年下降率为11.29%。

尽管此最后的方案是最差的，且白暨豚种群达到灭绝的平均时间最短，然而由于这些结果，此方案可能是最现实的。此模型制作的数据指明一个老化了的种群，那里的成体正遭受人类导致的死亡率的更恶化的作用，因此不能生殖，从而把种群引入一个越来越剧烈的灭绝漩涡。**此最后的模型制作结果表明一个100%的灭绝概率及40年的至灭绝的平均时间。根据已知的白暨豚种群数量的急剧下降以及许多成体正被杀死的消息，这些数据看来是相当现实的。**

野生种群兼有捕豚

分析了三种不同捕豚方式的作用，提出了全部结果。包含的三种方式如下:

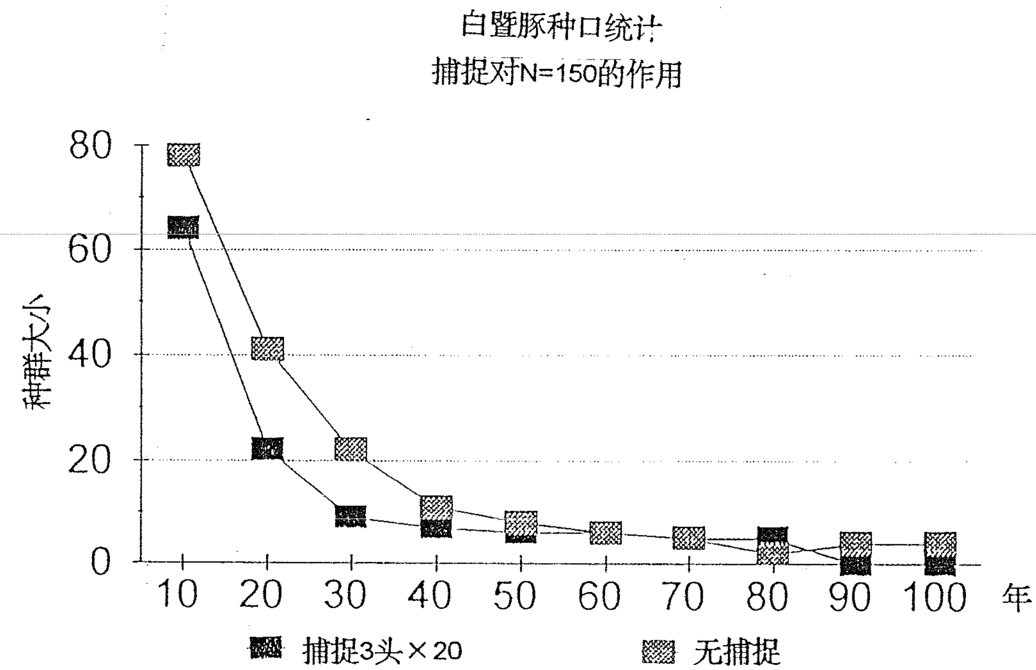


图3. 高死亡率水平下连续20年每年捕五头豚对种群大小(150 的作用。

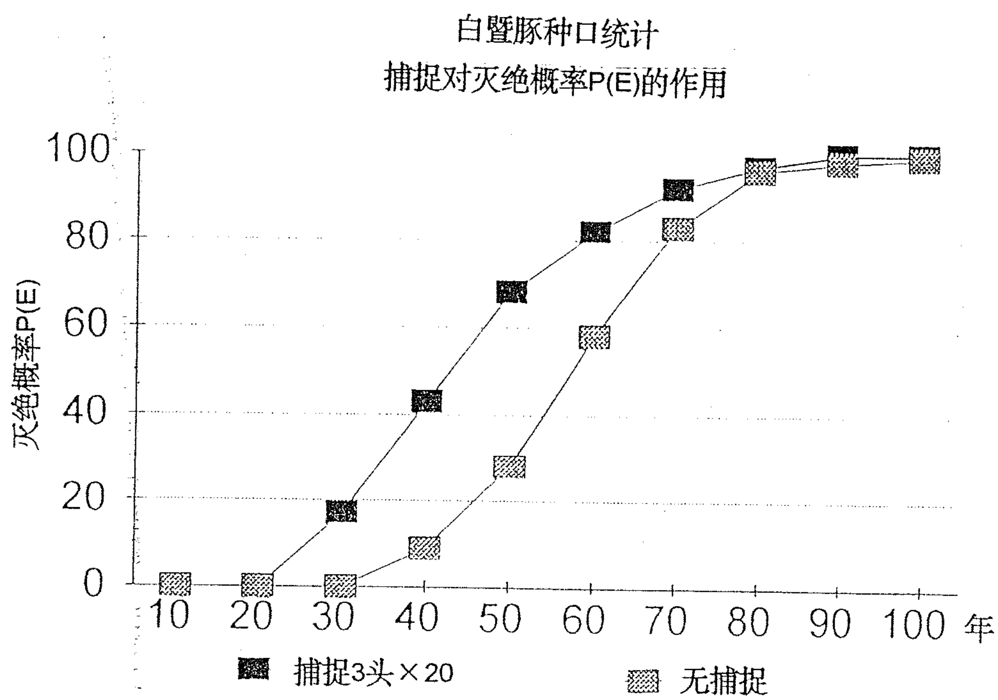


图4. 高死亡率水平下的野生种群,连续20年每年捕3头豚对灭绝概率的作用。

表2. 不同的特定年龄/性别死亡率水平在100年中对起始种群为240头的白暨豚种群大小的作用，以平均种群大小(n)及以10年为单位的时期后存活的种群模拟百分数(P)表示，死亡率见表1.

		死亡率水平、灾难和灭绝风险						
时间系列年	存活种群数	高	高+人类	中	中+人类	低	低+人类	很低
模拟投射：平均种群大小(N)和存活概率(Ps)								
10	N= Ps=	122 100	118 100	165 100	157 100	202 100	193 100	261 100
20	N= Ps=	64 100	57 100	115 100	105 100	171 100	153 100	275 100
30	N= Ps=	33 100	29 100	79 100	68 100	143 100	126 100	293 100
40	N= Ps=	17 98	14 94	53 100	44 100	115 100	105 100	302 100
50	N= Ps=	10 87	8 80	34 99	28 100	97 100	87 100	319 100
60	N= Ps=	7 58	5 41	23 98	18 94	79 100	71 100	335 100
70	N= Ps=	5 31	4 17	16 95	12 84	66 100	57 100	353 100
80	N= Ps=	5 14	4 6	12 80	8 66	53 100	44 100	367 100
90	N= Ps=	4 5	2 1	9 68	6 47	43 100	36 97	379 100
100	N= Ps=	4 2	0 0	7 47	5 27	36 100	28 95	397 100
r sto		-.067	-0.075	-0.040	-0.045	-0.018	-0.022	+.006
Te yrs		64	59	85	81		86	

r sto=随机的种群增长率.　Te=达到灭绝的平均时间

表3. 不同的特定年龄/性别死亡率水平在100年中对起始种群为150头的白暨豚种群大小的作用，以平均种群大小(n)及以10年为单位的时期后存活的种群模拟百分数(P)表示，死亡率见表1.

		死亡率水平、灾难和灭绝风险							
时间系列年	存活种群数	高	高 + 人类	中	中 + 人类	低	低 + 人类	很低	很低 + 人类
模拟投射：平均种群大小(N)和存活概率(Ps)									
10	N= Ps=	79 100	75 100	104 100	97 100	126 100	119 100	157 100	154 100
20	N= Ps=	41 100	37 100	70 100	68 100	104 100	96 100	164 100	157 100
30	N= Ps=	22 100	18 98	48 100	45 100	88 100	80 100	176 100	160 100
40	N= Ps=	12 91	9 88	33 100	30 100	72 100	63 100	188 100	167 100
50	N= Ps=	8 73	7 54	23 99	20 100	62 100	52 100	202 100	169 100
60	N= Ps=	5 42	5 27	17 87	13 95	50 100	41 100	213 100	176 100
70	N= Ps=	4 17	5 8	11 77	9 80	40 100	33 100	228 100	179 100
80	N= Ps=	5 4	5 3	9 50	7 60	35 99	26 98	243 100	186 100
90	N= Ps=	3 2	3 1	8 31	6 41	30 97	21 93	269 100	189 100
100	N= Ps=	3 1	0 0	7 20	5 19	25 94	17 89	284 100	193 100
r sto		-0.067	-0.075	-0.040	-0.045	-0.018	-0.022	0.006	0.003
Te yrs		58	53	77	80	90	88		

r sto=随机的种群增长率， Te=达到灭绝的平均时间.

1. 采捕铜陵和武汉研究组建议的总共7—8头豚。
2. 移出3头豚(每年移出不同年龄亚成体雌性2、雄性1，共二十年)。
3. 移出5头豚(每年移出不同年龄成体和亚成体雌性3、雄性2，共二十年)。

模型制作的结果:

1. 采用全部各种死亡率时，移出所建议的7—8头豚对种群不发生作用。因此结论是，根据模型并采用所述的参数，**从此种群中移出8头豚不会损害此物种生存的机会或增加其灭绝概率。**

2/3. 每年捕捉3头或5头豚对此物种灭绝概率的作用比上述的一次性捕捉更明显。图3和图4示在高、中、低死亡率情况下连续二十年每年移出3头豚的作用。在图3可以看到，被捕捉二十年之后，平均种群大小是未被捕捉的种群的50%(20头与40头相比较)。另外，被捕捉的种群达到50%灭绝概率的时间比未被捕捉的早10—15年(图4)。

在第一个二十年中每年移出5头豚有更加显著的效果，模拟的某些种群在第一个二十年(捕捉的时期)结束前就灭绝了。

进行了"更差的方案“的模型制作。在这里，60%的幼体死亡率与人类导致的死亡率合起来加到年龄分布偏向成体和青年成体的种群。对连续二十年每年移出3头豚和5头豚的作用都做了模型制作。

因此连续二十年从野生种群持续地捕捉即使是很少几头豚可能将对野生种群的大小产生严重的可测量的后果。

在自然保护区建立的种群的模型制作

湖北省新螺自然保护区

这是长江的一个支持着约42头半常住的白暨豚的开放江段，现在有约20头豚经常使用这一区域，我们把这个数字假定为起始种群的大小。渔捞将被禁止，污染被严格控制，且人类活动将大为减少。我们就中、低自然死亡率(50%和40%的幼体自然死亡率)做了模型制作。尽管与污染有关的上游的意外事故仍将影响此种群，与人类相关的死亡率将被消除。在历史上，此江段可能曾支持超过42头的豚，我们按21、42、75及150头豚的容纳量做了模型制作.

结果

当环境容纳量为21时，作40%幼体死亡率的种群有17%的灭绝概率，至首次灭绝的平均时间为72.47年，存活种群平均最终种群大小为13.65，种群平均年增长率为0.45%。作50%幼体死亡率的种群有78%的灭绝概率，至首次灭绝的平均时间为53.56年，存活种群最终种群大小为8.77，种群平均年下降率为2.67%。当环境容纳量为42时，作40%幼体死亡率的种群有5%的灭绝概率，至首次灭绝的平均时间为57.80年，存活种群平均最终种群大小为28.36，种群平

均年增长率为0.73%。作50%幼体死亡率的种群有79%的灭绝概率，至首次灭绝的平均时间为54.61年，存活种群平均最终种群大小为9.10，种群平均年下降率为2.96%。

当环境容纳量为75时，作40%幼体死亡率的种群有10%的灭绝概率，至首次灭绝平均时间为66.90年，存活种群平均最终种群大小为44.84，种群平均年增长率为0.59%。作50%幼体死亡率的种群有79%的灭绝概率，至首次灭绝的平均时间为59.94年，存活种群平均最终种群大小为10.67，种群平均年下降率为2.67%。当环境容纳量为150时，作40%幼体死亡率的种群有10%的灭绝概率，至首次灭绝平均时间为56.70年，存活种群平均最终种群大小为66.53，种群平均年增长率为0.71%。作50%幼体死亡率的种群有70%的灭绝概率，至首次灭绝平均时间为58.63年，存活种群平均最终种群大小为8.73，种群平均年下降率为2.49%。

从这些结果看来，似乎强化管理可促进种群的生长并达到容纳量。低死亡率方案(幼体死亡率40%)很好，有低的灭绝概率且平均最终种群大小可高达容纳量的83%。

半自然保护区和饲养建立的一些种群的模型制作

(1) 湖北省天鹅洲半自然保护区

这是一个有可能封闭，充分地管理的保护区。如前所述，鱼产在理论上足够喂养80头豚，而项目建议是在保护区放入25头豚。我们假定强化管理将立即消除所有与人类相关的死亡率，并把首次生殖的年龄在雄性提前一年在雌性提前两年(如在其他周密管理的鲸类物种所观察到的)。我们按三种方案进行了模型制作。1.种群将在一次行动中被引入，将由被选中的代表稳定年龄分布的25头豚建成，以后不再补充。这与野生种群的"捕捉全部"方案相一致。2.在前二十年中每年将引入2头豚。3.在前二十年中每年将引入3头豚。后两个模型在不同程度上与逐步捕捉方案相一致。

结果

1. 在假设50%、40%及30%幼体死亡率的条件下测试了第一方案。假设50%幼体死亡率时，此种群有43%的灭绝概率，到灭绝的平均时间66.70年，存活种群平均最终种群大小14.05，种群大小平均年下降率1.7%。假设40%幼体死亡率时，此种群有2%的灭绝概率，至灭绝的平均时间76.50年，存活种群平均最终种群大小54.46，种群大小平均年增长率0.87%，最后，假设30%幼体死亡率时，此种群有0%的灭绝概率，平均最终种群大小73.10，种群大小平均年增长率2.99%。

在这一方案下，如果首次生殖的年龄和死亡率水平能被控制在一个低水平，一个自我维持的白暨豚种群显然能以很高的概率生存100年。另外，即使没有来自其他种群的补充，能保存86%(40%幼体死亡率)至90%(30%)的原始杂合性。

2. 由2头豚(1头最后一年的雌性亚成体和1头雄性成体)构成的起始种群在前二十年每年得到另2头豚的补充，模拟的结果表明即使在中(50%)幼体死亡率时，灭绝概率是低的(7%)。

不管怎样，还有一个低的最终种群大小23.31。在低(40%)幼体死亡率时，灭绝概率为0%，平均最终种群大小71.32(容纳量的90%)。

由3头豚(1头最后一年的雌性亚成体，1头雌性成体和1头雄性成体)构成的起始种群在前二十年每年得到另2头豚的补充，模拟的结果表明即使在中(50%)幼体死亡率时，灭绝概率是低的(4%)。不管怎样，还有一个低的最终种群大小34.79。在低(40%)幼体死亡率时，灭绝概率为0%，平均最终种群大小72.77(容纳量的91%)。

再次，在这一方案下，一个自我维持的白暨豚种群显然能以很高的概率生存100年。

(2) 安徽省铜陵半自然保护区

这个保护区包含一个封闭的1.5公里长，100米宽的夹江，江内没有自然鱼产。现在的计划是放入3头豚(2头雌性，1头雄性)，最大容纳量5头豚(3头雌性，2头雄性)。我们去除了人类导致的死亡率的作用，把首次生殖的年龄保持与野生种群的一致，并包括密度制约的生殖成就。另外，我们按每年从其他饲养种群引入1头豚做了模型制作。

(3) 武汉水生生物研究所的饲养设施

在武汉当前建议只建立一个饲养种群，那里有4个不同大小的饲养池。远期计划把10头豚(4头雄性和6头雌性)引入此设施。但首先引入4头，在未来三年加另外6头。

做模型制作时，我们假设在远期死亡率将剧烈降低(30%幼体死亡率)，但在前十年要大得多(10%成体死亡率，50%幼体死亡率)。我们包括了2%的重病爆发概率，其死亡率为20%，对生殖没有影响。

结果

对铜陵和武汉种群的模型制作给出的直觉的显著结果是，没有连续的直接干预，两者都不是种口统计稳定的种群。必须注意保证种口统计的和遗传的稳定性在这两个小种群得到保持，而这将必然包含把豚转移到各周密管理的种群并从那些种群引入豚。

POPULATION BIOLOGY AND MODELLING

Participants: Mike Bruford, Wang Ding, Gao Anli, Liu Qing, Wang Yaming.

INTRODUCTION

This report synthesizes the results produced from the simulations and scenarios as recommended in the workshop. The models tested were of three kinds;

1. Models of the **wild population** over a period of 100 years, assuming no removal of any animals for the establishment of a captive or semi-natural reserve population.

2. Models of the **wild population** over a period of 100 years, taking into consideration the removal of realistic numbers of animals for the establishment of breeding programs.

3. Models of the **reserve** and **captive populations** assuming different stocking rates and levels of gene-flow among reserves and captive institutions.

WILD POPULATION MODELLING

Parameters Of The Wild Population

1. The simulations were projected over 100 years. The need for short term urgent data and action to reverse the decline of this critically endangered species necessitated that the attention of the group be focussed solely on the next 100 years with frequent reports to track rapid changes.

2. Population and extinction reports were obtained at ten year intervals of the simulation.

3. There was some debate within the group about the possible existence of either one or two populations along the middle and lower reaches of the Yangtze river. The longest dispersal distance measured for an individual so far (by Prof. Zhou and colleagues using photo identification techniques) is 200 km. The densest areas of the two putative populations exist in the middle and lower reaches of the Yangtze. If the populations do indeed exist, they are separated by approximately

500 km (e.g. Anqing section to Honghu section). However it is entirely possible that the dispersal distance of baiji is much higher than the 200 km maximum measured to date, especially with the small sample size so far identified by photographs. Therefore although initial models concentrated on the existence of one population only, we decided to eventually model both possibilities, with a relatively high (5% - entered as 0.05) per year genetic exchange rate between the two populations.

4. The possible correlation between variance in reproduction and survival was discussed. Overall the group felt that years where reproduction was successful would be correlated with years of good survival, particularly as recorded mortality by age/sex indicated that adult females were predominant in human caused mortality.

5. The group, in broad agreement with the Habitat/Threats/Catastrophes Working Group, considered that only two environmental events would have a significant effect on the survival and reproduction of the baiji (larger than normal environmental variance). These were 1) the effects of explosion events - either by explosion fishing or for river construction work, and 2) the effects of a chemical accident in the river.

6. It was decided that the most parsimonious policy would be to include the effects of inbreeding depression by the Heterosis model, where each individual carries 3.14 Lethal Equivalent genes. Given the lack of genetic data of any kind on the baiji, this course would cover most eventualities.

7. Given the lack of other data on baiji, we assumed that there was the potential for a polygynous mating system in the species. However, given the fact that the species is sexually dimorphic with females being larger than males, it is entirely possible that this species is not, in fact, polygynous (Ralls and Brownell, 1986; Perrin, pers. comm.). The real situation might actually be one of promiscuity with loose, temporally unstable affiliations forming between males and females. Such a scenario cannot be modelled in the present form of VORTEX. However, it is possible that males could have equal reproductive success, in which case an effectively monogamous situation might arise. Therefore a sensitivity analysis involving the effect of modelling a monogamous mating system will be carried out.

8. The available evidence (Liu et al 1988, Chen et al 1984) suggests that females begin breeding at between 6 and 8 years (we took the most recent estimate of 8) and that males begin breeding at between 4 and 6 years (we decided that 6 was probably more realistic).

9. The oldest recorded baiji was estimated to be approx. 24 years old (Gao and Zhou, 1992). The group felt that therefore some individuals probably survived to

30 - 40; so a conservative estimate of 30 was adopted.

10. The sex ratio at birth is unknown for baiji; however, evidence from other cetacean species indicates that an expected 1:1 ratio occurs.

11. Although reproduction in baiji could be density dependent, this parameter was regarded by the group to have little meaning because of the very low densities of the wild baiji population.

12. Data suggest that 30% of adult females produce a calf in any given year (Liu et al. 1988). The standard deviation on this figure was, however, considered to be very high so we chose 20%.

13. The most problematic parameter in the wild baiji population modelling was age and sex specific mortality, both natural and human caused. No natural mortality data are available. The only data where age and sex at death was known is available from both Wuhan (Institute Hydrobiology, unpub.) and Nanjing (Gao and Zhou, 1992, and unpub.) on primarily human induced mortality - accidents where the public or scientists discovered beached or floating bodies.

In line with both published and unpublished data from other cetacean species, (e.g. killer whale 40-50% for first six months, long-finned pilot whale 35% in first year, gray whale 35-36% in first year, bottlenose dolphin 60% in first year) we modelled natural death rates which considered mortality in the first year as 60%, 50%, 40% and 30%, and the expected decreasing scale for subadult and adult mortality (see **Table 1**). A figure of 50 - 60% was considered most realistic for baiji by the Modelling Group.

Further, we factored in the human induced mortality data in the following way. Over the last three years ten dead individuals have been observed in the lower Yangtze under study by the Nanjing group - however only two of these (20%) have been obtained, and therefore aged and sexed in the laboratory of Prof. Zhou. Dr. Wang felt that the figure was nearer 40% for Wuhan - so we settled for a 30% compromise figure for the proportion of anthropogenic deaths recovered. The Wuhan and Nanjing groups collected 28 females and 16 males between them over a fifteen year period - these figures may therefore be extrapolated to 93 females and 53 males over this fifteen year period - or 6 females and 4 males per year.

We can distribute these mortalities according to a realistic age/sex structure such as those we are already using (see above). Fifteen years ago there were approximately 400 animals, now there may be as few as 150; so, we have taken a mean value of 275. Assuming 1:1 sex ratio, then increased human-caused mortality is 4.4% for females and 2.9% for males. These percentages were apportioned across age classes (see **Table 1**). It is important to note that the

Table 1. Mortality scenarios (natural and natural + human) modelled for the wild population.

Mortality by age	High with human	High	Mid with human	Mid	Low with human	Low	V.low with human	V.low
0-1	62.7	60.0	52.2	50.0	41.8	40.0	31.3	30.0
1-2	20.9	20.0	16.7	16.0	13.6	13.0	10.5	10.0
2-3	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
3-4	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
4-5	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
5-6	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
Male adult	6.2	6.0	5.2	5.0	4.2	4.0	3.1	3.1
6-7	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
7-8	10.5	10.0	8.4	8.0	7.3	7.0	5.2	5.0
Female adult	6.2	6.0	5.2	5.0	4.2	4.0	3.1	3.0

Habitat/Threat/Catastrophes Group felt that human-caused mortality was potentially considerably higher (5 - 10% per year), and that these figures should be used in some of the modelling. Further modelling will test the effect of loading the human induced mortality on firstly juveniles and then adults. The model may be more sensitive to adult than juvenile mortality (Seal, pers. comm).

14. The catastrophes were apportioned probabilities in the following way.

A. **Explosion** (fishing or construction): In 1974, 6 baiji were killed during a construction-related explosion and in 1984, 5 animals were killed in a fishing explosion. These occurrence (twice in twenty years) leads to a 10% probability with up to 2% of the population's being killed with no effect on the reproductive capacity of the survivors.

B. Chemical Accident: In 1989, a car carrying 4 tons of phosphorous fell in to the river. The pollution was heavy and many fish died as a result. Within a few days, 3 baiji were discovered dead with no obvious external symptoms - it was presumed that the mortality was related to the chemical spill. The Group decided that since it was likely that approximately six additional animals would have died but remained undetected, this type of catastrophe accounted for at least 3% of the population. Furthermore, this type of accident is likely to increase in frequency over time with the continued industrialization of the Yangtze river valley. Accordingly, the Group assigned a probability of 10% to the occurrence of a chemical spill, i.e. we expected that it would happen once every ten years. Such a chemical spill might be expected to have an incidental effect on the reproductive capacity of surviving animals in close proximity to the spill. We considered that a further 3% of the population would have been affected but not killed, and therefore a 3% negative effect on reproduction was assigned.

15. In the absence on data on the baiji, but taking into consideration data from other cetacean species, we decided that the most prudent course was to suppose that all adult males were in the breeding pool.

16. There are some data which suggest that population(s) have an age distribution slightly biased towards individuals in the age class between 5 and 13 (Lin et al. 1985). However, the sample size was small (33 + 3 fetuses) and was taken over a ten year period. These data are thus probably not reliable for the production of a population age structure at a point in time. In the absence of hard data, the group adopted the use of a stable age distribution whilst recognizing that more simulations could be undertaken modelling a possible slight bias recorded in the subadult age classes.

17. The census evidence, as reviewed by the Census Working Group, indicated that the population is between 240 and 150 individuals. The group modelled both the upper and lower of these estimates of the present population size.

18. The carrying capacity of the river was universally regarded by the Group and the Habitat Working Group as very much larger than the present population size in both the middle and lower reaches of the Yangtze river. It is therefore difficult to estimate the true size of the population that could be supported if the conditions were ideal for the species. We arbitrarily chose the figure of 1,000 in the knowledge that if the simulations indicated that if the population would at any point achieve carrying capacity, we would measure the effect of increasing the carrying capacity.

19. We did not model a trend in carrying capacity, even though the general feeling of the group was that the carrying capacity was decreasing at some rate, as the capacity was felt to be much larger than the current population size, and would not significantly impinge on the growth of the population during the time period of the modelling. However the modelling was done with the caveat that if the

population would at any point achieve carrying capacity, we would attempt to model the trend accordingly.

20. Neither a projected harvest nor supplement were included in the initial analysis of the wild population.

Wild Population Modelling With Harvesting

1. A modelling exercise was carried out based on proposed capture(s) by the Tongling and Wuhan groups;

Wuhan plans to take 5 individuals for the Wuhan facilities and Shishou.	- 2 males age 3-4 - 3 females age 6-7
Tongling plans to take 2 or 3 individuals	- 1 adult male - 1 adult female - 1 sub-adult male.

An additional exercise was carried out, which incorporated an "aggressive effort" to capture sufficient animals to establish a self-sustaining captive population within 30 years. Accordingly, models were constructed assuming a) the capture of 3 animals per year (2 females, 1 male) for the first 20 years of the model, and b) 5 animals (3 females, 2 males) per year for the first 20 years. 20 years was chosen as a time-frame for harvesting, because our initial idea was that 5 animals should be captured for years 1-4, and 3 animals per year for 15 years thereafter. VORTEX does not allow different harvesting rates to be modelled, so we decided use both 5 and 3 animals for 20 years.

Modelling Of Population Established In Natural Reserve

Xin-Luo natural reserve in Hubei province: This is a 135 km section of the Yangtze river, which is intended to be an open section where fishing will be banned, pollution stringently controlled, and other human activities (i.e. river traffic etc) substantially reduced.

In 1984, this section of the river supported approximately 42 semi-resident dolphins. At present approximately 20 individuals use the area regularly.

For modelling purposes the presumptive effect on the population within the reserve is that human related mortality will be eliminated over a relatively short period of time to the stage where it reflects natural mortality.

Given that historically, the 135 km stretch of river might have supported considerably more than 42 individuals, we modelled the carrying capacity at 21 (initially with the K increasing 10% for the first 10 years) 42, 75 and 150 individuals. It is not proposed to actively transport any animals into this section of the river.

Modelling Of Populations Established In Semi-Natural Reserves And Captivity

1. <u>Tian-e-Zhou ox-bow semi-natural reserve, Hubei province</u>

This is a potentially closed, fully managed reserve which is 21 km long and approximately 1 km wide. Fish production has been accurately measured at 184,000 kg fish per year. This is theoretically enough to feed 80 animals throughout any given year. However it is unlikely that this number of animals can be supported, so the proposal is to put 25 animals into the reserve.

For the model, we assumed that this intensive management would result in immediate elimination of all human related mortality, and the bringing forward of the first age of reproduction by one year in males and two years in females (as has been observed in other closely managed cetacean species).

2. <u>Tongling semi-natural reserve, Anhui province</u>

This reserve is a 1.5 km long and 100 m wide canal which is closed by dams at both ends and requires pumping water at low water to maintain the river level. There is no natural fish production in the river, and current plans are to put three (2 females, 1 male), to 5 (3 females, 2 males) animals in the reserve.

For modelling purposes, we decided to remove the effect of human-caused mortality, to keep the age of first reproduction the same as in the wild population, and to include density dependent breeding success.

3. <u>Captive facility in Wuhan (Institute of Hydrobiology)</u>

Only one captive population is currently proposed at Wuhan, where four different sized pools are available. It is proposed to introduce ten individuals (4 males and 6 females) to this facility in the long term, but 4 individuals in the first instance.

For modelling purposes, we assumed that mortality would be severely reduced in the long term (30% juvenile mortality) but that it would be much larger (10% adult mortality, 50% juvenile mortality) in the first ten years. Further, we included density dependent breeding, a 2% probability of a severe disease outbreak, with 20% mortality and no effect on reproduction.

The modelling took into account all three captive and semi captive populations, assuming that there was genetic exchange among populations and that there was;

A. 2 males, 2 females - Ox-bow, Tian-e-Zhou

B. 2 females, 1 male - Tongling

C. 1 female (+ existing male Qi Qi) - Wuhan

SIMULATION RESULTS

To date the simulations have been primarily carried out on the wild population, with and without harvesting. The semi-natural reserve and captive populations are much harder to model because it is difficult to predict when, where and how many animals will be captured. However for the final report a full analysis of the semi-natural and captive populations will be presented.

Wild Population

Firstly, we ascertained in preliminary simulations that the effect of using different levels of mortality (including human induced mortality) was very great. The magnitude of this effect was then investigated further on populations comprising both 240 and 150 individuals. All other parameters are as described in the "Parameters of the Wild Population" section. The result of changing mortality rates on a population starting with 240 individuals is shown in **Table 2**, and with 150 individuals in **Table 3**.

Mortality clearly had large effects on growth rate (**r**), population size (**n**) and probability of survival (**p**) (and consequently its reciprocal, the probability of extinction P(E)); the addition of annual human-caused mortality, spread according to the partitioning of natural mortality by age and sex, had a small but noticeable impact on all parameters. However, it is not clear from these data what effects differential loading of the human-caused mortality factor would have on the outcome. Further simulations are being carried out, loading the mortality at first in the juvenile and then in the adult end of the age distribution. The results show that, as expected, the size of the starting population that is taken (in this case 150 or 240) has some effect on the probability of survival (p) and the MTE (mean time to extinction).

The more salient parts of these data can be graphically represented, and **Figures 1** and **2** show the effect of mortality (excluding human mediated) on population size (using the upper range of 240 individuals as the initial size) and the probability of extinction. It can be seen that the population size only increases over 100 years when mortality levels are very low (i.e. 30% for the first year, and 3% for adults). Unfortunately, these mortality levels are probably unrealistically low for the wild population.

Our conclusion from this evidence is that, using the parameters described above, unless baiji mortality can be kept at the very lowest recorded levels for a cetacean, the population will continue to decline steadily in the wild.

Furthermore, Figure 2 shows that at high and medium levels of mortality, the probability of the specie's becoming extinct within the next 100 years is between 50% and 100%. However the extinction process could take longer than 100 years at low mortality (40% for first year and 4% for adults), and might not occur at all if mortality levels are very low.

Figure 1. Effects of mortality on Baiji population size (240) over 100 years.

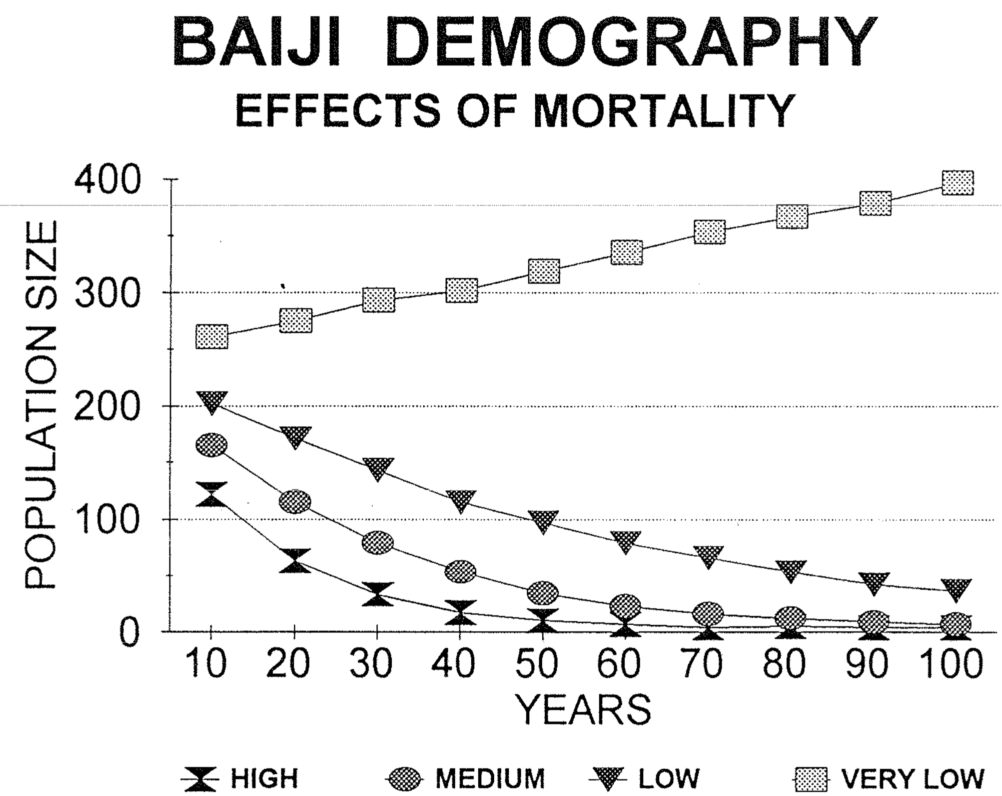


Figure 2. The effects of mortality on the probability of extinction for the Baiji.

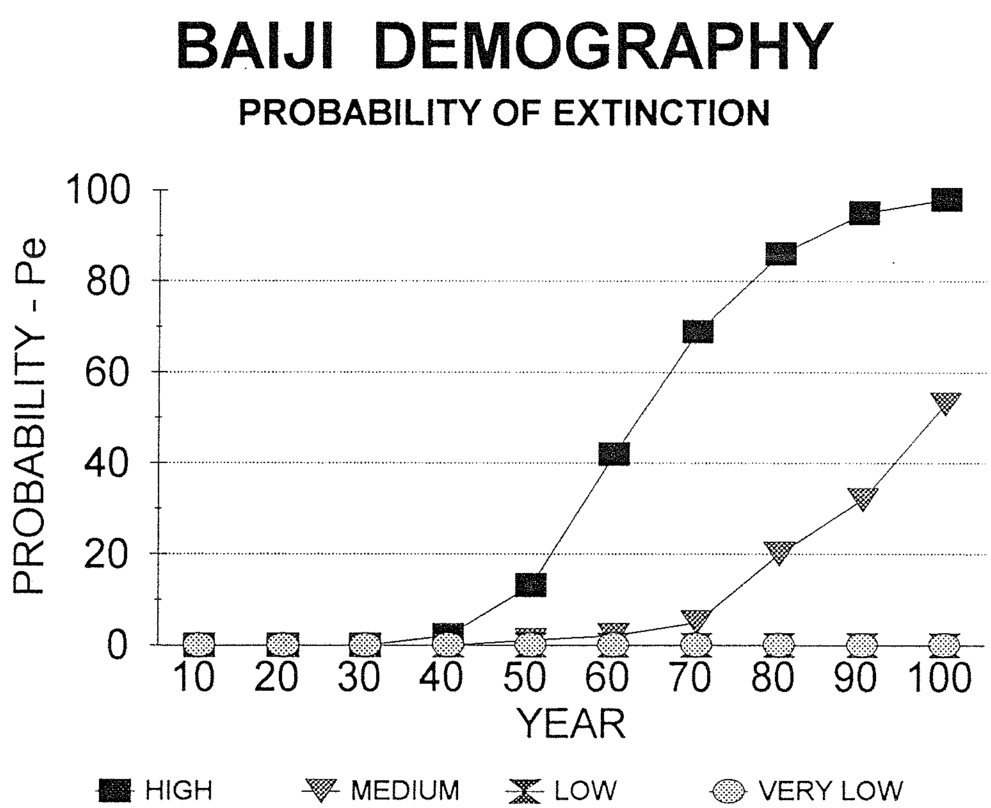


Table 2. The effects over 100 years of different age/sex specific mortality levels on size of a starting population of 240 baiji, expressed as mean population size (n) and the proportion of simulations where the population survived after units of ten years (p). For mortality rates see Table 1.

		Level of Mortality, Catastrophes and Risk of Extinction						
Time Series - Years	**Pop N Surv**	**High**	**High + human**	**Mid**	**Mid + human**	**Low**	**Low + human**	**Very low**
Simulation Projections: Mean population size and probability of survival								
10	**N=** **Ps=**	122 100	118 100	165 100	157 100	202 100	193 100	261 100
20	**N=** **Ps=**	64 100	57 100	115 100	105 100	171 100	153 100	275 100
30	**N=** **Ps=**	33 100	29 100	79 100	68 100	143 100	126 100	293 100
40	**N=** **Ps=**	17 98	14 94	53 100	44 100	115 100	105 100	302 100
50	**N=** **Ps=**	10 87	8 80	34 99	28 100	97 100	87 100	319 100
60	**N=** **Ps=**	7 58	5 41	23 98	18 94	79 100	71 100	335 100
70	**N=** **Ps=**	5 31	4 17	16 95	12 84	66 100	57 100	353 100
80	**N=** **Ps=**	5 14	4 6	12 80	8 66	53 100	44 100	367 100
90	**N=** **Ps=**	4 5	2 1	9 68	6 47	43 100	36 97	379 100
100	**N=** **Ps=**	4 2	0 0	7 47	5 27	36 100	28 95	397 100
r sto.		-.067	-0.075	-0.040	-0.045	-0.018	-0.022	+.006
Te yrs		64	59	85	81		86	

r sto = Stochastic population growth rate. Te - Mean time to extinction - years.

Table 3. The effects over 100 years of different age/sex specific mortality levels on size of a starting population of 150 baiji, expressed as mean population size (n) and the proportion of simulations where the population survived after units of ten years (p). For mortality rates see Table 1.

		Level of Mortality, Catastrophes and Risk of Extinction							
Time Series - Years	**Pop N Surv**	**High**	**High + human**	**Mid**	**Mid + human**	**Low**	**Low + human**	**Very low**	**Very low + human**
Simulation Projections: Mean population size and probability of survival.									
10	**N=** **Ps=**	79 100	75 100	104 100	97 100	126 100	119 100	157 100	154 100
20	**N=** **Ps=**	41 100	37 100	70 100	68 100	104 100	96 100	164 100	157 100
30	**N=** **Ps=**	22 100	18 98	48 100	45 100	88 100	80 100	176 100	160 100
40	**N=** **Ps=**	12 91	9 88	33 100	30 100	72 100	63 100	188 100	167 100
50	**N=** **Ps=**	8 73	7 54	23 99	20 100	62 100	52 100	202 100	169 100
60	**N=** **Ps=**	5 42	5 27	17 87	13 95	50 100	41 100	213 100	176 100
70	**N=** **Ps=**	4 17	5 8	11 77	9 80	40 100	33 100	228 100	179 100
80	**N=** **Ps=**	5 4	5 3	9 50	7 60	35 99	26 98	243 100	186 100
90	**N=** **Ps=**	3 2	3 1	8 31	6 41	30 97	21 93	269 100	189 100
100	**N=** **Ps=**	3 1	0 0	7 20	5 19	25 94	17 89	284 100	193 100
r sto		-.067	-.075	-.040	-.045	-.018	-.022	.006	.003
Te yrs		58	53	77	80	90	88		

r sto = Stochastic population growth rate. Te = Mean time to extinction in years.

Clearly, unless the causes of both natural and direct human-caused mortality population can be determined and controlled, the baiji has a high probability of extinction in the wild. Further simulations were carried out to further pinpoint the critical thresholds of sensitivity for the model of mortality, inter-birth interval, age structure and other parameters as described below.

FURTHER SIMULATIONS

As described in the 'Parameters of the Wild Population', several alternative life history parameters were analyzed.

1. Two populations (the putative "middle" and "lower" reaches populations) were modelled.

The effect of dividing the population into two was measured by simulation, and was compared with the single population assuming 60% and 40% mortality, as described earlier. If two populations exist, then it was felt that, on the basis of recent sightings, the lower reaches population would be approximately twice the size of the upper reaches population. 100 simulations were carried out for each mortality estimate assuming a total population size of 150, with 100 individuals in the lower reaches population, and 50 in the upper reaches.

Results

Using the 60% mortality estimate, population 1 (lower reaches, n = 100) had a 99% probability of extinction, a mean time to first extinction of 49.8 years and an annual rate of decline in population size of 7.8%. Population 2 (upper reaches, n = 50) also had a 99% probability of extinction, a mean time to first extinction of 52.1 years and an annual rate of decline in population size of 6.4%. The metapopulation had a 98% probability of extinction, a mean first time to extinction of 62.5 years and a mean final size of surviving populations of 3.5. The metapopulation results are extremely similar to the equivalent simulations where one population was modelled (see High Mortality data in Table 3).

Using the 40% mortality estimate, population 1 (lower reaches, n = 100) had a 62% probability of extinction, a mean time to first extinction of 83.3 years and an annual rate of decline in population size of 4.1%. Population 2 (upper reaches, n = 50) also had a 64% probability of extinction, a mean time to first extinction of 74.8 years and an annual rate of decline in population size of 3.8%. The metapopulation had a 43% probability of extinction, a mean first time to extinction of 85.8 years and a mean final size of surviving populations of 8.67. The metapopulation results differ significantly from the equivalent simulations where one population was modelled (see Low Mortality data in Table 3). In particular, the single population analysis indicated a much reduced (6%) probability of extinction.

In the light of these results, the modelling group recommends that further observational investigation take place to determine whether the baiji comprise one or two populations, and that this effort should be backed up by molecular population genetic analysis where possible.

2. The effect of modelling a monogamous mating system was investigated.

As described in the "Parameters of the Wild Population" section, a sensitivity analysis involving the effect of modelling a monogamous mating system was carried out. A medium (50%) mortality rate and lower estimate population size (150) was modelled. After 100 simulations, the population had a 77% probability of extinction, a mean time to first extinction of 81.1 years, an annual rate of decline in population size of 4.8% and a mean final size of surviving populations of 5.0. This compares with an 80% probability of extinction, a mean first time to extinction of 76.7 years, an annual rate of decline in population size of 4.0% and a mean final size of surviving populations of 7.2 for the equivalent data for a polygynous system (see Table 3). The data therefore indicate that there is little difference in probability of extinction p(E), mean time to extinction (M.T.E), and mean final population size. Although a difference was observed in the annual rate in decline in population size r(LM), this was not reflected in the other parameters.

3. The effect of modelling 50% of females reproducing per year (the equivalent to a 2 year interbirth interval), as opposed to 33% of females, was assessed.

Changing this parameter had a very large positive effect on the probability of survival of the baiji population. Using a 60% mortality estimate, the population had a 79% probability of extinction, a mean time to first extinction of 78.3 years, an annual rate of decline in population size of 4.9% and a mean final size of surviving populations of 5.2. With a 50% mortality estimate, the population only had a 1% probability of extinction, an annual rate of decline in population size of 1.4% and a mean final size of surviving populations of 44.6. Furthermore, simulations using 40% and 30% juvenile mortality types resulted in positive growth in the population, which, in the case of 30% mortality, reached carrying capacity.

It remains to be seen whether a two year inter-birth interval is the natural state for the baiji, and the accurate determination of this life-history trait in the species is clearly very important. If there is a two year inter-birth interval the capacity of the species for a rapid recovery from its probable low numbers is great, given the removal of the factors which are currently contributing to its decline. However, the present sharp decline in numbers is less easily explained given this relatively high level of productivity.

4. The loading of human-caused mortality was changed firstly to juveniles only and secondly to adults only. The effects of this manipulation of the mortality data was carried out to see how sensitive the model was to age-specific fluctuation in mortality.

A. ***Results of loading mortality on juveniles.***

Using a 64% juvenile mortality estimate, the population had a 100% probability of extinction, a mean time to first extinction of 61.0 years, an annual rate of decline in population size of 7.3%. With a 54% juvenile mortality estimate, the population only had a 67% probability of extinction, a mean time to first extinction of 81.4 years, an annual rate of decline in population size of 4.4% and a mean final size of surviving populations of 6.0. In the results of the 44% juvenile mortality estimate, the population only had a 1% probability of extinction, an annual rate of decline in population size of 1.8% and a mean final size of surviving populations of 32.2. With a 34% juvenile mortality estimate, the population achieved carrying capacity during the 100 years of the simulation.

These results would appear to indicate that there is only a marginal effect of loading the human-mediated mortality on the juvenile age-class. The effects are marginally less severe in the highest base-line mortality (60%) simulation, where juvenile mortality was 64% than where mortality is spread throughout the entire age range (see Table 3). The results of all other simulations described above are considerably less severe than where mortality is spread across the entire age-range, and therefore in the opposite trend to that which is apparently being observed. However, it is of extreme importance that age-specific mortality data are collected on the wild population.

B. ***Results of loading human-mediated mortality on adults.***

The additional mortality attributed to human-related factors was loaded entirely onto the adult male and female age classes, and all four base-line mortality levels were simulated. According to the predictions of a stable age distribution, the human-mediated mortality was divided by eleven as, given the extremely small population size and although the maximum age for the species is 30, effectively all adult individuals in the age distribution comprise the age category 8-19 for females and 6-17 for males.

The effect of loading mortality solely on adults was profound, and fell in line with the predictions most delegates seemed to think was accurate.

At a 60% base-level mortality, the population had a 100% probability of extinction, a mean time to first extinction of 47.0 years, an annual rate of decline in population size of 9.3%. With a 50% juvenile mortality estimate, the population only had a 99% probability of extinction, a mean time to first extinction of 64.5 years, an annual rate of decline in population size of 6.9%. In the results of the 40% juvenile mortality estimate, the population had a 67% probability of extinction, an annual rate of decline in population size of 3.9%, a mean time to first extinction of 83.5 years, and a mean final size of surviving populations of 8.36. With a 30% juvenile mortality estimate, the population only had a 2% probability of extinction, an annual rate of decline in population size of 0.9% and a mean final size of surviving populations of 57.7.

These results indicate that it is likely that the major factor effecting the recent precipitate decline in baiji numbers is human-mediated adult mortality. The modelling group recommends urgent further research to examine adult mortality so that appropriate action can be quickly taken.

5. The age distribution was altered to over-represent the 5-13 year age class, as found by Lin et al. (1985).

In this simulation a stable age distribution in the population was not assumed and the over-representation of the young adult (40% being in the 5-13 age class) was modelled. The basic 60%, 50% and 40% juvenile mortality models were examined, and a 50% juvenile mortality with human mediated mortality loaded on adult baiji model was also examined. A population size of 150 was used.

Results

Using a 60% juvenile mortality estimate, the population had a 100% probability of extinction, a mean time to first extinction of 57.6 years, and an annual rate of decline in population size of 7.6%. With a 50% juvenile mortality estimate, the population had an 82% probability of extinction, a mean time to first extinction of 81.5 years, an annual rate of decline in population size of 4.9% and a mean final size of surviving populations of 5.0. In the results of the 40% juvenile mortality estimate, the population only had an 8% probability of extinction, an annual rate of decline in population size of 2.55% and a mean final size of surviving populations of 16.7. Finally, in the results of the 50% juvenile mortality with human mediated effects loaded on to adults, the population had a 100% probability of extinction, a mean time to first extinction of 55.7 years, and an annual rate of decline in population size of 7.9%.

It can be concluded therefore, that a young adult-biased population age distribution increases the probability of extinction and when in combination with human mediated mortality loaded on adults, results in a rapid decline in population size closely followed by extinction. A final simulation investigated the results of adding 60% juvenile mortality and loading human-mediated mortality on adults as a "worse case scenario". Under these parameters, the population had a 100%

probability of extinction, a mean time to first extinction of 39.89 years, and an annual rate of decline in population size of 11.29%.

Although the last scenario is the least optimistic and the baiji population has the shortest mean time to extinction, it is nevertheless by virtue of these results possibly the most realistic. The modelling data point to an ageing population where adults are undergoing the worst effects of human mediated mortality and therefore are unable to breed leading the population into an extinction vortex of ever increasing severity. **The final modelling results indicate a 100% probability of extinction and a mean time to extinction of 40 years. These data seem quite realistic given the current precipitous decline in numbers within the baiji population and the knowledge that many adults are being killed.**

Wild Population With Harvesting

The effects of three different harvesting regimes were analyzed, and the full results are presented. The regimes involved the following:

1. The collection of a combined total of 7-8 individuals proposed by the Tongling and Wuhan groups.

2. The removal of 3 individuals (2 females and 1 male of a variety of subadult ages per year for twenty years).

3. The removal of 5 individuals (3 females and 2 males of a variety of adult and subadult ages per year for twenty years).

Modelling Results

1. The removal of the proposed removal of 7-8 individuals had no effect on the population using all levels of mortality. The conclusion is therefore that, according to the model and using the parameters described, **the removal of eight individuals from the population does not prejudice the chances of survival or increase the probability of extinction of the species.**

2/3. The annual harvesting of three or five individuals has a more pronounced effect than the above one-time captures on the probability of extinction of the species. **Figures 3** and **4** show the effects of removing 3 animals per year for twenty years under conditions of high, medium and low mortality. In **Figure 3** it can be seen that after the twenty years of harvesting, the mean population size is 50% of the unharvested population (20 individuals compared with 40). Furthermore, a 50% P(E) is reached 10 -15 years earlier for the harvested population (**Figure 4**).

Figure 3. The effects of harvesting three animals per year for 20 years on the population size (150) with high mortality.

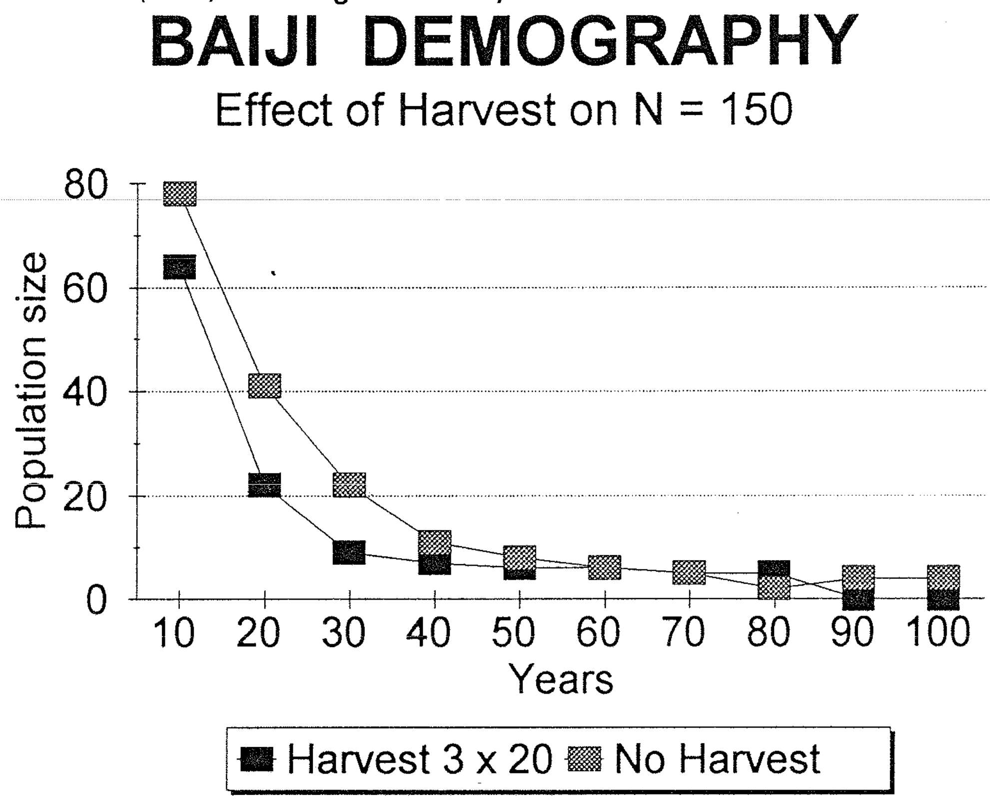
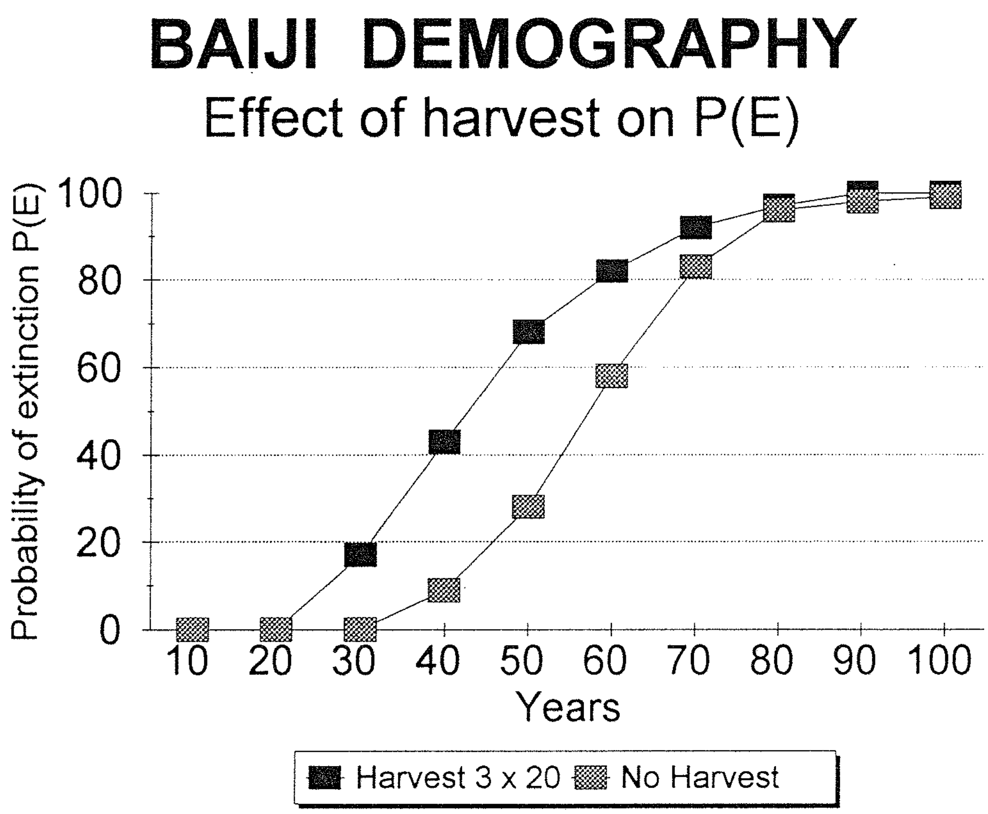


Figure 4. The effects of harvesting three animals per year for 20 years, with high levels of mortality in the wild population, on the probability of extinction.



Removing 5 individuals per year for the first twenty years has a much more pronounced effect; some of the simulated population become extinct before the first twenty years (the period of harvesting) is complete.

A modelling exercise of the "worst case scenario" was carried out. Here 60% juvenile mortality was combined with human-mediated mortality loaded onto adults and a young adult-biased age distribution. The effects of removing both 3 animals per year for twenty years and five animals per year for twenty years were modelled.

It is therefore probable that sustained capture of even a few animals from the wild for twenty years will have a serious and measurable consequence on the size of the wild population.

Modelling Of Population Established In Natural Reserve

Xin-Luo natural reserve in Hubei province

This is open section of the Yangtze river, where fishing will be banned, pollution stringently controlled, and where human activities will be heavily reduced supported approximately 42 semi-resident dolphins and at present approximately 20 individuals use the area regularly, and we assumed a starting population of that figure. We modelled moderate and low natural mortality (50% and 40% for juveniles) and that human related mortality will be eliminated, though pollution related accidents upstream would still affect the population. Historically, the stretch of river might have supported more than 42 individuals, we modelled the carrying capacity at 21, 42, 75 and 150 individuals.

Results

For populations with an environmental carrying capacity of 21, the population with 40% juvenile mortality had a 17% probability of extinction with a mean time to first extinction of 72.47 years, a mean final population size for surviving populations of 13.65 and a mean rate of population growth of 0.45% per year. The population with 50% juvenile mortality had a 78% probability of extinction with a mean time to first extinction of 53.56 years, a mean final population size for surviving populations of 8.77 and a mean rate of population decline of 2.67% per year. For populations with an environmental carrying capacity of 42, the population with 40% juvenile mortality had a 5% probability of extinction with a mean time to first extinction of 57.80 years, a mean final population size for surviving populations of 28.36 and a mean rate of population growth of 0.73% per year. The population with 50% juvenile mortality had a 79% probability of extinction with a mean time to first extinction of 54.61 years, a mean final population size for surviving populations of 9.10 and a mean rate of population decline of 2.96% per year.

For populations with an environmental carrying capacity of 75, the population with 40% juvenile mortality had a 10% probability of extinction with a mean time to first extinction of 66.9 years, a mean final population size for surviving populations of 44.8 and a mean rate of population growth of 0.59% per year. The population with 50% juvenile mortality had a 79% probability of extinction with a mean time to first extinction of 59.9 years, a mean final population size for surviving populations of 10.7 and a mean rate of population decline of 2.67% per year. For populations with an environmental carrying capacity of 150, the population with 40% juvenile mortality had a 10% probability of extinction with a mean time to first extinction of 56.7 years, a mean final population size for surviving populations of 66.5 and a mean rate of population growth rate of 0.71% per year. The population with 50% juvenile mortality had a 70% probability of extinction with a mean time to first extinction of 58.6 years, a mean final population size for surviving populations of 8.7 and a mean rate of population decline of 2.49% per year.

From these results, it would appear that intensive management may enable the population to grow and achieve carrying capacity. Low natural juvenile mortality scenarios (40%) did well, with low probabilities of extinction and mean final population sizes up to 83% of carrying capacity.

Modelling Of Populations Established In Semi-Natural Reserves And Captivity

1. Tian-e-Zhou ox-bow semi-natural reserve, Hubei province

This reserve is a potentially closed, fully managed reserve. As stated previously, fish production is theoretically enough to feed 80 animals, however the proposal is to put 25 animals into the reserve. For the model, we assumed intensive management would result in immediate elimination of all human related mortality, and the bringing forward of the first age of reproduction by one year in males and two years in females (as has been observed in other closely managed cetacean species). We modelled three scenarios. 1. That the population would be introduced in one effort, and that 25 individuals, picked to represent a stable age distribution, would found the population which would not be subsequently supplemented. This is consistent with a "catch all" scenario for the wild population. 2. That 2 animals would be introduced every year for the first twenty years. 3. That 3 animals would be introduced every year for the first twenty years. The latter two models are consistent with different degrees of a gradual harvesting scenario.

Results

1. The first scenario was tested assuming 50%, 40% and 30% juvenile

mortalities. Assuming 50% juvenile mortality, the population had a 43% probability of extinction with a mean time to extinction of 66.7 years, a mean final population size for surviving populations of 14.0 and a mean annual rate of decline in population size of 1.7%. Assuming 40% juvenile mortality, the population had a 2% probability of extinction with a mean time to extinction of 76.5 years, a mean final population size for surviving populations of 54.5 and a mean annual rate of growth in population size of 0.87%. Finally, assuming 30% juvenile mortality, the population had a 0% probability of extinction with a mean final population size of 73.1 and a mean annual rate of growth in population size of 2.99%.

Under this scenario, it is clear that if age of first reproduction and mortality levels can be controlled at a low level, a self-sustaining population of baiji can survive with a very high probability for 100 years. Further, between 86% (40% juvenile mortality) and 90% (30%) of the original heterozygosity can be retained, even without supplementation from other populations.

2. The results of a simulation where a starting population of two individuals (one final year subadult female and one adult male) is supplemented by a further two individuals for the first twenty years of the simulation indicates that even with moderate (50%) juvenile mortality, there is a low (7%) probability of extinction, however there was also a low final population size of 23.3. With low (40%) juvenile mortality there was a 0% probability of extinction with a mean final population size of 71.3 (90% of carrying capacity).

The results of a simulation where a starting population of three individuals (one final year subadult female, one adult female and one adult male) is supplemented by a further two individuals for the first twenty years of the simulation indicates that even with moderate (50%) juvenile mortality, there is a low (4%) probability of extinction, however there was also a low final population size of 34.8. With low (40%) juvenile mortality there was a 0% probability of extinction with a mean final population size of 72.8 (91% of carrying capacity).

Again, under this scenario, it is clear that a self-sustaining population of baiji can survive with a very high probability for 100 years.

2. Tongling semi-natural reserve, Anhui province

This reserve comprises a closed 1.5 km long and 100 m wide river where there is no natural fish production and current plans are to put three animals in (2 females, 1 male), with a maximum carrying capacity of 5 animals (3 females, 2 males). We removed the effect of human mediated mortality, and kept the age of first reproduction as the same as in the wild population, and to include density dependent breeding success. Further we modelled additions to the reserve from other captive populations at the rate of one individual per year.

3. <u>Captive facility in Wuhan (Institute of Hydrobiology)</u>

Only one captive population is currently proposed at Wuhan, where four different size pools are available. It is proposed to introduce ten individuals (4 males and 6 females) to this facility in the long term, but 4 individuals in the first instance with a further 6 added in the next three years.

For modelling purposes, we assumed that mortality would be severely reduced in the long term (30% juvenile mortality) but that it would be much larger (10% adult mortality, 50% juvenile mortality) in the first ten years. We included a 2% probability of a severe disease outbreak, with 20% mortality and no effect on reproduction.

Results

Modelling efforts for both the Tongling and Wuhan populations indicated the intuitively obvious result that neither population is demographically stable without continual directed intervention. Care must be taken to ensure both demographic and genetic stability is maintained in these small populations and this will certainly involve transfer of animals to and from different closely managed populations.

BAIJI

(Lipotes vexillifer)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Section 5

HABITATS, THREATS, AND CATASTROPHES

白暨豚所面临的危险状况以及中国水生野生动物主管部门为保护白暨豚所做的主要工作

汪小炎
农业部渔政渔港监督管理局，北京　１０００２６，中国

白暨豚是中国特有的珍稀水生动物，仅仅分布于长江中下游约１６００公里的江段。长期以来，由于社会经济生产活动的发展，使白暨豚的栖息环境发生了很大的变化，并带来了不利的影响。目前对白暨豚的生存产生严重威胁的主要原因是：长江中日益增多的航运船舶；渔业生产中有害的渔具渔法；长江沿岸工农业生产造成的水域污染以及水利工程的兴建等等。由于这些因素的综合影响，导致白暨豚种群数量从八十年代初的近４００头，下降为九十年代初的不到２００头，已经处于濒临灭绝的危险状况。如果不采取紧急和切实有效的措施，白暨豚这一珍贵物种将有可能在本世纪末灭绝。

中国国家和地方政府及水生野生动物主管部门高度重视对白暨豚的拯救和保护管理工作，多年来所采取的措施主要有：

１．法律措施

１９８９年１月经国务院批准公布的《国家重点保护野生动物命录》中，白暨豚被列为一级重点保护野生动物。根据《中华人民共和国野生动物保护法》的规定，严禁捕捉。如果因为科学研究等特殊情况需要捕捉白暨豚的，必须报农业部批准。白暨豚主要分布地所在的湖北省、安徽省人民政府及其渔业行政主管部门也都发布了保护白暨豚的法规。

2．开展资源调查和科学研究工作

１９８６年以来，农业部先后组织了长江中下游白暨豚的科学考察和白暨豚种群监测等资源调查工作，并安排了一部分经费用于支持大学和科研部门进行白暨豚的科学研究工作。

３．加强长江中下游特别是白暨豚栖息江段的渔政管理工作

长江是中国第一大江，也是中国淡水鱼类种质资源的宝库和淡水渔业的重要基地。长江不仅生活着种类繁多的经济鱼类，而且也是白暨豚、中华鲟、江豚、胭脂鱼等国家重点保护水生野生动物的栖息地。为保护长江的渔业资源和珍贵濒危水生野生动物，长江沿岸的各省、市、县基本上都已成立了渔政管理机构。１９８７年还成立了长江渔业资源管理委员会，每年召开一次年会，以加强领导和协调工作，包括白暨豚在内的水生野生动物保护也是该委员会的重要工作内容之一。

４．加速白暨豚自然保护区和养护场的建立工作

经过多年认真的调查研究和论证，国务院已于１９９２年１０月正式批准建立湖北长江新螺段白暨豚自然保护区和长江天鹅洲白暨豚自然保护区为国家级自然保护区。在安徽省铜陵市建立的白暨豚养护场也基本竣工。这些自然保护区和养护场建立后，将实行保护管理和科学研究紧密结合的管理体制，积极开展对白暨豚的抢救、保护工作。

以上所采取的措施，对拯救和保护白暨豚起了积极的作用。

The Dangers the Baiji faces and the Main Tasks for the Chinese Government Departments responsible for aquatic wild animal protection

Wang Xiaoyan
Bureau of Fisheries Management and Fishing Port Superintendence Ministry of Agriculture, Beijing 100026, P.R. China

Baiji is a precious and rare aquatic animal which is only found in the 1600 kilometer range of Yangtze River in China. The economic activities have brought negative changes to habitats of baiji. The most dangerous changes are: increasing traffic in the river, the existence of harmful and dangerous fishing gears and fishing methods, industrial and agricultural pollution, and irrigation projects. The combined effects made the number of baiji going down from about 400 in the early 1980's to less than 200 in the 1990's and put the baiji at the verge of extinction. The baiji will probably disappear by the end of the century unless immediate and effective measures are taken.

Therefore, the Chinese central and local governments and government departments responsible for aquatic wild animal protection showed great concern to the conservation and restoration of baiji and the main measures taken were as follows:

1. Law
In January, 1989, the List of National Protected Wild Animals approved by the State Council includes baiji as the first grade protected animal. Baiji is therefore forbidden to catch according to the Wild Animal Protection Law of the People's Republic of China. Capturing of baiji for scientific research has to be approved by the Ministry of Agriculture. The local governments and their departments responsible for fisheries management in Hubei and Anhui provinces have also made regulations to protect the baiji.

2. Investigation of resources and scientific research
Since 1986 the Ministry of Agriculture has organized a number of surveys and population monitoring studies on baiji, and allocated financial resources to universities and institutions to conduct researches on baiji.

3. Fisheries management
Yangtze River is the largest river in China with an abundance of fresh water fishes, serving as an important base of aquatic products. There are also fishes listed as the national key conservation animals. In order to protect fishery resources and the endangered species, fisheries management departments have been established along the Yangtze River. In 1987 the Yangtze River Aquatic Resources Management Committee was established with conservation of baiji as its important commitment.

4. Setting up reserves for baiji
On the basis of investigations, the State Council approved to set up new national natural reserves in Xinluo and Tian'ezhou, Hubei Province. The semi-natural reserve in Tongling will be completed very soon. We wish that setting up of these reserves and improving of management will help conservation and restoration of the baiji.

栖息地、威胁和灾难工作组报告

参加者：李悦民（主持人），小罗伯特·L·布朗内尔（主持人），陈远新，威廉·F·佩林，汪小炎，张忠祥和周开亚

栖息地

小组讨论主要集中在种群容纳量。小组认为原始的种群大小无法估计，然而，可供生存的栖息地正在减少。由于区域性严重的水污染、鱼群数量的减少、以及水坝的兴建，导致了种群容纳量减少。但是，减少的数量无法估计。小组认为，栖息地在现阶段并不是一个限制因子，目前仍有足够数量的鱼供白暨豚捕食，有足够的生存环境供白暨豚种群增长。然而，小组相信：随着人类与豚类之间为鱼和空间的竞争的加剧、随着污染的增加并影响到食物链和白暨豚的健康（一些被发现的白暨豚看起来已患重病），将来栖息地可能成为一个重要的限制因素。

长江的容纳量会不会变为零呢？小组的答案是：不会（鱼种场将会终止鱼群数量的减少，并将有措施来控制污染）。

人为因素导致的死亡

1990年发现了6具白暨豚尸体。近年来，监测死亡变得越来越困难，因为人们未能发现、或是由于害怕因杀害白暨豚遭逮捕而不敢报告。**1990**年，在长江下游记录到的6具白暨豚尸体占估计的种群大小**120**头的**5%**。小组认为总的死亡数可能是其一倍。因此，一个非常粗略的估计认为，人为导致的死亡率为**10%**。小组一致认为目前而数据太少，无法进行量的估计，但是为了“漩涡”程序的运行，我们同意每年的死亡率在**5–10%**之间，且呈均匀概率分布。为了进行更好的估计，还需要更多的较为完善的人为导致死亡的数据。

人为导致的死亡中最重要的部分是滚钩导致的死亡。我们讨论了将来即使在保护区内禁止使用滚钩，保护区外的豚仍会被杀死。例如：新螺白暨豚保护区为**135**公里长，但至少有一头白暨豚被观察到游了**200**公里。

灾难

小组讨论了三类能导致白暨豚死亡的灾难事件：

①爆炸：**1984**年在一次炸鱼事件中，6头白暨豚被炸死；**70**年代在整治航道时有6头白暨豚被炸死。小组同意把爆炸致死设定为每**10**年有5头（基于**21**年中**12**头被杀死）。

②我们讨论了大量死亡的可能性（近年来在欧洲和美国已观察到这一现象）。小组认为在当前的模型运算时不必考虑这一现象，理由是白暨豚种群非常稀疏，疾病将不大可能传播。

③小组认为任何活捕也应该被看作是灾难性事件，比如：石首、铜陵和武汉各捕**2–3**头白暨豚（**6–9**头）就占了目前种群估计大小的**5%–10%**。这样的事件应被当作今后5年里发生一次而在模型运算时予以考虑。

Habitat, Threats, and Catastrophes

Participants: Li Yuemin (Cochairperson), Robert L. Brownell, Jr. (Cochairperson), Chen Yuanxin, William F. Perrin, Wang Xiaoyan, Zhang Zhongxiang, Zhou Kaiya

Habitat

The discussion of the group centered on carrying capacity. The group agreed that no estimate of the original population size is available. However, we agreed that the available habitat is declining. The decrease in carrying capacity is because of locally intense water pollution, declining fish stocks, and dam construction, but no quantitative estimate is available. The group did not think that habitat is a limiting factor at the present time. At present, the baiji still has enough fish and physical habitat to allow the baiji population to grow. However, the group believed that the habitat could be limiting in the future as competition between humans and dolphins for fish and space grows and as pollution increases and affects the food chain and the health of the baiji (some baiji found appear to have been very sick).
Will carrying capacity of river ever become zero? The group said no since fish hatcheries are expected to halt decline in fish stocks, and because measures are being taken to control pollution.

Human-caused mortality

During 1990 six carcasses were observed. In recent years, it has become difficult to monitor mortality because people are not recovering or reporting carcasses out of fear of being arrested for killing baiji. The six carcasses recorded in the lower reaches of the river in 1990 represent about 3-5 % of the estimated population of 120-200 baiji. The group believed that the total mortality may be double. Therefore, a very rough estimate of human-caused mortality could be 6-10%. The consensus of the group was that the data are very few for a quantitative estimate, but for the purposes of VORTEX we agreed on a range of 5-10% per year, with a flat probability distribution over that range. More complete data on human-caused mortality are needed for a better estimate.

The most important component of human-caused mortality is from rolling hooks. We discussed the problem that while rolling hooks may be controlled in the reserves in the future the dolphins may still be killed outside the reserves. For example, the Xinluo Baiji Reserve is 135 km long, but at least one dolphin has been observed to travel 200 km.

Catastrophes

The group agreed to estimate the additional mortality due to catastrophic events. Three areas were discussed.

1. Explosions - Six baiji were killed in a fishing explosion in 1984 (Zhou & Li, 1989) and six others were killed during the construction of a channel in the 1970's (Zhou, 1982). The group agreed on the conservative value of 5 in 10 years (based on 12 known to have been killed in 21 years).

2. We discussed the possibility of a mass die-off, as has been observed in the Persian Gulf, Europe and the U.S. in recent years. At this time, the group agreed that no estimate should be included in the model. The reason we did not make any estimate is because the population of baiji is extremely sparse, and a disease would probably not spread.

3. The group decided that any live captures should be interpreted as catastrophic events. If, for example, Shishou, Tongling and Wuhan each captured 2-3 baiji (6-9 animals) or 3-7.5% of the estimated current population (120-200). Such a event should be included in the model as a "harvest" once in the next 5 years.

可供白暨豚生活的栖息地及其管理

刘　晴
农业部渔政渔港监督管理局
北京 100026，　中国

白暨豚是我国特有的珍稀水生哺乳动物。20世纪50年代，在长江中下游和富春江中都有白暨豚的分布。1957年，由于在富春江上游兴建新安江水电站和在下游的钱塘江抛石后，造成富春江的水位下降，白暨豚从此消失。目前，白暨豚仅分布于长江中下游从湖北枝城至江苏浏河口长约1600公里的江段。近几年由于长江捕捞业、航运业、水体污染、水利设施建设以及河道治理等因素的影响，使长江的环境遭到破坏或改变，导致白暨豚栖息地的衰退，种群数量减少，现存数量仅150头左右。 成为世界五种淡水豚中数量最少的一种，十分珍贵。为此国家和地方政府对白暨豚的保护给予了高度重视。在对白暨豚抢救和保护工作中，对其栖息地的保护管理工作是一个重要内容。

鉴于长江水域生态环境的恶化，国家对白暨豚的保护采取了就地和迁地保护相结合的措施，为白暨豚提供一个较为安全的栖息环境。1992年10月，国务院批准长江新螺段白暨豚自然保护区，长江天鹅洲白暨豚自然保护区为国家级自然保护区。并确定连续四年共出资1200万元作为白暨豚保护的专项经费，统一由农业部按排使用。目前，两个保护区正在建设之中，并将在1995年以前全部完工，投入使用。保护区还制定了保护白暨豚的法律，围绕着白暨豚保护的有关科学研究和资源调查工作也正在进行之中。此外，长江下游的安徽铜陵，于今年初建成了我国第一个白暨豚养护场，现已投入试运行，正在从试养江豚逐步转入白暨豚的迁地保护工作。在沿江有关省，计划建５个保护管理站，现也正在抓紧筹建之中。这些保护站由各省渔业行政主管部门及其所属的渔政管理机构负责，主要负责查处各江段违法捕杀白暨豚和破坏白暨豚生存环境的行为；救助受伤、搁浅的白暨豚，观察记录活动情况，向当地群众宣传有关法律、法规和保护白暨豚的知识，使保护白暨豚成为人们的自觉行动。争取到本世纪末，在长江中下游建成一个由保护区、保护站专管与沿岸群众自觉保护相结合的管理网络，为白暨豚创造一个良好的栖息环境。

Habitat of Baiji and its Management

Liu Qing
Bureau of Fisheries Management and Fishing Port Superintendence
Ministry of Agriculture, Beijing 100026, P.R. China

Baiji (Lipotes vexillifer) is a rare and precious aquatic mammal which only live in the Yangtze River of China. In the 1950's, baiji could be found not only in the Yangtze River, but also in the Fuchun River. Because of the establishment of Xin'anjiang Hydropower Station in the upper reaches of Fuchun River in 1957, baiji disappeared from this river. At present, baiji is only distributed in the middle and lower reaches of the Yangtze River, i.e. from Zhicheng of Hubei Province to Liuhekou of Jiangsu Province, which are about 1600 km long. In recent years, the environment of the Yangtze River is getting worse because of over-fishing, increasing transportation, severe pollution and construction of dams and floodgates, etc. As a result, habitat of baiji degraded, and the population size of the baiji becomes smaller and smaller. Now, the estimated population size is only about 150 individuals, and baiji is one of the most endangered freshwater cetaceans in the world. National and local governments pay much attention to the conservation of the baiji, and believe that the management of its habitat play an important role in saving and conserving baiji.

Because the Yangtze River environment is changing rapidly and getting worse, Chinese government decide to protect baiji by setting up natural and semi-natural reserves, in other words, provide a much safer environment for the baiji. In October 1992, Chinese State Council approved the plan to set up Xinluo Baiji Natural Reserve and Tian'ezhou Baiji Natural Reserve, and decided to invest 12 million Chinese yuan as a special fund for setting up these national reserves during the following four years, and also decided that the whole plan would be managed by the Ministry of Agriculture. Now, the construction of the two reserves are in its way, and will be completed before the end of 1995. Regulations for protecting baiji have been put into force, and scientific research and population surveys are being carried too. Moreover, the first baiji semi-natural reserve in China was set up in Tongling of Anhui Province, in which several finless porpoise (Neophocaena phocaenoides) are reared now as a preparation for keeping some baiji in the future. We are also planning to set up five baiji protection stations in certain provinces along the Yangtze River. These stations will be under the leadership of departments of Fishery Administration. The main purposes of these stations are monitoring baiji's population status, rescuing injured, sick or stranded animals, observing behavior and movement, banning harmful fishing gears, and educate the mass. We hope and will try our best to set up a conservation network along the Yangtze River in next several years for protecting baiji, and to create a safer habitat for it.

白暨豚的保护:威胁和问题

王 丁

(中国科学院水生生物研究所，武汉，湖北 430072，中国)

白暨豚 (Lipotes vexillifer) 是世界上最为濒危的鲸类之一，目前种群数量还不足 200 头，分布在长达 1600公里的长江中下游干流中(陈等，1990)。讨论白暨豚的生存能力对于白暨豚的物种保护而言无疑是十分重要的。白暨豚已濒临灭绝的边缘，如果不采取任何有效的措施的话，可能在十年或二十年之内就会在长江中消失。但是，不幸的是对于白暨豚的生物学、生态学、生理学及生殖等方面还存在着许多未知的领域，这为实行白暨豚的有效保护带来了障碍。此文将讨论一些严重威胁白暨豚生存的因素及一些应该解决的问题，为更准确地估计白暨豚的种群现状且在此基础上提出更有效的保护措施提供科学依据。

威胁白暨豚生存的因素可分为两部分，即外部环境条件的影响和白暨豚自身适应环境的能力。

外部环境条件对于白暨豚生存的影响主要来自于人类活动。 从1978年起在整个长江中下游得到的标本中发现，所有已知死亡原因的标本中由于人类的活动而导致死亡的占 95% 以上(Chen and Hua, 1989b; Zhou and Li, 1989) 这些人类活动包括：

1)渔业的过度捕捞：长江两岸有成千上万的渔民依赖于长江中的渔业捕捞而维持生活。当近年来长江中白暨豚的数量急剧减少的时候，两岸人口数量却急剧增加。虽然没有关于长江渔业资源减少的确切资料，一般人认为长江现存鱼类种类和数量是大大下降了。渔民经常可能工作一整天而毫无所获。事实上，从 1978 年以来收集到的白暨豚标本中的绝大多数其胃中除了石块、草根、谷粒和鱼钩外，别无它物(陈 等，1985)。有理由怀疑白暨豚找不到足够的食物。如果是这样，他们如何能维持生存?

2)渔业作业的误伤：在收集到的已知死亡原因的白暨豚标本中约有60% 以上是由于渔业作业的误伤而引起的。这些有害业司包括滚钩和炸鱼等。滚钩用来捕捞底栖鱼类，有时也可能将白暨豚钩死。而炸鱼作业可能一次就杀死一群白暨豚(Chen and Hua, 1989b; Zhou and Li, 1989)。例如，在1978年至1985年之间在长江下游就有 6头

白暨豚死于炸鱼作业，这大约占这一阶段在长江下游所有已知死亡原因的白暨豚标本的20%(Zhou and Li, 1989)。而实际上的数字可能比这还要高，因为炸鱼作业在长江中是国家渔业法所禁止的，很有可能一些误伤事件发生后，渔民害怕法律制裁而不敢报告。

3)航运业对白暨豚的伤害：长江是中国最重要的内陆水运航道。由于中国经济的增长，长江中的船舶数量也在同步迅速增加。由于某些目前尚不清楚的原因，白暨豚有时会被螺旋浆击死，特别是在枯水季节航道较窄的时候。也许是太强烈的噪声使得白暨豚无所适从，导致行为混乱从而无处逃生；或者是白暨豚的声呐系统由于噪声的干扰而暂时工作失灵。不完全的统计资料表明，自 1978 年以来整个长江中有13头白暨豚死于螺旋浆之下，这占了整个已知死亡原因的标本中的大约25%(Chen and Hua, 1989b; Zhou and Li, 1989;未发表资料)。过往船只带来的噪声也许还严重影响白暨豚的社群行为，从而进一步影响白暨豚的生殖。同时，清理航道的爆炸作业也可能杀死白暨豚。1974 年一个群体共4头白暨豚其中包括两头怀孕个体一次被这种作业方式炸死。

4)现存自然环境的破坏：长江中及其支流湖泊之间水坝及控洪坝的兴建切断了一些鱼类在干流、支流及湖泊之间的洄游路线，导致鱼类资源大大下降，同时也破坏了白暨豚所喜爱的赖以生存的生态环境。如一些沙洲上下端和支流进入主流的河口周围的洄水区域。更为严重的是，正在施工中的三峡大坝的建立将对长江的生态环境带来更为严重的影响(陈等， 1990；Chen and Hua, 1989a; Chen et al; 1992)。

5)污染：长江水就总体而言，符合中国国家地面水一级标准，即水质相对较好。但是，在一些地区，特别是靠近大中城市的地区，水体污染极为严重。主要污染源是工业废水。80年代，每年约有120亿吨工业废水和生活污水排入长江，其中工业废水约 95 亿吨，占全流域污水总排量的 78% 。而比这一数字更为严重的是约有 90% 以上的废水和污水未经任何处理，其中包括 2 百万吨以上的有机化合物， 5 千吨重金属(包括汞 Hg、铬 Cr、镉 Cd 等)，3万吨酚和氰化物，以及3万 5 千吨石油污染物（ 袁等， 1987)。水体污染导致了白暨豚食物资源的下降。同时由于这些食物资源的被污染也可能严重影响白暨豚的健康进而影响其繁衍能力。1989年，一车重5吨的黄磷由于事故被全数倾倒入长江，几天后即在事故发生的下游发生大量死亡的鱼类。不久，亦在离事故发生不远的下游发现几条已死亡的白暨豚，而这些标本没有明显的创伤揭示其死亡的原因，估计也与这次事故有关。虽然

中国政府正在逐步重视环境污染问题，但这一问题的解决远非易事。

白暨豚濒临灭绝的边缘也可能受到了内部因素即其自身适应环境的能力的影响。一个显而易见的问题是江豚（Neophocaena neophocaenoides）与白暨豚生活于同样的环境之中，为什么白暨豚已濒临灭绝的边缘，而江豚的种群现状却还相对建康？

初步看来，这两个物种的听觉能力的差异也许是原因之一。由于白暨豚的视力很差，加之长江水非常混浊使得能见度极低，白暨豚的声学系统在其生活中扮演了极为重要的角色。有些科学家甚至假设白暨豚也许拥有极其发达的回声定位和声通讯能力。可是，形态研究表明，白暨豚的听觉系统不如其它一些豚类，如宽吻海豚（Tursiops truncatas）和江豚发达（Feng et al.,1989）。我们利用行为学的方法测定了白暨豚的听觉灵敏度，实验对象为一头在人工饲养条件下的成年雄性白暨豚"淇淇"（王等，1988；Wang et al.，1993）。第一个实验完成于1987年，使用长 5秒的纯音单频刺激信号；另一个实验完成于1990年，使用不同时间长度的纯音单频和调频信号。这第二个实验用来测定白暨豚的听觉能力随刺激信号长度的变化规律以及其对单频和调频信号的反应的差异（白暨豚的回声定位信号是调频信号，Xiao and Jing，1989）。结果表明，白暨豚听觉频率的上限高于200 KHz，下限低于1 KHz；最敏感的频率范围为16－64 KHz；当刺激信号持续时间为5秒时，敏感频率范围内的最小听阈阈值为67－55 dB（re 1 upa）；刺激信号时间较短时听阈阈值升高；调频信号的听阈阈值比同样信号长度的单调信号的阈值低 3 dB 以上，同时敏感频率范围向高端扩展 20 KHz左右。

然而，这一实验的更重要的发现也许是证明了虽然白暨豚的听阈曲线总体上与其它豚类相似，但是最低听阈阈值却比这些豚类如宽吻海豚和亚河豚（Inia geoffrensis）等高出 5 - 10 dB 以上。虽然我们不能排除"淇淇"在池子中的长期豢养或许对其听觉能力有所影响的可能性，但这两个实验似乎还是证明了一个事实，即与其它一些豚类相比，白暨豚的听觉能力相对较差。这就意味着白暨豚的声能力，包括回声定位能力和声通讯能力或许不如其它一些豚类。不幸的是，这也许是导致白暨豚处于目前这一悲哀境地的原因之一。因为声能力的相对低下可能是导致白暨豚被滚钩钩死、螺旋浆击死的一个内部因素。这种声能力的相对不发达甚至对白暨豚的生存能力就发现和寻找食物而言亦有影响。如上所述，长江中的鱼类资源正在大幅度下降，而

航运业和渔业却日益发展，即白暨豚很有可能寻找不到足够的食物以维持生存。而在另一方面，江豚却有着较好的视力和听力(Feng et al.,1989)，且食性较杂。也许正是这些区别导致了这两个物种生存能力的区别。这种生存能力的区别最终导致了这两个物种的种群现状的差异。当江豚的种群现状还相对稳定和健康时，白暨豚已濒临灭绝的边缘。

对于白暨豚的物种保护而言，还有许多问题需要解决，以下仅涉及其中的一部分：

1)对于白暨豚的社群结构、社群行为、运动和迁移以及生殖等方面还有许多未知数。另外，应尽早尽可能建立长江中白暨豚的个体档案资料，就象在武汉召开的首届淡水豚生物学学术讨论会所建议的那样(Perrin et al., 1989)。

2)活捕白暨豚是保证人工饲养条件下白暨豚的繁殖和半自然保护区的建立的成功以及开展一些科学研究如无线电跟踪等的必要条件。而由于白暨豚数量少,分布范围大,环境条件复杂,使得捕捞十分困难。

3)目前我们对白暨豚和江豚之间的关系知之甚少。他们是否互为竞争？为什么白暨豚已濒临灭绝而江豚种群现状还相对稳定和健康？

4)训练是进行人工繁殖白暨豚和一些科学研究项目的必要条件。但是，由于白暨豚生性胆怯且视力较差使得训练十分困难。迫切需要掌握一些先进的训练方法和技巧，如果它们存在的话。

5)经费过去是今天仍是一个大问题。白暨豚的物种保护工作，包括生态考察、捕捞、保护区及研究设施的运转均需要大量的经费支持。

基于以上的考虑和分析，我们感到在自然条件下进行白暨豚的就地保护如在白暨豚的活动相对频繁的区域建立白暨豚自然保护区仍十分重要的同时，白暨豚物种繁衍的最大希望是建立一些半自然保护区。如果能将一些白暨豚移入一些自然条件与长江环境条件相似且又能将动物置于完全的人工控制和保护之下的半自然保护区，如石首天鹅洲故道白暨豚半自然保护区，我们或许能拯救白暨豚走向灭亡的命运。同时，人工饲养条件下的繁殖工作对于自然条件下和半自然条件下的白暨豚保护具有重要的指导意义。

最后，我强烈呼吁所有关心白暨豚命运的人都能一起有效的合作，

共享想法，共享资料，共享结果，互相支持。因为我们只有一个目标，那就是拯救已濒临灭绝的白暨豚。我们必须与时间竞争，我们已不能浪费任何时间了。

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Conservation of Baiji: Threats and Problems

Wang Ding

(Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan, Hubei 430072, P. R. China)

Baiji (*Lipotes vexillifer*) is one of the most endangered cetacean species in the world, and there are only less than 200 individuals distributed in the middle and lower reaches of the Yangtze River in China which is about 1,600 km long (Chen et al., 1990). To discuss baiji's viability in a very rapid changing environment, which, of course, is very important for baiji's future, and hopefully, some effective ways can be worked out for helping this lovely animal to break away from its misfortune of extinction, which might happen in next ten or twenty years, if nothing will be done. But, unfortunately, there are still very many needed to be known about some basic parts of baiji's biology, ecology, physiology and reproduction, etc. before any effective measures can be carried out to save this very much endangered animal which is already on the brink of extinction. This paper presents some thoughts and data about some threats which mostly threaten baiji's survial and some problems needed to be solved for us to more precisely assesss baiji's population status for further proposing and carrying out proper and effective measures to save this animal.

The threats which threaten baiji's survival could be divided into two parts, threats from external and internal.

The threats from external are mainly from human activities. From the specimen obtianed from the whole river section since 1978, some more than 95% of known death of baiji were directly caused by human activities (Chen and Hua, 1989b; Zhou and Li, 1989). The human activities include:

1. **Over fishing:** There are thousands and thousands fishermen along the Yangtze River depending on fishing in Yangtze River for their survival. While baiji's population size is declining rapidly in recent years, men's population size is increasing markedly. Even no detailed data about the decreasing of the fish resources of the Yangtze River are available, it is believed that there is less and less fish in the river, and it happens very often that fishermen don't get anything for working all day long. As a matter of fact, for most of the specimen obtained since 1978, their stomaches were empty except some stones, rice, and fishing hooks (Chen et al., 1985). It is suspected that baiji cannot find good enough food for living, if so, how can they survive?

2. **Incidental capture by fishing:** Some more than 60% of the known death of baiji were caused by several different kinds of fishing gears, such as rolling hooks, which is a long line equiped with thousands of sharp hooks for snagging bottom fish; and fishing by explosion, which could kill a whole group of baiji (Chen and Hua, 1989b; Zhou and Li, 1989). For example, in lower reaches, there were 6 baiji killed by explosion fishing between 1978 and 1985 which were about 20% of all known death in lower reaches in that period (Zhou and Li, 1989). It is very possible that actural number is much higher than this, since explosion fishing is illegal in China, and fishermen usually daren't report the death of baiji which might bring them into jail.

3. **Accidental killed by traffic:** Yangtze River is the most important inland transportation channel in China. Since China's economy is growing very rapidly, boats and ships in Yangtze River is increasing along very markedly,

even though no body knows exactly how many times has increased in recent years. For some reasons, baiji are killed by propellers of ships sometimes, especially in dry season of the river while the ship channel is relatively narrow. Baiji may get confused by too much noises from ships in this narrow channel, and has no way to go to get out; or baiji's acoustic system is destroyed temporarily by the noises. Based on incomplete data, there were at least 13 baiji which were killed by propellers since 1978 in the whole river, which were about 25% of the known death (Chen and Hua, 1989b; Zhou and Li, 1989; Unpl. data). Noises from the traffic may also seriously affect baiji's social behavior, which may further affect baiji's successful breeding. Meanwhile, explosion for cleaning ship channel also kills dolphins. In 1974, a whole group of 4 baiji, which included 2 pregnant females were killed once by transportation department while they were cleaning the channel by using explosive.

4. Destruction of the existing environment: This is an indirect factor causing the decline of baiji. The increasing construction of dams and floodgates has resulted in blockages between the river and lakes, the mainstream and the tributaries, so that fish resources have been reduced markedly and the ecological environment which had been favorable for dolphins, such as counter-current areas around sandbars and entrances to the river by streams, has been destroyed. Furthermore, the establishment of Three-gorges Dam is expected to change the dynamics of the river drastically (Chen and Hua, 1989a; Chen et al., 1992)

5. Pollution: The water quality of Yangtze River accords with the grade I standards of surface water in China, which means that it is relatively fine. However, at some local sites, especially sites close to cities, the water is very much polluted. The major sources of pullutants are wastewater from factories and mines as well as city sewage. About twelve thousand million tons of wastewater was put into the river each year in the 1980s, of which nine thousand and five hundred million tons were industrial wastes. Even worse than this number is that over 90% of the wastewater was untreated, including over 2 million tons of organic chemical, 5000 tons of heavy metals (such as mercury (Hg), chromium (Cr) and cadmium (Cd)), 30000 tons of phenols and cyanides, and 35000 tons of petroleum wastes (Yu et al., 1987). Water pollution has resulted the declining of food sources of baiji, and may also affect baiji's health since the fish feeded by baiji may be polluted. We were reported in 1989 that a whole car of yellow phosphorus, which weighted 5 tons, was pulled into the river by accident. A lot of fish were found dead in the lower sections. Not long after that accident, several baiji were also found dead, which did not show any obvious clues to tell the reasons of their death, which might be related to the accident. Even though the Chinese government is paying much attention to the pollution problems and has adopted various countermeasures against water pollution in the Yangtze, the task is not easy at all.

There may also be some internal threats which may also threaten baiji's survial. These threats are from the dolphins themselvs. One obvious question is that *Neophocaena phocaenoides* shares the same kind of environment with baiji, why baiji is so endangered but *Neophocaena*'s population status is still relatively healthy?

One difference between two species may be from comparisons between hearing ability of the two species. Since baiji's vision is very poor, and the water of Yangtze River is very turbid which makes the visibility of the river is very limited, acousitc system of baiji plays an very important role in baiji's life. Some researchers have speculated that baiji may possess excellent echolocation and sound communication abilities. Morphometric studies, however, have suggested that the auditory and vestibular systems of baiji are relatively underdeveloped in comaprison to those of some other dolphins, such as *Tursiops truncatus* and *Neophocaena phocaenoides* (Feng et al., 1989). We did two experiments to estimate baiji's hearing ability by using behavioral methods, both of them were done on a male adult baiji named "Qi Qi" in capativity (Wang et al., 1988, 1993). One was finished in 1987, using 5 sec long pure - tone signals, and another one was finished in 1990, using different length pure - tone signals and frequency modulated (FM) signals. The second experiment was designed to measure the dolphin's auditory sensitivity as a function of signal duration, and to determine if the animal's sensitivity to pure tone signals and to FM signals was different (baiji's echolocation signals are frequency modulated, see Xiao and Jing, 1989). The results showed that the effective upper limit of baiji's hearing frequency is above 200 kHz, and the lower limit is below 1 kHz. The range of greatest sensitivity is between 16 and 64 kHz; the minimum audible sound pressure level at these frequencies was 67 to 55 dB re 1 μpa when the experimental signals were 5 sec long. The thresholds became higher as the duration of the experimental signals became shorter. The thresholds for FM signals were 3 dB or lower than for pure tone signals, and the most sensitive frequency range expanded about 20 kHz towards higher frequencies at the same time.

However, the most important discovery of this research may be that baiji's auditory threshold curve is generally similar to several other species, but, the lowest threshold is usually 5 to 10 dB higher than that of these dolphins, such as *Tursiops truncatus* and *Inia* *geoffrensis*. Even though we could not preclude the possibility that the long - term confinement in a tank of "Qi Qi" might have some effects on its hearing ability, it is very likely that both researhces may reveal one fact that, comparing to other species, baiji's hearing ability is relatively underdeveloped, which means that baiji's acoustic capability, including echolocation and sound communication capability, might not be as good as those of other dolphins. This, unfortunately, may be a contributive factor leading to its demise, in part, by being killed by fishing hooks, nets, and boat propellers (Wang et al., 1993). This disadvantage of its acoustic capability may even also have some impacts on its viability in term of searching and catching food in such a complex environment like Yangtze River, in which the fish resources are declining, but fisheries and traffic are increasing rapidly. As mentioned before, It was suspected that if the dolphin could find good enough food for its survial. On the other hand, *Neophocaena* in Yangtze River which shares the same kind of environment with baiji has a better vision ability and hearing ability (Feng et al., 1989), and also this species is a sundry food eater. It is very possible that these differences between baiji and *Neophocaena* make a big difference between the viability of the two species, which leads to the difference of the population status of these two species. While the population status of *Neophocaena* is still relatively healthy, baiji is already on the brink of extinction.

There are also some problems existed for the conservation of baiji needed to be solved, and a few of them are listed as follows.

1. Much more should be known about baiji's social structures, social behaviors, movement, and reproduction. A catalog of the individual dolphins should be compiled

as soon as possible, as Wuhan Workshop suggested 7 years ago (Perrin et al., 1989).

2. Alive capture of baiji, which is a very necessary step for the success of semi-natural, captive breeding program, and some research work such as radio-tracking, is very difficult.

3. Little is known about the relationship between baiji and *Neophocaena*. Are they competitor to each other? Why baiji is so engangered while *Neophocaena* is still doing ok?

4. Training is a piece of very basic technique for doing some research and breeding animals in captivity and in semi-natural reserves successfully. But, since baiji is very timid and has a very poor vision, it is very difficult to train baiji. We need to know some new advanced training technique, if they exist.

5. Money, as it always is, is still a big problem. Conservation work, such as population survey, animal capture, operation of reserves, etc., demands a great deal of money.

Based on the discussions and analyses above, we feel that, while the conservation work in baiji's natural environment is still very important, such as establishing natural reserves in some sections in which baiji most frequent, the best hope for baiji's future is the establishment of some semi-natural reserves. If we can move some baiji into some semi-natural reserves whose environment is very similar to baiji's natural environment, such as Shishou Baiji Semi-natural Reserve, and put the animals under complete control and full protection of people, we may save this animal. Meanwhile, breeding program in captivity is very important for guiding the conservation work in the wild and in semi-natural reserves.

It is my very strong hope that everybody who is willing to do something to save baiji can work together very effectively, sharing the ideas, sharing the data, and sharing the results. Since our purpose is the same, and our animal is in danger. We must compete with time, and we do not have time to lose at all.

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BAIJI

(Lipotes vexillifer)

POPULATION AND HABITAT VIABILITY ASSESSMENT

Section 6

COLLECTION, TRANSPORT, AND HUSBANDRY

捕捉、运输和饲养工作组报告

参加者：布莱德·安德鲁斯(主持人)，董明俐，苏·埃利斯－约瑟夫(主持人)，藤本朝海，华元渝，章贤，神谷敏郎，木下礼美，吴守坚，刘仁俊，吉姆·麦克贝恩，J·皮德·施罗德，盛佑中，鸟羽山照夫，赵长祥

Ⅰ．采捕

现用采捕技术

有计划的捕捉只成功过一次，1986年5月31日采捕到一对豚并运输到在武汉的水生生物研究所。迄今所得的其他白暨豚均系误捕。

试捕的网长2000米，深10–15米，网目(四边的周长)32厘米。网由塑料浮子提到江面，在网底有沉子。1986年采捕时江水的流速在0.3至0.6米/秒之间。

采捕时，第一步是选择一些曾观察到白暨豚的区域。第二，识别障碍物较少，江底平缓，易于下网作业的区域。第三，识别水流较缓并流向江岸的区域。

当选定了一个区域后，一支由三种船组成的船队开始运动。船长5–7米，装备的发动机分别为4、6及12马力。小船用于发出背景噪声，据感觉，这是白暨豚所习惯的噪声。由于白暨豚在整个区域中活动，这些小船协调一致地航行把白暨豚导入认定的捕豚区。第二类是12马力的船，这些船通常二条为一组，布置在二到三个关键位置。成对的船可在放网时协同工作，包围该区域。4马力和6马力的船在放网后用于堵口。白暨豚被放下的网围住后，它在包围圈内急速游泳形成水流。此时在大网内放下另一张网。船上发动机发出的噪声使豚不向网靠拢。采捕的过程包括选定并包围一个区域，然后进一步使用小船和新的网把动物逐步限制在一个较小区域内。需要快速的行动。1986年捕豚时，白暨豚冲破了一层网，因为网是双层的，它们未能逃脱。没有发生任何把白暨豚缠在网上的事故，一旦白暨豚被网带近岸边时，人们就下水将白暨豚从网中抱出。

当撒下网将白暨豚围住时，它们就显得恐慌，并试图逃脱。还没有见到过白暨豚跳出水面以逃到网外，相反，它们潜水，在水下撞网，那些6马力的船用于产生噪音阻止白暨豚缠到网上。1993年5月，用与1986年相同的方法捕豚，起网时发现有两个洞，据认为这是由白暨豚造成的。失败的原因归咎于船只与人手的不足，尽管方法与1986年的一样。

白暨豚通常在往上游时被捕获，因为在它们向下游时，游动很快，且是在主流中。在往上游时，它们趋近岸边。在采捕工作中，首先选择水流向岸边的区域，使采捕者不是逆着水流工作。试捕在较浅(8–10米)的区域进行。

网的运用和船速将视情况而定。重要的是在船上配置各种网具，拥有多艘足够快速的船，以适应捕豚时会发生的任何情况。

采捕技术的改进：

1986年成功的采捕在长江中游进行，整个过程大约用了10条5–7米长的船，马力为4–12匹，网有2000米长，网格为21，最近的工作用了36格网。

小组认为迄今所用的方法在很大程度上是地区性江河条件和其它条件的反映。采捕时所用的器具取决于招来的渔船和渔民。如能使用高速船技术将有所提高。

春、秋季可能是捕豚的最佳季节。春季是指2月-4月，春季捕捉会出现的一些问题， 可能会影响资助捕豚的组织。春季水温低，人不可能不穿水衣而呆在水中很长时间。春季的天气忽冷忽热，忽静忽风，然而风和雨都是短时间的。可供采捕作业的好日子有限更是在这一时期进行采捕的弊端。

春季捕捉的一个好处是下雨，江水水位上升，水流刺激鱼在近岸处活动。白暨豚随着鱼在浅水区索饵。尽管天气不好，但在那些条件下是较易捕捉的。秋季，随着水位下落，天气更容易预测，因此就有利于组织一队人马到江上。秋季白暨豚捕食的鱼也会集中在近岸区。

２月到３月底不是一个捕鱼季节，因此江上交通较少。在长江中游，捕鱼季节是从４月到９月，在下游，捕鱼季节是从４月到５月底。中国代表均认为如果江上航运的主管部门批准，为采捕的需要而得到对航速限制的特许是不成问题的。

当前的采捕后勤

从那些每年都被招来捕豚的渔民中组织一支队伍需要一个星期。一支采捕队伍，包括14条船，30个人，每天的费用平均为1500元（300美元）。现在已有上水时时速可达８公里（５英里）、 下水时可达12公里（7.5英里）的高速船用于考察。这条船现在用于发现白暨豚。如有时速可达60 公里的船可供使用，有助于减少在船只的数量和航速方面的问题。使用高速船最大的不利方面是马达的噪声可能把白暨豚吓跑。

航空调查已在中国被讨论过，但是至今仍因耗资巨大而不能使用。关于用航空调查来发现白暨豚有不同的观点，有些代表相信水太混浊，此技术将无效。其他的代表认为经过适当的训练，一个航空调查员能学会从那些由于白暨豚在水下游动而产生的细微的波纹中看到白暨豚。

“快速”捕白暨豚的估算

拟定了一次捕豚行动所需装备和人员的初步清单,此清单包括：

项目	需要数	现 状	费用(人民币)
小船	10条	现租用	1,500元
小船带网	２条	现租用	1,500元
快艇	２条	现 无	200,000元(购买)
人员	30人	研究者和渔民	1,500元
水衣	≥６	无	6,000元
对讲机(UHF)	14	现有４	20,000元
网(4具)	3000米	现有１具	未作估计

提议：

应该在秋季采捕之前配备好快艇、对讲机和水衣，这些装备估计需人民币226,000元。

小组达成共识：白暨豚如果没有被捕捉到，应该被照相识别，同时也应进行对社群的观察。不应该捕捉带有幼体的豚群，只能捕捉个体大小相近的群体，并且仅当豚群中有３头或更多的个体时才能采捕。捕捉后应该立即对其进行遗传学鉴别。

在捕捉和运输过程中，应有兽医参加。

Ⅱ.运输

捕捉到的白暨豚的运输应尽可能的迅速和小心。

小组讨论了理想的运输条件，一致认为：

(1)时间—从白暨豚离开江水到放养处之间的运输时间应限在4小时以内。

(2)湿运输—在运输时应把白暨豚放在海绵上并向它喷水。

(3)温度控制和监测—在运输过程中应不断地测量白暨豚的体温。

(4)不准用药—在运输过程中不应使用药物，除非一个经过训练的兽医确认有医学需要。

(5)运输方法—应视采捕地点、条件和至放养处的距离而定。

(6)监护和避免擦伤皮肤—在运输过程中应对白暨豚密切监护，尽量避免任何皮肤擦伤。

运输过程中的操作标准程序将由中国科学家提供。

前次的捕豚区距武汉150-200公里。由于武汉人口众多，船运繁忙，有必要到较远处捕豚。为保护区捕豚时将根据发现豚的地点尽可能接近保护区。1992年，在离铜陵养护场1公里以内的地方发现了白暨豚，最远的发现地点距保护区约100-200公里。如果从采捕点到放养处的距离短，可用船运输，也曾用过卡车。而如果较远，则用直升飞机(1986年就这样)。

Ⅲ.饲养技术

饲养白暨豚所需的条件与饲养江豚的可能在某些方面不一样。在水族馆或浮网箱里养豚与在半自然条件下饲养可能需要不同的程序。如果是为繁殖计划而饲养白暨豚，应在捕捉新豚前建立基本的、标准化的饲养技术和饲养设施。这将有利于把迁移的影响减到最小，把实现繁殖的可能性加到最大。

小组讨论了饲养标准化的几个方面：营养、预防性兽医学、水质、社群、饲养训练。在下面各节中逐一讨论。小组基本同意可逐步开展提出这些事项的项目。

小组提议应设立一个设施和饲养技术考察委员会来检查本节所包含的建议的实施。在白暨豚被放入这些设施前，这个委员会应定期开会，现场检查。之后也应该定期开会，以提出更进一步的建议。这个委员会应由8-10个人组成，包括一位主席、一位政府主管部门的代表以及鲸类设施和饲养技术设定和监测鲸类饲养标准的国际专家和来自铜陵和武汉的专家。

设　施

设施应具有足够的大小和数量，以适于饲养的社群。池的大小应符合最佳标准以增进繁殖的成功。应具有尽可能大的育儿池以隔离饲养在怀孕、分娩和哺乳时的雌性个体。重要的是考虑到在室外设施饲养时是否需要遮光的顶棚或其它类似的设备以适合白暨豚的视觉。

营　养

为了保证最佳的营养水平，应具有可靠的来源来供应高质量的、大小适宜的，一种以上的活鱼。应记录个体的耗鱼量（体重的百分比和千卡/公斤）和饲喂的鱼的种类。应估算不同季节食物鱼的营养价值并检测食物中的重金属、多氯联苯、有机氯和其它污染物。

诊断设施

应具备基础的医疗诊断设备和补给，保证在出现疾病时能迅速作出对策，必备的医疗设施包括：一个医学/水质实验室，包括一个药房和独立的尸体解剖设施。

医学实验室：

一个基础医学实验室必须具备下列设备：微量血液离心机，用于离心血清的离心机，显微镜，折光仪，血细胞计数器，红细胞沉淀架和试管，一个无霜冰柜，和一些辅助设施。无论是在当地或外出时都应该有血清生化试验和微生物试验的设施。

水质实验室：

基本的水质实验室可并入医学实验室，包括下列设备：PH计和测氯试剂盒或设备，水温计，冰箱，温箱和一些辅助设施。

水 质

水温：

在武汉的设施中，水温的变化范围是4℃到25℃。目前，当温度达到低限时(2℃)，改变食物结构来提供足够的热量摄入，这种温度变化与石首段长江水温变化相同（需要铜陵的数据）。铜陵在干旱季节把水泵入设施中。小组一致认为所有设施，包括半自然的和饲养下的，水温的变化应与长江水温变化相近（10-25℃)。在繁殖季节，长江水温平均为15-18℃。

PH：

小组一致认为：饲养池中能忍受的PH值的范围为6.5-8.5，最适值为7.5。目前保护区的PH值无法控制。

气温：

除了室内设施外，气温不可能控制。

浊度：

小组一致认为能见度应在0.5-3.5米内，最佳值为能看到池底。

氯：

小组一致认为可接受的自由氯的浓度为0.25-0.75ppm，最佳浓度为0.5ppm。总氯的含量也是重要的，范围应为0.75-1.5ppm，最适值为1.0ppm。

总菌：

小组一致认为可接受的范围是每100毫升水有0-50个菌落，最佳值为25个。

水质综合表

水质因子	可接受范围	最佳值
温度	10-25℃	取决于季节，繁殖季节为15-18℃
PH	6.5-8.5	7.5
浊度	0.5-3.5m	池底
自由氯	0.25-0.75ppm	0.5ppm
总氯	0.75-1.5ppm	1.0ppm
总菌	0-50菌落/100毫升	25菌落/100毫升

社 群

在野外观察到的白暨豚群通常由4－5个动物组成，但是没有关于豚群的性比的数据。根据历史上所有的白暨豚标本(102头)，我们推测性比接近于1:1(54雄:48雌)。参照其它鲸类，白暨豚有可能是多配偶制的。目前尚无有关配偶系统的资料。工作组成员提议在制订饲养技术和社群组合的准则时，尤其是组合有可能已怀孕或快要生产的社群时，应考虑已发表的其它小型鲸类的有关资料。如能获得有关的资料，社群结构应与野外的相近。

饲养训练

在训练白暨豚时，重要的是要考虑到这一物种与被训练过的其它动物感觉能力的不同。可能需要发展和/或应用新或不同的训练技术，例如：更多地靠触觉、听觉或其它感觉方式来形成刺激并强化。下列的适应新环境和去敏感的训练，包括手喂和饲养行为训练应是最优先的，应该对所有饲养下的动物进行训练的是下列行为，根据紧急性和难度依次排列：

(1)给身体
(2)给尾鳍
(3)口腔检查
(4)呼吸孔取样培养
(5)直肠/阴道取样培养
(6)人工授精

只要有可能，应从死亡个体中收集精液。

建 议

对石首半自然保护区的建议：

(1)如地方政府已经规定的，在牛轭湖内不准捕鱼。
(2)如地方政府已经规定的，在牛轭湖内除了与动物管理有关的船只外，不准其它任何船只航行。
(3)在网内养豚是不可取的，对在同一保护区同时饲养两个物种表示不安，因为两者的相互关系不明。根据上述考虑，成功的适当条件是单个物种的保护区，没有网、只饲养白暨豚。

对铜陵半自然养护场夹江所提的建议：

(1)应立即开始对铜陵夹江中流沙的无限期的监测。
(2)在采捕或把白暨豚迁入铜陵半自然养护场之前，至少有一个江豚群已在夹江中成功地饲养了一年。养护计划的成功性由保护委员会评估。
(3)在网内养豚是不可取的，并且在同一保护区同时饲养两个物种也因其关系不明而令人不安。根据上述考虑，在近期内，成功的适当条件是单个物种的保护区，没有网、只饲养白暨豚。
(4)短期内，应从当地采捕江豚来试用铜陵夹江。

铜陵半自然保护区需要的设备和人员

采捕

1） 2艘高速快艇（60 公里/时）
2） 10件水衣
3） 10台手持报话机
4） 网（1,000 米 X 14 米 — 2 X 20 米 X 50 米）
5） 担架
6） 泡沫垫
7） 测深仪
8） 羊毛脂
9） 10付望远镜
10） 测深尺
11） 急救医药包

实验室设备

1） 血清分离离心机
2） 微量血液离心机
3） 显微镜
4） 折光仪
5） 冰箱
6） 冷藏柜
7） 红细胞沉淀架和试管

水质分析

1） 生命支持系统，包括一个冷却系统
2） pH值和氯检测试剂盒
3） 温度计
4） 基础微生物分析设施
5） 温箱

浮栏

1） 设计（计划从里奇韦和斯威尼获得）

2） 建造的材料

3） 固定系统

饲养设备及其他需要

1） 称动物体重的称

2） 作尸体检查的验尸工具包

3） 作食物分析的经费

4） 作遗传学分析的经费

培训人员

1） 实验室技术员1名

2） 鲸类驯兽员1名

建议培训人在铜陵住6个月，根据需要可再住6个月。费用包括旅行、住宿和伙食津贴。

武汉设施需要的设备和人员

采捕

1） 2台长距离通讯用高频电话

2） 10台手持报话机

3） 4艘高速快艇（2艘下网，2艘作交通管理）

4） 10件水衣

5） 网（2,000 米 X 12 米）

6） 10付望远镜

7） 急救医药包

8） 测深尺

9） 其他费用（租船、渔民工资、燃料、运输等）

实验室设备

武汉设施

1） 微量血液离心机

2） 折光仪

3） pH值和氯检测试剂盒

4） 温箱

石首野外工作站

1） 血清分离离心机

2） 微量血液离心机

3） 显微镜

4） 折光仪

5） 冰箱

6） 冷藏柜

7） 红细胞沉淀架和试管

饲养设备及其他需要

石首野外工作站

1） 称动物体重的称

2） 作尸体检查的验尸工具包

3） 2艘划艇

4） 医疗浮栏

人员

武汉 — 做培训工作

1） 实验室技术员 — 担任水质和实验室技术培训

2） 鲸类驯兽员1名

3） 兽医1名

建议培训人在当地住6个月，根据需要可再住6个月。费用包括旅行、住宿和伙食津贴。

石首野外工作站

1） 需要1名长期聘请的兽医

COLLECTION, TRANSPORT, AND HUSBANDRY

Participants: Brad Andrews (Cochairperson), Dong Ming-Li, Susie Ellis (Cochairperson), Asami Fujimoto, Hua Yuangyu, Zhang Xian, Toshiro Kamiya, Reimi Kinoshita, Ng Sau-Kin, Liu Renjun, Jim McBain, Pete Schroeder, Sherry Sheng, Teruo Tobayama, Zhao Changxiang

COLLECTION

Current Collection Techniques

Only one successful capture has taken place as a result of intentional efforts; the pair was collected and transported on 31 May 1986 to the Institute of Hydrobiology in Wuhan. All other collection of baiji to date has been incidental.

Collectors use nets which are 2000 m long and 10-15 m in depth and have a mesh size (perimeter of four sides) of 32 cm. Nets are held at the surface with plastic floats and are weighted on the bottom. Flow velocity during the 1986 collection was estimated to be between 0.3 and 0.6 m/sec.

Collection proceeds as follows: (1) select an area where there have been sightings; (2), identify an area that is relatively free of obstructions and has a relatively flat and gently sloping bottom, so that it is easier to set nets and operate; (3) identify areas where the river flow is relatively slow and is moving toward the shore; (4) mobilize a fleet consisting of three kinds of vessels.

Three sizes of motors are used (4-6-12 hp) by the respective vessels, which range in length from 5 to 7 m. The small boats are used to create background noise to which, it is felt, the baiji is habituated. As baiji move throughout the area, the boats move in unison to guide baiji into an area which has been identified as a capture site. The second size of vessels in the fleet are 12 hp boats. These boats usually work in teams of two and are located in strategic locations in two to three areas. This allows the pair of boats to work together as they set nets, encircling the area. The 4 and 6 hp boats are used to plug openings as the nets are being set.

Once enclosed, the baiji swim rapidly enough to create currents within the circle. Additional nets are then dropped within the larger nets. Motor noise from the boats is used to keep dolphins away from the nets. Collection is accomplished by creating and circling a larger area, then using small boats and additional nets to confine the animals into progressively smaller areas. Rapid action is required. In the 1986 capture, baiji went through one layer of net; because two layers were present they were not able to escape. There has not been any entanglement of baiji during capture. Swimmers enter the water to remove the animals from the net once they are enclosed near shore.

As baiji are encircled and nets dropped, they appeared to panic and attempt to escape. Baiji have not been observed to leap to avoid nets, but instead dive and charge the nets underwater. The 6 hp boats are used to create sounds that will discourage this behavior. In collections in May of 1993, nets ended up with two holes thought to have been created by baiji. It is felt that the lack of success in 1993 is attributed to the limited number of boats and personnel, even though the method were the same as those used in the 1986 collection.

Baiji are caught only as they travel upstream, when, they usually stay near the shore (when moving downstream they travel too fast and in the main stream of the river). The best collection areas are 8-10 m deep shallows where the current moves toward shore.

The particulars of net deployment and boat speed are situation-specific. It is important equip boats with a variety of nets and have boats available with sufficient speed to be able to accommodate any collection situation which may arise.

Variations in capture techniques

The successful capture in 1986 took place in the mid-section of the river. The effort used approximately 10 boats of 5-7 m in length and a 4-12 hp range. The nets were 2,000 m long, 21 gauge. More recent captures have used 36-gauge netting.

It was suggested that the methods used to date reflect local river conditions. Capture relies on recruiting local fishing boats and fishermen as crew. Techniques could be improved with boats capable of higher speeds.

It was suggested that spring (February - April) and fall are the best seasons for collecting. Water temperatures are low in spring so people can not stay in water very long without wetsuits. Spring weather can fluctuate rapidly between warm to harsh and windy, although wind and rain are transient. Thus the principal drawbacks to collection during spring may be more the limited number of days optimal for collection operations.

One advantage of spring capture is that as the river rises during and after rains the baiji follow fish to feed and travel near shore creating better conditions for capture despite the weather. In the fall, as the river recedes, the weather becomes more predictable so crews can be more easily enticed to go and stay on the river and baiji may prey fish may aggregate near the shore.

There is less traffic in the river from February through the end of March, when it is not the fishing season. The fishing seasons are April to September in the middle section of the river and April through May in the lower section. Chinese participants concurred that for the purposes of collection activities it is possible to obtain a speed-level variance (high speeds are legally prohibited) from the agency that has authority over transportation on the river.

Current Collection Logistics

It takes one week to assemble a team from the already-available pool of fishermen who are annually recruited for collection. The cost of a collection team for one day, including 14 boats and 30 staff, is 1500 Yuan/day ($300 US) on average.

A high-speed boat [potential of 8 km/hr (5 mph) upstream and 12 km/hr (7.5 mph) downstream] already in use for surveys is currently used to spot animals to capture. Boats that could go 60 km/hr would be helpful during collecting provided their motors do not scare the baiji away.

Aerial surveys has been discussed in China but, to date, have been cost prohibitive. There are differing views on the utility of aerial surveys for spotting baiji. Some participants believed that the water is too turbid for this technique to be effective. Other participants suggested that with proper training an aerial surveyor could learn to watch for the more subtle patterns indicating the presence of dolphins, such as the water pattern caused by animal swimming under water.

Estimates of cost for "fast" collection of baiji.

A preliminary list of items needed for one collection operation was developed.

Item	Needed	Current status	Cost
Small boats	10	rental now	cost included 1500 Yuan
Small boats w/nets	2	rental now	"
Speedboat purchase)	2	none now	estimate 200,000 Yuan (to
Personnel	30	staff + fishermen	cost included 1500 Yuan
Wetsuits	$\geq$ 6	none	6,000 Yuan
Radio (UHF)	14	4 now	20,000 Yuan
Nets (4 sets)	3000m	1 now available	no cost estimated

Recommendations

It is RECOMMENDED that speedboats, radios, and wetsuits be obtained prior to the fall collection. The cost for this equipment is estimated to be 226,000 Yuan.

It is RECOMMENDED that all animals not collected be photo-identified and that observations regarding social groupings, etc., should be carried out during collection expeditions. If groupings contain calves, capture should be avoided. Only same-size groupings should be collected. Collection should take place only if animals are found in groups of three or more animals. Morphometrics, blood samplings, and genetic evaluation should take place immediately upon capture. Veterinarians should be present during capture as well as transport.

TRANSPORT

It is RECOMMENDED that transport of collected baiji should take place as expeditiously and humanely as possible. Ideal transport conditions were discussed and consensus reached with regard to the following factors:

1. **Time** - Transports should be limited to four hours maximum from removal of the animal from the water to release in the facility.

2. **Wet transport** - Animals should be transported on foam with sprayed application of water.

3. **Temperature control and monitoring** - The systemic temperature of animals being transported should be closely monitored

4. **No drugs** - No drugs should be administered during transport unless medically indicated, as ascertained by a trained veterinarian

5. **Method of transport** - The method of transport should be appropriate to the collection site, conditions, and distance from release site

6. **Monitor and avoid abrasions** - Animals should be closely monitored during transport and skin abrasions avoided

Standard protocols exist regarding handling of animals during transport. A copy of them will be provided by Chinese scientists.

The Wuhan group's past capture area is between 150-200 km away. Wuhan is highly populated with lots of boat traffic; so, it is necessary to travel longer distances to capture dolphins. For only these reasons, collections for reserves will take place as close to the reserve as sightings permit. In 1992, baiji were seen within 1 km of the

Tongling reserve; the longest distance from the reserve at which baiji were seen by Tongling crews was 100 - 200 km. If the distance between the collection site and the release site is short, animals are transported by boat or truck, and if it is a long distance by helicopters (e.g. 1986 effort).

HUSBANDRY

The husbandry needs of baiji may differ in some aspects from those of finless porpoises. Separate husbandry programs may be required for dolphins housed in aquariums or floating pens and for those living in semi-natural settings or reserves. It is RECOMMENDED that if baiji are to be maintained in propagation programs, basic, standardized husbandry and facility requirements be established before additional baiji are collected. This will help minimize effects of removal and maximize potential breeding success.

Areas for husbandry standardization included: nutrition; preventive veterinary medicine; water quality; social groupings; and husbandry training. These topics are discussed in the following section. There was general agreement that programs addressing these issues can be developed.

This working group recommended that the following conditions be met by each facility prior to the further collection of baiji for that facility.

Facilities

Facilities be of adequate size and number to allow optimum social groupings. Standards of optimum pool size should be established to enhance reproductive success. Nursery pools should be available and as large as possible for separate housing of females during pregnancy, parturition, and nursing. Roofing or some other protection from bright light may be needed to accommodate baiji in an outdoor facility.

Nutrition

A reliable source of top-quality, appropriately-sized, live fish, of more than one species, need to be provided to ensure optimal nutritional levels. Keep records of individual consumption of fish (percentage of body weight and kilocalorie/kg), and species. Food fish should be evaluated to determine its the seasonal value and examined for the presence of heavy metals, PCBs, organochlorides, and other pollutants.

Diagnostic Facilities

Basic medical diagnostic equipment and supplies should be provided to allow for rapid response in the event of illness. Minimum medical facilities should contain: a medical/water quality laboratory, including a pharmacy, and separate necropsy facilities.

Medical Laboratory: A basic medical laboratory needs to include at least the following equipment: microhematocrit centrifuge; centrifuge for spinning serum; microscope; refractometer; hemocytometer; erythrocyte sedimentation rack and tubes; a non-defrosting freezer; and associated supplies. Facilities for serum biochemistry testing and microbiology testing should be readily accessible either on- or off-site.

Water Quality Laboratory: The basic water quality laboratory should be incorporated into medical laboratory facilities and should include: PH and chlorine test kits or equipment; water thermometer; refrigerator; incubator; and associated supplies.

Medical Procedures

Medical and laboratory procedures should be performed by people with formal, specialized training in these procedures. Assistance from individuals with cetacean experience is essential. Following from the diagnostic facilities recommendations, and in an effort to incorporate all the suggestions within the Husbandry Section of this report, each facility should have a resident veterinarian to carry out the following duties:

Daily veterinary inspection

Periodic physical examinations to collect baseline physiological data and to check the health status of every animal. These examinations should be performed on a regularly scheduled basis.

Recently collected animals should receive physical examination every other week unless medical status indicates a necessity for more frequent examinations.

Necropsy examination should be performed by veterinarians or trained pathologists on every animal as rapidly as possible following death. Serum and tissue should be saved from all organs for histopathological, microbiological examination and toxicology studies including any test deemed appropriate, e.g., virology, vitamin levels. Whenever possible, sperm should be collected from animals that die.

A physical examination should consist of the following: visual examination; morphometrics; tactile examination; auscultation; sampling, including blood and microbiology; and biopsy, if indicated. All of these procedures and sample collection should be laid out in detailed protocols and standardized between all participating facilities to facilitate information exchange and comparison. Protocols for regular, detailed exchange of this information should be established.

Water Quality

Water quality requirements are summarized in Table 2. Specific components of water quality are discussed below.

Temperature: Water temperature fluctuates between 4° C and 30° C at the Wuhan facility. Currently, the animal's diet is regulated to provide it sufficient caloric intake. When the facility's water temperature begins to drop in September, higher quality food is offered to increase the animal's body fat content to assist it to endure lower winter temperatures. Temperature alteration is similar to that at the Yangtze River at Shishou. Water is pumped in to Tongling during the dry season. Consensus was that **water temperature in all facilities, both semi-natural and captive, should approximate that of the Yangtze River (10-25° C).** During the breeding season, the Yangtze River temperature averages 15-18° C.

Ph: Consensus was reached that **acceptable PH ranges from 6.5 - 8.5 for controlled pools with an optimum PH of 7.5.** PH is not controllable in reserves at present.

Air Temperature: Air temperature is not controllable, except in indoor facilities.

Turbidity: Consensus was reached that the **visibility range acceptable is .5 - 3.5 m with good visibility to bottom of pool in a controlled environment.**

Chlorine: Consensus was reached that **acceptable chlorine levels are 0.25 - 0.75 parts per million (ppm) free chlorine, with an optimal level of 0.5 ppm. Total chlorine is also of importance and should range between 0.75 - 1.5 ppm, with an optimal value of 1.0 ppm.**

Total bacteria: Consensus was reached that **0-50 colonies/100 ml. is the acceptable range with an optimal level being 25 colonies/100 ml.**

Table 2. Water Quality Summary Table.

Water Quality Factor	Acceptable Range	Optimal Value
Temperature	10 - 25° C	seasonally dependent; breed at 15 - 18° C
PH	6.5 - 8.5	7.5
Turbidity	0.5 - 3.5 m	bottom of pool
Free Chlorine	0.25 - 0.75 ppm	0.5 ppm
Total Chlorine	0.75 - 1.5 ppm	1.0 ppm
Total Bacteria	0-50 colonies/100 ml	25 colonies/100 ml

Social Groupings

Wild groups of baiji usually consist of from 4-5 animals, but there are no data on the sex ratio of the groupings. Based on historical data of all baiji specimens (n = 102), we suspect the sex ratio to be close to 1:1 (54 males:48 females in specimens). It is likely that baiji are polygynous if other cetaceans are used as models; no data regarding mating systems are currently available. Working group participants suggest that publications for which these and similar data are available for small cetaceans should be consulted to assist in developing guidelines for husbandry and social groupings, especially in consideration of the composition of groupings where pregnancies or births are imminent. Social grouping should approximate groupings in the wild, when data exist.

Husbandry Training

In training baiji, it will be important to consider the sensory differences between this species and other kinds of animals which have been trained. New or different training techniques may need to be developed and/or used, for example, depending more on touch, hearing, or other sensory modalities for stimulation and reinforcement.

Following acclimation and desensitization to the new environment, including hand-feeding, training for husbandry behaviors must be a high priority. In descending order of urgency and difficulty of training, all captive animals should be trained to:

1) present the body for physical examination
2) present the fluke for blood sampling
3) open the mouth for examination

4) permit insertion of a sterile swab into the blow hole for culture
5) permit rectal/vaginal examination and culture
6) station for artificial insemination

Recommendations Concerning Facilities: Working Group On Collection, Transport And Husbandry

Recommendations for the Shishou Semi-natural Reserve:

1. **No fishing** should be allowed in the oxbow, as outlined already by the regional government.

2. **No boat traffic** except that which is animal management related should be allowed in the oxbow, as already outlined by the regional government.

3. Nets are undesirable and there is concern about housing two species in the same reserve because of unknown interaction. Therefore, given these concerns, **optimal conditions for success would be that this reserve should be for a single-species, without nets, for baiji alone.**

Recommendations for the Tongling Semi-natural Reserve Channel:

1. Siltation in the Tongling channel should be monitored beginning immediately for an indefinite period.

2. A group of finless porpoise should be successfully maintained in the channel for a one year period before baiji are collected or moved to the Tongling semi-natural reserve. Success of the program shall be assessed by the oversight Baiji Conservation Committee.

3. Nets are undesirable and there is concern about housing two species in the same reserve because of unknown interaction. Therefore, given these concerns, optimal conditions for success would be with a single-species reserve, without nets, for baiji alone, for the foreseeable future.

4. For the short-term, finless porpoise should be locally collected to test the Tongling channel.

Equipment and Personnel Needed For the Tongling Semi-natural Reserve

Collection

1) 2 high speed boats (capacity 60 km/hr)
2) 10 wetsuits
3) 10 hand-held radios
4) Nets (1,000 m x 14 m - 2 x 20 m x 50 m)
5) Stretchers
6) Foam pads
7) Fathometer
8) Lanolin
9) 10 pairs of binoculars
10) Depth gauge
11) Emergency medical kit

Laboratory Facilities

1) Serum separator centrifuge
2) Microhematocrit centrifuge
3) Microscope
4) Refractometer
5) Refrigerator
6) Freezer
7) Erythrocyte sedimentation rack and tubes

Water Quality Analysis

1) Life support system including a cooling system
2) PH and chlorine test kits
3) Thermometer
4) Basic bacterial analysis facilities and apparatus
5) Incubator

Floating Pen

1) Design (plans to be obtained from Ridgway and Sweeney)
2) Materials to build
3) Stranding system

Husbandry Equipment and Other Needs

1) Scale to weigh animals
2) Necropsy kit for post-mortem examination
3) Funding for proximate analysis of food
4) Funding for genetic analysis

Training Personnel

1) 1 laboratory technician
2) 1 cetacean trainer

It is suggested that personnel stay at the Tongling site for six months, then with revision they may stay for another six months. Expenses for this would include travel, accommodation, and per diem allowance.

Equipment and Personnel Needed for the Wuhan Facility

Collection

1) 2 High-frequency telephones for long distance communication
2) 10 Hand-held radios
3) 4 high-speed boats (2 for placing nets and 2 for traffic control)
4) 10 wetsuits
5) Nets (2,000 m x 12 m)
6) 10 pairs of binoculars
7) Emergency medical kit
8) Depth gauge
9) Miscellaneous expenses (renting boats, fishermen's salaries, fuel, transportation, etc.)

Laboratory Facilities

Wuhan facility

1) Microhematocrit centrifuge
2) Refractometer
3) PH and chlorine test kits
4) Incubator

Field station at Shishou

1) Serum separator centrifuge
2) Microhematocrit centrifuge
3) Microscope
4) Refractometer
5) Refrigerator
6) Freezer
7) Erythrocyte sedimentation rack and tubes

Husbandry Equipment and Other Needs

Field station at Shishou

1) Scale to weigh animals
2) Necropsy kit for post-mortem examination
3) 2 rowboats
4) Medical floating pen

Personnel

Wuhan - for training

1) laboratory technician - to encompass water quality and laboratory techniques training
2) 1 cetacean trainer
3) 1 veterinarian

It is suggested that personnel stay at the site for six months, then with revision they may stay for another six months. Expenses for this would include travel, accommodation, and per diem allowance.

Field station at Shishou

1) 1 veterinarian is needed as permanent staff

白暨豚饲养群体和管理关系综论

刘仁俊

中国科学院水生生物研究所

一、白暨豚的疾病

1980年元月12日，中国科学院水生生物研究所获得一头雄性白暨豚，从而揭开了世界上人工饲养白暨豚的历史，它饲养至今已超过13年，现在它在新建的白暨豚馆内健康成长。

1980年以来，在中国饲养过6头白暨豚，除白暨豚"淇淇"以外，1981年4月22日，中国科学院水生生物研究所获得另一头白暨豚"容容"(Rong Rong)，存活9个月。1986年3月， 中国科学院水生生物研究所捕获2头白暨豚，1头性成熟雄性"联联"，存活2.5月，另一头幼豚雌性"珍珍"，存活2.5年，死于肺炎。

另外，江苏省水产研究所(Institute of Fisheries, Jiangsu Province)饲养过一头雄性白暨豚"江江"，存活4个月。南京师范大学(Nanjing Normal University)饲养过一头雌性白暨豚"苏苏"，存活时间较短，从1981年3月3日至19日仅17天。

从上面资料可以看到，在中国，饲养白暨豚半年以上成活率为50%，2.5年以上成活率为33%，13年以上成活率为17%。豚类动物的饲养，除了在捕捉、 运输过程中和因饲养条件不好会引起伤亡外，主要是经常会遇到各种各样的疾病。我们饲养13年多以来，主要遇到以下几种疾病：

1、外伤

在自然条件下，豚的外伤不是主要问题(除特别严重的外伤外)，因为长江是流水环境，细菌少，豚的自愈能力强，而在人工饲养下，由于豚在捕捉过程中一般会受伤，由于白暨豚少，无挑选余地，因此外伤治疗是白暨豚人工饲养需要解决的首要问题。例如，白暨豚"淇淇"被渔民用铁钩钩伤，在颈背部有4CM直径，8CM深2个相通的大洞。另一头豚"容容" 腹部皮肤大面积擦伤，我们采用中西药结合，特殊绷带包扎，外伤全部治愈。

2、体表细菌感染

豚在捕捉、运输和饲养过程中皮肤均会有不同程度的损伤，在饲养池水没有消毒杀菌设备的情况下，均不可避免地会被细菌感染，例如，江苏水产研究所饲养的白暨豚"江江"，体表被细菌严重感染。白暨豚"淇淇"在饲养过程中体表经常被细菌感染， 其致病菌为I型荧光极毛杆菌(*Pseudomonas fluorescens*)，而江豚体表皮肤感染的致病菌为嗜水性气单胞菌(*Aeromonas hydrophila*)。体表严重感染细菌，会引起并发症，导致死亡。

3、严冬酷暑的威胁

白暨豚生活在长江中，长江水温变动范围在10－25℃之间，由于中国现有的经济条件，不可能建设有控温设备的人工饲养环境，这里包括设备费用和昂贵的运转费用。10多年来，我们的饲养池水温最高达30℃，最低到2℃，温差近30℃，显然给白暨豚的饲养带来很大威胁。

4、消化道疾病

在过去解剖的标本中，经常发现白暨豚的胃肠溃疡。我们饲养的"容容"就是因为肠道溃疡，

消化道吸收功能差，在饲养的9个月中始终未能长胖，加上没有室内饲养条件， 结果冬天突然降温，温差20℃，而未能成活。在饲养"淇淇"13年中，经常发生便泌、拉稀，肠胃发炎，严重时发生呕吐，完全拒食达4天之久。

5、肺炎。

肺炎是对饲养豚类的严重威胁。我们饲养2年半的白暨豚"珍珍"就是死于间质性肺炎。 我们采用经常性体检，及早预防和治疗的办法，较好地防止了"淇淇"呼吸系统的疾病。

6、肝炎。

我们饲养的白暨豚"联联"，肝脏组织学检查发现大面积出血坏死。13年来，我们经常监测"淇淇"的血液生化指标，服用保肝药品，很好地防止了肝病的发生。

在自然条件下，尽管我们收到了近40头标本，但大量标本为人为伤亡，还有许多标本为已腐烂个体，所以未能发现在自然条件下的疾病情况， 仅1头标本是由于体表长满霉菌而引起死亡的。

二、人工条件下的饲养与繁殖

1980年在中国开始饲养白暨豚以来，我们克服了重重困难，已经积累了饲养白暨豚的丰富经验，特别是1986年在武汉召开了首次"淡水豚类生物学和物种保护"国际学术讨论会以来，白暨豚的人工饲养和保护工作在国际鲸类学界和友好人士的大力帮助下，取得了很大进展。

在中国科学院水生生物研究所已经建成新的白暨豚饲养和繁殖设施，它包括一座饲养大厅，内有一个主养池(20X8X3.5m)，一个副养池(12m直经，3.5m深)和一个治疗池7m 直经，2m深)。另有一座繁殖厅，厅内有一个直经12m，深3.5m的饲养池。与饲养和繁殖设施配套的有2套滤水和冷却系统。同时还有一座实验楼，这套设施的总投资1200万元。白暨豚馆的建成是1986年国际会议以后国际合作的成果。这里我特别要感谢江之岛水族馆馆长Yukiko Hori， 她为白暨豚馆的建成作出了巨大贡献；日本JICA提供了先进的滤水和冷却系统以及其它许多设备。我们还特别怀念香港海洋公园周佐民先生对白暨豚保护的关心。因此，白暨豚馆的建成是国际合作的范例，它凝聚了国际上各界人士对白暨豚的爱心。

白暨豚馆的建成大大改善了白暨豚的饲养条件，同时为今后开展人工饲养条件下白暨豚的繁殖工作打下了基础。根据我们的计划，准备在新的白暨豚馆内饲养2对白暨豚和2对江豚，开展人工饲养条件下豚类的自然繁殖和人工繁殖工作。近几年来，我们已连续测定了白暨豚" 淇淇"的雄性生殖激素的变动规律，结果表明，"淇淇"的睾丸酮的分泌水平在春夏季存在高峰期。同时我们还开展了"淇淇"的人工采精训练。现在"淇淇"已能自动游到训练员身边，翻转身体，腹部朝上，接受训练员的抚摸，并伸出阴茎。尽管尚未达到排精采精的成功，但在白暨豚视力很差，训练难度很大的情况下，取得这样的进展，亦来之不易。

三、白暨豚半自然饲养和繁殖

根据1986年武汉国际会议的建议，我们对石首天鹅洲白暨豚自然保护区完成了各项背景值

的调查。同时已在1990年和1993年分别捕进来自3个不同自然群体的江豚共10头(4♂6♀)， 并已在故道内出生江豚3头，其中1头已成活3年多。

为了从种群遗传学及种群统计学原理(Genetic and Demographic Considerations) 考虑白暨豚在Semi-captivity的繁殖计划，我们首先从江豚作为实验对象，为白暨豚的繁殖计划作准备。

根据Katherine Ralls的建议，从种群遗传学和种群统计学考虑， 极大地增加白暨豚的生存机会，在Semi-captivity必须完成3个重要步骤，即1.Achieving Routine Breeding in Semi-captivity；2.Assuring the Security of the Population in Semi-captivity；3.Preserving Genetic Diversity. 根据以上考虑，我们以江豚为对象，为实现上述3个步骤作了以下几项工作。

1、1990年3月，我们从长江2个不同的江豚的自然群体引进5头江豚(2♂3♀)， 其中2头为怀孕个体，他们先后于3月底和4月初顺利产仔，其中1头成活至今已3年多；另外于1992年10月又出生1头，由于这一头是1990年3月捕进保护区的江豚所生，所以说明江豚已能在保护区内自然交配繁殖。

2、引进的江豚，由于自然保护区内水域辽阔，水质良好，食料丰富，又无工业污染， 所以生长良好。由于目前自然保护区内仍有少数当地渔民作业，以前又无经费解决他们的生活出路，所以造成引进的2头江豚和出生的2头幼豚被误杀。但现在国家已正式批准在石首半自然保护区建立国家级的白暨豚自然保护区，帮助当地渔民转业的经费已经解决，因此今后可以避免白暨豚和江豚被误杀，确保群体安全。

3、为了保存半自然条件下的基因变异，防止近亲交配(Close inbreeding)， 提高幼体成活率，我们在1990年分2次从长江不同的自然群体共引进5头江豚，1993年又引进1群5头江豚(2♂3♀)，期望增加在半自然条件下保存基因变异，增强豚的生存力。

由于对江豚的上述工作，为下一步引进白暨豚从理论和实践上作了准备。从理论上讲，为了保持物种的生存力，应该在半自然条件下引进20－25头白暨豚有效群体，才能较长时间的保存基因的变异，我们将向这一目标努力。

尽管我们已经作了大量工作，但我们面临的困难还很多，随着中国经济的发展，长江沿岸的人类活动加剧，要在长江自然条件下保存白暨豚极为困难，因此我们唯一的希望是要加快把白暨豚从长江移到半自然保护区的步伐，同时加强人工饲养下白暨豚的繁殖研究，沿着既定的目标加紧工作，为保存这一濒危物种而努力。

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Overview of Captive Population and Management Concerns of Baiji, *Lipotes vexillifer*

Liu, Renjun

(Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan, China)

1. Diseases of Baiji

In January 12th of 1980, one male baiji was moved into the Institute of Hydrobiology, The Chinese Academy of Sciences at Wuhan, which opened the first page of the history for rearing baiji in captivity. This dolphin was named Qi Qi, who has been living in captivity healthily more than 13 years.

Since 1980, 6 baiji had been tried to be kept in captivity in total in China. Besides Qi Qi, the Institute of Hydrobiology obtained another baiji named Rong Rong in April 22nd of 1981, who survived 9 months. In March of 1986, the Institute captured two baiji, one of them was an adult male named Lian Lian, who survived 2.5 months; another one was a juvenile female named Zhen Zhen, who survived 2.5 years, died because of pneumonia. Meanwhile, the Institute of Fisheries of Jiangsu Province tried to rear one male baiji named Jiang Jiang, who survived 4 months. Nanjiang Normal University reared one female baiji named Su Su, who only survived 17 days from March 3rd to March 19th of 1981 (see Table1).

We can see from the table that the success rate for keeping baiji in captivity longer than 0.5 years is 50%; longer than 2.5 years is 33%, and longer than 13 years is 17%. Disease is a big problem for keeping dolphins in captivity. Depending on our experience from keeping baiji in captivity, several diseases described as follows happened more often.

a. External Injury

In natural, external injury is not a major problem (except some serious injuries), since the water of Yangtze River is relatively clean, and the dolphin has a good self-curing ability. But, in captivity it is very important to cure the external injury which might be caused by capture. For example, Qi Qi was incidently caught by fisherman, who used a big hook made two big hole on its neck back, both of hole was 4cm in diameter and 8cm in depth. The belly of another dolphin Rong Rong was badly injured when it first arrived the institute. So, the first and very important thing needed to be done often is that the treatment of external injury.

b. Skin Bacterium Infection

While in the process of capturing, transporting and rearing, it is very often that the skin of the anminal is injured in different degree. Baiji is often infected by *Pseudomonas fluorescens*, and the finless porpoise is often infected by another kind of bacterium, which is *Aeromonas hydrophila*. It is possible that the animal will be died by verious infecting of some bacteria. One of the solutions is to keep the water clean, while using some medicine to treat it. Such kind of problems of Qi Qi have been controled and treated effectively since 1980.

c. Hot diseases

In Yangtze River, temperature alteration range is 10-25°C. The temperature in our tank can be as high as 30°C, and as low as 2°C. This will bring a big problem for animals in captivity under the condition without temperature controling facility. We usually feed the dolphin with some cooling and refreshing medicine for preventing heatstrole in summer and increase nutrition of the animals daily intake for strengthenig physique in winter, both ways have worked very well.

d. Alimentary Canal Diseases

In the specimen dissected so far, intestines and stomach ulcer have been found very commmon on baiji. One dolphin, whose name was Rong Rong, died in captivity, because it had intestine ulcer which made its assimilating function very poor, and could not stand the sudden decrease of the pool water temperature. For the past 13 years, QiQi often had some problems about alimentary cannal, such as indigestion, inflamnation in the cannal, etc. The animal may volmit, and refuse to eat. Such kind of problems of Qi Qi has been effectively prevented and treated by using a combination of Chinese and west medicine.

e. Pneumonia

Pneumonia is a big threat for dolphins in captivity. Zheng Zheng, who had been kept in captivity for two and half years, died because of intertitial pneumonia. Regular healthy examination is a good way for preventing the happening of the disease in respiratory treat.

f. Hepatitis

Lian Lian, another dolphin used to be in captivity died because of hepatitis. We regularty monitor Qi Qi's blood and biochemistry indexes, and feed the animal with some medicines for protecting liver which has effectively prevented the happening of hepatitis.Even through we have obtained about 40 specimen, but most of them were killed by human activities, and many were alreadly rotted. Little is known about diseases in nature.

2. Rearing and Breeding in captivity.

A new and much improved facility for keeping and breeding baiji in captivity was already finished in the Institute of Hydrobiology, The Chinese Academy of Sciences, which includes a main hall(30m in diameter) consisting of one main pool(20x8x3.5m), one auxiliary pool(12m in diameter, 3. 5m in depth) , and one treating pool(7m in diameter, 2m in depth); a hall for reproduction(15m in diameter, 3.5m in depth); a laboratory building; and two control systems for water cycling filtration, and temperature cooling. Establishment of baiji aquarium is an achievement of international cooperation about baiji's conservation after freshwater dolphin workshop in 1986. I would like to take this opportunity to especially thank Yukiko Hori, who is director of Enoshima Aquarium , and Japan Interation Cooperation Agency, both of them provided great financial support and supplied much equipment. Chinese government and China Bank also raised a great deal of money. We especially cherish the memory of late Dr.Zuo min Chow, who showed his great concerns about baiji. I must say that baiji Aquarium condenses many people and organizations love to baiji, which is a very successful example for cooperating our efforts for helping baiji in internation level.

The establishment of baiji aquarium has greatly improved baiji's living conditions in captivity, which supplys a solid basis for carrying an baiji breeding program in captivity. We are planing to keep 2 pairs of baiji and 2 pairs of Neophocena to carry out breeding program. In recent years, we have continously measured the alteration regularity of Qi Qi's male reproductive hormones, which shows that his serum testosterone(T) level has obviously cyclical changes. It reaches its maximum from March to July, over 300mg/dl and mimimum from August to Septemter, below 100mg/dl. Meanwhile, we have been training Qi Qi for artificial collection of sperm, and up to now, Qi Qi can finish the necessary process for this collection following trainer's order, i.e., swims to and stops by the trainer, lies on its side or its back and, exposes its penis. We hope that a bank of sperm and body cells of baiji can be established in the near future.

3. Rearing and Breeding in Semi-natural Reserve

Following Wuhan freshwater dolphin workshop's suggestion, we finished the study of the feasibility of establishing a semi-natural reserve in an obsolete oxbow of Yangtze River named Tian-e-zhou near Shishou city in middle reaches. In the workshop, Katherine Ralls suggested that three measures are very important for increasing baiji's survival opportunity in semi-captivity, which are 1. Achieving routine breeding in semi-captivity, 2. Assuring the security of the population in semi-captivity, 3. Preserving genetic diversity. Based on these considerations, we did some experiments using *Neophocoaena* as the objects:

a. In March of 1990, we moved 5 *Neophocoaena* from two different groups in the river into the reserve, among which two of them were pregnant females. Two calves were born in March and April 1990, respectly and among them one has survived for about three years. Another calf was born in October of 1992, which suggested that *Neophocoaena* can breed naturally in the reserve.

b./ The environment of this semi-natural reserve is very similar to the mainstream of the river, and doesn't have any industry pollution. Fish resources are good enough for supportig 50-80 baiji's life. Even though there are still few fishermen fishing in this area, which actually caused two adult and two calves of *Neophocoaena* killed incidently by fishing gears. But fortunately, the Chinese government has already decided to set up a national level baiji reserve in this area, and donated the necessary fundings for helping fishermen changing their living ways. Therefore, baiji and *Neophocoaena* will be no more killed incidently by fishing gears, and we can assure the security of the animals in this reserve.

c. For preserving genetic diversity, and prohibit close in breeding, we moved another 5 *Neophoaena* from two groups into this area in March of this year. Hopefully, this can increasing the animal's genetic diversity and its viability.

The work mentioned above supplied a solid basis for further moving baiji into this area. For preserving baiji's population viability, an effective population of 20-25 baiji should be moved into the area, which is our next object, and we will try our best for finally carring out this great task.

Even though much work has been done, we still face many great difficulties. Following along the growing of Chinese economy, human activities will increase very rapidlly along the river. It will be more and more difficult to preserve baiji in its natural environment, even though it is still an important measure. The greatest hope for baiji is to move them into semi-natural reserve whose environment is similar to the river but could be under complete control by people. Meanwhile, we must intensity reproduction research in captivity, which will be very important for guiding the conservation work in semi-natural and natural reserve.

海兽在饲养下的成功繁殖

布莱德. 安德鲁斯

二十年前，北美的水族馆和海洋生物馆把海兽的出生看作是一件大事。自那以后,已有900多头加州海狮(*Zalophus californianus*)和300多头港海豹(*Phoca vitulina*)在饲养下出生。

可用3种鲸类的繁殖项目作为例子。在北美的动物园里现饲养着29头虎鲸(*Orcinus orca*)。在1976年至1993年间出生了23头，有关这些动物的数据库保存了所有建立者及其家族的资料。对这一种群进行了孕激素与排卵及生产时间的关系的研究。虎鲸的妊娠期为515±1-7天，产仔间隔平均为35个月。在4个海洋公园中共有18头虎鲸，其中5头是雄性，13头是雌性。现在该种群包括2头野生雄性(11%)，7头野生雌性(39%)及9头饲养下出生的动物(50%)。

第二个例子是康海豚(*Cephalorhynchus commersonii*)。这个种群在1983年从12头建立者开始，现有9头动物，妊娠期为345±20天，产仔间隔为27个月。现在该种群包括2头野生雄性(22%)，2头野生雌性(22%)及5头饲养下出生的动物(56%)。Asper等(1990)提示，这个例子表明，在适宜的条件下，在短期内建立能积极地生殖的鲸类繁殖群是可能的。

第三个例子是瓶鼻海豚(*Tursiops truncatus*)。保持着的一个数据库存有全部建立者的家族的资料。现有的瓶鼻海豚种群包括84头动物，10头是野生雄性(12%)，24头是野生雌性(28%)，及50头饲养下出生的动物(60%)。妊娠期为370 ±7天，产仔间隔为32个月。在15年中饲养下出生的动物的存活率为83%。

对北美的饲养种群全部331头瓶鼻海豚的简单回顾表明它们包括84头野生雄性(25%)，150头野生雌性(45%)，及97头饲养下出生的动物(29%)(Duffield等,1992)，这与在佛罗里达州的萨拉索塔所研究的野生种群(Wells 等,1991)十分相似。

REPRODUCTIVE SUCCESS OF MARINE MAMMALS IN CAPTIVITY

Brad Andrews, Vice president Zoological Operations, Sea World, Inc., Orlando Florida, 32821, USA.

Twenty years ago in North American aquariums and oceanariums, the birth of marine mammals was a big event. Since then, more than 900 California sea lions (*Zalophus californianus*) and more than 300 harbor seals (*Phoca vitulina*) have been born in captivity.

Three cetacean reproductive programs can be used as models. Twenty-nine killer whales (*Orcinus orca*) are now housed in zoological parks in North America; 23 births have taken place from 1976 to 1993. The data base maintained on these animals contains all founder and pedigree information. For this population, progesterone studies are carried out with regard to ovulation, conception and birthing times. Gestation in killer whales is 515 $\pm$ 1-7 days and calving intervals averaged 35 months. In the four Sea World parks, there are 18 killer whales with a gender ratio of five males and 13 females. The current population consists of two wild-born males (11%), seven wild-born females (39%), and nine captive-born animals (50%).

The second model is that of the Commerson's dolphin (*Cephlorhynchus commersoni*). This population started with 12 founders in 1983 and is now nine animals. Gestation is 345 $\pm$ 20 days with calving intervals of 27 months. The current population consists of two wild-born males (22%), two wild-born females (22%), and five captive-born animals (56%). Asper et al. (1990) suggest that this example shows that, given proper conditions, it is possible to constitute breeding colonies of cetaceans which can become reproductively active in a short period of time.

The third model species is Atlantic bottlenose dolphins (*Tursiops truncatus*). A data base is maintained that tracks all founders and pedigree information. The existing population of bottlenose dolphins consists of 84 animals; ten are wild-born males (12%), 24 are wild-born females (28%), and 50 are captive-born animals (60%). The gestation period is 370 $\pm$ 7 days and calving intervals averaged 32 months. Survivorship of captive-born animals through 15 years, is 83%.

A brief review of the entire North American captive population of *331 Tursiops* shows that animals are 84 wild-born males (25%), 150 animals are wild-born females (45%), and 97 animals are captive-born (29%) (Duffield, et al. 1992). This is very similar to wild populations studied in Sarasota, Florida (Wells et al., 1991).

疾 病

J. 皮德. 施罗德

疾病是威胁动物种群的最严重的因素之一。疾病对小种群或联种群比对健康而稳定环境中的一个大种群有更大的灾难性危险。当一种淡水豚的栖息环境被化学品、人和动物的废弃物、噪声及所捕食的物种的丧失所污染时，此栖息地，即长江中下游，变成了压迫者。海豚无法避免的长期压力将削弱其免疫能力并可能降低生殖成功率。这对于一个小的，缩减中的种群，如在所有鲸类中最濒危的白暨豚，是最严重的。

Ridgway等(1989)和Liu(1993)已识别了一些饲养下的淡水豚的病例。但已有的病例很少，尚待研究的仍很多。

对野生和饲养种群的疾病监测将显示交叉传播各种病原体的危险，两者对这些病原体的抵抗力甚小或无。鉴别野生和饲养的豚的环境中的病体是件重要的工作，还可从豚的呼吸孔和肠道的微生物区系获得有用的知识，藉此可快速诊断病因，从而可以及早进行治疗。

豚体表皮的一个裂口，加上遭到损害的免疫系统，将为微生物、病毒或原生动物的感染提供通路。白暨豚和江豚的皮肤病灶和体内寄生虫对种群可能有重要影响。而避免外伤和寄生虫感染是饲养种群生存的必要条件。对每一个体都应该查明是否有寄生虫寄生。

应建立可应用于白暨豚的，反映科技进步的快速诊断技术，包括各种单克隆、多克隆抗体、酶联免疫测定(ELISA)和淋巴细胞刺激试验。应该研究可能很有价值的应用超免疫血清的治疗技术。

应该研究白暨豚生存环境中的马鼻疽假单胞菌(*Pseudomonas pseudomalei*)的影响及白暨豚对这种病原体的抵抗力。Vedros等(1991)报道说：只是最近才认识到，在亚洲，饲养下的动物如大猩猩、鹿、尤其是鲸类，在每年的特定时间容易感染类鼻疽(melioidosis)。像Vedros等(1988)最近给饲养下的海生鲸类制成的疫苗一样，研制一种给白暨豚预防这种疾病的疫苗可能是必要的。白暨豚的遭污染的环境还表明应该建立免疫毒理学的各种技术。

一个成功的饲养下的白暨豚繁殖项目直接依赖于豚的良好健康。一个预防性的医疗/饲养的示范项目包括：训练每头豚在水中展示身体的各个部位供作检查。此项训练及训练形成的各种行为是：尾叶展示，生殖器展示，身体从头到尾展示，呼吸孔展示及张口展示。这些有利于采集诊断用的样品，有利于快速诊断疾病并建立生殖研究所必须的行为。如不能训练上述的各种行为，可改为训练豚全部出水到一块泡沫垫上，舒适地躺在上面或至少在作医疗/饲养检查时保持驯服克制。

定期的检查，称体重，最佳的营养水平是此项目的整体组成的各个部分。此外，按公斤和千卡/公斤豚重监测每头豚的摄食，比较增重或减重可提供极其重要的资料。Ridgway等(1989)报道了在亚河豚(*Inia*)血液中高尿酸水平的影响。这种高尿酸水平可能与食物有关，

查明野外的白暨豚是否也是这样，饲养下食物的改变是否影响这些水平或导致代谢问题，评价产生的每一种疾病，鉴别引起疾病的原因，定义预防对策，保持一个血清库以及对死亡个体进行全面的尸检将对白暨豚疾病的病因和过程提供更多的知识。

在捕获白暨豚时立即进行全面的体检，配合实施预防性项目所得到的疾病的资料，将提供关于白暨豚的基础资料，并供作白暨豚和江豚间的比较研究。值得注意可供用于白暨豚的治疗药物的药物动力学的研究。此外，应该对健康状况确立客观的指标。

藉着最佳的在饲养下生存的能力，很少数量的白暨豚可能提供十分重要的资料。白暨豚在野外的存话能力仍是高度推测性的，种群的下降趋势及持续的环境变异显示了在不远的将来的凄凉图景。在一个半自然的环境中的成功的繁殖可为该物种的生存提供一线希望。

DISEASE

J. P. Schroeder

Disease is one of the most critical factors affecting a population of animals. Small populations or meta-populations may be at greater catastrophic risks from a disease than a large population in a healthy, stable environment. When a river dolphin's natural habitat is polluted with chemicals, human and animal waste products, noise and loss of prey species, the habitat, middle and lower reaches of the Chingjiang (Yangtze) River becomes the stressor. Chronic stress, from which the dolphin cannot escape will reduce immune competence and may decrease reproductive success. This becomes critical in a small, decreasing population, as represented by the most endangered of all cetacean species, the baiji, *Lipotes vexillifer*.

Ridgway, et al. (1989) and Liu (1993) have identified disease conditions of captive river dolphins. The number of cases is small and there is still much to learn.

Disease surveillance of wild and captive populations will indicate the risk of exchanging pathogens to which either population has limited or no resistance. Identification of the pathogens in the dolphin's environment, both wild and captive, is important. Additional knowledge can be gained in characterizing each dolphin's blowhole and intestinal microbial flora. Rapid diagnosis of the cause of illness is facilitated by this knowledge, allowing the earliest possible treatment.

A break in the dolphin's epidermis, coupled with a compromised immune system, will provide a route for infection by bacteria, virus, or protozoa. Skin lesions and internal parasites of baiji and *Neophocoena* may be important to the wild population, and an absence of wounds and parasites would be vital to the captive population. The presence or absence of parasites should be determined for each individual.

Rapid diagnostic techniques, representing state of the art technology, including mono/poly clonal antibodies, enzyme immunoassays (ELISA) and lymphocyte stimulation, should be developed for use with the baiji. Treatment techniques employing hyperimmune serum may be valuable, and should be investigated.

The incidence of *Pseudomonas pseudomalei* in the baijis' environment and natural resistance of the baiji to that pathogen should be determined. Vedros et al., (1983) reported that only recently has it been recognized that, in Asia, captive animals such as gorilla, deer, and particularly cetaceans are susceptible to mellioidosis during specific times of the year. It may be necessary to develop a vaccine against this disease in baiji, as was recently accomplished by Vedros et al., (1988) for marine cetaceans in captivity. The baijis' polluted environment indicates that immunotoxicology techniques should also be developed.

The success of a baiji controlled breeding program is tied directly to good health of the dolphins. A model preventative medicine / husbandry program includes training each individual dolphin to present various parts of its body for examination while remaining in the water. This training and subsequent behaviors; fluke presentation, genital area presentation, general overall body, blowhole and open mouth presentation facilitates collection of diagnostic samples, rapid diagnosis of disease and establishes the behaviors necessary for reproductive studies. If the above behaviors cannot be trained, the same goals can be achieved through alternative training to induce the dolphin to come totally out of the water on a foam pad and be comfortable there or, at least, be conditioned to gentle restraint for medical / husbandry examination procedures.

periodic physical examinations, weighings, and optimal nutritional levels are integral parts of the model program. Additionally, monitoring of each dolphin's food intake in kilograms and kilocalories / kilogram of dolphin, when compared to weight gains or losses, provides critically important information. Ridgway et al., (1989) reported on the incidence of high uric acid levels in the blood of *Inia*. These high uric acid levels may be due to diet and it would be of interest to determine if this were true of the baiji in the wild and if dietary changes in captivity affect those levels or lead to metabolic problems. Evaluation of each disease that occurs, identification of the causative agent, definition of the preventative strategy and maintenance of a serum bank as well as complete necropsy performed in the event of a fatality will provide additional knowledge of baiji disease etiology and processes.

A complete physical examination immediately upon capture of a baiji, coupled with disease data obtained during performance of the preventative medical program, will provide baseline information on baiji, and comparative studies between baiji and *Neophocoena.* Studies to provide pharmacokinetic information for therapeutic drugs for use in the baiji would be of interest. Additionally, a battery of objective indicators of health status should be identified.

With the ability to survive in captivity optimized, a small number of baiji could provide much needed information. Survival of baiji in the wild is still highly speculative. The downward trend of the population and continued environmental variation present a bleak picture for the near future. Successful breeding in a semi-natural setting could provide a slim hope for survival of the species.

为拯救濒危珍稀动物白暨豚而努力工作
——铜陵白暨豚养护场工作进展报告

董明利　　　　章　贤

为拯救白暨豚这一濒危珍稀物种，国家环保局1985年委托安徽省科协组织有关方面专家对长江中下游江段的生态环境和白暨豚的活动规律进行了实地考察，根据专家论证意见，国家环保局1985年 9月批准在安徽省铜陵市大通镇建立白暨豚养护场。该工程自1987年底动工兴建以来，经几年的建设，已具备了养护白暨豚的基本条件。

一、基本建设情况：

根据国家环保局批准的扩初设计内容和采纳专家意见增建、改建的设施项目，我场现已完成的主要建设项目有：

1、夹江工程，包括夹江疏浚、土坝工程、进、排水闸工程，提水泵船、筑夹江堤埂、人行桥等。其中：

进、出口土坝顶高程17米，顶宽6 米，内外坡比1：3，土方总量为8.05万方。

进、排水闸工程闸口径为4 m^2 ，按水位13m计算，夹江水体自流换水一次需2.5 天，换水84.25 万m^3 。

提水泵船选用2台12英寸混流泵，配动力40KW，水泵总扬程15m，提水总量3.4万方／日，换水一次需6.5 天。

此项工程的完成可使夹江在丰水期开启进出水口闸进行水体自流，在长江水位低于8.5m时采用船式提水泵站供水。

2、暂养池和治疗池：

暂养池为直径16m，近似园形的三叶形水池，容量600 吨，池深3.5 m。治疗池为直径10米的园形水池，池壁深2.5 m，容量150 吨。可供豚

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类暂时饲养和治疗使用。

3、净化泵房和给排水装置：

净化泵房220 m^2，净化器一台，容量100吨蓄水池一个，15吨取水船一条，日净化和供水能力1200吨。

4、实验用房：

面积1070m^2，房间20个，有解剖室、无菌室、化验室、饲养室等组成。

5、办公及生活用房：

面积960 m^2，房间18个，包括大会议室两个以及供电、供排水、通讯设施等。

6、饲料基地：

成鱼塘15亩，鱼种池5亩。93年在成鱼池和夹江中共投放了鲤、鲫、鲢、草、鳙、鳊等鱼类共18.5万尾以解决豚类饲养用鱼。

7、室内豚馆：

面积306 m^2的长园形室内馆，长22.9m，宽12m，深4.2 m，可容水1000吨，能解决豚类安全越冬渡夏问题。

8、科研仪器设备：

包括家用电视摄录像设备，生物显微镜、恒温生化培养箱、分光光度计、离心机、高压灭菌锅等，可以进行水质理化分析和豚类血液生化分析等。

二、试运行工程：

1991年10月，我场基建工程通过了由省环保局和铜陵市政府共同主持的预验收，1992年元月经国家环保局批准转入试运行阶段，并要求试养江豚以积累经验。根据国家环保局和省水产局指示精神，我场制定了详细科学的实施计划和捕养方案，于92年4 月14日在铜陵江段活捕七头江豚，运入场内养护。捕获的七头江豚中，因病死亡一头，放回长江两头。1993年

元月，我们又成功地采用直升飞机空运的方法将两头人工饲养了九个月、生长状况良好的江豚运至上海中华水族园展出。经过一年多的试运行，江豚活体捕获和饲养工作取得了成功，积累了大量有价值的科研基础资料，为今后开展白暨豚养护工作提供了宝贵经验。

三、生态考察活动：

1993年元月中旬，国家农业部渔政局主持召开了“安徽省铜陵白暨豚养护场技术、设施条件论证会”，应邀参加会议的专家有中科院水生所陈宜瑜、刘仁俊、南师大周开亚、安徽省水产局赵乃刚等。

与会专家经实地考察后一致认为，铜陵白暨豚养护场已初步具备饲养白暨豚的能力，待室内豚馆建成后，可以捕捉并饲养来自一个自然群体的２～３头白暨豚。

根据会议精神，我场一方面加紧室内豚馆建设，另一方面组织白暨豚考察队自1993年2月 9日开始重点考察长江安徽段白暨豚和江豚的活动规律，至1993年 5月31日，先后发现白暨豚群体活动13次（详见附表）。根据考察结果，估计现存于安徽江段的白暨豚数量为50至60头。且多以３头或２头的小群体形式存在，少见单个豚，今年没有发现４头以上的群体。

我场自 4月15日接到农业部批准的捕获来自同一个群体的２～３头白暨豚指标的批复后，即转入捕获白暨豚工作。由于５月份江水涨势较猛，流速较大，白暨豚活动不稳定，不靠边，给捕豚工作增加了难度。目前我们正全力以赴，克服困难，力争年内完成捕豚任务。

四、困难与不足：

我场当前面临的困难和急需解决的问题主要有以下几个方面：

１、水过滤净化系统需要更新：

我场现有水净化系统只有一台净化器，每小时净化处理30吨，净化后水质达到人的饮用水标准。但没有循环过滤系统，目前急需配置一套完全循环净化水系统及臭氧发生器。

2、科研设备缺乏：

我场虽已初步具备基本的科研实验条件，但仍缺乏先进科研仪器设备，无法开展深层次的科研工作。

3、我场在基建期间已派出过多名技术人员赴国内、国外学习和进修。现在周开亚教授、施罗德先生和香港海洋公园同仁帮助下，我场正安排一名兽医赴香港海洋公园学习海豚预防性医疗技术。在此，向他们表示感谢。同时，我们希望有更多的国内外专家学者帮助我们培训技术人员，以提高技术水平。

我们热情欢迎国内外专家学者，与我们共同合作开展技术交流与科研协作，为抢救频临灭绝的古老的水中动物白暨豚做出努力。

附表：93年春考察安徽江段白暨豚活动情况表：

日　期	发现时间	失踪时间	跟踪时间	豚群结构
3月20日	12:20	16:40	4小时20分	2大＋1小
4月 2日	14:05	17:00	2小时55分	2大
4月 6日	7:10	10:20	3小时10分	2大
4月 7日	7:34	10:00	2小时20分	2大
4月 9日	14:50	18:10	3小时20分	1大
4月10日	9:35	9:37	/	1大
4月12日	6:30	7:00	30分	1大
5月 3日	12:30	15:30	3小时	2大＋1小
5月 4日	14:00	16:40	2小时40分	2大＋1小
5月 8日	16:00	18:00	2小时	2大
5月11日	10:30	13:00	2小时30分	2大
5月15日	13:55	17:15	3小时20分	2大＋1小
5月31日	15:20	18:40	3小时20分	2大＋1小

TO WORK HARD FOR SAVING RARE ANIMAL-BAIJI DOLPHIN

___Reports on ongoing progress of

Tongling Baiji Semi-Nature Reserve

Anhui China

Dong Min-Li

Zhang Xian

1993 5

To Work Hard For Saving Rare
Animal-- Baiji Dolphin
--- Reports on ongoing progress of
Tongling Baiji Semi-Nature Reserve
Anhui Province

In order to save this rare species being in imminent danger -- Baiji dolphin, 1985 Environmental Protection Bureau of China (beneafter abbreviated as EPBC) entrusted Science Association of Anhui Province to organize the experts concerned to make an on-the-spot investigation about ecological environment of the lower-middle reaches of the Yangtze River and regularity of activity of the Baiji dolphin. On the basis of the experts' proofs, EPBC authorized to build Baiji Semi-Nature Reserve in Datong Town, Tongling, Anhui Province in September 1985. This project has processed several years' construction and had the essential requirements of conserving the Baiji dolphin since we started building in the end of 1987.

I. Present situation of Capital Construction

According to the tentative design content which was authorized by EPBC and the experts' opinions that was to promote and rebuild some installations, we have finished some main construction items which include:

1. Reserve project: that is dredging tributary, earth dam project, head and drainage gate project, water lift pump-boat, building a tributary dike, foot bridge etc.

Among them: The height of earth dam's top of exist and entrance is 17m., width of top is 6m., the proportion of inside and outside slop is 1 : 3, the total cubic metre of earth is 80,500m^3.

The diametre of head and drainage gate is 4m. Suppose the water level is 13m., one tributary water artesian change will take 2.5 days with water renewing volume of 842,500m^3.

Water lift pump-boat elects two pieces of 12 inches mixed flow pumps with power of 40kw. The total lift height of pump is 15m., the total water lifting volume is 34,000m^3/day and it needs 6.5 days to renew water once.

The completion of this project can make the tributary open the water gate of exist and entrance to flow by itself during high-water season. This project will supply water by using lift pump station which is as like as a ship when the Yangtze River's water level is lower than 8.5m.

2. The holding pool and the curing pool

The diametre of the holding pool is 10m., with a three-leaf-like shape similar as circle, its volume is 600 tons, the depth is 3.5m.

The curing pool is a 10-metre-long circle one, with wall's height of 3.5m., and volume of 150tons. It can supply a place where we temporarily feed the Baiji dolphin and cure them.

3. Pumping station for purification and equipments for water and wastewater control

The pump station occupies 220m^2, inclusive of a clarifier, a 100-ton-volume storage pond, a 15-ton-water-fetching ship. It can purify and supply 1200 tons water every day.

4. Experiment building: its built-up area is 1070m^2., and it has 20 rooms. It consists of dissecting room, germfree room, laboratory, breeding room etc.

5. Office and residential architecture: the built-up area of them is 960m^2 and this building has 16 rooms, including two big meeting rooms and power supply, water and wastewater control, and communication facilities.

6. Forage base: We have a fully-grown fish pond which takes up 15 mu and a fry pool of 5 mu. We have thrown in 18,500 fishes including common carp, crucian carp, silver carp, black carp, big head, blunt-snort etc. to serve as dolphin's food.

7. Indoor pool of dolphin

It is a long-circle indoor pool occupying $306m^2$., with a length of 22.9m., width of 12m. and depth of 4.2m. It can hold 1000 tons water and can make the dolphin live comfortably both in winter and summer.

8. Scientific research instrument: refers to tele-recording and television camera, organisms microscope, Constant temperature biochemical culture box, spectrophotometre, centrifuge, autoclave etc. These equipments can conduct water physical chemistry analysis and dolphin's blood biochemistry analysis etc.

II. The work of test run

In October 1991, the capital construction project of our reserve passed through the check and accept in advance which taken charge of by Environment Protection Bureau of Anhui Province and Government of Tongling city.

In June 1992, we changed over to the period of test run after the approval of EPBC, and we required to feed finless porpoise experimentally in order to accummulate experience. According to the instructions given by EPBC and Aquatic Product Bureau of Anhui Province, we drew up a detailed, scientific enforcement plan for catching and feeding, we catched seven finless porpoises livingly during Tongling part of the Yangtze River and shiped in our reserve to feed and conserve on April 14, 1992. But it was pity that one finless porpoise was dead due to illness. Two was set free in both sides of the Yangtze River. We used helicopter to transport two finless porpoises which we fed nine months and grew well to Chinese Aquarium Garden of Shanghai to be on show. After more than one year's test run, the work of finless porpoise catching and feeding has made achievement and accumulated a lot of valuable scientific research basic materials, and provided valuable experience for improving the work of feeding and conserving Baiji dolphin in the days to come.

III. Ecological investigation

The Fishing Bureau of Ministry of Agriculture held a discussion about "Technology, Installations of Tongling Baiji Semi-Nature Reserve Anhui Province", in the middle of June 1993. the invited experts were Chen Yiyu, Liu Renjun who work in Aquatic Institute of Academy of Sciences of China, Zhou Kaiya who works in Nanjing Normal University, Zhao Neigang a research fellow in charge of Anhui Aquatic Product Bureau.

After having made an on-the-spot investigation, all experts thought that Tongling Baiji Semi-Nature Reserve has had an initial capability to feed the Baiji dolphins, and it can catch and feed 2 - 3 dolphins coming from a natural group when we finish the indoor pool of dolphin.

According to the gist of the conference, on one hand we speed up to build the indoor pool of dolphin, on the other hand we organized an investigation group to start a major investigation on the regularity of dolphins and finless porpoises' activities in Anhui part of the Yangtze River. From February 9 to May 15, 1993, we found 12 times activities of dolphin's group early to late (For details, see the following)

List: The conditions of the Baiji dolphins activities in Anhui part of the Yangtze River.

DATE	Time of appearing	Time of disappearing	Time of watching	A colomy of dolphins
March 20	12:20	16:40	20 minutes and 4 hours	two big, one small
April 2	14:05	17:00	55 minutes and 2 hours	two big
April 6	7:10	10:20	10 minutes and 3 hours	two big
April 7	7:34	10:00	20 minutes and 2 hours	two big
April 9	14:50	18:10	20 minutes and 3 hours	one big
April 10	9:35	9:37	/	one big
April 12	6:30	7:00	30 minutes	one big
May 3	12:30	15:30	3 hours	two big, one small
May 4	14:00	16:40	40 minutes and 2 hours	two big, one small
May 8	16:00	18:00	2 hours	two big
May 11	10:30	13:00	30 minutes and 2 hours	two big
May 15	13:55	17:15	20 minutes and 3 hours	two big, one small

We switched to the catching Baiji dolphin's work after Ministry of Agriculture had authorized to catch 2 -- 3 Baiji dolphins coming from the same natural group since April 15, 1993.

Because now it is a high water season, the Baiji dolphins' activity in May is not steady and they don't keep to the side, this added to the difficulties for the catching work. At present, we are going all out to overcome the difficulties and working hard for finishing the catching job in this year.

IV. Difficulties and problems

At the moment, we are in urgent need of deeling the following problems:

1. The renewal of water filtering and purifying facilities

We have a purifier now on hand, it purifys 30 tons water per hour, the water quality is up to the drinking water standard after purification. But we have not a circulatory system of filtening water, at present we are in urgent need of a complete set of circulatory system of purifying water and ozone generator.

2. Lacking of scientific research instrument

Although we have had an essential requirements of scientific research, we are still lack of advanced scientific research instruments, it's difficult for us to make further scientific research.

We have sent many technical personnels to study at home and abroad. Now under the help of professor Zhou Kaiya, Mr. Schroader and colleagues from the Sea Park of Hong Kong, we are arranging to send a vet to the Sea Park of Hong Kong to study preventive medical treatment of dolphin.

We wish more internal, external experts and scholars to help us to train technical personnels so as to raise the technical level, simultaneously we are very much obliged to them.

All experts and scholars both at home and abroad will be welcomed warmly to work together to carry out technical exchange and scientific research cooperation, for rescuing the animal -- Baiji dolphin which is in imminent extinction to make great efforts.

促进白暨豚种群的保护和增殖

晏家荣
长江天鹅洲白暨豚自然保护区管理处

长江天鹅洲故道经过科研部门五年的考察，论证认为是白暨豚栖息，繁衍最理想的自然环境。1990年3月在该故道放养5头江豚，试养获得成功。1993年4月再次放养5头江豚，至今生长良好。实践证明：长江天鹅洲水域不仅适应江豚的生活习性，更是白暨豚生活的理想场所。将来引进白暨豚后，为了确保白暨豚有一个安宁舒适的环境，我们采取了以下措施：

1. 封存滚钩。长江天鹅洲水域长期以来是沿江渔民捕捞的地方，而且有用钩类作业的历史习惯。为了不伤害白暨豚，我们于1987年就封存滚钩二十万口。在故道内使用滚钩的现象正在逐步杜绝。

2. 取缔有害渔具。长江天鹅洲渔业资源极为丰富，有害渔具一度大量增加。为了白暨豚、江豚在该水域有足够的饵料，我们依法取缔蔛箔24部，麻布网4部。目前严重危害鱼类资源的渔具已全面禁止使用。

3. 帮助渔民转向。白暨豚自然保护区被国家批准后，在当地政府的重视和支持下，转向了沿江的两个渔业村。开挖精养渔池13公顷，承包给渔民。成立运输公司两家。捕捞强大大降低。

4. 加快防逃、养护等基础工程建设。经省渔业行政主管部门批准，建在长江天鹅洲的管理站办公楼、住宅楼已于1993年5月动工兴建，8月竣工。交通、通讯已初具规模。防逃栏栅的设计已经完成，今冬开工，预计1995年建成。

5. 加强管理，完善法制。长江天鹅洲白暨豚管理处人员按行政、管理、科技各三分之一的原则基本到位。按其分工，各司其职，各负其责。目前，省、市渔业行政主管部门关于重点保护白暨豚的地方法规即将颁布实施，做到保护"国宝"白暨豚有法可依，依法管理。

6. 组织队伍，尽快从长江引进白暨豚。我们已于1992年开始监测石首江段的白暨豚活动情况。一旦时机成熟，我们将尽快从长江捕入白暨豚进行养护和增殖。

白暨豚是珍贵稀有的水生野生动物，濒临灭绝。为了拯救"国宝"白暨豚，我们将全力以赴做好工作，加强管理，保护生态平衡，为造福人类做出极大的贡献。

Working paper for the Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

Protection and Reproduction of Baiji Population by Bringing Advantages of Semi-natural Conditions of Tian-e-zhou By-passed Oxbow into Play

Yan Jiarong

Management Agency of Baiji Semi-natural Reserve of Tian-e-zhou of Yangtze River, China

On the basis of five years' investigations and demonstrations by research institutions, Tian-e-zhou by-passed oxbow of the Changjiang River is considered to be the best ideal natural environment for the habitat and reproduction of Baiji. Five individuals of finless porpoise were introduced into the oxbow in March, 1990 and the result is successful and, additional five were introduced into it in April, 1993 which grow well up to date. The results show that the natural water area of Tian-e-zhou is not only suitable for the living habitat of finless porpoise but is also an ideal place for Baiji. When Baiji is introduced into the oxbow in the future, the following measures will be adopted in order to ensure Baiji to have the quite and suitable environment.

1. To ban rolling books. For a long time, fishermen along the river were engaged in fishing in Tian-e-zhou water area. And, they used to catch fish with rolling hooks. In order to protect Baiji, 200000 rolling hooks have be gradually stopped in the oxbow.

2. To ban the harmful fishing gear. Fish resource is very abundant in Tian-e-zhou and the harmful gear was increased greatly for a time. In order to have the sufficient food for Baiji and finless porpoise, 24 sets of bewildering and 4 sets of gunny net were banned. Now harmful fishing gear are wholly stopped.

3. To help fishermen change their work. After the natural reserve was approved by the central government, two fishery villages changed their work by the help of the local government. More than 13 ha. intensive fish ponds were built up for fishermen and, two transportation corporations were established. The fishing intensity is greatly reduced now.

4. To speed up construction of basic projects for preventing against escape and for rearing. Granted by the provincial fishery management department, the construction of administrative building and residence building was began at Tian-e-zhou on May 5, 1993 and will be completed in August, 1993. Transportation and communication equipments are provided. Designation of equipment of preventing against escape has been finished and the project will be started in coming winter and will be completed in 1995.

Working paper for the Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

5. To strengthen management and perfect legal system. The management office for Baiji at Tian-e-zhou is fitted with administrative staff, management staff and technical staff among which the number of person for each accounts for one third. They divide up their work with individual responsibility. At present, the provincial and municipal fishery management departments are going to promulgate and put into effect the local regulations for the Baiji protection. Therefore, protection and management of Baiji are carried out on the basis of law and regulations.

6. To introduce Baiji into the reserve as quick as possible. Since 1992, we have kept watching on the activities of baiji in Shishou section of the Changjiang River. Once the time is ripe, we will catch Baiji and introduce them into the reserve for rearing and reproduction.

Baiji is rare aquatic wild animal which is in the danger of extinction. In order to rescue this rare species, we will try our best to strengthen management, keep ecological balance and make great contributions for bringing benefit to mankind.

湖北省长江新螺段自然保护区的进展

陈远新
长江新螺段白暨自然保护区管理处

1982年10月28日，国务院批准长江新螺段白暨自然保护区为国家级自然保护区，现正在进行此江段的管理和初期建设，还和科研单位合作进行了野外研究。

新螺段保护区位于湖北省洪湖县、埔圻县、嘉鱼县和湖南省临湘县境内。它从长江中游的螺山至新滩口，全长135.5公里。江面宽且形成一定数量的弯道，水深约25米，流速0.3米/秒至0.8米/秒。全江段都有沙洲散布并与很多支流相通。两岸有少量石矶限制了水的流向，因而形成了很多深槽和夹堰水区。这对白暨豚是理想的场所。另外，分布在新螺段的白暨豚的相对密度比其它江段高很多，而且此密度相对稳定。 鱼类资源丰富，水污染不严重。因此这是保护白暨豚的自然栖息地和自然种群的理想地点。随着此国家级自然保护区的建立，此江段的白暨豚逐渐得到了有效的保护。为使白暨豚的保护工作进一步加强，我们采取了并将继续实施以下措施:

1. 严格执法，使新螺段白暨豚栖息地依法得到保护。在中华人民共和国野生动物保护法和中华人民共和国渔业法的基础上，根据保护区的实际情况，拟定了湖北省长江新螺段白暨豚管理条例，将在湖北省人大常委会批准后实施。

2. 为了白暨豚的安全，强化了对新螺段的综合管理。最近两年，在新螺段没有发生伤害白暨豚的意外事件。在保护区建立后，我们大力强化了对新螺段的管理。我们于今年4月26日和27日进行了检查，试图查明对白暨豚有害的情况。今年的5月4日至7日，我们在省渔政处的领导和新螺段渔政站的配合下，在新螺段依法取缔了有害渔具(如滚钩、簖箔、电捕鱼)，迁出非本江段的渔民，以有效地保护豚的食物资源和栖息地。对在长江中上下行驶的船舶进行了控制。另外，我们与环保局共同检查了向本江段排污的工厂，限期要求他们提高污水处理能力。

3. 与科研单位合作监测白暨豚的活动，定期观察保护区内的白暨豚种群。近两年，我们在新螺段共42次观察记录到白暨豚的活动，最大的群有17头豚。 国内和国外的专家也在本江段观察到白暨豚。中央电视台动物世界报导组第一天就在本江段拍摄到一群共8头白暨豚。从今年开始，我们在经常有白暨豚出没的关键地点设立了三个观察站。定期的观察逐渐查清了白暨豚的活动规律。渔民报告说他们于4月26日在靠近赤壁矶处发现一群4头豚，于1993年5月在复新洲下端发现一群8头豚。此外，在5月初的考察期间，我们于两天内5次观察到与白暨豚一同栖居在长江中的江豚。

4. 加强科普教育，提高了公众对保护白暨豚的认识。在白暨豚保护区的上下两端(新滩口和螺山)，设立了永久性的标语牌，以提醒进入保护区的船只严格遵守保护白暨豚的法规

。标语牌也在科普教育和扩大保护区影响方面起重要作用. 在报刊、电视、和广播中介绍了白暨豚的重要性及其生物学特性。有一艘150 马力的观察艇和一艘60马力的摩托艇用于保护区的管理, 也用于宣传保护区的重要意义。因此, 群众中保护白暨的意识大大提高。新螺江段的一些渔民自愿成立了"保护队", 负责保护白暨豚的安全。

我们希望并深信湖北省长江新螺保护区的白暨豚栖息地和自然种群将由于上述措施而得到有效的保护。

Working paper for the Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

Protection of Habitat and Natural Population of Baiji to the Maximum ----- Progress of the Natural Reserve in Xinluo Section of the Changjiang River in Hubei Province

Chen Yuanxin
Management Agency of Baiji Natural Reserve at the Xintankou-Luoshan Section of Yangtze River, China

On October 28, 1992, the State Council granted the natural reserve of Baiji in Xinluo section of the Changjiang River in Hubei Province as the natural reserve at the state level. Now the section management, field investigation coordinated with research institutions and construction of earlier stage are being carried out.

The natural reserve of Xinluo section is located within the boundaries of Honghu City, Puqi City and Jiayu County of Hubei Province and LinXiang County of Hunan Province. It is from Luoshan to Xintankou in the middle reaches of the Changjiang River and its total length is 135.5 km. In the section, the river is wide and a number of meanders are formed. The water depth is about 25m and current velocity is from 0.3m/sec to 0.8m/sec. Bars spread all over the section and there are many tributaries. A few of projecting rocks along the both sides of banks control the current direction and pattern so that many deep troughs and boundary water areas are formed. It is an ideal place for Baiji. In addition, the relative density of the distribution number of Baiji in Xinluo section is much higher than that in other sections. Moreover, the density is relatively stable, the fish resource is abundant and the water pollution is not serious. Therefore, the section is an ideal place to protect the natural habitat and natural population of Baiji. Along with the establishment of this state natural reserve, the effective protection of Baiji in this section is gradually obtained. In order to make the protective work of Baiji still further, we are now carrying out and will continue to carry out the following measures.

1. The management of the reserve is strengthened by enforcing law so that Baiji habitat in Xinluo section is protected according to law. On the basis of the Wild Life Protection Law of the People's Republic of China and the Fishery Law of the People's Republic of China and in the light of the actual situations in the reserve, Provincial Management Regulations for Baiji Natural Reserve in Xinluo Section of the Changjiang River in Hubei Province has been formulated and will be put into effect when the Standing Committee of the Hubei People's Congress approves it.

2. Comprehensive management and rectification of Xinluo section are strengthened in order to guarantee Baiji Against harmfulness. In recent two years, accident of harming Baiji hasn't occurred in Xinluo Section. After the establishment of the reserve, we have greatly strengthened the management of Xinluo Section. From April 26 to 27 of this year, we made survey and tried to find out the situations which are harmful to Baiji. On May 4 of this year, under the guidance of the Hubei Provincial Fisheries Management Department and cooperating with the fisheries management stations along the banks of Xinluo Section, it took us for 4 days to make the investigation in Xinluo Section and to ban the harmful fishing gear and methods (such as rolling hooks, bewildering

net and electrofishing) in accordance with law. Fishermen not native to the section were arranged to move out of the section so that food resource and habitat are effectively protected. Ships which go up and down wantonly in the river are controlled. Additionally, we coordinated with environmental protection departments to survey factories which discharged wastes into the section and to order them to improve the treatment of wastes in limited time in order to protect water from pollution.

3. Coordinating with research institutions to monitor the activities of Baiji, we regularly observe the movements of Baiji population in the reserve. In recent two years, we observed and recorded the activities of Baiji in Xinluo section for 42 times. The maximum number of a school was 17 individuals. Domestic as well as foreign experts also observed Baiji in this section. Report group of animal world from central TV shot a Baiji group of 8 individuals in the section in the first day. Beginning from this year, we set up three observation stations in the key section in which Baiji appears frequently. Regular observation is carried out and activity patterns of Baiji are gradually found out. Fishermen reported that they found a Baiji group of 4 individuals near projecting rocks of Chibi on April 26 and a group of 8 individuals in the lower end of Fuxin Bar on May, 1993. In addition, during our investigation in early May, we observed for 5 times within 2 days finless porpoise (<u>Neophocaena phocaenoides</u>) which lives together with Baiji in the Changjiang River.

4. Popular science education is strengthened so that the public consciousness of protecting Baiji is raised. In the both ends of the natural reserve of Baiji (in Xintankou and Luoshan), permanently eye-catching placards are set up in order to warn the ships coming into the reserve to strictly abide by regulations and law of protecting Baiji. The placards also play an important role in science education and extending the influence of the reserve. Biological characteristics and important value of Baiji are introduced in newspapers and magazines and, are broadcasted on television and over the radio. An investigation ship of 150 h.p. a motorboat of 60 h.p. are provided for both managing the section and propagating the important significance of the reserve. Therefore, public's awareness of protecting rare Baiji are greatly raised. In Xinluo Section, some fishermen voluntarily set up "protection team" which is responsible for protecting the safety of Baiji.

We hope and deeply believe that the habitat and natural population of Baiji in the natural reserve of Xinluo section of the Changjiang River in Hubei Province will be effectively protected by carrying out above-mentioned measures.

关于两个国家级白暨豚自然保护区情况的报告

赵长祥
湖北省水产局

湖北省地处长江中游。长江流经我省江段长达1200公里，占长江总长的五分之一。我省江段不仅是淡水渔业的摇篮，发展我国淡水渔业的重要原种基地，而且是我国重点保护的珍稀水生野生动物—白暨豚、中华鲟、白鲟、江豚、胭脂鱼等洄游、栖息、繁衍的场所。为了保护这些濒临灭绝的水生野生动物，我们在农业部的直接领导和国家有关部委的大力支持下，以科学研究为先导，以法制管理为基础，围绕建立湖北长江新螺段和湖北长江天鹅洲两处国家级白暨豚自然保护区做了大量工作，并取得了初步的成效。

1. 同有关部门密切协作共同做好保护区前期准备工作。1978年以来，我们与科研单位一起对湖北省江段白暨豚的种群数量，活动规律，栖息环境特征和天鹅洲水域生态环境背景值进行了反复的调查。在此基础上，提出了在湖北保护白暨豚的三大措施：(1) 建立国家级湖北长江新螺段白暨豚自然保护区；(2) 建立国家级湖北长江天鹅洲白暨豚自然保护区；(3) 建立人工繁育基地。为了使三大措施落到实处，我们进一步组织有关科研人员和洪湖、石首两市有关人员对新螺段和天鹅洲的生态环境、水质理化和保护区的管理体制、管理办法以及建设规划进行了更加深入的调查研究。经多方努力，完成了建立湖北长江新螺段白暨豚自然保护区可行性论证报告和建立湖北长江天鹅洲白暨豚自然保护区可行性论证报告。并于1990年和1991年10月分别通过了省级论证和国家级评审。1991年12月，农业部又在武汉主持召开了有关方面专家、领导参加的白暨豚保护总体规划综合性论证会。会议一致通过了论证。1992年10月，国务院正式批准了我国仅有的两个国家级白暨豚自然保护区。

2. 保护区基本建设进展情况。1992年4月，农业部批准了"白暨豚保护总体规划"和"湖北长江段白暨豚自然保护区实施方案"。两个保护区从1992年开始，分别按三至四年完成基本建设，包括配备必需的交通、通讯等管理设施和相应的观察、环境监测、抢救治疗所需的仪器设备，以及办公实验楼、抢救治疗池、保护区标志碑(牌)、禁区浮标等辅助设施。为保证高标准，高质量，高速度建设好两个保护区，我们始终坚持"统一领导，全面规划，统一设计，分期实施"的原则，按农业部批复的基本建设的具体要求，于1992年8月完成了两区总体初步设计，并多次召开保护区所在地政府领导的协调会议，进一步协调落实有关事宜，严把资金使用关。今年，有关土建工程的施工设计已基本完成，正投入备料实施阶段。管理设施已陆续投入使用。新螺段已修建14米高的保护区标志碑两座，建造150马力的观察艇和购置60马力的巡逻艇各一艘以及照相设备一套。天鹅洲已配备运豚工具车一辆和部分通讯设施。

组织建设是保护区的关键环节。我们按"先急后缓，先护豚后安人"的原则，依靠当地政府，加快保护区管理机构的建设。目前，根据基本建设、法制管理、科研任务的需要，保护区已健全完善了管理机构，建立了保护区管理处。两处各定编制17人，人头经费已列人地方财政预算。配备人员的标准按三个三分之一，即：法制管理人员占1/3，科技人员占1/3，行政人员占1/3。目前，部分人员根据要求条件审查后，随保护区工作进展陆续到位。两个保护区的隶属关系已基本明确，行政上由当地政府领导，业务上接受省水产局的领导。

3. 深入宣传强化法制管理。建设保护区的根本目的在于使白暨豚得到有效的保护。因此，整治长江秩序，保持良好的生态环境是较为艰巨的任务。宣传工作要常抓不懈。我们一是基层管理人员把宣传工作渗透到日常管理和考察中。二是利用报纸、电台、向全社会进行宣传。去年，我们在湖北广播电台举办了野生动物保护专题节目，仅水生动物安排六讲，播放达半年之久。近年湖北日报还专版刊登了保护白暨豚的宣传文章。依据中华人民共和国野生动物保护法，我们还草拟了白暨豚的保护管理条例，准备报请省人民政府批准颁布。

保护区刚刚开始组建，由于涉及面广，环境复杂，在今后将会遇到不同程度的困难。在5月中旬，我们组织有关地市县在保护区管理的水域进行了一次联合大检查，效果比较好。我们始终坚持两手抓的办法，一手抓建设，一手抓管理，定期或不定期地对保护区水域进行检查。在有关地、市、县管理基础上，严格查处有害渔具渔法，取缔无证作业，控制捕捞强度，遣散外地渔民和兼业渔民，为把保护区建设管理好铺平道路。同时，我们组织保护区有关人员和渔民在长江布点及流动观察白暨豚的活动规律，分析白暨豚种群消长变化情况。通过强化法制管理，江段情况明显好转。新螺江段出现白暨豚、江豚活跃的好局面。天鹅洲前两年放养的5头江豚至今生长良好，为放养白暨豚奠定了基础，并摸索了一套管理办法。

湖北省长江新螺段和湖北长江天鹅洲是我国目前仅有的两个国家级白暨豚自然保护区，也是我国首批国家级野生动物保护区之一。同时，受到了国际上有关专家、学者、朋友们的关心和支持，借此机会，我向到会的国内外专家、学者以及所有支持我们工作的朋友们表示感谢。欢迎大家光临指导，并给予大力支持。今后，任重而道远，我们决心把保护区建设好，管理好，争取达到国际先进水平，使保护区真正成为白暨豚的乐园。

Working Paper for Baiji PHVA Workshop, Nanjing, China, June 1-4, 1993.

Report on the Situation of Two National Natural Reserves of Baijji

Zhao Changxiang

(Fisheries Bureau of Hubei Province)

Hubei Province is located in the middle reaches of the Changjiang River. The length of the river section which flows through the province is about 1200 km, accounting for one fifth of the total length of the river. The river section in the province is not only the cradle of freshwater fish and development of the important base of original species of freshwater fishery in China but is also the place for habit and reproduction of baiji, Chinese sturgen, Chinese paddlefish and finless porpoise which are rare aquatic wild animals and specially protected by the Central Government . In order to protect these rare species from the danger of extinction, led directly by the Ministry of Agriculture, supported greatly by the other state ministries and committees, guided by scientific research and basing on the management ruled by law, much work has been done for the establishment of the national natural reserve of baiji in Xin-luo section and Tian-e-zhou of the Changjiang River. The effective results have been obtained preliminarily.

1. To make close cooperation with concerned organizations and do the earlier stage preparations well for the reserves. Since 1978, we have cooperated with research institutions to make investigation of population number, activity regularities and habitat of baiji in the river section of the province and , background value of the ecological environment in Tian-e-Zhou water area. Accordingly, three key measures for protection of baiji in Hubei Province have been suggested: (1) Establishment of baiji natural reserve in Xin-luo section of the Changjiang River; (2) Establishemnt of baiji semi-natural reserve in Tian-e-Zhou of the Changjiang River; (3) Establishment of artificial reproduction base. In order to put these three key measures into practice, we organized scientists from research institution and staffs from Honghu City and Shishou City to make further investigations and studies on the ecological environment , physical-chemical property of water quality in Xin-luo section and Tian-e-Zhou and, management system, management methods as well as construction planning in the reserves. By great effort, "Demonstration Report on Feasibility of the Establishment of Baiji Natural Reserve in Xin-luo Section of the Changjiang River" and "Demonstration Report on Feasibility of the Establishment of Baiji Natural Reserve in Tian-e-Zhou of the Changjiang River" were completed. These two reports were approved by the provincial government and the Central Government in 1990 and October, 1991, respectively. In December, 1992, Ministry of Agriculture held a comprehansive demonstration meeting on the overall plan of baiji protection in Wuhan and, experts as well as leaders from concerned department attended the

meeting. The demonstration was approved in this meeting. In October, 1992, the State Council ratified these two national reserves of baiji.

2. Progress of the basic construction in the reserves. In April, 1992, Ministry of Agriculture approved "the Overall Plan of Baiji Protection" and "Implementation of Plan for the Natural Reserves in the Section of the Changjiang River in Hubei Porvince". It takes three and four years for completing the basic construction of these two reserves, respectively, starting from 1992. The basic construction includes the necessary equipment of transportation and communication, instruments for observation, environmental monitoring, rescue and treatment and, supplementary facilities such as administration building, rescue and treatment ponds, placards in the reserves and buoys in the restricted zone. In order to guarantee the construction of the reserve with high standard, high quality and high speed, we consistently adhere to the principle of " unified leadership, overall planning, unified designation and implementation by stages". According to the requirements of the basic construction in the document by Ministry of Agriculture, preliminary designation of overall plan for these two reserves was completed in August, 1992. The construction designation of land engineering has been basically completed and now material preparation is being carried out. Management facilities are now put into the use in succession. In the reserve of Xin-luo section, two placard which are 14m high are set up , an investigation ship of 150 hp, an patrol motorboat of 60 hp and a set of equipment are provided. A car for transporting dolphins and some communication facilities are also provided in Tian-e-zhou reserve.

Organization construction is the key link in the reserve. Therefore, we speed up the construction of the management departments for the reserves according to the principle of "urgent thing first and other things second and, dolphin first and people second". At present, according to the requirtments of basic construction, management by legal system and research task, the management departments of the reserves are being perfected and the administrative offices are being established. Each office has 17 persons and the funds are listed in the local financial budget. The distribution standard of staff is: one third management staff, more than one third research staff and less than one third administration staff. At present, some staff went through the examination and now take their job in the reserves. Administration and professional work of the two reserves are under the leadership of the local governments and Fisheries Bureau of Hubei Province, respectively.

3. Making thorough propagation and strengthening management of legal system. The fundamental aim of establishing reserves is to protect baiji effectively. Therefore, rectification of order in the Changjiang River must be carried out and ecological environment must be kept well. Propagation work must be persevere unremittingly. Now the propagation work is made in the daily management,

investigation, in the newspapers and at televesion and over radio. A special programme of wildlife protection which was divided into six lectures was given at the radio of Hubei Province. Propagation articals of protecting baiji have been published in "Hubei Daily". According to "The Low of Protection of Wild Animals of the People's Republic of China", we drafted up the Management Regulations of Protection of Baiji which is now waiting to be approved and put into practice by provincial government.

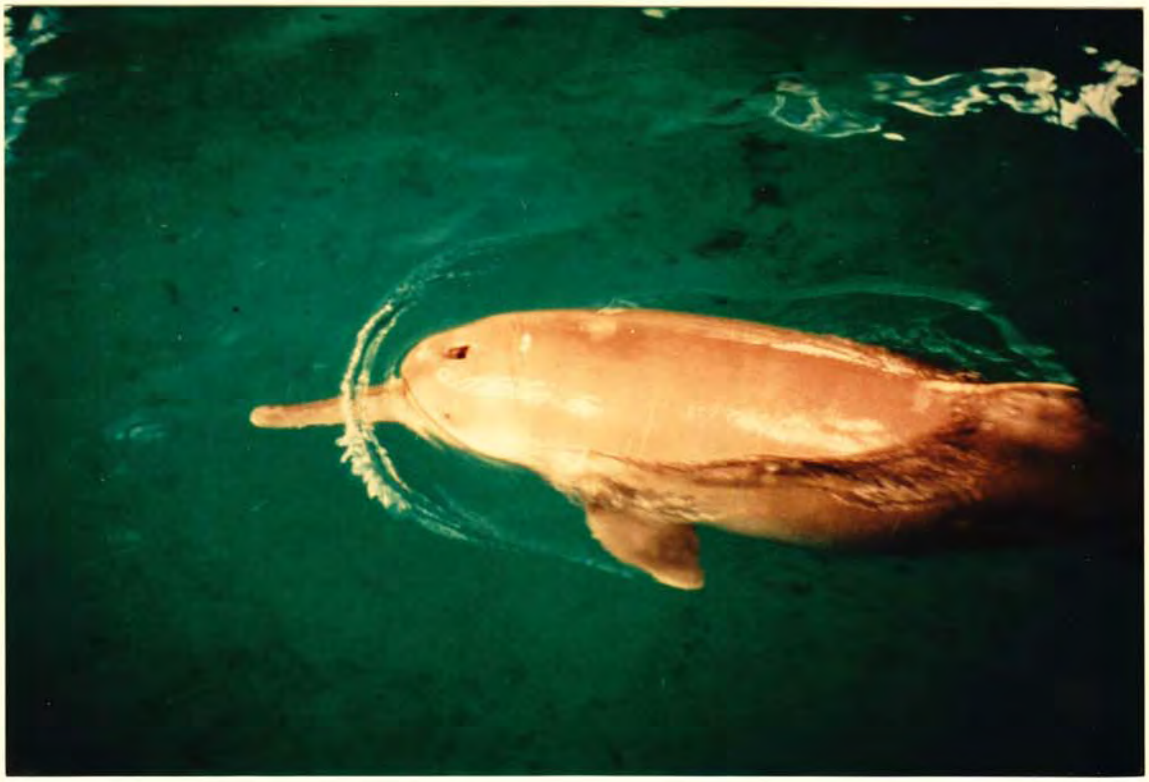
Because of the reserves deal with a wild range of aspects, their environment is complicated and, moreover, they are newly established, there are many difficulties existed. Therefore, in the middle of May, 1993, we made comprehensive investigations in the water areas of the reserves, together with people from local cities and counties, and the results are good. However, we persist in dual tactics: one is construction and the other is management. Inspection is carried out regularly or irregularly in the reserves. On the basis of the management of local cities and counties, harmful fishing gear and methods are strictly prohibited, fishing operation without certification is banned, fishing intensity is controlled, non-native fishermen and non-professional fishermen are moved out of the reserves. In order to open the good path of construction and management of the reserves, we organized fishermen in the reserves to set up observation stations to keep watch on the activity regularities of baiji and analyze the changes of baiji population. By strengthening the management of legal system, situations in the reserves are becoming better and baiji and finless porpoise appear in Xinluo Nautral Reserve often. Two five individuals of finless porpoise were introduced into the Tian-e-zhou in 1990 and 1993, respectively, and they are growing well. This lays the foundation for rearing baiji and provides a good set of management methods.

Xin-luo section and Tian-e-zhou of the Changjiang River are the only two national baiji natural reserves in China at present and they are also the ones of the first batch of the national aquatic wild animal reserves. These two reserves are concerned and supported by experts, scientists and friends at home and abroad. Taking this opportunity, I express our many thanks to all experts and scientists here. We welcome you to visit these reserves and give us your good suggestions. From now on, the burden is heavy and the road is long but we are determined to make construction and management of the reserves well to the international advanced level. The reserves will become the paradise of baiji through our great efforts.

BAIJI

(*Lipotes vexillifer*)

POPULATION AND HABITAT VIABILITY ASSESSMENT



Section 7

APPENDIX: PARTICIPANTS AND REFERENCES

BAIJI DOLPHIN CONFERENCE
NANJING, CHINA 1-4 JUNE 1993

Left to Right

Row 1: Li Yuemin, Remi Kengshita, Stephen Leatherwood, Ng Sam-Kin, Zhao Changxiang, Wang Qixin, Asami Fujimoto, Wang Ding.

Row 2: Cheng Zhohgun, Yan Jiarong, Zhuang Haiping, Li Shaohua, Marialice Seal, Toshiro Kamiya, Bill Perrin, Toshio Kasuya, Liu Renjun, Liu Qing.

Row 3: Gao Anli, Sherry Sheng, Wang Qixin, Zhang Xian, Zhang Zhongwiang, Susie Ellis, Mike Bruford, Wang Xiaoyan, Dong Ming-Li, Chen Yuanxin, Jim McBain.

Row 4: Zhang Xianfeng, Teryo Tobayama, Liu Shenli, Bob Brownell, Brad Andrews, Ulie Seal, Tu Guohua, Zhou Kaiya, Pete Schroeder, Hua Yuanyu.

Note: Please see participant list for complete addresses, phone, and fax numbers.

白暨豚保护评估研讨会参加者名单
中国南京，1993年6月1-4日

[A]
布莱德·安德鲁斯博士
动物学行动组副主席
海洋世界公司
海洋世界路7007号
奥兰多，FL 32821-8097
美国
传真： 01-407-345-5397

[B]
小罗伯特·L·布劳内尔博士
海兽部主任
美国鱼及野生动物部
斯密森研究院，NHB大厦378房间
华盛顿特区 20560
美国
传真：01-202-647-1106

迈克尔·布鲁福德博士
伦敦动物学会
里琴公园
伦敦 NW1 4RY
英国
传真：44-71-586-2870

[C]
陈远新
长江新螺段白暨豚保护区管理处
湖北省洪湖市人民政府大院
洪湖 433200
中国
电话：07213-425620

陈正国副处长
东海区渔政局
上海中山东一路23号11楼
上海 200002
中国
电话：86-021-3230708

成忠林副站长
长江天鹅洲白暨豚自然保护区管理处
湖北省石首市东方大道44号
石首 434400
中国
电话：86-07264-74537

[D]
董明俐场长
铜陵白暨豚养护场
铜陵 244000
中国
电话：86-05612-237529

[E]
苏·埃利斯博士
项目官员
IUCN/SSC饲养下繁殖专家组
约翰尼凯克里奇路12101号
苹果谷，MN 55124
美国
传真： 01-612-432-2757

[F]
藤本朝海先生
副馆长
江之岛水族馆
藤泽市片濑海岸 2-17-25
日本国
传真： 81-03-3216-4665

[G]
高安利博士
助理研究员
南京师范大学生物系
南京 210097
中国
传真：86-025-7718174

华元渝副教授
南京师范大学生物系
南京 210097
中国
传真：86-025-7718174

[K]
神谷敏郎博士
客座科学家
东京大学博物馆
文京区本乡 7-3-1
东京 113
日本国
传真： 81-03-3815-7053

粕谷俊雄博士
外洋资源部
水产厅远洋水产研究所
静冈县清水市折户 5-7-1
日本国
传真： 81-543-35-9642

木下礼美博士
兽医主任
海洋公园公司
香港仔
香港
传真: 852-553-8302
[L]
斯蒂文·莱瑟伍德先生
IUCN/SSC鲸类专家组主席
邮政信箱 1090 号
索拉纳滩, CA 92075
美国
传真: 01-619-546-7003

李绍华
江苏省水产局
新模范马路90号
南京 210003
中国
传真: 86-25-3341757

李悦民教授
南京师范大学生物系
南京 210097
中国
传真: 86-25-7718174

刘 晴
农业部渔政渔港监督管理局
北京农展馆南里11号
北京 100026
中国
传真: 86-1-500-3427

刘仁俊副研究员
中国科学院水生生物研究所
武汉 430072
中国
传真: 86-27- 725132

刘身利副局长
农业部渔政渔港监督管理局
北京农展馆南里11号
北京 100026
中国
传真: 86-1-500-3427

卢子杰处长
江苏省水产局
新模范马路90号
南京 210003
中国
传真: 86-25-3341757
[M]
吉姆·麦克贝恩博士
兽医部副主任
加州海洋世界
南岸路1720号
圣地亚哥, CA 92019-7995
美国
传真: 01-619-226-3951
[N]
吴守坚先生
高级教育监督
海洋公园公司
香港仔
香港
传真: 852-553-8302
[P]
威廉·F·佩林博士
西南渔业科学中心
邮政信箱271号
拉霍亚, CA 92038
美国
传真: 01-619-546-7003
[S]
J·皮德·施罗德博士
海兽研究中心
安德森西路620号
斯奎姆, WA 98382
美国
传真: 01-206-683-5428

尤里塞斯·西尔博士
IUCN/SSC饲养下繁殖专家组主席
约翰尼凯克里奇路12101号
苹果谷, MN 55124
美国
传真: 01-612-432-2757

玛丽亚斯·西尔
IUCN/SSC饲养下繁殖专家组
约翰尼凯克里奇路12101号
苹果谷, MN 55124
美国
传真: 01-612-432-2757

盛佑中小姐
米特罗华盛顿公园动物园主任
西南峡谷路 4001号
波特兰, OR 97221
美国
传真: 01-503-226-6836
[T]
鸟羽山照夫博士
执行馆长
鸭川海洋世界
鸭川市东町 1464-18
千叶县 296
日本国
传真: 81-4709-3-3084
[W]
王丁博士
助理研究员
中国科学院水生生物研究所
武汉 430072
中国
传真: 86-27-725132

王启新高工
安徽省水产局
合肥市徽州路31号
合肥 230001
中国
传真: 86-551-246164

汪小炎处长
农业部渔政渔港监督管理局
北京农展馆南里11号
北京 100026
中国
传真: 86-1-500-3427

吴鼎福教授
南京师范大学科研处
南京 210097
中国
传真: 86-25-7718174
[Y]
晏家荣工程师
长江天鹅州白暨豚自然保护区管理处
湖北省石首市东方大道44号
石首 434400
中国
电话: 86-7264-74537
[Z]
张海平
农业部渔政渔港监督管理局
北京农展馆南里11号
北京 100026
中国
传真: 86-1-500-3427

张忠祥
长江新螺段白暨豚保护区管理处
湖北省洪湖市人民政府大院
洪湖 433200
中国
电话: 86-7213-425620

章 贤
铜陵白暨豚养护场
铜陵 244000
中国
电话: 86-5612-237529

张先峰助理研究员
中国科学院水生生物研究所
武汉 430072
中国
传真: 86-27-725132

赵长祥副处长
湖北省水产局渔政处
武汉 430060
中国
电话: 86-27-875871转1607

周开亚教授
南京师范大学生物系
南京 210097
中国
传真: 86-25-7718174

Workshop Participants

Nanjing, China 1-4 June 1993

Mr. Brad Andrews
Vice President/Zoological Operations
Sea World, Inc.
7007 Sea World Drive
Orlando, FL 32821-8097 USA
FAX: 01-407-345-5397

Dr. Robert L. Brownell, Jr
Southwest Fisheries Science Center
P. O. Box 271
La Jolla, CA 92038 USA
FAX: 01-619-546-7003

Dr. Mike Bruford
Zoological Society of London
Regent's Park
London NW1 4RY UK
FAX: 44-71-586-2870

Chen Yuanxin
Xinluo Baiji Reserve
Honghu 433200 CHINA
Tel. 86-07213-425620

Chen Zhengguo
Division Chief
Division of Fisheries Management
Fisheries Bureau of East China Sea
No. 23, 11 F. Zhongshan Dong Yi Rd.
Shanghai 200002 CHINA
Tel. 86-021-323-0708

Cheng Zhonglin
Tianezhou Baiji Natural Reserve
44 Dongfang Daidao
Shishou, Hubei 434400 CHINA
Tel: 07264-74537

Dong Mingli
Director
Tongling Semi-natural Reserve for Baiji
Datong
Tongling 244000 CHINA
Tel. 05612-237529

Dr. Sue Ellis
IUCN/SSC Captive Breeding Specialist Group
12101 Johnny Cake Ridge Road
Apple Valley, MN 55124 USA

FAX: 01-612-432-2757

Mr. Asami Fujimoto
Enoshima Aquarium
17-25, Katasekaigan 2 Chome
Fujisawa City
Kanagawa Pref., 251 JAPAN
FAX: 81-03-3216-4665

Dr. Gao Anli
Department of Biology
Nanjing Normal University
Nanjing 210097 CHINA
FAX: 86-25-7718174

Associate Prof. Hua Yuanyu
Department of Biology
Nanjing Normal University
Nanjing 210024 CHINA
FAX: 86-25-7718174

Dr. Toshiro Kamiya
Guest Scientist
The University Museum
The University of Tokyo
7-3-1 Hongo, Bunkyo-ku
Tokyo 113 JAPAN
FAX: 81-3-3815-7053

Dr. Toshio Kasuya
Division of Offshore Fishery Resources
National Research Institute of
Far Seas Fisheries
5-7-1 Orido, Shimizu-shi
Shizuoka-Ken 424 JAPAN
FAX: 81-543-35-9642

Dr. Reimi Kinoshita
Ocean Park Corporation
Aberdeen HONG KONG
FAX: 852-553-8302

Mr. Stephen Leatherwood
Chairman
IUCN/SSC Cetacean Specialist Group
P.O. Box 1090
Solana Beach, CA 92075 USA
FAX: 01-619-546-7003

Li Shaohua
Fisheries Bureau of Jiangsu Province
90 Xinmofanmalu
Nanjing 210003 CHINA
FAX: 86-025-341751

Prof. Li Yuemin
Department of Biology
Nanjing Normal University
Nanjing 210024 CHINA
FAX: 86-25-7718174

Liu Qing
Division of Fisheries Management
Bureau of Fisheries Management and
Fishing Port Superintendence
Ministry of Agriculture
Beijing 100026 cHINA
FAX: 86-01-500-3427

Associate Prof. Liu Renjun
Institute of Hydrobiology
Academia Sinica
Wuhan 430072 CHINA
FAX: 86-027-725132

Liu Shenli
Deputy Director
Bureau of Fisheries Management and
Fishing Port Superintendence
Ministry of Agriculture
Beijing 100026 CHINA
FAX: 86-01-500-3427

Lu Zijie
Division Chief
Fisheries Bureau of Jiangsu Province
90 Xinmofanmalu
Nanjing 210003 CHINA
FAX: 86-025-341751

Dr. Jim McBain
Corporate Director of Veterinary Medicine
Sea World of California
1720 South Shores Road
San Diego, CA 92109-7995 USA
FAX: 01-619-226-3951

Mr. Ng Sau-Kin
Ocean Park Corporation
Aberdeen HONG KONG
FAX: 852-553-8302

Dr. William F. Perrin
Southwest Fisheries Science Center
P.O. Box 271
La Jolla, CA 92038 USA
FAX: 01-619-546-7003

Dr. J. Pete Schroeder
Marine Mammal Research Associates
620 W. Anderson Road
Sequim, WA 98382 USA
FAX: 01-206-683-5428

Dr. Ulysses Seal
IUCN/SSC Captive Breeding Specialist Group
12101 Johnny Cake Ridge Road
Apple Valley, MN 55124 USA
FAX: 01-612-432-2757

Marialice Seal
C/O IUCN/SSC Captive Breeding Specialist Group
12101 Johnny Cake Ridge Road
Apple Valley, MN 55124 USA
FAX: 01-612-432-2757

Ms. Y. Sherry Sheng
Director
Metro Washington Park Zoo
4001 SW Canyon Road
Portland, OR 97221 USA
FAX: 01-503-226-6836

Dr. Teruo Tobayama
Executive Director
Kamogawa Sea World
1464-18, Higashi-cho
Kamogawa-shi, Chiba 296 JAPAN
FAX: 81-4709-3-3084

Dr. Wang Ding
Institute of Hydrobiology
Academia Sinica
Wuhan 430072 CHINA
FAX: 86-027-725132

Wang Qixin
Division Chief
Division of Fisheries Management
Fisheries Bureau of Anhui Province
31 Huizhou Road
Hefei 230001 CHINA
FAX: 86-0551-246164

Wang Xiaoyan
Deputy Division Chief
Division of Fisheries Management
Bureau of Fisheries Management and Fishing Port Superintendence
Ministry of Agriculture
Beijing 100026 CHINA
FAX: 86-01-500-3427

Prof. Wu Dingfu
Division Chief
Division of Research
Nanjing Normal University
Nanjing 210024 CHINA
FAX: 86-25-7718174

Yan Jiarong
Tianezhou Baiji Natural Reserve
44 Dongfang Daidao
Shishou, Hubei 434400 CHINA
Tel: 07264-74537

Zhang Haiping
Division of Fisheries Management
Bureau of Fisheries Management and Fishing Port Superintendence
Ministry of Agriculture
Beijing 100026 CHINA
FAX: 86-01-500-3427

Zhang Zhongxiang
Xinluo Baiji Reserve
Honghu 433200 CHINA
Tel. 86-07213-425620

Zhang Xian
Tongling Semi-natural Reserve for Baiji
Datong
Tongling 244000 CHINA
Tel. 05612-237529

Zhang Xianfeng
Institute of Hydrobiology
Academia Sinica
Wuhan 430072 CHINA
FAX: 86-027-725132

Zhao Changxiang
Deputy Division Chief
Division of Fisheries Management
Fishereis Bureau of Hubei Province
237 Pengliuyang Road
Wuhan 430060 CHINA
Tel: 86-027-875871, ext. 1607

Prof. Zhou Kaiya
Department of Biology
Nanjing Normal University
Nanjing 210024 CHINA
FAX: 86-25-7718174

Chang Qing,
Sun Jiang,
Xu Xinrong,
Wang Yaming
Department of Biology
Nanjing Normal University
Nanjing 210024 CHINA
FAX: 86-25-7718174

REFERENCES

Asper, E.D., Duffield, D.A., Dimeo-Ediger, N., & Shell, E.D. (1990). Marine mammals in zoos, aquaria and marine zoological parks in North America: 1990 census report. INTERNATIONAL ZOO YEARBOOK 29: 179-187.

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Chen, P., Liu, R., & Lin, K. 1984. Reproduction and reproductive system in the Baiji, *Lipotes vexillifer.* REPORT OF THE INTERNATIONAL WHALING COMMISSION (Special Issue 6), 445-450.

Chen, P. and Hua, Y. 1989. Distribution, population size and protection of *Lipotes vexillifer.* pp.81-85, in W.F. Perrin, R.L. Brownell, Jr., Zhou Kaiya and Liu Jiankang (Eds.): BIOLOGY AND CONSERVATION OF THE RIVER DOLPHINS. Occasional Papers of the IUCN Species Survival Commission (SSC) No. 3. 173pp.

Gao, A. & Zhou, K. 1992. Sexual dimorphism in the Baiji, *Lipotes vexillifer.* CANADIAN JOURNAL OF ZOOLOGY 70 (8): 1484-1493.

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Liu, R. 1988. Study on the regularity of reproduction in *Lipotes.* AQUATIC MAMMALS 14 (2): 63-68.

Zhou, K. 1982. On the conservation of the baiji, *Lipotes vexillifer*. JOURNAL OF NANJING NORMAL COLLEGE (Nat. Sci.) 4:71-74. (in Chinese).

Zhou, K., Pilleri, G. and Li, Y. 1979. Observation on the Baiji (*Lipotes vexillifer*) and the finless porpoise (*Neophocaena asiaorientalis*) in the Changjiang (Yangtze) River between Nanjing and Taiyangzhou, with remarks in some physiological adaptations of the baiji to its environment. INVESTIGATIONS ON CETACEA 10: 109-120.

Zhou, K., Li, Y. Nishiwaki, M. and Kataoka, T.. 1982. A brief report on the observations of the Baiji, *Lipotes vexillifer*, in the lower reaches of Yangtze River between Nanjing and Guichi. ACTA THERIOLOGICA SINICA 2(2):253-254. (in Chinese).

Zhou, K. and Li., Y. 1989. Status and aspects of the ecology and behavior of the Baiji, Lipotes *vexillifer*, in the lower Yangtze River. pp.86-91 in W. F. Perrin, R. L. Brownell, Jr., Zhou Kaiya and Liu Jiankang (Eds.): BIOLOGY AND CONSERVATION OF THE RIVER DOLPHINS. Occasional Papers of the IUCN Species Survival Commission (SSC) No. 3. 173pp.

Zhou, K. & Gao, A. 1993. General biology of the baiji, *Lipotes vexillifer.* Document presented at the Baiji Conservation Assessment Workshop, Nanjing, 1-4 June 1993. 11 pp. (unpublished).

Zhou, K., Sun, J., and Gao, A. 1993. Population status of the baiji (*Lipotes vexillifer*) on the lower Yangtze. Document presented at the Baiji Conservation Assessment Workshop, Nanjing, 1-4 June 1993. 9 pp. (unpublished).

种群和栖息地生存力分析研讨会简介

饲养下繁殖专家组

种群栖息地生存力分析(PHVA)研讨会根据会议的安排对一个种或亚种的每个种群作种群生存力的估测。这种估测将深入分析每个种群的生活史、种群动态、生态学及种群历史的资料。在会前或会议中做PHVA的准备时，将汇集与估测每个种群的现状及在当前管理状况下与灭绝风险有关的种口统计的、遗传的及环境因子等资料及察觉到的威胁。

有关的资料数据为：(1) 雄性和雌性首次生殖的年龄；(2) 野生种群前一次生殖到后一次生殖之间的间隔；(3) 初生幼仔及第一年的死亡率；(4) 生产时的性比；(5) 存活到首次生殖年龄的幼体；(6) 成体的性比；(7) 繁殖策略，在一繁殖季中单配或多配；(8) 成体死亡率(按性比，如果可能)；(9) 种群大小；(10) 栖息地容纳量及可能随时间发生的变化；(11) 影响繁殖或死亡的环境变化因素；(12) 潜在的灾变及其频率，以及在发生灾变年份对繁殖和死亡率的作用的可能的严重性；(13) 繁殖群间动物的散布和运动。

研讨会的一重要特色是向研究者征集尚不能以发表形式得到的、且对了解该物种在野外的行为有决定性重要意义的资料。这些资料将为构建每个种群的模拟模型提供基础，将在单一模型中评估决定性的及随机的作用，评估遗传的、种口统计的及环境的相互作用。以及作用于种群动态及灭绝风险的一些灾变因子。整理资料输入模型的过程要求所作的假设及能支持这些假设的数据是明确的。此过程有助于在该物种已知的生物学的基础上达到共识。并通常达到该物种的基本的模拟模型。在获得新的资料时，该模型可对该物种或种群的一些替代的管理方法及改进的管理作继续不断的讨论。它实际上提供了一个实施管理项目的工具，使项目成为不断评价新资料的科学实践，有利于足够及时地调整管理措施。

研讨会的这些操作可帮助制定有关物种的管理概要，并评估它们在减少灭绝危险方面可能发挥的作用，还可能通过灵敏性分析去寻找那些可对种群的生存和生长起最大作用的因子。实际上，可用大幅度数值迅速地探测模型的参数，从而获得该物种如何对管理变化做出反应的图景。这一方法也有助于对申请的和进行中的研究项目的评估，即评估其研究结果对该物种的保护管理的贡献。

在研讨会中还撰写简短综述及种群保护管理和复壮方面的重要题目的新资料的总结，特别关注的题目如下:

(1) 很可能对该物种起了作用的那些因子，它们使该物种数量减少或未能通过管理而复壮，以及它们现在是否仍然重要。

(2) 分子分类学，遗传杂合性及家系研究的需要。

(3) 疾病在野生种群动态，在可能的再引人或迁地，及在饲养下繁殖的选址和管理方面所担当的角色。

(4) 近亲繁殖在饲养或野生种群的动态和管理方面所可能担当的角色。

(5) 繁殖技术，不论是通过人工帮助的繁殖或基因组贮存，在物种保护中可能的用途。

(6) 在管理操作中监测种群状况的技术，用于评估这些管理操作并在研究得到新资料时修改管理操作。

(7) 为了该物种的长期生存，而需要进行联种群(metapopulation)管理的可能性。

(8) 制定该物种复壮的定量遗传的及种口统计的种群目标，以及为达到和保持这些目标将需要何等的管理水平。

(9) 对建议的该物种的进一步保护管理所需的各项活动，逐项估算所需的经费。

（白暨豚种群和栖息地生存力分析研讨会议秘书组注：在阅读这篇材料时，建议参阅周开亚：保护生物学的发展趋势及我国近期的发展战略，动物学杂志1992年第5 期，第45-48页，以便了解PHVA在保护生物学中的位置。）

APPENDIX A

DEVELOPMENT OF A PREVENTIVE MEDICINE AND HUSBANDRY PROGRAM FOR CAPTIVE OR SEMI-NATURAL BREEDING PROGRAMS

In general, protocols should be developed for each of the numbered items below to optimize the care and health of captive dolphins.

Nutrition

Provide dolphins with high quality diet consisting of enough food species to allow adequate flexibility to account for variability in food supply and animal preference.

1. Fresh/frozen food variety; recommended species, size and % of total ration.
2. Calories; adjustments for individuals based on activity level, air/water temperature, and current length to weight ratio.
3. Nutritional standards for:

   growth
   maintenance
   activity level
   gestation/lactation
   minimum diet

4. Weight guidelines; minimum/maximum for each dolphin.

Food

1. Identify food acquisition sources and inspection routines subject to Export Quality Control.
2. Food analysis should include : Standard Bacterial Plate Count, and moisture/protein/ash/fiber and fat percentages.
3. Food preparation and short term storage.
4. Facility/equipment; cleaning/sanitation schedules.
5. Monitoring programs: bacterial contamination; feed buckets and food preparation surfaces.

Preventive Medicine & Husbandry

Provide dolphins with state of the art medical programs to insure good health, early diagnosis and rapid response to illness or injury.

1. Training protocol for physical examination procedures.

2. Perform regular medical rounds and complete physical examination at regular intervals on each dolphin in the collection.

   weight change compared to prior examination; average food intake in pounds per day, % of body weight and kilocalorie/kilogram/day haematology, blood chemistries and appropriate hormone analysis results.
   Other laboratory test results, vaccines and comments.

3. Normal physiological values for each individual and various groups of dolphins in the collection.

4. Inoculations; type, schedule and monitoring of dolphins response.

5. Infectious disease monitoring:

   major disease concerns and surveillance.
   current test reliability and interpretation.
   establish serum bank/retrospective studies.
   epidemiology.

6. Parasite screening; schedule regular intervals, commonly observed and recommended treatment.

7. Common injuries; facility design and monitoring to insure prevention.

8. Medical records; complete, up to date.

9. Physical separation may be accomplished in the most appropriate area of the facility consistent with sound medical principles and compensatory social structure.

10. Quarantine; may be accomplished at the dolphin's point of origin or destination, in the most appropriate area of the facility. Appropriate testing before transport and during quarantine.

11. Individual identification.

Clinical

1. Veterinarian/personnel communication; identify individual with final authority for treatment paradigms; develop team approach to approve and monitor unusual treatments, define emergency procedures, establish **animal health** as the basis for arbitration and policy to resolve disagreements.

2. Diagnosis; rapid, followed up by confirmatory tests and standard treatment for common dolphin diseases.

3. Treatment for common injuries; control and restraint equipment and techniques.

4. Progress evaluation.

5. In the event of treatment failure; necropsy/pathology/additional tests and reporting protocols.

General Sanitation

1. Disinfection of food Preparation facility and individual feeding buckets.

2. Elimination of standing pools of water, rusty surfaces and decaying organic material.

3. Disinfection and maintenance, stretchers, haul out areas, stomach tubes and nets.

4. Separation (as possible within the facility) and disinfection of quarantine and isolation areas and equipment used there.

Once a successful Preventive Medicine and Husbandry program is in place, the following items should be addressed relative to the controlled propagation program:

Institutions participating in small cetacean propagation should provide the following conditions:

1. The opportunity to separate pregnant females prior to the time of delivery.

2. Maternity pools should be of size and configuration facilitating successful nursing and calf rearing.

3. Institution personnel should possess or have access to expertise concerning small cetacean reproduction.

4. A program to monitor delivery and calf rearing.

5. Monitoring of the daily activity level of pregnant and nursing females.

6. Laboratory capabilities to monitor the reproductive status of males and females using hormonal assays and/or ultrasonography.

7. Breeding programs should consider the reproductive and physical condition of participating animals.

8. Breeding, pre-parturient and lactating animals should be maintained in social environments encouraging successful rearing of offspring.

Additionally,

1. Contingency plans should be developed, protocols recorded and resources for implementation should be in place for:

   a) emergency intervention before, during and after delivery

   b) unexpected pregnancies

   c) weaning

   d) illness

   e) pathological examination of mortalities

2. Consideration should be given to species-specific needs.

Goals

1. To maximize genetic diversity.

2. To maintain managed population of sufficient size to serve present and future needs for conservation, education, recreation and potential reintroduction of genetic material into natural populations should the needs arise in the future.

3. To contribute to a better understanding of dolphin reproductive biology and physiology, developing models that can be applied to wild populations.

To facilitate research derived from the care and husbandry of dolphins, various record keeping protocols are important:

Acquisition/Disposition Records

1. Date of location of acquisition
2. Type of acquisition (Wild caught, births, transfer, loan, temporary holding).
3. Sex
4. Species
5. Progeny
6. Identification
7. Disposition
8. Date of disposition

Food Handling Records

1. Type
2. Caloric values
3. Analysis

Medical Records

1. Date of exam
2. Veterinarian's name
3. Reason for exam
4. Action taken/conditions under which exam was conducted (was animal restrained and for how long, voluntary submitted to exam through trained behavior)
5. Medications
6. Supplements
7. Caloric requirement for each animal
8. Measurements
9. Blood results
10. Collection records, if applicable
11. Necropsy
12. Photographs, characteristics
13. Subjective and objective findings (therapeutic approach and treatment plan)
14. Differential diagnosis
15. Availability of quarantine facilities
16. Frequency of visits by vet if part-time or consulting
17. Transportation records if applicable

Water Quality Records

1. Test parameters for water quality (ph, salinity, temp., chemicals, bacteria)
2. Test added chemicals
3. Bacterial results
4. Record amount of added chemicals
5. Facility maintenance log
6. Mechanical maintenance log
7. Filtration operation log

Behavioral/Observation Records

Daily record (amount and type of interaction, anomalies and patterns, outside factors, adequate animal diets for the collection (quality and quantity) - species/amount/weight of food consumed/frequency of feeding.

Facilities Description

1. Enclosure sizes and location
2. Water System Type
3. Emergency preparedness protocol (pre, during and post emergency)