Report of the Workshop on Conservation of the Baiji and Yangtze Finless Porpoise

Hosted by the Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan, Hubei, China, 28 November – 3 December 2004

Co-organised by baiji.org Foundation and Changjiang Fishery Resources Administrative Committee, Ministry of Agriculture, China.

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Executive Summary

The Workshop on Conservation of the Baiji and Yangtze Finless Porpoise took place from 28 November to 3 December 2004 at the Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan, China. The primary objective of the workshop was to consider options for preventing extinction of the baiji (*Lipotes vexillifer*), the world's most endangered cetacean species. Participants included government officials and scientists from China as well as international experts in various fields of conservation and scientific research. The workshop was officially endorsed by China's Ministry of Agriculture and was initiated and organised by the Swiss baiji.org Foundation in collaboration with the Institute of Hydrobiology, the Changjiang Fishery Resources Administrative Committee of the Ministry of Agriculture, China, Conservation International and the IUCN/SSC Cetacean Specialist Group.

A number of participants visited the Shishou semi-natural reserve (a 21km oxbow lake adjacent to the Yangtze River) and the Wuhan dolphinarium (a research facility housing captive finless porpoises), and then spent two days at the Institute of Hydrobiology discussing the role of *ex situ* approaches (i.e. removing animals from the wild for protection and study outside their natural habitat) in improving the conservation status of the Critically Endangered baiji and the Yangtze River population of the Endangered finless porpoise (*Neophocaena phocaenoides asiaorientalis)*. Issues discussed included: 'best practices' for the capture, transport, care and maintenance of dolphins; strategies to optimise chances of establishing a self-sustaining breeding population of baiji in the oxbow and/or dolphinarium; modifications necessary to improve the security and quality of the oxbow as habitat for baiji and finless porpoises; and the importance of restoring the Yangtze River environment so that it can once again support healthy populations of both species.

China's successful programme of capture, translocation and maintenance of finless porpoises in the Shishou oxbow has demonstrated its adequacy as an *ex situ* environment for cetaceans. The good survival and reproduction of porpoises, despite recognised problems with water quality, fishing and reserve infrastructure, gives reason to hope that baiji can also survive and reproduce there in spite of a failed first attempt at maintaining a single baiji. It was strongly recommended, however, that facilities and personnel be in place to allow newly arrived dolphins to be kept in holding-pens for intensive observation and assessment prior to their release into the oxbow, and for intensive husbandry and health monitoring of released animals. Moreover, provision needs to be made for ongoing research and management of the reserve, including regular observations of the cetaceans, their prey resources, water quality and human activities.

Discussion of where to put captured baiji – whether in the dolphinarium or the semi-natural reserve – did not result in consensus. Workshop participants unanimously agreed, however, that any decision should be made on the basis of ensuring the health and safety of the individual animals *and* meeting the long-term conservation objective of establishing a self-sustaining *ex situ* population that can eventually help restore the baiji to its natural Yangtze environment. It was recognised that regardless of how well-planned, well-equipped and well-executed capture operations may be, and even with state-of-the-art facilities and care, catching animals and relocating them into either the oxbow or the dolphinarium carries some risk of failure. However, a decision not to remove baiji from the Yangtze carries a risk that the species – which represents an entire family - will go extinct because of the ongoing, and increasing, threats in its natural environment. There is, therefore, no risk-free approach to preventing the baiji's extinction.

Participants agreed that scientists and conservationists both within and outside China must collaborate more closely with Chinese authorities and key decision makers. A steering committee, including representatives of the Institute of Hydrobiology, the Chinese Ministry of Agriculture, baiji.org Foundation and the Cetacean Specialist Group will coordinate the efforts of all stakeholders and work to create a broader-based platform for communication and action on behalf of the baiji.

1.0 Background

1.1 Status of baiji and Yangtze finless porpoises in the wild

The baiji, or Yangtze River dolphin (*Lipotes vexillifer*), is endemic to the Yangtze basin in China, and is the world's most threatened cetacean (Reeves et al. 2003). The baiji's extinction would mean not only the loss of a species but of an entire family of mammals (Lipotidae). Baiji numbers have rapidly and continuously declined since at least the 1970s and the prospects for survival of the species are poor (Zhou et al. 1994; IWC 2001). Various expert groups have concluded that fewer than 100 baiji may now remain in the Yangtze River (IWC 2001; Zhang et al. 2003; Reeves et al. 2003). The most recent direct count is from 1997, when only 13 individuals were recorded during a series of intensive boat surveys (Zhang et al. 2003). Informal surveys conducted since 2000 have shown that baiji still occur in at least three areas – Honghu, Balijianku and Tongling (Figure 1). Zhang presented details of opportunistic baiji sightings between 1999 and 2004 (summarised in Annex C).

Historically, the baiji occurred along approximately 1700km of the middle and lower reaches of the Yangtze River from Yichang to the estuary near Shanghai (Figure 1). This range has declined by at least several hundred kilometres at both the upstream and downstream limits of distribution (Reeves et al. 2003). Broadly speaking, the decline of the baiji can be attributed to the fact that approximately 12% of the world's human population lives within the Yangtze River catchment. Causes of baiji mortality have included entanglement in fishing gear, electrocution from electric fishing, collisions with vessels, and blasting for channel maintenance or harbour construction (Reeves et al. 2003). Habitat has also been severely degraded by upstream damming of the Yangtze and its tributaries, drainage and isolation of previously appended floodplain lakes, channel dredging and overfishing (Zhou et al. 1998). The baiji was listed as Critically Endangered in the 2004 IUCN Red List of Threatened Species due to its very low abundance and projected continuing decline (Smith et al. 2004).

Yangtze finless porpoises (*Neophocaena phocaenoides asiaorientalis*) are sympatric with baiji. Although they are less immediately threatened with extinction (listed by IUCN since 1996 as Endangered), porpoises are subject to the same threats from human activities as baiji. Chinese scientists report that porpoise abundance has been declining rapidly in the Yangtze in recent years (Wang et al. 2000; Wei et al. 2002a; Zhang et al. 2003).

The workshop focussed on approaches to save the baiji from extinction and did not discuss in detail the status of either the baiji or the Yangtze finless porpoise (see Annex B for the agenda). Their status has been reviewed and discussed elsewhere (e.g. Perrin and Brownell 1989; Zhou et al. 1994; IWC 2001; Reeves and Leatherwood 1995; Smith and Reeves 2000; Reeves et al. 2000; Wang et al. 1998 & 2000; Zhang et al. 2003; Smith et al. 2004) and no new information was available to the workshop that would change those previous assessments.

1.2 Shishou Tian-e-Zhou oxbow semi-natural cetacean reserve

The Tian-e-Zhou oxbow located near Shishou City in Hubei Province (hereafter termed the 'Shishou oxbow') is a 21km long, 1-2km wide lake appended to the Yangtze River (see Figure 2). The Shishou oxbow was described in 1986 as being 'like a miniature Yangtze', possessing

'all the requirements for a semi-natural reserve' (Baiji Research Group 1989). It was designated as a national reserve in 1992, and although it was identified as a reserve for conservation and management of the baiji, from the outset it was intended to be a managed habitat for both baiji and finless porpoises (Baiji Research Group 1989). Finless porpoises from the middle reaches of the Yangtze were first introduced to the reserve in 1990 (it had been reported in 1986 that porpoises were frequently seen in the oxbow before it was cut off from the mainstream of the river; Baiji Research Group 1989) and they have been surviving and reproducing well since that time (Wang et al. 2000; Wei et al. 2002b). As of April 2005, there were approximately 26 finless porpoises in the reserve. Four of these were known to be adult females and another four sub-adult females were introduced in 2003 and 2004. A single female baiji was introduced to the oxbow in December 1995, but she died during the summer flood of 1996.

Following a large flood in 1998, the central government constructed a dyke between the Yangtze River and the Shishou oxbow to control flooding. Water exchange between the oxbow and the main river is now controlled by a sluice gate located at the downstream mouth of the oxbow (Figure 2). There is concern that since construction of the dyke, water quality in the reserve has declined because of reduced flushing during the flood season (Hao et al. 2004). Approximately 6,700 people live on the island in the centre of the oxbow and some limited and controlled fishing is permitted.

1.3 Wuhan dolphinarium

The baiji dolphinarium at the Institute of Hydrobiology in Wuhan was established in 1992. It includes both indoor and outdoor holding pools, a water filtration system, food storage and preparation facilities, a research and office building and a small museum. The main indoor facility includes three holding pools: a main pool (kidney shape, 25m in arc, 7m wide, 3.5m deep), a secondary pool (circular shape, 10m diameter, 3.5m deep), and a medical pool (circular shape, 5m diameter, 2m deep). Another hall includes one indoor pool (circular shape, 12m diameter, 3.5m deep). The filtration and water treatment system for these pools consists of pressure sand filters and chlorine- and ozone-sterilisation equipment. This system is able to filter the pool water at least four times each day. As of April 2005, four Yangtze finless porpoises were kept in the indoor pools, the longest period of residence being eight and a half years. The outdoor pool is circular, 15m in diameter and 4.5m deep; it lacks a water filtration or purification system. One baiji, Qi Qi, was maintained in this pool for ten years. The refrigerator and food-preparation facilities have the capacity to store one ton of fish. A veterinarian and the cetacean trainers provide medical treatment, health monitoring and training for the captive animals in the facility. The finless porpoises and single baiji held at the dolphinarium have been the subjects of research on echolocation, acoustic behaviour, husbandry, reproduction and physiology (e.g. Chen and Liu 1989; Hua et al. 1989; Liu and Wang 1989; Wang et al. 1989 & 1992; Wei et al. 2004; Youfu and Rongcai 1989; Zhimei and Daoquan 1989; Zhou 1989)

1.4 Present baiji conservation initiatives in China

A *Conservation Action Plan for Cetaceans in the Yangtze River* was developed by Chinese scientists at the Workshop on Conservation Action Plan for Cetaceans in China held in Shanghai in 2001 (Ministry of Agriculture 2001). The plan has three components to be implemented simultaneously – an *in situ* (i.e. in the Yangtze River) strategy and two *ex situ* strategies (i.e.

removing animals from the wild for protection and study outside their natural range). One of the latter involves artificial breeding and research in a dolphinarium and the other involves establishment or further development of a 'semi-natural' population in the Shishou oxbow. The Chinese Ministry of Agriculture has officially approved the action plan but the plan has yet to be implemented due to the lack of funding.

China, with support from Japan, is committed to pursuing one or both of the *ex situ* strategies. A trial capture operation is planned for 2005, with the objective of collecting one or two dolphins and placing them in either the Wuhan dolphinarium or the Shishou oxbow.

2.0 Workshop Objectives and Procedural Matters

The primary objectives of the workshop were to:

1. Recommend guidelines for baiji capture operations.
2. Recommend guidelines for baiji husbandry.
3. Recommend guidelines for introduction and maintenance of baiji in the Shishou oxbow semi-natural reserve.
4. Recommend steps towards restoration of baiji to the Yangtze River.
5. Highlight finless porpoise conservation needs.
6. Engage international specialists on the baiji issue.

The workshop was opened by Zhang Qiu Hua, Deputy Director of the Changjiang Fishery Resources Administrative Committee of the Ministry of Agriculture, China. This was followed by welcome and introductory presentations from He Jian Xiang of the Ministry of Agriculture on behalf of Chen Yi De, Deputy Director of the Fisheries Bureau, Ministry of Agriculture, Gui Jianfang, Director of the Institute of Hydrobiology of the Chinese Academy of Sciences, and Liu Nengyu, Deputy Director of Hubei Fisheries Administration Office.

Wang Ding, Deputy Director of the Institute of Hydrobiology, Chinese Academy of Sciences, welcomed participants to his institute and gave a formal introduction and brief history of Chinese baiji and finless porpoise conservation efforts. He explained future conservation plans and his expectations of the workshop. Randall Reeves, Chairman of the IUCN/SSC Cetacean Specialist Group, summarised the history of international efforts in baiji conservation and international expectations of the workshop. Participants then briefly introduced themselves and explained how they expected to contribute to the discussions (see Annex A for list of participants and observers).

Reeves chaired the discussions, Wang Ding and Sun Chan provided simultaneous translation and Ellis served as the principal rapporteur.

3.0 Terms of Engagement

The workshop was designed with the premise that Chinese authorities had already adopted a strategy and developed an action plan for conserving the baiji and the Yangtze finless porpoise. Workshop participants operated under the assumption that the Chinese authorities had decided:

a) to proceed with capture operations to remove some baiji from the Yangtze River; and
b) that Yangtze finless porpoises in the Shishou oxbow would not be removed before or after baiji were introduced there.

These issues were not debated explicitly during the workshop. Instead, discussions focussed on how to improve the prospects for survival of the species (baiji) and subspecies (finless porpoise) within the pre-existing framework, while also keeping open options for the future.

4.0 Summary of Discussions

Here we summarise points raised during the 'international participant feedback sessions' (see Annex B). Conclusions, recommendations and points of agreement are highlighted under the relevant headings.

4.1 Identify short- and long-term goals for an *ex situ* baiji conservation programme

The Chinese government has adopted an *ex situ* conservation strategy for the baiji because the factors believed to have caused its decline in the wild are still at work and authorities consider it unlikely that conditions in the river will improve significantly in the foreseeable future (Ministry of Agriculture 2001; see also Zhou et al. 1998). If, as it is assumed, dolphins in the Yangtze River are doomed, then removal and translocation to a safer environment is the only feasible option to save the species from extinction.

The following short- and long-term goals for an *ex situ* programme were identified:

Short-term Goal
Rescue animals from the Yangtze River and establish a viable breeding population in a closely monitored semi-natural reserve.

Long-term Goal
Release baiji back into the Yangtze River when the threats have decreased and the natural environment has improved.

Workshop participants deliberated whether the short-term goal should be to remove all baiji from the Yangtze River or simply to capture sufficient animals to establish an *ex situ* breeding population, leaving remaining animals in the wild. They **concluded** that the question was probably academic, as the greatest obstacle to establishing a viable *ex situ* population is likely to be the inability to capture sufficient animals. Ralls (1989) specified that approximately 20 founder individuals would be needed to preserve most of the genetic variability present in the wild population (albeit at that time it was believed that there were still several hundred baiji alive in the river).

It was **recommended** that strong links should be maintained between the short- and long-term goals. There was concern that establishment of an *ex situ* population could divert attention and funds from Yangtze River restoration, therefore delaying eventual reintroduction of the baiji.

Although it may be inevitable that accomplishing the short-term goal will compromise or slow progress towards the long-term goal, it is crucial that the *ex situ* baiji population is not seen as a substitute for conservation in the wild and that eventual reintroduction or restocking in the Yangtze River remains the ultimate objective of the *ex situ* effort.

4.2 Capture site selection and capture technique

4.2.1 Case study: Bottlenose dolphin capture operations in Sarasota Bay, Florida

Wells described techniques used to capture and release bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Since there is little experience with baiji capture, it is assumed that methods used for baiji will be similar.

A. Seine net encirclement

- Small groups of dolphins (usually no more than four) are selected and followed until they reach a desirable capture site.
- An ideal site is less than 2m deep, with minimal currents and a bottom clear of obstructions that could interfere with the operation of the net.
- Four to ten boats, including a net boat, remain several hundred metres away until capture begins, while a scout boat confirms the identifications and desirability of the dolphins.
- A seine net (600m long x 4m deep, with 15-20cm stretch mesh) is stacked on the stern of the net boat and then deployed in a circle around the dolphins, at high speed (> 25 knots).
- A second boat moves at high speed in the opposite direction from the net boat, closing the circle with sound and bubbles until the net circle can be completed.
- The net circle is completed in about 30sec. If additional net remains onboard after completing the circle, the net boat spirals into the circle, shrinking the size of the corral and adding additional barriers for dolphins should they escape over, under or through the innermost net circle.

B. Crew boat deployment

- Crew boats move quickly to predetermined or guided positions around the net circle to:
    - Fix net overlays or investigate other problems with the net.
    - Help monitor dolphins in the circle and watch for indications of dolphins striking the net (e.g. places where floats dip below the surface).
    - Provide effective, quick response to dolphins striking the net nearby.
- If necessary, boats move with the net corral as the entire circle is dragged into shallow water.
- Crews are assigned to specific boats as ‘special teams’ based on size, swimming capabilities and experience with dolphin handling, and are deployed accordingly. For example, boats with the tallest crewmembers are deployed to the deepest areas of the circle, which is also the most likely place for dolphins to try to escape.
- Veterinarians and emergency medical kits are distributed among crew boats.
- If water depth exceeds the height of a crewmember, he or she is required to wear personal flotation devices.
- If the current is running, crew boats deploy special net anchors upstream to maintain the net position and prevent collapse.

C. Crew deployment

- Crews are deployed from boats by captains on request from the capture coordinator.
- Crews are deployed when a dolphin hits the net or when net movement into shallow water is complete.
- Personnel are deployed as pairs, or 'buddies', for safety.
- If dolphins have not struck the net, crewmembers enter the water and are evenly distributed around the outside of the net to prevent entanglements.
- If the dolphins have still not struck the net, a few crewmembers enter the circle to help physically restrain them.
- If a dolphin strikes the net in deep water, a large floating pad is deployed and the dolphin is brought aboard with the net for disentanglement, then taken to shallow water.

D. Capture

- It is preferable to capture dolphins by physical restraint rather than by having them strike the net.
- Physical restraint of dolphins occurs while they are stationary or slowly circling within the net corral, not while they are moving quickly.
- Once the dolphin has been captured, after either physical restraint or removal from the net, 4-6 people work together to hold the dolphin in the water.
- Individual dolphins are placed in a sling and lifted onto a padded, shaded boat deck

4.2.2 Key considerations for capture site selection

Given the difficulty of locating and tracking baiji, it was recognised that captures may need to be attempted opportunistically and that they may take place at sub-optimal sites. A planned range-wide baiji survey in 2005/2006 was expected to provide a basis for better-informed decisions on where to carry out capture attempts. To minimise risk to dolphins and the capture team, capture specialists recommended that the following factors should be considered when selecting a capture site:

- Presence of animals
- Low current velocity
- Shallow and constant water depth
- Minimisation of transport time
- Avoidance of vessel traffic
- Avoidance of debris on the bottom that may entangle the net
- Road access (if using road transport)
- Suitable locality for temporary holding-pen
- River width

4.2.2 Recommendations for baiji capture methods

1. The primary consideration is safety for crew and dolphins.

2. Captures should take place in shallow water (< 2m deep) where:
   - Personnel are able to reach the bottom readily.
   - Dolphins are able to reach the surface to breathe.
   - It is possible to use a light, shallow net, which minimises entanglement because the dolphin can push it to the surface and breathe.

3. In deep-water conditions, use of personal flotation devices for crew and floating pads for dolphins will increase safety.

4. There needs to be a sufficient number of fast boats to ensure or facilitate:
   - Close monitoring of the entire net circle and rapid response to entanglement.
   - Quick restraint of the animals to minimise risk of injury (both to animals and people) and reduce likelihood of escape.
   - Detection of animals entangled at the bottom of a deep net.

5. A large, experienced team should be in place prior to the capture operation with:
   - A clear chain of command for coordination and good radio communications.
   - Sufficient people to allow at least four handlers per dolphin captured in a single set involving up to five dolphins.
   - Sufficient people to have one person positioned every 4-6m around the deployed net.
   - Special teams trained to handle difficult situations such as deep-water entanglements.
   - Crewmembers working in pairs to increase safety.
   - Trained veterinarians, researchers and dolphin handlers included.
   - Training provided, as needed, prior to each capture operation.

It must be recognised that regardless of how well-planned, well-equipped and well-executed capture operations may be, catching animals carries some risk. It is **imperative** that the risk of a baiji capture operation be minimised by involving people with capture experience and expertise, from both inside and outside China. It was **recommended** that the baiji capture team practice capturing Yangtze finless porpoises prior to baiji capture attempts. There is an opportunity for training Chinese scientists with the experienced Chicago Zoological Society dolphin health assessment team based at the Mote Marine Laboratory in Sarasota, Florida, USA, and experts there have offered to assist in the design of a special dolphin handling boat and net boat for use on the Yangtze (Wells et al. 2004).

4.3 Protocols for deciding to keep or release captured individuals

When dolphins are captured for scientific study, mothers with young calves are often avoided, or are released quickly in order to reduce stress on the less resilient young individuals. The captures in the Yangtze River present a different scenario where the high level of threat to baiji in the wild, the difficulty of locating and capturing them and the importance of obtaining sufficient individuals to stock the semi-natural reserve, will likely preclude selectively targeting or

releasing individuals of particular age classes. While this situation is not ideal, baiji are thought to be relatively robust and unlikely to be highly susceptible to capture myopathy. Stress could be further reduced by transferring animals to a temporary enclosure following capture to allow for their stabilisation prior to transport. Participants **agreed** that attempts should be made to capture all individual baiji in a group, regardless of age or sex, and to use medical and scientific expertise to manage any problems that arise.

Social affiliations within an *ex situ* baiji population should reflect those observed in the wild as closely as possible. However, very little information exists on the composition or structure of baiji social groups or on their life history, sex ratio and mating strategy in the wild. Papers by Lin et al. (1985) and Zhang et al. (2003) provide some preliminary information regarding social organisation. Baiji are not heavily scarred and there is little evidence of aggressive intraspecific interactions, therefore selection of appropriate social groupings for this species may be less critical than it would be for a more aggressive species such as the Amazon River dolphin, or boto (*Inia geoffrensis*).

An understanding of baiji social organisation would likely increase success of an *ex situ* conservation programme, and since there are so few data on baiji in the wild, it was **recommended** that the most useful way forward would be to:

1) Initiate a retrospective analysis of published and unpublished data to obtain insights into social organisation; and

2) Designate a team of experienced dolphin behaviourists to study social organisation and interactions in areas where baiji are regularly sighted, to achieve increased understanding of 'normal' baiji social organisation and behaviour. (It was recognised that 'normal' social characteristics may no longer exist due to the extremely low abundance of the species.)

A related issue is whether capture efforts should focus on a specific section of river or, alternatively, whether individuals should be taken from multiple locations along the river. It was suggested that there might be behavioural or cultural differences within the baiji population, which would lead to concern about mixing animals from different locations. It was **agreed** that the optimal strategy would be to take all animals from one site so that social bonds within a group would remain intact and the integrity of group social structure would be maintained. It was **acknowledged**, however, that genetic variability of the *ex situ* population also needs to be considered and that such variability would likely be maximised by taking individuals from many different locations and social groups. Once again, participants recognised that the difficulties of simply finding and capturing animals may preclude any serious effort at determining the composition and affiliations of the *ex situ* baiji population.

4.4 Cetacean transport techniques

It is imperative that transport of baiji takes place as expeditiously and humanely as possible. For travelling distances of any length, transport in water is generally considered superior to transport on foam. However, depending on the mode of transport selected (e.g. on a bumpy road or by helicopter), transport in water may not be feasible. Transport methods need to be carefully

considered and a variety of options should be investigated, for example, use of transport boxes with the capacity to circulate water, transport by boat or barge or use of a helicopter to maximise speed.

During capture, handling and transport of baiji, an experienced dolphin veterinarian, with an emergency medical kit, should be present at all times. Drugs should be administered during transport only if the veterinarian judges it medically necessary. The dolphin should be kept wet and shaded and the transport environment should be as calm and quiet as possible. The following aspects of each baiji should be monitored closely during transport:

- Respiration rate.
- Behaviour (monitored by a trained biologist).
- Body temperature.
- Heart rate.
- Abrasions (monitor and avoid).

4.5 Methods and procedures for baiji introduction to the Shishou oxbow

Discussions focussed on whether baiji should be placed directly into the Shishou oxbow following capture (hard-release) or, instead, temporarily monitored in a holding-pen (or pens) prior to their release (soft-release).

While it was noted that Yangtze finless porpoises have coped well with hard-release into the oxbow, all parties **agreed** that soft-release of baiji would maximise success by increasing ability to (a) closely monitor individuals, (b) manage the population and (c) identify and solve any problems in an expeditious manner.

Coastal marine dolphins and Yangtze finless porpoises adapt quite well to feeding in a captive environment, and participants with direct experience handling those and other species anticipated that baiji would as well. As long as each animal is evaluated and managed individually by experienced veterinarians and husbandry specialists, there should be few impediments, and many advantages, to keeping baiji in a holding-pen prior to release.

Potential advantages of keeping baiji in holding-pens prior to release and establishing the holding-pen (or pens) as an essential aspect of management and husbandry within the oxbow include:

- Facilitating and reducing the risks associated with routine health checks.
- Allowing regular medical monitoring and evaluation of all individuals in the population.
- Allowing medical treatment of animals injured during capture.
- Allowing individuals judged to be in poor health after release into the oxbow to be returned to a holding-pen for medical treatment, feeding and monitoring.
- Enabling the manipulation and management of genetics of the captive population, e.g. a dominant male could be held in a pen during the breeding season, thereby giving another male (or males) readier access to the female(s) if a genetic management plan indicated that the dominant individual was over-represented.

- Enabling baiji individuals or groups to be returned to the safety of a holding-pen if aggressive interactions with finless porpoises or other baiji are observed. Alternative management strategies could then be developed (e.g. dividing the oxbow into two zones separated by a fence) without further risk to the baiji.
- Facilitating evaluation of the oxbows ability to sustain baiji while reducing the risk of this evaluation to the introduced individuals. If the health of the group deteriorates, they can be returned to the safety of holding-pens (or even moved to the dolphinarium in Wuhan) while alternative management strategies are developed.

Workshop participants stressed the **importance** of strong involvement of experienced animal care personnel, including veterinarians, in the management and assessment of dolphins at the oxbow. Additional expertise from outside China probably will be required and it would be optimal for international veterinary specialists to be present during key events such as capture and release operations. Sea World made a firm commitment to offer intensive training in cetacean medicine and husbandry to at least one nominated Chinese veterinarian.

Recommendations

- Holding-pens should be carefully designed with the input of specialists familiar with their design and use.
- Following capture, baiji should be transported to a safe holding-pen environment in shallow water within the Shishou oxbow where they can be closely monitored.
- All newly captured animals from the same social group should be kept together in a single pen and monitored carefully for behavioural interactions.
- Animals should be trained so that they will take fish directly from a trainers hand.
- Physical examinations should be conducted often enough to ensure that animals are in good condition, but infrequently enough to reduce risk of skin abrasions and other injuries. If animals need to be handled, and it is determined that taking samples of biomaterials will not be detrimental to their health, then blood, urine, faeces and semen should be obtained, analysed and banked.
- Experienced veterinary personnel should closely monitor the progress of each individual.
- When a baiji is judged to be stable and feeding well, the gate to its holding-pen can be opened and the animal allowed to exit or enter the pen as it wishes.
- Feeding should continue as long as necessary and can continue, if necessary, well after release.
- Animals should not be released into the oxbow (or moved to the dolphinarium) until daily food intake is 5% of body weight.
- If problems are observed (e.g. loss of body weight, poor health etc.), individuals should be returned to a holding-pen for intensive medical treatment and monitoring.
- Animals determined to be reproductively senescent or for other reasons inappropriate for introduction to the oxbow may be transferred to the Wuhan dolphinarium.

The best cetacean husbandry capacity in China presently is located in Wuhan and setting up a soft-release facility at the oxbow would mean moving much of that capacity to Shishou. Such a move would increase project expenses. However, in comparison to the extremely high costs of expanding the Wuhan dolphinarium and developing a captive maintenance and artificial breeding

programme for baiji there, upgrading the capacity of the oxbow along the lines outlined above would be more cost-effective and probably would be easier to sell to international donors.

4.6 Factors determining placement in the Shishou oxbow *versus* the Wuhan dolphinarium

Although plans exist to conduct a baiji capture operation in the near future, the Chinese government has not yet decided whether to place captured animals in the Wuhan dolphinarium or the Shishou oxbow. It will take considerable time to find and capture baiji and therefore it could be several years before an *ex situ* population can be established, regardless of when the operation begins.

Strenuous discussion of where to put captured baiji – whether in the dolphinarium or the Shishou oxbow – did not result in consensus. Workshop participants unanimously **agreed**, however, that any decision should be made on the basis of ensuring the health and safety of the individual animals *and* meeting the long-term conservation objective of establishing a self-sustaining *ex situ* population that can eventually help restore the baiji to its natural Yangtze environment. Thus the overriding consideration should be to maximise the probability that captured animals breed successfully, as otherwise maintaining animals *ex situ* will simply delay, not prevent, the species' extinction. Workshop participants also **agreed** that if a *group* of baiji were captured (i.e. three or more rather than just one or two individuals), they should be placed in the Shishou oxbow to establish a breeding population there.

There was agreement among the international participants, the Nanjing Normal University group and several other individual Chinese participants that any captured dolphins should be placed in the oxbow under soft-release conditions. Another group consisting of Chinese officials and scientists believed that if only a small number of baiji were captured, they should be placed in the Wuhan dolphinarium. The reasoning behind both of these opinions is presented below:

4.6.1 Dolphinarium

There is realistic concern that it may not be possible to capture more than one or two baiji. Supporters of the dolphinarium option do not believe that one or two animals would be sufficient to establish a breeding population in the Shishou oxbow. They prefer the idea of placing animals in the dolphinarium where assisted reproductive techniques can be attempted and where there can be intensive research and medical care.

The Wuhan dolphinarium is valuable as a medical facility or as a short-term holding area. Its strengths include good water quality, the ability to handle animals and the presence of a laboratory. Experience with Commerson's dolphins (*Cephalorhynchus commersonii*) at Sea World in San Diego, USA, suggests that it is possible for colonies of captive cetaceans to become reproductively active in a short period of time, provided that the facility is large and well designed and the social structure is representative of that in the wild (Joseph et al. 1987; Cornell et al. 1987). However, the facility in Wuhan is currently fairly small, and costly expansion would be needed for it to be able to hold enough animals to constitute a viable captive dolphin population. One consideration is that introducing baiji to the dolphinarium, without increasing

the capacity of the facility, would compromise the existing finless porpoise captive breeding programme

4.6.2 Shishou oxbow

China's successful programme of capturing, translocating and maintaining finless porpoises in the Shishou oxbow has demonstrated its adequacy as an *ex situ* environment for at least one cetacean species. It is instructive to compare the relatively good experience with finless porpoise reproduction in the oxbow and the difficulties experienced in the dolphinarium thus far. Viewed alongside the problems encountered in attempts to establish viable captive populations of cetacean species, other than bottlenose dolphins, in dolphinaria elsewhere, this makes it seem likely that the prospects of success with baiji breeding would be greater in the larger, closer to 'natural' environment provided by the oxbow.

There was also considerable scepticism about whether captive breeding in the dolphinarium could ever contribute to the baijis survival in the wild. Two bottlenose dolphins from Tampa Bay, Florida, were kept in captivity for two years and then successfully returned to the wild (Wells et al. 1998). However, experience with bottlenose dolphins in Australia (Gales and Waples 1993) and a killer whale (*Orcinus orca*) released in Iceland (Williamson 2004) has shown that captive-born dolphins and adult animals that have spent long periods (more than two years) in captivity have a poor ability to survive when released into the wild, even under soft-release conditions. Any baiji that remains in the Wuhan dolphinarium for an extended period, or is born there, will have poor chances for survival if it is released into the semi-natural reserve, or into the Yangtze River. A carefully managed, adequately resourced effort to establish baiji in the oxbow represents the best option for accomplishing the long-term goal (see Section 4.1) of eventually re-stocking or re-introducing them to the Yangtze River.

As mentioned above (Section 4.5), after capture and transfer to holding-pens in the oxbow, some individuals, such as those that are too old to breed or that are severely injured, may be judged unsuitable for release into the oxbow and they could be selected for transfer to the dolphinarium.

4.7 Improvements needed at the Shishou oxbow prior to introduction of baiji

Fishing is restricted in the Shishou semi-natural reserve but approximately 300 people continue to fish there under supervision of reserve staff. The Government plans to relocate the community currently living on the island in the Shishou oxbow and to further restrict fishing. Optimally, this should occur prior to introduction of baiji.

A study conducted by the Institute of Hydrobiology in the 1980s estimated the available quantities of confirmed baiji prey species of appropriate sizes and determined that the Shishou oxbow could support between 50 and 80 baiji (Baiji Research Group 1989). The estimate made no explicit allowance for finless porpoises that might be in the oxbow at the same time as the baiji. The workshop **recommended** that the previous study be updated and expanded, given that the productivity of the reserve and the fish species assemblage have changed as a result of construction of the dyke.

It also was **recommended** that the following evaluations be conducted in the semi-natural reserve as soon as possible, and before baiji are introduced:

- Determine the presence of sufficient baiji prey species.
- Gather baseline data on fish stocks and instigate a long-term fish monitoring programme.
- Assess the cetacean carrying capacity of the reserve.
- Initiate routine water quality monitoring (already underway - see Section 4.9)

Finally, workshop participants **emphasised** that it is essential that a qualified management and research team, as well as necessary infrastructure such as holding-pens, are in place and functional at the oxbow prior to baiji capture operations.

4.8 Managing a dual-species reserve

There is considerable concern as to whether baiji and finless porpoises can live together harmoniously in the Shishou oxbow, even though the two species live sympatrically in the Yangtze. Zhang et al. (2003) reported an apparently aggressive interaction between the two species in the Yangtze, stating, 'occasionally, a porpoise's body crossed above the baiji's. It appeared as though the porpoise was trying to push down or submerge the baiji, even though the baiji was strong enough to resist'. In addition, it remains unclear whether the presence of finless porpoises contributed to the demise of the single baiji introduced to the oxbow in 1995.

Workshop discussions revealed that there had been numerous sightings of baiji and finless porpoises moving together in the wild and that the apparently aggressive encounter had been published because it was unusual. Baiji and finless porpoises often use different parts of the river (porpoises near the bank and baiji near the centre of the channel) but in areas where they occur together, they can be in close proximity without any signs of aggression. The group **concluded** that there is no solid evidence that the presence of finless porpoises will have a negative effect on baiji if both are present in the Shishou oxbow, but **agreed** that a cautious approach was necessary. Competition between the two species in the oxbow could increase if the carrying capacity is approached and if there is insufficient food or space. Some participants also suggested that if a single baiji were introduced to the oxbow, the presence of other cetaceans, regardless of species, might actually have a positive effect on its ability to adapt.

Depending on the social dynamics observed once baiji are present, participants **agreed** that the possibility of allocating the two species to separate oxbow lakes or physically subdividing the Shishou oxbow with some kind of barrier should not be ruled out. However, if the oxbow were to be divided, the separating fence or net would have to be carefully designed to avoid entanglement. This option needs to be investigated only if there is clear evidence that baiji and finless porpoises cannot co-exist in the reserve.

Participants **stressed** the importance of close monitoring and evaluation of released baiji. They **agreed** that a soft-release of translocated animals into the oxbow would enhance the possibility of returning them to the safety of the holding-pens should aggressive interactions between the two species be observed. A soft-release approach would therefore improve the ability to manage the situation adaptively and to solve potential problems as they arise.

4.9 Water quality issues

4.9.1 Dolphinarium

The water quality standards for maintenance of Yangtze cetaceans in the Wuhan dolphinarium that were recommended by the Nanjing workshop in 1993 (Zhou et al. 1994) were judged to be equally relevant now and they are recapitulated in Table 1.

Table 1. Recommended water quality standards for the dolphinarium (Zhou et al. 1994)

WATER QUALITY FACTOR	ACCEPTABLE RANGE	OPTIMAL VALUE
Temperature	10 – 25^{o} C	seasonally dependent; breed at 15 – 18^{o}C
pH	6.5 – 8.5	7.5
Turbidity	0.5 – 3.5m	bottom of pool
Free Chlorine	0.25 – 0.75ppm	0.5ppm
Total Chlorine	0.75 – 1.5ppm	1.0ppm
Total Bacteria	0-50 colonies/100ml	25 colonies/100ml

During a presentation on Yangtze cetacean husbandry, Wang Kexiong of the Wuhan dolphinarium explained that baiji are considered easier to maintain in captivity than Yangtze finless porpoises because finless porpoises are prone to skin infections and therefore require better water quality (see Annex E for full presentation).

4.9.2 Shishou oxbow

Previous and planned water quality monitoring

At present, some basic monitoring of water quality and aquatic plants is conducted by the Institute of Hydrobiology (IHB) and Hubei Provincial Fishery Institute. IHB undertook extensive water quality monitoring in the oxbow in 1987 and 1988 as part of the reserve feasibility study, and also before and after the introduction of finless porpoises in 1990. Because the presence of the dykes has changed the pattern of water flow through the oxbow, it is necessary to repeat, and augment, the previous monitoring work. The IHB recently signed a formal agreement with the semi-natural reserve to undertake environmental monitoring. The monitoring will be conducted by IHB staff and involve the construction of a new laboratory beside the oxbow. The planned monitoring programme will have the following components:

1. Routine biological monitoring
    - Hydrological parameters such as temperature, pH, conductivity, turbidity (or transparency), suspended solids, dissolved oxygen, BOD, COD, total nitrogen, phosphates and other potentially important nutrients such as CA^{2+}.
    - Bacteriological measures, such as counts of total bacteria and coliforms.

- Phytoplankton (measured as chlorophyll *a*) and zooplankton (species composition).
- Aquatic plants (composition and cover).
- Zoobenthos (grab samples, analysed for species composition of macroinvertebrates).

2. Monitoring pollutants

The IHB has a formal agreement with the Shishou reserve authority to monitor heavy metals and 17 different persistent organic pollutants (POPs). POPs will be monitored in water, in zooplankton, in fishes, and in finless porpoises (blood or tissue samples) to estimate the rate and scale of biological magnification up the food chain. Sampling will be carried out once or twice per year on the assumption that accumulation of metals and POPs is a long-term process and less subject to seasonal vagaries than are the parameters slated for routine monitoring. Instruments needed to measure POPs and other pollutants are available at the IHB in Wuhan and it will be possible to conduct routine environmental monitoring at the new laboratory at the semi-natural reserve once construction has been completed.

Discussions and Recommendations

A monitoring program capable of detecting changes in water quality and fluctuations in productivity on relatively small time scales is important if baiji are to be maintained in the semi-natural reserve. Without such a programme, it will be impossible to anticipate and respond to changes in the oxbow before they compromise the health of the animals. However, it was recognised that conducting all the above planned monitoring would be expensive and time-consuming, and it was therefore **recommended** that priorities should be set for monitoring water quality and fish. Water quality parameters of highest priority for monitoring are: temperature, pH, conductivity, turbidity, suspended solids, dissolved oxygen, BOD, COD, total nitrogen and phosphates.

Fish sampling will be required to (a) evaluate the carrying capacity of the reserve prior to introduction of baiji (see Section 4.7), (b) monitor POPs in fish (described above), and (c) establish baseline data on fish stocks in the reserve for long-term monitoring to detect changes in those stocks (see Section 4.7). Each of these studies requires a separate, well-designed sampling protocol that includes comprehensive spatial and temporal coverage, replication of samples and standardised data collection and analysis guidelines.

The proposed routine biological monitoring outlined above matches the work undertaken previously. For ease of comparison with the earlier data set, the methods used and sites sampled should be identical. Samples at 0.5m below the surface and 0.5m above the oxbow bed should be collected as before, however, the results should not be pooled but instead reported individually. It is **recommended** that there be comprehensive spatial sampling. Temporal sampling can be adjusted to one or more of the following strategies:

- Sample dates could match those calendar dates (day, month) in the earlier survey exactly.
- Samples could be taken once per month.
- Samples could be replicated (three or four times) within the wet season (high water) and dry season (low water) to represent the seasonal extremes in the study area.

It was **suggested** that inclusion of sampling stations at duplicate sites in the Yangtze mainstem close to the oxbow 'gate' would be beneficial. This would ensure that assumptions about water quality in the Yangtze River are supported by relevant data. Due to mixing of water in the river, sampling at only one depth is needed – e.g. 0.5m.

It was noted that samples of zoobenthos are highly variable and it was therefore **recommended** that samples taken within the oxbow should be replicated at each site ($n > 4$ per site was suggested).

Geographic Information Systems (GIS) may provide a means to analyse and integrate data on water quality, contaminants and the seasonal and daily movements of animals. As such, GIS might be viewed as a useful habitat assessment and management tool.

4.10 Considerations to maximise chances of baiji breeding in the dolphinarium

The primary requirement for successful captive breeding is the presence of reproductive-age males and females.

Other aspects that can increase the chances of a successful pregnancy and birth include:

- The ability to physically separate females from males, preferably into separate pools, as parturition approaches. This can be accomplished optimally by separating the animals for short periods initially, then increasing the separation time gradually so that the female becomes acclimatised to being alone and so that her first experience of separation from the male does not coincide with the birth. In some cetacean species in captivity, there has been success with placing expectant mothers with other conspecific females, who can serve as 'aunties' during parturition and the post-partum period.

- Ultrasound is a useful tool for monitoring the foetus and predicting the parturition date. At present, there is no ultrasonographer in Wuhan with experience working with cetaceans. It may be possible to train a Chinese ultrasonographer at Ocean Park in Hong Kong.

- The first month after birth is critical to offspring survival and the mother-calf pair should be closely observed, 24 hours a day, during this period so that any problems can be detected early.

- The opportunity for adolescent female dolphins to learn parenting skills through observation is very important and can greatly influence their later breeding success.

- A captive-breeding situation is an ideal opportunity to monitor life history, reproductive status, foetal growth and gestation period, all of which are very difficult to study in the wild. Studies of this type have already begun on finless porpoises in the dolphinarium, and they could be extended to include baiji with the input of international behaviour, husbandry and veterinary experts if necessary.

4.11 Monitoring cetacean health status in the dolphinarium

As was true of water quality issues (Section 4.9), the recommendations from the 1993 Nanjing workshop (Zhou et al. 1994) were deemed still relevant and valid without amendment. These **recommendations** are re-stated below:

4.11.1 Housing Facilities

Facilities should be of adequate size and number to allow optimal social groupings. Pool size should be sufficiently large to enhance reproductive success. Nursery pools should be available, and as large as possible, for housing females separately during pregnancy, parturition and nursing. It will be important to consider whether roofing or some protection from bright light is needed if baiji are to be accommodated in an outdoor facility.

4.11.2 Diagnostic Facilities

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

4.11.3 Medical Laboratory

A basic medical laboratory should minimally include the following equipment: microhematocrit centrifuge, centrifuge for spinning serum, microscope, refractometer, hemocytometer, erythrocyte sedimentation rack and tubes, a non-defrosting freezer and associated supplies. Serum biochemistry testing and microbiology testing capacity should be accessible either on- or off-site.

4.11.4 Water Quality Laboratory

A 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.

4.11.5 Nutrition

A reliable source of top-quality, appropriately sized live fish, of more than one species, should be provided to ensure adequate nutrition. For animals fed by hand, individual consumption of fish (percentage of body weight and kilocalorie/kg) and species fed should be recorded. Preferably, the seasonal energetic and nutritional value of food fish should be evaluated. The fish should also be examined for the presence of heavy metals, PCBs, organochlorides and other pollutants.

4.11.6 Medical Procedures

People with formal, specialised training should perform medical and laboratory procedures. Assistance from individuals with cetacean experience is essential. 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.
- Physical examinations of recently collected animals every two weeks unless medical status indicates that more frequent examinations are necessary.
- Necropsies to be performed in concert with a trained pathologist, on every animal as rapidly as possible following death. Serum and tissue should be saved from all organs for histopathological and microbiological examination and toxicology studies as well as any other tests deemed appropriate, e.g. virology and/or vitamin levels. Whenever possible, epidydimal sperm should be collected from deceased males.

4.11.7 Physical examinations

A physical examination should consist of visual examination, morphometrics, tactile examination and auscultation. Samples, including blood, microbiology and biopsies, should be collected, if indicated. All of these procedures and sample collection should be specified in protocols and standardised among all participating facilities to ease information exchange and comparison. Protocols should be established for regular and detailed exchange of this information.

4.12 Monitoring cetacean health status in the Shishou oxbow

4.12.1 Infrastructure

At present there is no infrastructure for animal management at the semi-natural reserve. A fundamental prerequisite for all of the animal health monitoring recommendations, as presented below, is the presence of appropriate infrastructure and hardware as well as the appropriate husbandry and handling expertise.

It is **strongly recommended** that for maintenance of a baiji population in the Shishou oxbow, a holding-pen complex be installed at the reserve and that this complex includes (a) one or more lifting platforms and (b) adaptable pens with movable walls.

A well-designed and well-maintained holding-pen complex would allow easy access to, and safe capture of, dolphins so that health monitoring procedures can be followed with minimal harm to humans or animals. This facility could be used for introducing new individuals, recollecting animals that exhibit signs of illness, and other management functions. Detailed designs should be available from the U.S. Navy Marine Mammal Program.

4.12.2 Initial Assessment – Capture

Assessment at the time of capture should include determination of sex, measurement of body weight, respiration and heart rate and a standard array of morphometric measurements. An initial physical examination (including auscultation) should involve collection of blood, faecal and blowhole samples, measurements of blubber thickness (non-invasive assessment using ultrasound) and rectal temperature (can also be monitored during transport) and photographic

documentation. Opportunistic sampling of milk, swabs from lesions, urine, faeces and biopsies can be collected as indicated.

Blood analysis should include the following tests: haematology, serum biochemistry, serology (e.g. morbillivirus, brucella), hormones, genetics and contaminants. Blood should also be banked. Faecal analysis should include standard parasite assessments.

As a general guideline, and depending on findings and the state of health of the animal, assessments should be conducted on day 0, day 3 and day 14.

4.12.3 Medium-term Monitoring – Initial 2 Weeks

The period that a dolphin remains in the holding-pen will depend on its progress. However, this period is expected to be at least two weeks, during which time it may be advisable to begin habituating the dolphin to a boat that will be used to continue monitoring after release from the pen. Basic health monitoring during this period should include respiration rates, behaviour and visual assessment of body condition. Prior to release into the main oxbow, another complete health assessment (described in Section 4.12.2) should be conducted. Depending on the circumstances, a urine sample could also be collected, by catheterisation if necessary, and an ultrasound examination conducted.

All animals released into the oxbow need to be marked by at least two methods, preferably a combination of freeze branding, tagging and subcutaneous transponders. The method of marking would have to be made on an individual basis depending on observations while the animal is in the holding-pen.

4.12.4 Long-term Monitoring

Basic observations that should be recorded over the long term include respiration rates, behaviour and body condition. It is important that a long-term dolphin monitoring programme be developed for the semi-natural reserve to answer specific relevant questions regarding animal health, reproductive status etc. Regardless of what plan is adopted, there is a need to adapt and respond as the situation changes and evolves.

4.13 Genetic Management

The unpublished findings of two recent studies on the genetics of baiji and finless porpoises were presented at the workshop (Annex D). Brief summaries of those presentations and the associated discussions follow. (Some of these studies have now been published; see Xia et al. 2005 and Zheng et al. 2005).

4.13.1 Baiji

A study by Nanjing Normal University analysed tissue samples (muscle and bone) of 20 baiji from the lower reaches of the Yangtze River and concluded that genetic diversity in this area was low. A separate study by the IHB analysed 21 formalin-fixed baiji samples from the middle

reaches of the Yangtze River. Although difficulty was encountered extracting good-quality DNA, the two control regions amplified also showed critically low diversity.

Workshop participants noted that the sample size in both baiji genetics studies was small and that there was little geographic overlap between the two, with one study analysing samples from the middle reaches and the other from the lower reaches. The workshop **recommended** that the two research groups cooperate and combine their data or samples so that the broader genetic picture could be better understood, using the same techniques on both sample sets.

The question was raised as to whether there would be any advantage in managing the baiji as a single stock or as multiple units. It was unanimously **agreed** that because there are so very few animals left, it makes the most sense to proceed on the basis of a single management unit. If the *ex situ* population is held at more than one facility, it should be managed as a metapopulation, with genetic exchange as needed and as appropriate.

Generally, however, discussions of genetic management should not overshadow the more immediate issue of how to capture baiji safely and establish an *ex situ* population. Genetic management will become important once the hurdle of establishing such a population has been overcome. Options for increasing genetic diversity could ultimately include (a) introducing baiji from different geographic locations and (b) confining dominant males in pens to allow more opportunity for other males to contribute to the gene pool.

4.13.2 Finless porpoise

Nanjing Normal University (NNU) analysed DNA from 103 finless porpoises from the Yangtze River, South China Sea and Yellow Sea. Mitochondrial diversity was similar in the Yangtze River and South China Sea populations and was highest in the Yellow Sea population. The authors concluded that there was a high level of gene flow between finless porpoises in the Yangtze River and those in the Yellow Sea. A separate study by the IHB analysed DNA from 39 finless porpoises from the middle and lower reaches of the Yangtze River and 22 from the Shishou oxbow. Animals from the lower reaches of the Yangtze showed higher nucleotide and haplotype diversity than those from the middle reaches. Mitochondrial diversity was very low for the population in the oxbow, which consists only of founders from the middle reaches of the Yangtze. The IHB study concluded that genetic diversity of the oxbow population could be increased by introducing animals from the lower reaches of the Yangtze.

The study at NNU indicated that there is ample gene flow between finless porpoises in the Yangtze River and the Yellow Sea. This finding is in line with that of Yang et al. (2002), whose mitochondrial analyses led them to question 'whether the Yangtze River [porpoise] population is really genetically and geographically isolated and should be regarded as an independent management unit'. However, it is in contrast to several other studies that found significant differences, in external morphology (Gao and Zhou 1995) and in the mitochondrial control region (Yang and Zhou 1997; 2000), between animals from the Yangtze River and Yellow Sea. Clearly, the population structure of finless porpoises requires further study, particularly in the estuary of the Yangtze River.

4.14 International Baiji Committee

Participants were surprised by the extreme similarity of issues and views expressed at this workshop and those expressed more than a decade ago at the Population and Habitat Viability Assessment (PHVA) workshop in Nanjing and they were concerned that most of the 1993 recommendations had never been implemented. It was agreed that there should be a mechanism to provide continuity and ensure that the recommendations from the present workshop are carried forward and translated into concrete actions. Chen Zhengguo of the Ministry of Agriculture explained that the main reason that the recommendations of the 1993 workshop had not been implemented was the lack of funding. The Chinese government would have liked to implement its baiji action plan, conduct annual abundance surveys and implement a trial baiji capture effort, but the lack of funds had made all of these impossible thus far. Throughout the workshop, it was acknowledged repeatedly that baiji conservation is utterly dependent on secure, long-term financial support. Moreover, it was recognised that international funding would not be forthcoming unless it was tied to an independent, international oversight body to provide technical input and guidance to the baiji rescue and recovery plan.

After considerable discussion concerning which group or person should take the lead in implementing the workshop recommendations, participants endorsed the idea from the PHVA workshop of immediately establishing a standing 'Baiji Conservation Committee' to monitor progress and advise the Chinese government on all efforts to conserve the baiji. Chen Zhengguo explained that the Federal Government would need to approve such a committee. He expressed his full support for the idea and offered to report back favourably to senior officials in the Ministry of Agriculture, recommending that the committee be formed without delay.

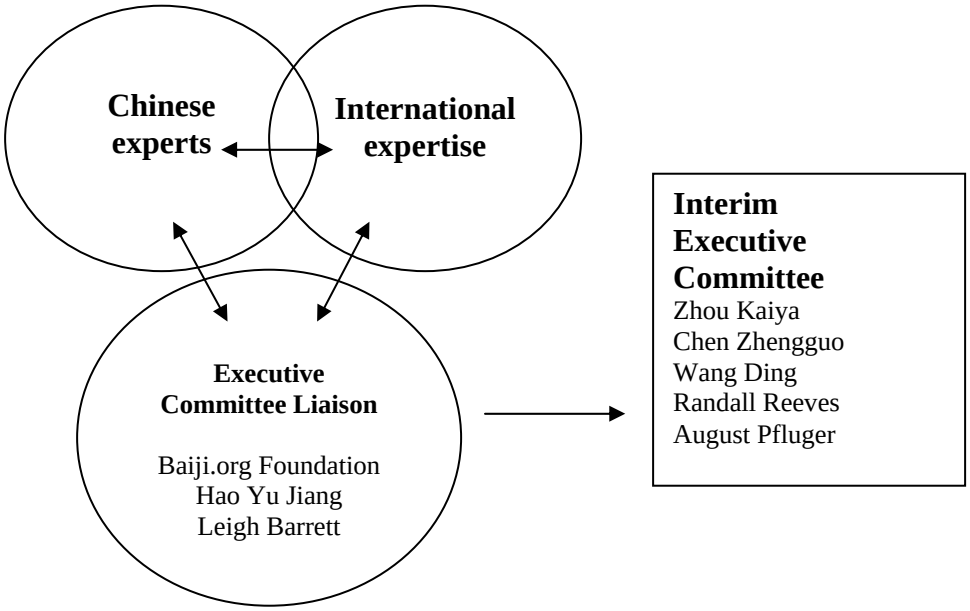
Recognising that it would take some time for the committee to be approved and formed, workshop participants agreed that an Interim Executive Committee, consisting of Zhou Kaiya, Chen Zhengguo, Wang Ding, Randall Reeves and August Pfluger, should be established (see below) to initiate formation of the full committee. A working group was selected to outline the draft terms of reference for the International Baiji Committee. These are presented below:

Purpose

- Monitor all efforts to save the baiji.
- Provide expertise and advice to the Chinese government on 'best practices'.
- Coordinate the use of international financial and in-kind support for baiji conservation.

Functions

- Review proposals for internationally funded projects.
- Advise on particular issues as needed.
- Provide technical advice as needed.
- Coordinate the use of international financial and in-kind support for baiji conservation.
- Facilitate capacity building in China with regard to capture techniques, *ex situ* population management and animal medicine.
- Advise on release of dolphins into the Yangtze River habitat.



Composition

It was suggested that the Ministry of Agriculture join forces with the Institute of Hydrobiology and baiji.org Foundation to create a Baiji Conservation Committee comprised of Chinese and international members from the IUCN/SSC Cetacean Specialist Group, Nanjing Normal University, Institute of Hydrobiology, Ministry of Agriculture – Fisheries Management Bureau, Provincial Fisheries Management Authorities from Hunan, Hubei, Jiangxi, Jiangsu and Anhui, Changjiang Fisheries Resource Management Committee, baiji.org Foundation, Conservation International, Fisheries Agency of Japan, Institute of Cetacean Research (Japan) and other non-governmental organisations (e.g. WWF, Ocean Park Conservation Foundation, Pacific Environment, International Fund for Animal Welfare and the Wuhan Baiji Conservation Foundation). Members may represent more than one organisation or agency. The Ministry may add other members from organisations that make significant contributions to baiji conservation efforts.

4.15 *In situ* conservation plans

The focus of the present workshop was the second component of the Chinese Governments 2001 action plan – *ex situ* conservation. However, this should not be interpreted to mean that the participants considered that *in situ* conservation efforts were exhausted or should be abandoned. In fact, most participants believed that the two approaches were essential to a comprehensive management and recovery strategy and that they should continue in parallel. Given that the Yangtze environment is continuing to deteriorate, it seems prudent to remove at least some baiji from the river and place them in a cleaner, safer habitat, but also to persist with efforts to save those remaining in the wild. In addition, given that the ultimate objective of *ex situ* conservation is the re-introduction or re-stocking of baiji to a healthy Yangtze River, it is imperative that efforts to restore the natural ecosystem should continue at the same time that an *ex situ*

conservation effort is proceeding. It was **stressed** that activities intended to conserve baiji in the wild would have the incidental effect of benefiting the entire Yangtze ecosystem and other rare or threatened species such as the Chinese paddlefish (*Psephurus gladius*) and Chinese sturgeon (*Acipenser dabryanus)* as well as the Yangtze population of finless porpoises.

The urgent need for an immediate range-wide baiji survey, which can be used to guide many of the efforts described in this document, was **emphasised**. It was **recommended** that, following such a survey, threat levels should be evaluated at each area where baiji can be reliably found. Capture efforts should be targeted on the most threatened areas while *in situ* conservation work should be pursued in areas judged to be at lower risk.

5.0 Acknowledgements

Financial support for the workshop came from the baiji.org Foundation, Budweiser Wuhan International Brewing Company and Conservation International. For his extraordinary generosity, vision, energy and tenacity, all participants owe special thanks to August Pfluger, Director of the baiji.org Foundation. The organisational network necessary for the workshop was established in early 2004 by Wang Ding, August Pfluger and Randall Reeves and the challenging and often unrewarding work of organizing all aspects of the workshop was carried out mostly by Leigh Barrett of baiji.org Foundation with help from Hao Yu Jiang and Wei Zhuo of the Institute of Hydrobiology. The staff and students of the IHB enthusiastically assisted during the workshop and the institute also donated meeting rooms and office space. Most international participants donated their time, and the travel and time of Jim McBain was donated by SeaWorld/Busch Gardens. A number of individuals, in addition to those who attended and participated in the workshop, contributed to its planning and organisation. These include Tim Werner, formerly of Conservation International; Roger McManus, Adam Schoenberg and Philip Chou of Conservation International; Zhi Lu of Conservation International – China; and Aster Zhang of International Fund for Animal Welfare – China. We would also like to extend thanks to the Fishery Bureau of the Ministry of Agriculture of China, Changjiang Fisheries Resource Administrative Committee of the Ministry of Agriculture of China and the Fisheries Administration Offices of Hubei, Hunan, Jiangxi, Anhui, and Jiangsu Provinces.

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Annex A: Workshop Participants & Observers

Executive Workshop Committee

Wang Ding	Institute of Hydrobiology
Xianfeng Zhang	Institute of Hydrobiology
Randall Reeves	IUCN/SSC Cetacean Specialist Group
Yu Guoping	Administrative Committee of Changjiang Fisheries Resource, Ministry of Agriculture, China
August Pfluger	baiji.org Foundation
Roger McManus	Conservation International

Chinese Scientists

Zhou Kai Ya	Nanjing Normal University
Hua Yuan Yu	Nanjing Normal University
Gui Jianfang	Institute of Hydrobiology, Chinese Academy of Sciences
Nie Ping	Institute of Hydrobiology, Chinese Academy of Sciences
Wang Ding	Institute of Hydrobiology, Chinese Academy of Sciences
Zhang Xian Feng	Institute of Hydrobiology, Chinese Academy of Sciences
Wang Ke Xiong	Institute of Hydrobiology, Chinese Academy of Sciences
Zheng Jinsong	Institute of Hydrobiology, Chinese Academy of Sciences
Wei Zhuo	Institute of Hydrobiology, Chinese Academy of Sciences
Hao Yu Jiang	Institute of Hydrobiology, Chinese Academy of Sciences

International Guest Scientists and Conservationists

Randall Reeves	IUCN / SSC Cetacean Specialist Group (Canada)
Randall Wells	Chicago Zoological Society (USA)
Tony Martin	Biological Sciences Division, British Antarctic Survey (UK)
Reimi Kinoshita	Ocean Park Corporation (Hong Kong)
Tomonari Akamatsu	National Research Institute of Fisheries Engineering (Japan)
Bernd Würsig	Texas A&M University (USA)
Nick Gales	Australian Antarctic Division (Australia)
Susie Ellis	Conservation International (USA)
David Dudgeon	University of Hong Kong (Hong Kong)
Gill Braulik	Downstream Research Group (UK)
Jim McBain	Busch Entertainment Corp./Sea-World Adventure Parks (USA)

Baiji.org Foundation

August Pfluger	Baiji.org (Switzerland)
Leigh Barrett	Baiji.org (UK)

Chinese National and Provincial Government Officials

He Jian Xiang	Chinese Ministry of Agriculture
Zhang Qui Hua	Administrative Committee of Changjiang Fisheries Resource (Chinese Ministry of Agriculture)

Chen Zheng Guo	Administrative Committee of Changjiang Fisheries Resource (Chinese Ministry of Agriculture)
Zhu Mei	Anhui Fisheries Administration Office
Liu Nengyu	Hubei Fisheries Administration Office
Ye Jian Gang	Hubei Fisheries Administration Office
He Xin Chun	Hunan Fisheries Administration Office
Li Shaohua	Jiansu Fisheries Administration Office
Qian Xin'e	Jiangxi Fisheries Administration Office

Chinese National and Provincial Baiji Reserve Officers

Hu Lianghui	Tian-e-Zhuo National Baiji Reserve
Ma Daoyun	Xinluo National Baiji Reserve
Zhang Zhong Xiang	Xinluo National Baiji Reserve
Yu Daoping	Tongling Anhui Provincial Baiji Reserve
Gao Cheng Hong	Zhengjang Provincial Baiji Reserve

Non-governmental Organisations and Guests

Sun Chan	Conservation International China
Chen Qi	Conservation International China
Fan Enyuan	Fishery Ecological Monitoring Centre, China Ministry of Agriculture
Melinda Kramer	Pacific Environment
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Timothy Ng	Ocean Park Conservation Foundation
Evan Sun	International Fund for Animal Welfare China

Institute of Hydrobiology, Chinese Academy of Sciences, PhD & Master Students and Staff

Peng Juli, Wu Min, Zhao Xiujiang, Wang Xianyan, Li Songhai, Zhang Xinqiao, Guo Zheng, Li Haiyan, Dong Weiwei, Du Bo, Kuang Xinan, Gong Wei Ming, Wang Xiao Qiang, Yu Bin Fang, Zhao Qing Zhong, Chen Dao Quan, Zhang Chun Mei

Annex B: Workshop Agenda

28/11/04: Workshop Registration and Welcome Reception

12:00 – 16:00: Registration Desk Opens. Hongyi Hotel,Wuhan
16:30 – 19:00: Hongyi Hotel Conference Room (level 4)
Official opening of workshop & welcome and introductory speeches
19:00 – 20:30: Welcome Banquette Reception, Hongyi Hotel, Wuhan

29/11/04: Shishou Tian-e-Zhou Semi-Natural Baiji Reserve Excursion

19:30: Depart from Hongyi Hotel to travel to Shishou Tian-e-Zhou Oxbow 'Semi Natural' Baiji Reserve
11:30: Arrive at Heng Gou Town
11:45 – 12:45: Lunch. Restaurant of the Shishou Wetland Conservation Zone
13:00 – 14:30: Participants tour the Shishou oxbow semi-natural baiji reserve by boat
15:15 – 16:45: Participants tour Pere David's Deer Reserve and view the Shishou oxbow from the banks of the river.
17:30 – 18:30: Dinner, Restaurant of Shishou Wetland Conservation Zone
18:45 – 19:45: International participants questions and answers session, Shishou Wetland Conservation Zone Meeting Room

30/11/04: Shishou Oxbow Excursion

9:00 – 13:00: Programme starts with an inspection of the upper and lower mouth of the Shishou oxbow. This is followed by a tour of the adjacent Hei-Wa-Wu oxbow described in the WWF's re-linkage programme.
14:00 – 15:00: Lunch, Restaurant of Shishou Wetland Conservation Zone
19:15: Arrive at Hongyi Hotel and check in
20:00 – 21:00: Dinner, San Wu Chun Restaurant

1/12/04: Capture and Husbandry Discussions
Institute of Hydrobiology Meeting Room 506

8:30 – 9:45: Tour of the baiji dolphinarium
10:00 – 10:40: Lecture by Dr Zhang Xian Feng, IHB
Status of the baiji and the finless porpoise in the Yangtze River, and a review of capture processes in recent years

10:40 – 12:00: **International Participant Feedback Session 1**

1. Identify long- and short-term goals for a captive baiji programme
2. Site selection, capture technique and selection of capture location
3. Selection of size (age) and sex classes, capture technique
4. Protocols for deciding to keep / release an animal
5. Transport techniques
6. 'Best practice' procedures for release into the reserve

7. Factors in deciding placement in the Shishou Tian-e-Zhou oxbow vs the Baiji dolphinarium
8. Managing a dual species reserve

12:30 – 13:30: Lunch, Institute of Hydrobiology Meeting Room 506
13:30 – 13:50: Lecture by Wang Keixiong
Husbandry of the baiji and finless porpoise

13:50 – 15:30: **International Participants Feedback Session 2**

9. Water quality issues
10. Considerations to maximize chances of breeding in captivity
11. Short term monitoring for health status (e.g., general health and husbandry management following capture)
12. Longer-term monitoring for health and reproductive status

16:00 - 16:20: Lecture by Zheng Jinsong, IHB
Baiji and finless porpoise genetics

16:20 – 18:00: **International Participant Feedback Session 3**

13. Genetic management
14. Subdivision of populations

18:30 – 20:00: Donor Reception Banquette, Tai Zi Restaurant

2/11/04: Continuing Discussion
Institute of Hydrobiology Meeting Room 506

9:00 – 12:30: **International Participant Feedback Session 4**
Discussion of all unresolved issues from previous day

Lecture from Dr Zhou Kai Ya of Nanjing Normal University
Conservation genetics of the baiji and finless porpoise

12:30 – 13:30: Lunch

13:30 – 17:00: Discussion of baiji and finless porpoise restoration in the Yangtze River

Lecture by Yu Daoping, Tongling Baiji Reserve, Anhui Province
Status of baiji and Yangtze finless porpoise in Tongling

17:30 – 18:30: Workshop concluded with statements by Wang Ding and Randall Reeves

19:00 – 20:30: Farewell Banquette, Hongyi Hotel

Annex C: Presentations on status of baiji and Yangtze finless porpoise

Status of the baiji and a review of baiji capture methods

Presented by Zhang Xian Feng, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan

Abundance

The results of baiji surveys conducted between 1978 and 1996 indicate a steady decrease in estimated abundance (see Table C2, later). In 1997, a comprehensive survey of 1687km of the Yangtze River was conducted. The River was divided into 16 sections that varied in length from 50 to 200km. Thirteen baiji were sighted in 1997, four in 1998 and four in 1999 (Figure C1). Three 'hotspots' were identified where animals generally were seen: Honghu, Balijiangkou, and Tongling (Figure C2).

Opportunistic baiji sightings between 1999 and 2004 are listed in Table C1. The most recent sightings were of a single animal in September 2004 at Tongling and of two animals (one large and one small) in July 2004 at Honghu.

Table C1. Opportunistic baiji sightings between 2000 and 2004

Date	Number	Date	Number
TONGLING		HONGHU	
16/4/2000	1	30/11/2001	2
17/4/2000	2	5/1/2002	2
18/4/2000	2	8/3/2002	2
20/4/2000	2	9/3/2002	2
22/1/2001	1	2/6/2002	1
27/5/2001	1	16/12/2002	2
29/5/2001	3	16/7/2004	2
29/5/2001	2		
29/5/2001	1		
30/5/2001	1		
23/7/2001	2		
23/11/2001	1		
14/3/2002	1		
30/4/2002	1		
28/2/2003	1		
- /5/2004	1		
17/9/2004	1		

Captures

Two baiji capture expeditions have taken place, the first in 1986 and the second in 1995. Both used acoustic driving of animals and subsequent capture with nets. Generally, captures occurred in water 4-10m deep and animals became entangled in the net as the net circle size was reduced. Animals were held in temporary enclosures at the capture site prior to transport by truck or helicopter to the release site. During transport the baiji were kept wet with damp towels.

Proposed improvements to future capture operations include:

- using custom-designed speed boats for netting;

- extending the search area;
- holding animals in temporary pens on the river before transportation;
- using search and driving boats; and
- using safer and faster transportation.

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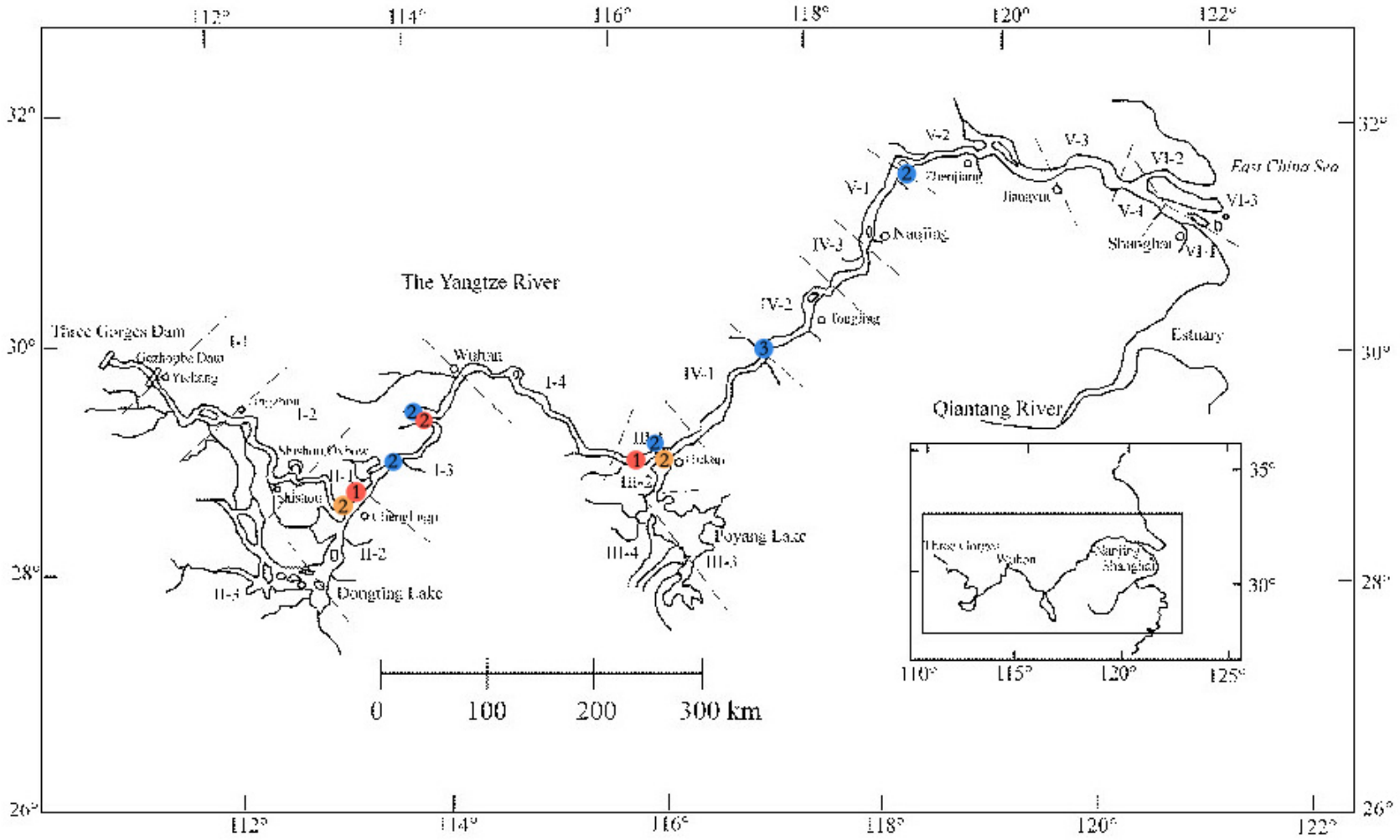
Table C2. Results of Yangtze River cetacean surveys between 1979 and 1996.

Year	Survey Area	Survey Method	No. of Boats	No. of km surveyed	No. of Surveys	No. of baiji sighted	No. of baiji estimated	Reference
1979	Wuhan- Chenglingji	S	1	230	1	19	-	Chen et al. 1980
1979	Nanjing-Taiyangzhou	S	1	170	2	10	-	Zhou et al. 1980
1979-1981	Nanjing-Guichi	S	1	250	6	3-6 groups	400	Zhou et al. 1982
1978-1985	Yichang-Nantong	S	1	1600	9	>20 groups	156	Lin et al. 1985
1985-1986	Yichang-Jiangyin	M	1+4~6*	1510	2	42 groups	300	Chen & Hua 1989
1979-1986	Fujiangsha-Hukou	S	1	630	18	78-79	100**	Zhou & Li 1989
1987-1990	Yichang-Shanghai	M+B	1+4~6*	1669	12	108	200	Chen et al. 1993
1989-1991	Hukou-Zhenjiang	P	8	500	5	29	120	Zhou et al. 1993a,b
1991-1996	Xinchang-Wuhan	M	1+4~6*	413	10	42	<100	Wang et al. 1998

S denotes single boat survey. M denotes multi-vessel survey. B indicates observation from the riverbank. P denotes that opportunistic photo-identification of individual animals was possible.
* One large vessel plus 4 to 6 small boats.
** Lower reaches only.

Figure C1. Location and number of baiji sighted during surveys conducted between 1997 and 1999. Blue = 1997; Orange = 1998; Peach = 1999.



The Tongling reserve and status of dolphins in the Anhui section of the Yangtze River
Presented by Yu Daoping, Tongling Baiji Semi-natural Reserve, Anhui.

The Tongling Reserve
The reserve is 51,950 hectares in area and 110km long. Two mammals, 9 fishes and 14 bird species within the reserve are listed as Chinese endangered animals.

Cetacean Abundance
Between 1986 and 2004, 21 surveys of baiji and finless porpoise were conducted in portions of the Tongling reserve, involving 126 boats and 382 staff. Sightings and density of finless porpoises recorded are presented in Table C3. Extrapolation of recorded densities to the whole reserve indicates that approximately 250 porpoises, or 12.5% of the estimated Yangtze finless porpoise population, is found in the Tongling Reserve.

Table C3. Abundance and density of Yangtze finless porpoise in the Tongling section of the Yangtze River.

Date	Number Sighted	Density Porpoises/km^2
Fall 1993	47	0.213
Fall 1994	59	0.326
Spring 1995	78	0.378
Fall 1997	34	0.183
Fall 1998	80	0.212
Spring 1999	142	0.328
Fall 1999	111	0.344
Spring 2000	182	0.392
Sum	733	-
Average	-	0.297

Tongling Semi-natural Reserve
The semi-natural reserve channel is 1600m long and up to 220m wide, with an average depth of 5-8m. The total volume in the channel is approximately 18×105m^3 in the flood season (Figure C2). Since March 2001, five Yangtze finless porpoises have been placed in the semi-natural reserve at Tongling (Table C4). One male calf was born in 2003.

The following data are collected routinely at the Tongling Semi-natural Reserve:
- Water quality measurements.
- Daily food consumption.
- Behaviour.
- Length and weight.
- Blood.

Skin diseases in the porpoises were noted to be a problem, especially in winter and following capture.

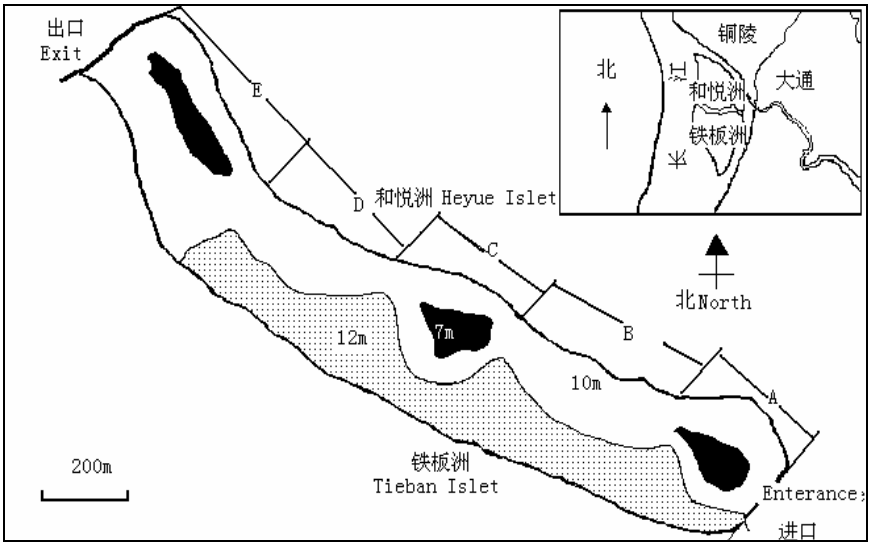


Figure C2 – Plan of the Tongling semi-natural reserve.

Table C4. Captive Yangtze finless porpoises in the Tongling semi-natural reserve.

Capture Date	**Sex**	**Length (cm)**	**Weight (kg)**
12/3/2001	M	137	34
14/3/2001	F	154	38
20/4/2001	F	152	37
3/6/2001	F	157	47
3/6/2001	M	108	19

Annex D: Summaries of presentations on genetics of baiji and Yangtze finless porpoises

Conservation genetics of baiji and Yangtze finless porpoises

Presented by Zheng Jinsong, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan

Rationale

Genetic information is crucial to the conservation and management of threatened populations, but few data are available for finless porpoises and even less for baiji.

Research questions

Is the Yangtze finless porpoise reproductively isolated from other finless porpoise subspecies?
Have isolated stocks formed within the wild population of Yangtze finless porpoises?
What is the genetic status of the finless porpoise population in the Shishou oxbow semi-natural reserve?
What is the genetic status of baiji in the Yangtze River?

Conservation genetics of the finless porpoises:

In the Shishou semi-natural reserve

In June 2002, all porpoises in the Shishou semi-natural reserve were captured to collect basic information such as the number in the population (22), sex ratio and body length. At the same time, blood samples were drawn from each porpoise for genetic analysis. Samples were analysed using microsatellite DNA, Amplified Fragment Length Polymorphism (AFLP) and mtDNA control region sequences. Analysis indicated that the nuclear DNA genetic diversity is moderate for this population. For ten microsatellite loci an average of 4.6 alleles were detected for each locus. Average observed and expected heterozygosity is 0.58 and 0.60, respectively. Through 21 AFLP primer combinations, expected heterozygosity was 0.4430.

Mitochondrial DNA diversity was very poor for the reserve population. The nucleotide and haplotype diversity for this population was 0.0007 and 0.6010, respectively.

In the Yangtze River

Blood samples from 39 porpoises, belonging to six different 'stocks' inhabiting the middle and lower reaches of the Yangtze River, were analysed. The complete mitochondrial DNA control region was examined. Very low genetic diversity was found. Nine variable sites and seven haplotypes were detected. Nucleotide and haplotype diversity was 0.0011 and 0.65, respectively. Significant population genetic structure exists in this region.

Animals in the middle reaches above Wuhan city have only one haplotype (HA or HB), while those in the lower reaches below Ezhou have more than three haplotypes. The animals in the lower reaches show relatively high nucleotide and haplotype diversity, while no diversity was detected for groups of porpoises in the middle reaches.

The Yangtze finless porpoise has very low mitochondrial genetic diversity compared with some other odontocete populations. In addition, the population in the semi-natural reserve has poor diversity compared with the natural population in the Yangtze River. For example, of the seven identified haplotypes in the wild population, only three were detected in the reserve population.

Recommendations for management of finless porpoises

1. Take finless porpoises from the lower reaches of the Yangtze River where genetic diversity is highest and introduce them to the Shishou semi-natural reserve to increase genetic diversity of that captive population. All founder animals in the Shishou semi-natural reserve originated from the middle reaches of the Yangtze River above Wuhan city where genetic diversity is low. This may explain, at least partially, the low genetic diversity within the reserve population.
2. Since genetic diversity was highest in the lower reaches of the Yangtze River, some finless porpoise reserves should be established in those reaches to protect that diversity.
3. The sample size was not very large. Therefore, it is necessary to conduct more extensive genetic investigations at both nuclear and mitochondrial DNA levels.

Genetics of baiji

The analysis was conducted on 21 formalin-fixed tissue samples collected from the middle reaches of the Yangtze River between Wuhan and Shishou during the 1980s. It is difficult to extract DNA from formalin-fixed tissue and although this was accomplished, the poor quality of the DNA resulted in only two segments of 310 and 260 base pairs being amplified from the control region. No variation was detected in the two segments; therefore all individuals share one mitochondrial haplotype, indicating critically low genetic diversity. However, it is important to note that only animals from the middle reaches of the Yangtze River above Wuhan were represented in this study.

Conservation genetics of the baiji and finless porpoise

Presented by Zhou Kaiya, Jiangsu Key Laboratory for Bioresource Technology and Institute of Genetic Resources, College of Life Sciences, Nanjing Normal University, Nanjing

Baiji

This study examined the mitochondrial control region variability of baiji. Twenty samples from individuals from the lower reaches of the Yangtze River were analysed and 428 base pair length sequences were obtained. Three variable sites and four haplotypes were identified. Haplotypes were separated by only one or two transition substitutions. Results are presented in Table D1.

In general, the baiji exhibited much lower genetic diversity in the mitochondrial genome than other marine mammals. Additional analyses conducted on the nuclear MHC genome indicated a richer genetic diversity than the mitochondrial DNA

Table D1. Results of genetic analysis conducted on mtDNA of baiji from the lower reaches of the Yangtze River.

Haplotype	Variable type			No of Individuals	Frequency (%)
	19	361	395		
A	G	T	A	1	5
B	A	C	-	1	5
C	-	C	-	12	60
D	-	C	G	6	30

Finless porpoise

This study examined the mitochondrial DNA control region of finless porpoises. We had 103 samples – 28 from the Yangtze River population, 26 from the Yellow Sea population and 49 from the South China Sea population. Sequences obtained were 420bp from the 5' end of the mitochondrial DNA control region. Seven variable sites were identified, all of which were transition substitutions. No transversion substitutions or indels were found. Nine haplotypes were defined, five (YS01-05) specific to the Yellow Sea population, one specific to the South China Sea population and the other three common to all populations.

Discussion

Much lower levels of mitochondrial genetic diversity exist in the Yangtze River population and the South China Sea population compared to the Yellow sea population. A relatively low level of genetic structure and a high level of gene flow between the Yangtze River population and the Yellow Sea population were indicated. Different populations could not be considered independent evolutionarily significant units, but should be treated as different management units.

Annex E: Presentation on husbandry of the baiji and Yangtze finless porpoise
Presented by Wang Keixong, Dolphinarium, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan

Details of the baiji and finless porpoises that have been held in captivity are presented in Tables E1 and E2, respectively.

Table E1. Details of baiji that have been held in captivity in China.

Name	Dates	Location	Body Length (cm)	Body Weight (kg)	Sex	Conditions of rearing	Survival Time
Qi Qi	12/01/1980 - 14/07/2002	IHB	143	36.5	M	Outdoor & indoor, non-filtered water & filtered water	22.5yr
Rong Rong	22/04/1981 - 03/02/1982	IHB	151	59.3	M	Outdoor non-filtered water	228da
Lian Lian	31/03/1986 - 14/06/1986	IHB	203	100.0	M	Outdoor non-filtered water	76da
Zhen Zhen	31/03/1986 - 14/06/1986	IHB	152	59.0	F	Outdoor non-filtered water	2.5yr
Su Su	03/03/1981 - 20/03/1981	NNU	182	55.0	F	Indoor	17da
Jiang Jiang	07/12/1981 - 16/04/1982	NFRI	174	66.6	M	Outdoor non-filtered water	129da

NFRI – Nanjing Fisheries Research Institute

Table E2. Details of Yangtze finless porpoises that have been held in captivity in China (not including those held in the Shishou oxbow).

Year	Location	Conditions of rearing	Survival Time
1970 to 1980	Shanghai Zoo	Outdoor pool	About 1yr (several individuals)
1978	IHB	Outdoor pool	60da
1981	IHB	Outdoor pool	About 1yr
1985	IHB	Outdoor pool	6mo
1988	NNU	Indoor pool (filtered)	About 2yr
1992	Shanghai China Aquarium	Indoor pool (filtered)	6mo
1993	IHB	Indoor pool (filtered)	18mo
1996	IHB	Indoor pool (filtered)	8yr (2 individuals), still alive
1997	Wuhan New Century Aquarium	Outdoor pool (filtered)	1yr
1999 to 2001	Wuhan New Century Aquarium	Outdoor pool (filtered)	1yr (several individuals)
1999	IHB	Indoor pool (filtered)	5yr, still alive

Water quality

After 1992, baiji and finless porpoises were kept in indoor pools with filters. Generally, most water quality parameters measured were lower in the pools with filters than those without. However, water is retained in the pools with filters for longer periods of time, which may contribute to the higher nitrate level and lower pH in the filtered water. After 2000, a sterilisation system was installed for the indoor pools. Usually, the water is completely exchanged every one or two months.

Water quality recorded in the Shishou oxbow is presented below in Table E3.

Table E3. Water quality recorded in the Shishou oxbow between 1988 and 2003.

Year	PH	Transparency (cm)	DO mg/l	COD mg/l	Total Nitrogen (mg/l)	NH_3-N (mg/l)	Total Phosphorous (mg/l)
1988	7.10-7.49	30-185	5.70-10.50	5.50-40.1	-	-	-
1993	7.11-7.96	60-200	7.24	1.59	1.02	0.064	0.029
1994	-	-	-	1.73	0.85	0.047-0.241	0.038
2003	7.80	79	-	2.72	0.70	0.140	0.060
2004*	7.95	-	7.59	2.60	-	0.360	-

* Values from the Yangtze River for comparison.

Energy requirements of Yangtze cetaceans

Fish species commonly fed to captive baiji are: silver carp (*Hypophthalmichthys molitrix)*, big head carp (*Arishichthys mobilis*), common carp (*Cyprinus carpio*), crucial carp (*Carassius auratus*), black carp (*Mylopharyngodom picens*) and grass carp (*Ctenopharyngodon idellus*). The daily energy requirement of Qi Qi, the baiji kept in the Wuhan dolphinarium for over 22 years, varied between 11.3 and 28.5MJ. The daily energy requirement of finless porpoises is approximately 24MJ.

Medical treatment

Treatment of external injuries:

Dry method – Put the animal in a stretcher and keep it immobile in a shallow-water tank. The animal can be injected and the injuries treated directly .

Wet method – After the injury is bandaged and drugs for external use have been administered, the animal is released immediately into a deep-water pool.

Prevention and treatment of skin diseases:

These conditions are most prevalent in cold and dirty water. The best way to avoid skin diseases is to keep the water clean and avoid external injuries.

The easiest method of treating skin disease is to wash the area with sodium chloride solution and sodium hydrocarbonate solution and then to apply diamond green solution with antibiotic ointment.

Treatment of indigestion:
Oral administration of yeast tablet or multi-enzyme tablet.

Prevention of hotness disease in summer:
Oral administration of Chinese medicines such as Ageratum pill or Jindan pill. Installation of a water cooling machine in 1992 has reduced this problem.

Prevention and treatment of enteritis:
Prevention – Feed the animal suitably sized fish and store the food at low temperature and in a clean environment. Treatment – Oral administration of garlic pill and antibiotics.

Treatment of pneumonia:
Oral administration of antibiotics.

Recommendations for successful maintenance of baiji and finless porpoises

- Keep newly captured animals in a net circle in natural waters for more than one week and train them to take and eat dead fish floating on the water surface.
- Do not move the animals to indoor pools until the daily intake is more than 5% of body weight.
- Keep newcomers in a shallow-water pool temporarily for relaxation of muscle and do not move them to deep water until they can swim freely.
- Keep the pool water clean using filter and sterilisation system especially in winter and spring; otherwise skin diseases will be out of control causing the animals, especially porpoises, to die.
- Train the animals to take fish from the keeper's hand as soon as possible in order to facilitate husbandry.
- Do not conduct physical examination of animals frequently, as it can cause skin injuries and stress.

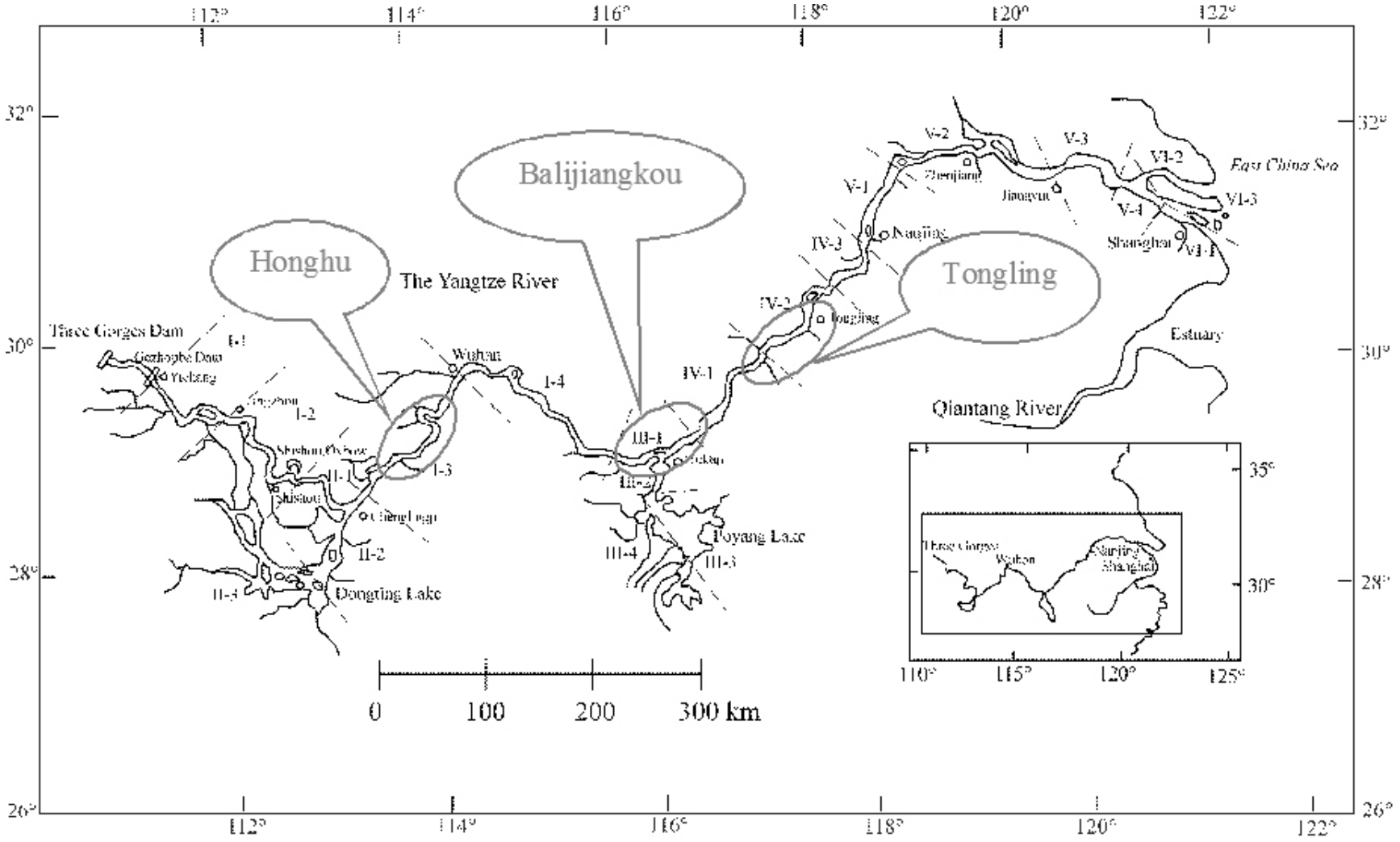


Figure 1 – Map of the middle and lower reaches of the Yangtze River, indicating areas where baiji are sighted occasionally.

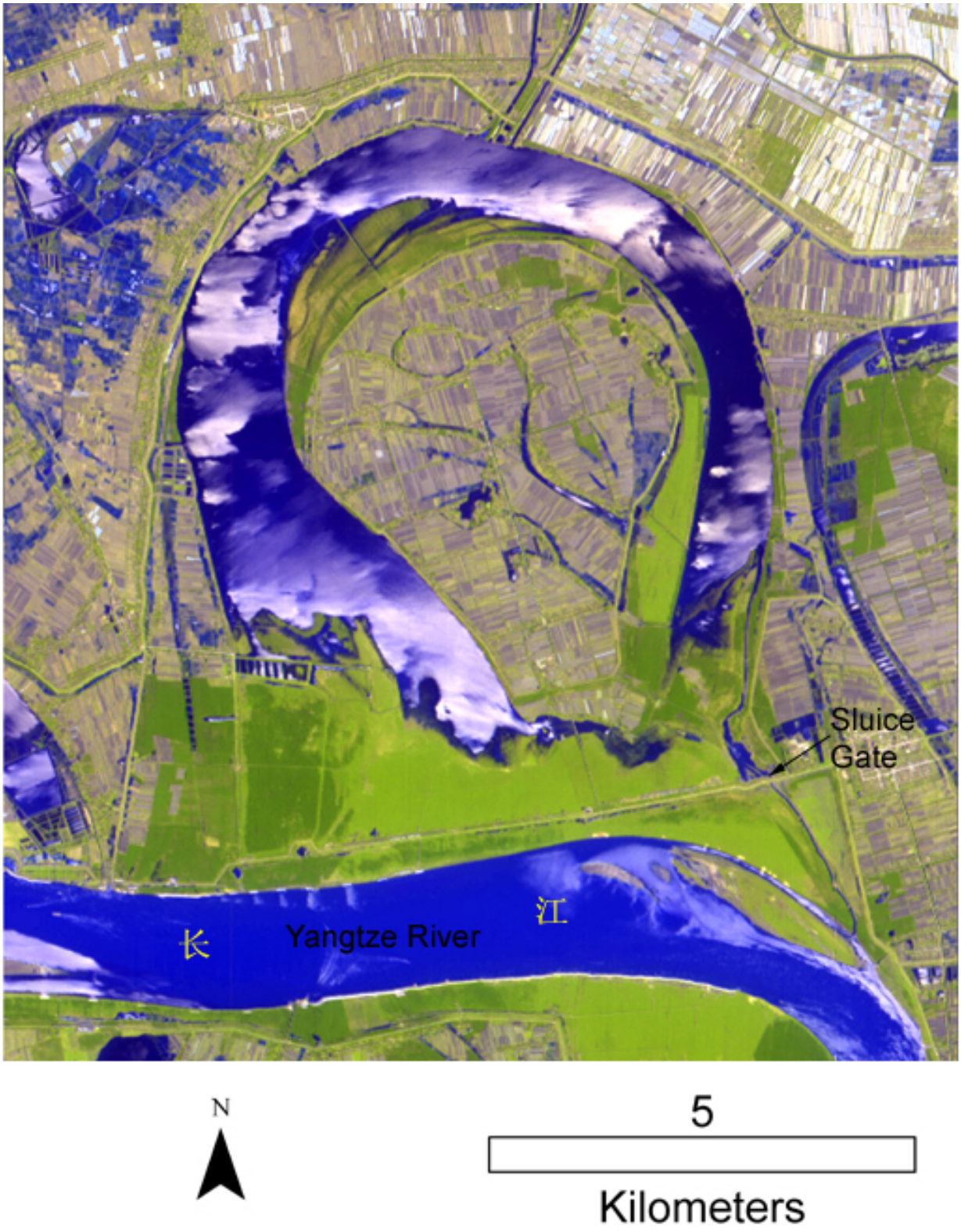


Figure 2 – Aerial view of Shishou semi-natural reserve.