An Ecosystem Approach to Resolving Conflicts Among

EXECUTIVE SUMMARY

Poyang

Step 1. The rationale for the proposed dam – that hydrology of Poyang Lake has changed in recent years, to the detriment of natural systems and economic benefits – needs to be rigorously and quantitatively assessed to determine the extent and impact of any change in hydrology.

Step 2. A conceptual model for the system should be developed and tested, that includes the watershed, hydrology, vegetation, fish, Finless Porpoise, waterbirds, the human components, and other important variables, so that complex interactions among these variables can be understood and future changes predicted.

Step 3. If environmental change has occurred, the drivers of this change need intensive analysis, including the effects of other water projects. The various factors probably interact, and in that case their separate and combined contributions need assessment.

Step 4. Information gaps need to be identified and, in some cases, filled through further research before the best choices can be made for Poyang Lake. For example, economic development opportunities and strategies have been elaborated for the dam option, but also need considerable study as part of steps 5 and 6 below for the other (non-dam) options for Poyang Lake. Such studies should examine potential benefits if the funds intended for the dam construction, and for mitigating its negative impacts, were instead spent directly upon improving livelihoods of people living within the basin or its watershed, through a Payment for Ecosystem Services or other development approach.

Step 5. Based on what has caused environmental change at Poyang, a diverse array of management options should be identified. The proposed dam would be one of these options. In order to evaluate the proposed dam as one alternative, the design and operation plan for the dam need to be completed so that their impacts can be fairly assessed.

Step 6. A thorough economic and environmental analysis should compare the various mitigation strategies with one another, in terms of costs and benefits and values of the ecosystem services of the wetland in particular.

Regardless of the decisions made after this process is completed, management of Poyang Lake and its waters is best accomplished by regarding the entire system as a whole, through creation of a management agency that operates across the entire lake basin and its watershed. Such a management body must have the authority, independence, and commitment to assess scientifically the impacts of management actions and to implement adjustments as needed to offset unintended, negative consequences.

Because informed decisions depend on technical information, an inter-disciplinary scientific or advisory council should be established to provide advice to the management body. This advisory council should oversee ל ל on to ̃ לto M ל ר

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INTRODUCTION

Poyang Lake is the largest freshwater lake in China, of extraordinary importance to the people of Jiangxi Province as well as millions of people downriver in the Yangtze

Recommend tools that enable balancing of ecological and economic values

Propose a process that supports sustainable development while maintaining ecosystem services of the wetland

EXPLANATION OF THE ECOSYSTEM APPROACH TO LAKE AND WETLAND MANAGEMENT

The Convention on Biological Diversity defines the Ecosystem Approach as: a

has a seasonal, reverse-flow system from the Yangtze River which greatly contributes to the complexity of its yearly hydrological variation. This variation, both within and among years, directly contributes to the large biomass of plant life (Li et al. 2004).

Figure 1. Map of Poyang Lake showing boundaries of Poyang Lake Nature Reserve, the location for the proposed dam, and hydrological station at Xingzi.

In the summer, the lake has a surface area of more than 4,000 km^2 (Shankman and Liang 2003). Falling water levels during autumn months expose extensive mudflats and leave behind isolated sub-lakes (Yesou et al. 2009). These dramatic hydrological variations at Poyang Lake drive the ecological processes within the system and are directly responsible for producing a wide range of habitats that support rich biodiversity. Specifically, the seasonal changes in water levels create two, separate

wetland and migratory birds and its countermeasures;

aquatic life resources in Poyang Lake and its countermeasures; and

the linkage between Poyang Lake and the Yangtze River.

Each team is charged with developing a report by May 2010. These reports will then be considered together and consolidated into one document.

This process is to be commended for the range of disciplines and expertise that has been involved. Yet the very short time for the teams to investigate and develop their reports – roughly six months – has precluded any new research that might fill gaps in what is currently known. In addition, the teams were not charged to consider the range of alternative options for Poyang Lake, but only to assess the dam, its impacts and countermeasures, and to then recommend whether or not the dam should be built. The process does not allow for comparison with actions other than the dam that might have a different balance of benefits and environmental safeguards.

A document prepared by the Jiangxi Office of the Key Water Projects at Poyang Lake (2010) summarized the reason behind the need for the dam:

> Poyang Lake no longer possesses its original ecological system and it is undergoing a gradual trend of shrinking. Especially in recent years, the dry season has come ahead of its time and lasted longer, exacerbating ecological problems of Poyang Lake and increasing pressure on the Lake's ecological system.

The document then lists the problems that have arisen: conflict between irrigation water and domestic water, gradual deterioration of wetland and water ecological environment, slow development of shipping and fisheries, deterioration of lake water quality, and prevalence of schistosomiasis due to T38(lake)1T

side and a fish ladder on the east side. The dam would consist of a series of sluice gates. Currently, a design with sluice gates of 16 to 20 meters in width is being considered. It is not yet decided how these gates would open.

The dam is intended to close the connection between the lake and the river only during the dry season, but would remain open and allow natural flow of water during the wetter half of the year. A tentative operation scheme has been outlined in this document:

> During the river and lake connection period (from April 1 to August 31), all gates are open to connect Yangtze River with Poyang Lake;
>
> During the water storage period of Poyang Lake (from September 1 to 20), the gates are closed to store the flood tail of Poyang Lake and maintain the water level at 16 to 17.5 meters;
>
> During the water storage period of Three Gorges (from September 21 to October 31), the upstream water level of the gates is lowered from 17.5 to 16 meters or so; and
>
> During the compensation regulation period (from November 1 to December 31) and lower water period (from January 1 to March 31), the water level is regulated in accordance with water demand of the lower reaches and the habits of migratory birds to rationalize the utilization of water resources, protect ecological environment and promote social-economic development.

This operational plan does not specify the water levels or fluctuation during the five-month winter period, nor does it consider how to resolve potentially incompatible objectives during that time. Such issues await reports from the six teams, but greater clarity on the goal of this project – is the primary purpose to restore the natural ecology of Poyang or to control and improve the lake? – would make impacts of the project more feasible to predict. The proposed design of the dam does allow adjusting water levels based on varying needs or on evaluation of impacts during its operation.

NEED FOR A CONCEPTUAL MODEL FOR LAKE FUNCTION

The ecological approach relies on an understanding of how a system functions. Poyang Lake is especially complex because of remarkable fluctuations in water within and among years, the size of the lake, and the scale of processes that encompasses not only almost all of Jiangxi Province as the lake's watershed, but also the vast upriver basin of the Yangtze.

The different parts of the system are all dynamically inter-connected, so that changing one element of the system alters other elements often in unexpected ways. Thus careful but separate analyses of the multiple elements of the system cannot simply be added together to make a whole, because these elements mutually interact with one another – this interaction is particularly sensitive to changes in hydrology because in many respects water drives the system.

We already described the example of the inter-relationships linking Siberian Cranes with its food plant *Vallisneria*. The

in the north, within the narrow channel and near the dam site) can be >4 meters. In the south, at Kangshan in January, the average water level is 13 meters, and at Wucheng (close by Poyang Lake Nature Reserve) it is 12 meters, while at Xingzi in January the water level averages about 9 meters. When the water level reaches about 15 meters, however, the surface of the entire lake flattens out (the entire basin is flooded). In other words, for water level changes of Poyang Lake, the winter-fall season water surface will slope downward from south towards the north. The process of water increase will exhibit the pattern of flooding that starts in the north then spreads to the south (even when water comes from the south). With a dam, all slopes during the low water will be dramatically reduced if the lake is maintained at 15 meters or higher, and the water level everywhere will become relatively flat.

Figure 2. Average monthly water levels (in meters above sea level Wu Song) for four monitoring stations at Poyang Lake, 1952-2007 (Hukou from 1978-2008). The stations are listed in order from Kangshan in the south to Hukou in the north.

In fall, when water drops below 15 meters, water withdrawal will exhibit a pattern from north to south (water will go down first in the north), so the slope will reappear. If the water levels are controlled near Xingzi, this basic and unique characteristic of Poyang Lake will disappear. Repercussions on other elements of the system are unknown, but the next paragraphs illustrate one significant impact.

Changes to the water exchange cycle for the lake, with impacts on water quality

The annual water exchange rate for Poyang Lake is on average 20.9 days (China Academy of Sciences). In other words, the waters exchange in the lake almost 18 times in one year. This exchange rate is only longer than Dongting (18.2 days), so that Poyang has the second fastest rate of exchange for large lakes in the country. The rapid exchange of water is a physical condition that keeps the water clean within the lake, by flushing out pollutants. When the water level drops below 15 meters, with the condition of slope described in the last section, the character of the flow is gravity flow, and the speed is

weakens so that wind becomes an important factor; during this period, the speed of wind-driven water is relatively slow, usually 0.1 to 0.8 meters/seconds. Therefore, the water exchange rate is slow. At the end of the five river flood season, when Yangtze River water level increases fast, the flow is small, usually within 0.1 meter/second. The higher the lake water level, the slower will be the speed. At this time, the lake exchange period will be longer than in winter (not considering evaporation). Thus the natural process of flood and water ebb together with the process of ŒS1$ñ“D) "HĐĐ

floodwater from Poyang Lake to the Yangtze River even when the sluice gates are open. The barrier at the outlet, as well as higher water levels in winter and early spring, increase the risk of flooding in the Poyang region.

Impacts on the distribution and abundance of aquatic plants

The distribution area for aquatic plants between 2006-08 averaged2,012km^2 of the lake (T. Marie, University of Louis Pasteur, unpublished data). While this average is lower than the ~ 2262 km^2, or 80% of the lake, covered by aquatic vegetation in the 1980s (Wang and Dou 1998), the three years 2006-08 showed considerable annual variation; such short-term change seems to account for the difference. Submerged aquatic plants are distributed between 9 and 12 meters elevation, and mainly include *Vallisneria* and *Potamogeton*, with previous area estimates of about 1366

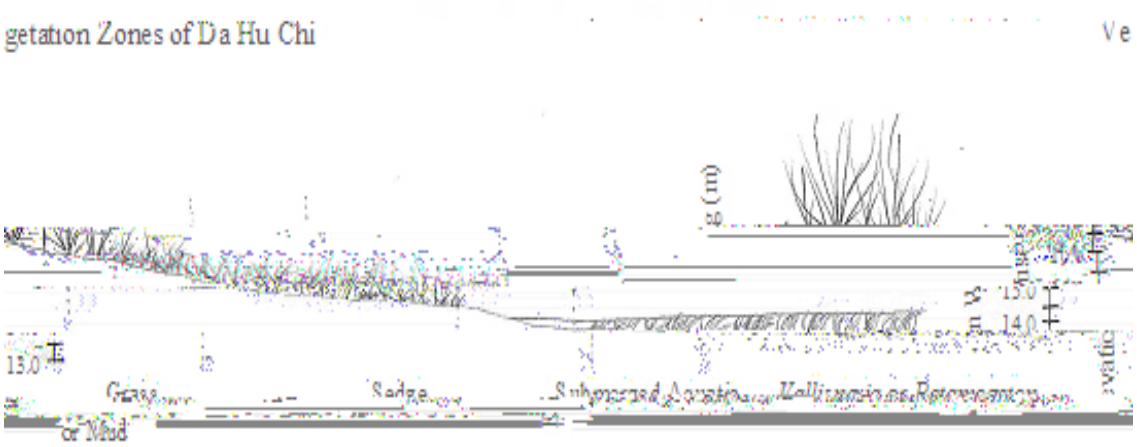

Figure 3. An illustration of different vegetation zones at

tuber-feeding foraging guild -- all feed on tubers of submerged aquatic plants, primarily *Vallisneria* (although White-naped and Hooded Cranes are less heavily dependent on this food in winter than the other three). Water levels in both summer and winter are critical for foods of these species. Summer water levels must be suited to growth of the plants (unlike the sedges and grasses, they grow during the warm seasons); during winter, *Vallisneria* is senescent, but the birds require shallow water or wet mud so that they can access the tubers. Deep water or dry mud prevents cranes and other birds from utilizing this food. Siberian Cranes primarily feed at water depths < 30 cm, and occasionally up to 50 cm (ICF unpublished data). If water levels were maintained at 14 or 16 meters Wu Song at Wucheng for even portions of the winter in areas utilized by the birds, almost all current habitat would be deeply submerged and tubers unavailable to the cranes (Barzen et al. 2009). The few areas remaining would force the birds to forage near the upper edges of the wetland, where human disturbance is high. Cranes, however, historically do not feed or roost near people at Poyang.

Other birds form the fish-eating foraging guild, including the Oriental Stork. The Oriental Stork specializes in fish injured or trapped where water levels are dropping and shallow. Significant changes in winter water levels could remove this favored habitat as well.

Collectively these species depend on Poyang Lake in winter for survival. The availability and condition of alternate habitats within the lower Yangtze River floodplain is declining. Dongting Lake, for example, has in recent years lost almost all its tuber-feeding birds, while over the last five years, tuber-feeding birds have drastically declined at Shengjin Lake (Fox et al. in press). Loss of Poyang Lake as foraging habitat due to high winter water levels could have catastrophic impact on a suite of threatened and declining species.

If available habitats at Poyang Lake

collisions, pollution and water management projects. The density of porpoises in Poyang Lake is the highest compared to all other water areas.

The Finless Porpoise is an aquatic mammal and depends on sonar reflection to navigate and feed. Therefore they

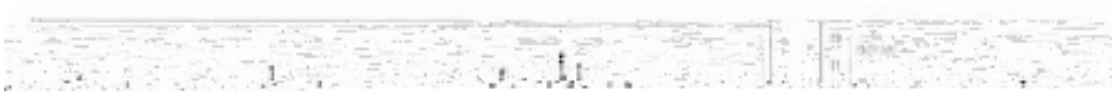

Figure 4. Average monthly water levels

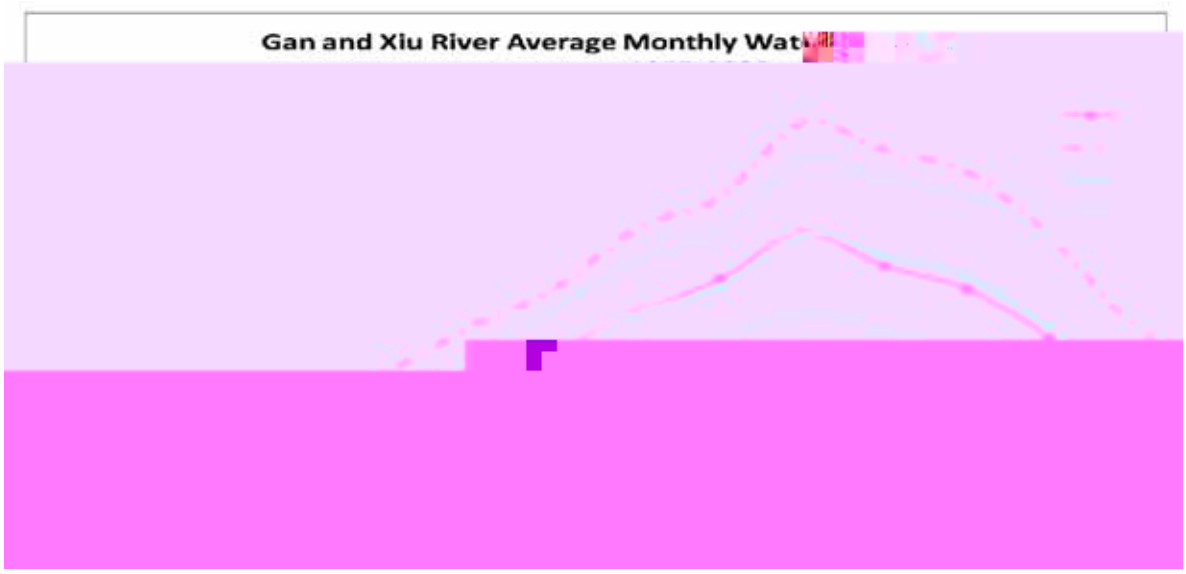

Figure 6. Average monthly water levels by month with variability for Gan and Xiu Rivers at Wucheng, 1955-2008

Standard deviation measures the variability of

seriously affect the propagation, growth and subsistence of fish in the lake. Poyang Lake is also significant habitat for rare animal species such as the IUCN Red List Critically Endangered Chinese Sturgeon, and the Vulnerable Finless Porpoise. The increased water turbidity from dredging activities (Wu et al. 2007a, Wu et al. 2007b) may decrease the available light for photosynthesis of *Vallisneria (Wu* et al. *2009b)*, and consequently cause a decrease or disappearance of the food source of Siberian Cranes. Dredging also modifies the topography and removes the sediments of the lake, and may reduce the winter water levels and result in increased hydrological gradient and stream velocities upstream. This could in turn might enhance

adjusting the operation of the dams should be evaluated. These two studies are linked but alternatives may exist for adjusting operation of dams even if they are not the primary cause for hydrological change at Poyang. For example, even if the Three Gorges Dam is not significantly affecting the length of the low water period in winter at Poyang, it is possible that delaying the water storage period at Three Gorges during the autumn period could help mitigate the early lowering of water at Poyang.

Water conservancy measures within the watershed

Establish an ecological buffer area to improve the water quality of Poyang Lake. While controlling industrial and agricultural pollution and treating domestic sewage before it goes into Poyang, establish an ecological buffer area outside the shoreline of the lake corresponding to the highest water level, while changing the traditional farming methods (which use large amounts of chemical fertilizer per unit area) to improve the water quality. Regulate land use activities within the ecological buffer, and restore natural vegetation, to minimize run-off into the lake.

Environmental flow support. Adjusting to the annual change in run-off water volume, a basin-wide system for water management and timed releases of water from the many impoundments on the tributary rivers could be developed. In addition, measures are needed to reduce unreasonable water consumption in the area -- for example by improving irrigation infrastructure, recycling water, or phasing out industries highly wasteful of water in favor of more water-efficient industries -- in order to ensure the normal survival and reproduction of species and ecological communities, and to maintain the

economic Development Zone can play a strong positive role by reconciling the many, sometimes conflicting objectives of stakeholders in the basin and ensuring that development policies, strategies and plans include the maintenance of ecosystem services and natural values.

In the case of Poyang, development of the area surrounding Poyang Lake needs to be linked to land use and conservation efforts across the watershed – which in this case includes almost the entire province. The fact that the province and the watershed so closely coincide is a strong advantage for integrated wetland, water, and watershed management. Current efforts of Jiangxi Provincial Government already are deriving benefits from a broad view of lake and environmental protection.

The recent establishment of the Poyang Lake Eco-economic Development Zone, as a special, national level priority, also allows the province to channel development money where it can mak.2240TD0.000eo2ioall

granted (e.g., water utility companies pay

in 2002); Article 6 of the Forest Law, revised in 1998, expressly declared that “the State will establish eco-benefit forest compensation fund to foster, tend, conserve and manage forests protecting ecological benefits, forest resource and trees with special uses.” The period from 2001 to 2004 was designated as the pilot stage for a forest eco-benefit subsidy program. In 2004, the forest eco-benefit compensation fund was officially established by the Central Government. At the same time, the Ministry of Finance and the State F(the)H7Rj/TT2eTD0tage

Numerous other case examples are relevant to the process and decisions underway for Poyang Lake. IUCN could provide additional case study materials if desired, or assist with arranging study visits by Jiangxi Government management and technical staff to

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Table 1. Recommended steps for a decision process for Poyang Lake management

Step 1. The rationale for the proposed dam – that hydrology of Poyang Lake has changed in the past several years,

rigorously and quantitatively tested through comparison with data on the lake collected over the past 50 years. Data should also be collected and analyzed for additional years before a decision on the dam is made, to avoid reacting to what may be a short-term cycle rather than a long-term change.

Step 2. To successfully analyze environment change and impacts of alternative management scenarios, a conceptual model for the system needs to be developed and tested that includes the watershed, hydrology, vegetation, fish, Finless Porpoise, waterbirds, human components, and other important variables. This model is especially important due to the complex hydrology of Poyang Lake. The model will help ecologists (who think in terms of complex systems, feedback loops, and ecological constraints) to collaborate effectively with engineers (who focus on key variables in the system and how to control or adjust them). These groups need a framework for building mutual understanding of the issues involved, how to address them, and the ways that perspectives on both sides can evolve in the decision process.

Step 3. If environmental change has occurred or is likely the various causes for this change need intensive analysis, including the effects of other water projects. The various factors probably interact, and in that case their separate and combined contributions need assessment.

Step 4. Given the importance of Poyang Lake regionally and globally, information gaps need to be identified and, in some cases, filled through further research before the best choices can be made for Poyang Lake. Time must be provided to identify and complete this research. For example, economic development opportunities and strategies have been elaborated for the dam option but also need considerable study as part of steps 5 and 6 below for the other (non-dam) options. Such studies should examine potential benefits if the funds intended for the dam construction, and for mitigating its negative impacts, were instead spent directly upon improving livelihoods of people living within the basin or its watershed through a Payment for Ecosystem Services or other development approach.

Step 5. Based on what has caused environmental change at Poyang an array of strategies should be identified and assessed. If multiple causes are responsible for negative environmental changes, then mitigation strategies likely need to be considered in various combinations (e.g., adjustment in water releases from upstream dams combined with water conservancy measures such as improving irrigation infrastructure). This step is crucial, as the dam appears to have many negative impacts that could be avoided through other more effective, and potentially much less expensive options.

Step 5a. In order to evaluate the proposed dam as one of the alternatives, the design for the dam and water management plan needs to be completed early enough that its impacts can be fairly assessed. The proposed dam could

Recent changes to Poyang Lake water levels in early autumn might be much more cheaply solved through an IWRM approach to the catchment as a whole through modifying the operation of more than 9,000 dams and upstream water diversions. A payments for ecosystem services scheme -- utilizing funds that might have gone toward the dam and mitigating the resultant loss of the ecosystem services of the wetland -- might be highly effective at compensating upstream water users at a far lower economic and ecological cost than for the dam option.

Other features of an effective assessment and decision process

As has already been recognized, the process for effective assessment and decision-making requires diverse teams of scientists across multiple disciplines. The effort to integrate information about different elements of the Poyang Lake ecosystem, and the human activities that depend on the lake, is especially important and should occur through an open process that invites external scientific comment.

Regardless of the options selected for future action, management of Poyang Lake and its waters is best accomplished by regarding the entire system as a whole, through establishment of a management committee or agency that can operate across the entire lake basin and its watershed. The creation of the Mountain, River and Lake Development and Management Project (MRL) in 1980 demonstrates that the Jiangxi Government has long recognized that issues surrounding Poyang Lake do not stop at the lake's boundaries. MRL, however, does not have regulatory authority over activities occurring within the lake basin.

Institutional mechanisms should place that regulatory authority within one agency, to reflect the large scale at which analysis and decisions should occur, and will need to involve the diverse stakeholders as members of the management body. After the selected responses to environmental change at Poyang have been put in place, such a management body must have the independence, commitment, and authority to conduct rigorous assessments of the impacts of those actions and to implement adjustments as

Ramsar Convention's context, monitoring is largely focused on measuring changes in ecological character of internationally important wetlands, such as Poyang Lake (Ramsar Convention Secretariat 2008a).

The recognized international importance of Poyang Lake for biodiversity, especially its populations of migratory waterbirds, mean that post-project monitoring against baseline information collected before the project, using comparative methodologies, will be critical in determining the actual impacts of proposed developments (including the operational phase if a dam is constructed) and the effectiveness of planned mitigation measures. The monitoring program specified in the project document should measure changes in ecosystem processes as well as effects on biodiversity over a long enough time (ideally 10 years or more) to adequately document the overall impact of the development and to guide management responses.

For Poyang Lake, inter-disciplinary teams should be formed to assess the monitoring data and to determine required adjustments in the monitoring regime. Institutional mechanisms are required that will allow recommendations of these teams to be implemented through adaptive management procedures.

Given the global, national and local importance of the resources at stake, it is critical that institutional mechanisms respond rapidly to unforeseen or underestimated environmental impacts to manage the environmental risks posed by this project.

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ANNEXES