Journal of Coastal Research	SI 39	912 - 914	ICS 2004 (Proceedings)	Brazil	ISSN 0749-0208

Lagoon Management and Black-faced Spoonbill Conservation: Issues and Challenges in the Greater Chiku Area, Taiwan

W.Y. Chiau

Professor, Institute of Marine
Resource Management
National Taiwan Ocean University
Keelung City 20224, TAIWAN
Email: chiau@mail.ntou.edu.tw

ABSTRACT

CHIAU, W.Y. , 2006. Lagoon management and black-faced spoonbill conservation: Issues and challenges in the greater Chiku Area, Taiwan. Journal of Coastal Research, SI 39 (Proceedings of the 8th International Coastal Symposium), 912 - 914. Itajaí, SC, Brazil, ISSN 0749-0208.

In the past few years, significant increases in the number of wintering Black-faced Spoonbills (*Platalea minor*) have been found in the Chiku Lagoon and its surrounding fish ponds in southwestern Taiwan. However, what must be born in mind is that a significant percentage of the population could quickly be wiped out by disease or a natural disaster; the spread of botulism in the Chiku Area in 2002 serves as a prime example. This incident, nevertheless, exemplifies the resulting unprecedented opportunity to closely investigate the biology of these birds. Research on mitochondrial genome diversity was conducted after the incident, and a very low level of genetic diversity of Black-faced Spoonbills was determined, thus implying that Black-faced Spoonbills are highly vulnerable to disease and that preventing any further genetic erosion of the species presents a great challenge for its future conservation. The botulism intoxication of the Black-faced Spoonbills also illustrates the importance of not only international cooperation and a national contingency plan to save wildlife, but also the overall environmental management of the Greater Chiku Area, including the Lagoon and its surrounding areas. In this regard, this paper discusses the major issues relating to Black-faced Spoonbills in the Greater Chiku Area and presents eight recommendations to achieve the goal of conserving both the wetlands and the Black-faced Spoonbill.

ADDITIONAL INDEX WORDS : *Lagoon, Black-faced Spoonbill, Taiwan.*

INTRODUCTION

A famous site for observing the endangered species the Black-faced Spoonbill (*Platalea minor*) in Asia, the Greater Chiku Area, including the Chiku Lagoon and its surrounding wetlands, in Tainan County is located in the southwestern part of Taiwan It is estimated that some 900 Spoonbills exist in East Asia and that two-thirds of them migrate from Northeast Asia (primarily Korea and Northeast China) to the Greater Chiku Area every year.

Since 1992, a series of studies on population, habitats and the management of the Black-faced Spoonbill has been carried out in the Greater Chiku Area. The primary habitats of Spoonbills are found at a reclaimed tidal flat in an area located to the south of the Chiku Lagoon and in the northern area of the Tsengwen Estuary, originally intended for industrial use. At night, the Spoonbills forage around the surrounding areas of the wetland which is mainly made up of aquaculture fish ponds. Based on repetitive observations of some tagged birds which had continuously been using the same fish ponds for many consecutive years, it seems that the species has site tenacity both for foraging and resting. Moreover, the widely accepted reason behind their using a given pond is seemingly water level -- usually less than 20 cm in depth (WANG, 2003). The research findings illustrate the interrelations between the primary habitat and the surrounding fish ponds in the Greater Chiku Area. The research also indicates the importance of water level adjustment in those identified fish ponds, the importance of communication with and education for local fishermen, and the necessity to reserve a portion of the fish ponds for routine and emergency uses.

Since Black-faced Spoonbills are rare, if not approaching extinction, and since many factors threaten the fate of the species, their conservation is definitely a challenge to Taiwan. A set of adequate mechanisms for the long-term conservation of Spoonbills in the Greater Chiku Area is essential.

BOTULISM OUTBREAK IN 2002

In the last few years, significant increases in the number of wintering Black-faced Spoonbills (*Platalea minor*) in the Chiku Lagoon and its surrounding fish ponds in south western Taiwan have been noted. Such increases can probably not be attributed to the success of natural breeding alone, for it is also likely a result of the concentration of birds at these sites. However, the over-concentration of more than 70% of the global population of Black-faced Spoonbills at these sites is a considerable threat to this endangered species. A significant percentage of the entire population could be wiped out by disease or a natural disaster; the spread of botulism in the Chiku Area in 2002 serves as a prime example (CHAN, 2003).

During the period of botulism intoxication among the Black-faced Spoonbills from 9 December 2002 to 5 February 2003, some 90 Spoonbills were infected, and only 17 of them recovered. The remaining 73 died in the first ever reported tragedy related to this critically endangered species (CHAUNG *et al.*, 2003a).

Based on experiments, including animal trials, Clostridium botulinum isolations from dead Black-faced Spoonbills, and studies on the dead Great Egrets, and on the sedimentary soil of the northern fish ponds as well as a PCR assay for the Clostridium botulism type C_1 toxin gene, botulism intoxication caused by Clostridium botulism type C_1 was diagnosed in this outbreak among the Spoonbills (HSIEH *et al.*, 2003).

The incident, nevertheless, has provided an unprecedented opportunity to closely investigate the biology of these birds. Research on mitochondrial genome diversity was conducted for sequencing the entire ND2 gene (about 1,100 bp) for 65 birds and part of the cytochrome-b (cyt-b) region (about 700 bp) for 30 birds. The research concludes that no variations exist in the cyt-b region, but minor polymorphism is present in the ND2 region. For the ND2 region alone, three haplotypes were discovered with low haplotype diversity (0.173; S.D. = 0.061) within the samples. The mean pairwise difference among the samples was as low as 0.00029 (S. D. = 0.00010). This low level of genetic diversity suggests that the population of Black-faced Spoonbills is highly vulnerable to disease. It also implies that preventing any further genetic erosion of the species presents a great challenge (LI, 2003).

Although the "Wildlife Disease Outbreak or Emergency Reporting and Crisis Management Measures for Endangered Species" was drafted by the central authority (i.e., the Council

of Agriculture), contingency schemes still need to be put into practice for future enforcement.. At the beginning of the botulism incident, many problems arose in responding to the call to save the Spoonbills. Though the response was deemed by some to be quick enough, practical experience was clearly lacking. The chaos that resulted underscored conflicts among NGOs, the weak integration of governmental agency policies and actions as well as the urgent need for related research and the development of a botulism antiserum. Without some outstanding domestic experts and prompt international assistance, Taiwan would be unable to adequately overcome a similar incident in the future. It is believed that the experience from the response to combating the botulism infection of Spoonbills in Taiwan can serve as a valuable reference for other parts of the Asia-Pacific region.

INCREASED LOSS OF WINTERING HABITATS

In addition to the botulism intoxication of the Black-faced Spoonbills, many other examples of large numbers of birds being killed in a very short time abound on account of botulism, avian cholera and various other infections or toxins. In this regard, it is a must that more suitable habitats for Black-faced Spoonbills be provided lest the birds should be over-concentration at just a few sites (CHAN, 2003).

As stated earlier, the botulism intoxication of the Black-faced Spoonbills illustrates the importance not only of international cooperation and a national contingency plan to save wildlife, but also of the overall environmental management of the Chiku Lagoon and its surrounding areas (i.e., fish ponds and nearby land areas) (WANG, 2003; GIBERT, 2003). Although some 634 hectares (i.e., 300-ha main habitat and 343-ha fish ponds) of "Black-faced Spoonbill Protected Area" has been delineated, many extraneous factors are still threatening the fate of the Black-faced Spoonbills (TAI *et al*., 2003.; CHAUNG *et al*., 2003b). The major threats which diminish the quantity and quality of the wildlife habitats include the following:

1. The Pinnan Industrial Complex Plans have been made to build this industrial area just on the edge of the Chiku Lagoon. The original plan of this some thousand-hectare area for a petroleum and steel industrial complex would have reclaimed the entire area of the Chiku Lagoon except that after a long controversial environmental impact assessment study that lasted for more than five years, the originally planned total area was reduced to around 1,000 hectares. The industrial plan has finally been passed on a conditional basis but is still being considered in light of the huge harbor and the land use application. The Pinnan project will certainly decrease the area of the habitats (i.e., the lagoon, fish ponds and salt ponds) as well as the overall environmental quality of the Greater Chiku Area.

2. The International Cargo Airport -- In addition to the future adverse impacts which may likely result from the on-going project of the Pinnan Industrial Complex, the Tainan County Government has insisted on building a new international cargo airport to the north of the Lagoon. The airport noise from landing and departing flights will certainly create a sound wall that will hinder birds from accessing their primary habitats and foraging areas. It will also significantly affect Black-faced Spoonbill behavior and habituation, causing them to mask, to be highly agitated, to avoid flying across the noise wall to foraging areas and even giving up their primary habitat (HESTER, 2003).

3. The change in the culturing products in nearby fish ponds As shown in Table 1, the Spoonbills heavily depend on neighboring fish ponds with their abundance of food and suitable water depths. However, these aquaculture ponds for shallow water fishes in the past have been gradually transformed into areas which culture clams in deeper water. Without effective control over the nearby foraging areas, changes in the aquaculture ponds will eventually threaten the feeding habits of the Spoonbills.

4. Shoreline erosion control projects along the coast and Lagoon The Water Conservation Administration has conducted several projects to control serious erosion in the nearby coastal areas including the Tsengwen Estuary and Chiku Lagoon. The Lagoon will possibly be dredged to clean out sediments, and this without a thorough and careful investigation and assessment of the impact. Obviously, this may influence the existing natural processes of the lagoon ecosystem. In addition, the dike bordering the primary habitats of the Spoonbills may be damaged by the side effects of man-made structures (e.g., offshore jetties) since they will block drifting sands for shoreline stability and eventually threaten the fate of the Spoonbills.

The above proposed coastal projects have, indeed, been controversial, but regardless, the Tourism Bureau, all the while, has been planning to establish a "National Scenic Area" on the Tainan Coast (HESTER, 2003). The lack of integrated efforts on the part of governmental agencies vis-`a-vis the coastal projects will be sure to further aggravate the difficulties of protecting Spoonbills and other wildlife in the region. It also implies that in Taiwan, there is an urgency for a cohesive and integrated coastal management system which includes a comprehensive spatial plan and an effective administrative mechanism.

RECOMMENDATIONS FOR WETLAND AND SPOONBILL CONSERVATION

The management challenges posed by the Chiku Lagoon and its surrounding areas, particularly since the recent botulism incident, will be toughe than ever before (CHIAU, 2002). Recommendations are, therefore, as follows:

1.Integrating all resources to save the Black-faced Spoonbills is essential, and this should include the establishment of a database on the availability of experts in the field, the development of botulism antiserums and accessibility to relevant information for the protection of Spoonbills. The 2002 botulism outbreak among the Black-faced Spoonbills was a shock to Taiwan owing to the large number of casualties it caused. Although the emergency response was fairly quick, a lack of experience, of experts, and of necessary materials for such an unprecedented outbreak still undermined the operation. An integration of all resources to save wildlife is necessary to avoid chaos in the early stages of a hazard response.

2. Reviewing all large-scale coastal projects such as the construction of the Pinnan Industrial Complex and the Tainan Cargo Airport is crucial in order to be able to examine their feasibility and/or to find alternative sites for their possible relocation. Recently, both projects have been pending by the central government which finds them economically unnecessary for the near future. It is believed that effectively maintaining fishing jobs and developing more employment in ecotourism can sustain the local economy and accommodate additional heavy industry or large-scale development projects.

3. Examining the carrying capacity of spoonbill habitats in the Greater Chiku Area and enhancing the overall management of all coastal wetlands in western Taiwan are two important measures. The over-concentration of Black-faced Spoonbills in the Greater Chiku Area is actually a threat to this vulnerable species. Although 95-99% of the spoonbill population stays in the Chiku Area, the remaining stays in 17 river estuaries. In particular, 6 of them (i.e., the Tamshui, Touchen, Dadu, Tsengwen, Yenshui and Lanyang Rivers) are also important for wintering Spoonbills (LIU and CHIANG, 2003). Except for the Lanyang River, these are all located in the coastal areas of western Taiwan. Therefore, it is necessary to establish an ecological axis or corridor along the western coastal wetlands for the wintering birds.

4. Extending the scope of the important fish ponds so that they might become "buffer zones" or serve as feeding areas and alternative habitats for Spoonbills is suggested. The buffer zone system at the Mai Po Nature Reserve of Hong Kong can serve as a reference model for Taiwan to develop one of its own.

Such a plan must be developed to create adequate habitats for additional roosting and foraging Spoonbills in the Greater Chiku Area and in the nearby areas in the southwestern part o

Table 1. *Observation records of Spoonbills in various habitats (1997-1999) (LIU and CHIANG, 2003).*

Types of Habitat	Percentage of Area (100%)	Number Observed in Day Time (1998-2001)	Number Located by Radio at Night (1997-1999)
Agricultural Farms	19.5	0 (0%)	0 (0%)
Water Channels	0.5	0 (0%)	0 (0%)
Estuaries	4.1	29 (2.3%)	3(0.6%)
Fish Ponds	46.2	622 (49.5)	338(71.9%)
Industrial Sites	3.5	4 (0.3%)	0 (0%)
Lagoon	7.6	0 (0%)	0 (0%)
Nature Reserves	2.6	24(1.9%)	4(0.9%)
Rivers	1.7	18(1.4%)	0 (0%)
Salt Ponds	11.9	0 (0%)	6(1.3%)
Primary Habitat	1.3	549 (43.7)	118(25.1%)
Trees	1.2	10(0.8%)	1(0.2%)
Total	100% (Total Area: 22,508 ha.)	Total Number Observed: 1,256 (100%)	Total Number Observed: 4,70 (100%)

F Taiwan. However, the comparable land use types should be planned and promoted to win wide support from land owners. A cost-sharing program to subsidize fish farmers in managing ponds for wildlife conservation should also be provided by either the local or central government.

5. Strengthening the monitoring and control of water quality as well as the water level in the Lagoon and nearby fish ponds on a regular basis is required. There is a necessity to set up an early warning water quality monitoring system at key locations and regularly measure contamination in sediments, oysters, fisheries and animals low on the food chain (HESTER, 2003). It is particularly important for this to be conducted before the arrival of the Black-faced Spoonbills for wintering.

6. Devising necessary policies, laws and/or regulations on wetland protection and mitigation mechanisms, for example, enacting the Coastal Management Act and the National Land Planning Act must be accelerated. A policy of no net loss for fish ponds, salt ponds, and other potential habitats, including the Chiku Area, should be immediately adopted by Tainan City, Tainan County as well as the Taiwan Salt Company. A zero-net-loss policy might not prevent the development of these habitats, but it would at least require one-to-one replacement (HESTER, 2003). Both Tainan City and Tainan County are urged to include the coastal wetlands in their "Comprehensive Development Plan", which provides the principal guidelines for the development of all sectors at the local level.

7. Continuing scientific research on the diseases of wildlife as well as setting up and enforcing contingency plans are necessary steps. This important work, however, requires a strong commitment from the government which must put aside an annual budget exclusively intended for long-term wildlife conservation. In many cases, the expression of international concern about matters pertaining to conservation in Taiwan serve as an impetus for the government to take concrete steps in this direction.

8. Facilitating international cooperation on wetland conservation and wildlife protection must remain a common goal. The Black-faced Spoonbill represents one of many wintering birds along the flyway in Asia. To save migratory birds should be the responsibility not only of Taiwan, but also of other countries in Asia. Any form of international cooperation such as international conventions, multilateral agreements, international research projects as well as international conferences will be most beneficial to the region.

CONCLUSIONS

The Black-faced Spoonbill is but one endangered species in the world. As such, it has been an important ecotourism resource in Taiwan. Aggravating the situation, however, is that since the botulism infection in 2002, the species is now regarded as being even more vulnerable than ever before, meaning that the conservation of Spoonbills is a great challenge to the country. To save wintering wildbirds in Taiwan necessitates improving the performance of the government's contingency mechanisms as well as enhancing the overall environmental quality of coastal wetlands in western Taiwan. In addition, the establishment of international cooperation is also essential for many migratory birds in the Asia-Pacific region. Clearly, this is the responsibility of both Taiwan and other parts of the region.

ACKNOWLEDGEMENTS

The author is grateful to the financial support of the National Science Council of Taiwan by research project NSC91-2621-Z-110-006.

LITERATURE CITED

CHAN, S., 2003. The importance of international cooperation to the long-term conservation of Black-faced Spoonbills. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), p. 134.

CHAUNG, H. B.; WENG, C.; WU, S.C.; HSU, R.M., and TZEN, T.J., 2003a. The process of dealing with botulism intoxication of Black-faced Spoonbills in Tainan. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), p. 11.

CHAUNG, H-B.; KOU, Y.B.; WENG, C.; W, S.C., and HSU, R.M., 2003b. The management improvement of the/a Black-faced Spoonbills wintering reserve in Tainan. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), pp. 93-95.

CHIAU, W.Y., 2002. Saving the Black-faced Spoonbills, *China News*, Taipei, Taiwan, 14 December, P. 15.

GIBERT, J. 2003. Planning and monitoring for a healthy wetland. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), p. 88.

HESTER, R. T. Jr., 2003. Land use and community design to ensure jobs and survival of *Platalea minor*. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), pp. 99-133.

HSIEH, Y.C.,; CHAUNG, Y.C.; LEE, Y.F.; SHIEH, C.Y.; WU, Y.C.; CHANG, C.D.; CHANG, T.C.; LEE, J.L.; WU, Y.H., and TSAI, S.S., 2003. Botulism caused by Clostridium Botulism type C1 toxin in Black-faced Spoonbills. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), p. 39.

LI, S.H., 2003. Mitochondrial DNA diversity and molecular sex typing of the Black-faced Spoonbill. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), p. 85-86.

LIU, L.L. and CHIANG, K.D. 2003. Wintering macro-habitats of Black-faced Spoonbills in Taiwan. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), pp. 35-40.

TAI, C.Y.; LAI, C.H., FANG, K.Y., 2003. Introduction of wildlife disease outbreaks or emergency reporting and crisis management measures for endangered species (draft). *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), pp. 1-9.

WANG, Y., 2003. Management of the wintering habitat by the ecological characteristics of Black-faced Spoonbills. *Program and Abstract of the International Symposium on Black-faced Spoonbill Conservation* (Tainan County, Taiwan), pp. 89-90.