

REPORT OF THE SECOND INTERNATIONAL WORKSHOP ON CONSERVATION AND RESEARCH NEEDS OF THE EASTERN TAIWAN STRAIT POPULATION OF INDO-PACIFIC HUMPBACK DOLPHINS, *SOUSA CHINENSIS*

4-7 SEPTEMBER 2007, CHANGHUA CITY, TAIWAN



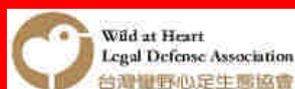
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A humpback dolphin floats in the waters fronting the southern shore of Formosa Plastics Group's Mailiao Industrial Area as land reclamation construction continues.

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(Also available from the websites are: *Conservation Action Plan for the Eastern Taiwan Strait Population of Indo-Pacific Humpback Dolphins* (2007), *Research Action Plan for the Humpback Dolphins of Western Taiwan* (2004), *Report of the First Workshop on Conservation and Research Needs of Indo-Pacific Humpback Dolphins, *Sousa chinensis*, in the Waters of Taiwan* (2004) and *Symposium Program of the First Symposium and Workshop on the Conservation and Research of Indo-Pacific Humpback Dolphins, *Sousa chinensis*, of the Waters of Taiwan* (2004)).

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Executive Summary

Taiwan's Indo-Pacific humpback dolphins (*Sousa chinensis*) face imminent extinction if measures are not taken to protect them and their habitat from a number of serious threats. The recent demise of the baiji (*Lipotes vexillifer*) in China's Yangtze River gives a particular sense of urgency to concerns about the fate of Taiwan's humpback dolphins. The humpback dolphin is a fish-eating mammal that lives in shallow estuaries and nearshore waters and is especially vulnerable because it relies on habitat at the interface of land and sea. Research suggests that humpback dolphins residing in the eastern Taiwan Strait (=waters of western Taiwan) comprise a distinct population of less than 100 individuals.

The eastern Taiwan Strait humpback dolphins were the focus of an international workshop held in Changhua City (Taiwan) on 4-7 September 2007. Participants included local dolphin researchers, conservationists and marine engineers, as well as experts from Canada, the United States, Japan, Brazil, United Kingdom and Hong Kong. Officials from government agencies, representatives of academic institutions and members of local conservation groups provided a grim picture of the state of the coastal marine environment along the west coast of Taiwan. Five major threats were identified: reduced river flow into estuaries, habitat loss, entanglement in fishing gear, industrial and municipal pollutant discharges, and underwater noise. More than 30% of the living dolphins in this population bear serious wounds or scars, at least some of which are thought to be from encounters with fishing gear or collisions with boats.

The expert group called on the Taiwanese government to proceed with a formal and public declaration of important habitat for the humpback dolphins; carry out public and transparent evaluations of existing and planned projects that may have impacts on the humpback dolphins and their habitat; mitigate such impacts using best available methods; prohibit the use of gill nets and trammel nets in nearshore waters; limit tourism focused on humpback dolphin-watching to shore-based platforms (including provision of public access to degraded habitat, thus promoting support for clean-up programs); and disclose pollutant concentrations and other environmental data.

Only through the concerted efforts of individuals, organizations, central and local government agencies and industry will the distinct eastern Taiwan Strait humpback dolphins survive.

Introduction

Indo-Pacific humpback dolphins (*Sousa chinensis*), as presently defined taxonomically, occur discontinuously in near-shore marine and estuarine waters from the Indian Ocean coast of Africa eastward to the Pacific coasts of China and Australia (Jefferson and Karczmarski 2001; Jefferson 2004). In East Asia, where they are often referred to as “Chinese white dolphins,” they have been studied in only a few areas, notably Hong Kong (Jefferson 2000). A small population discovered along the west coast of Taiwan in 2002 appears to be isolated from those off the mainland Chinese coast (e.g., the estuaries of the Jiulong and Pearl rivers) by deep waters of the Taiwan Strait (Wang et al. 2004a). Subtle but consistent differences in colouration pattern indicate that there is little or no demographic or genetic exchange. Therefore, based on the evidence currently available, Taiwan’s humpback dolphins are considered a distinct and separate population of a globally vulnerable species. This population, referred to elsewhere in this report as the ETS (eastern Taiwan Strait) population, is threatened by a variety of factors, and action is urgently needed to protect these animals and their habitat.

Recent news that the baiji, or Yangtze River dolphin (*Lipotes vexillifer*), is likely extinct has given a particular sense of urgency to concerns about the ETS humpback dolphin population. Investigators who conducted the recent futile search for baijis concluded that the species’ extinction was not caused by “active persecution” but instead was a result of “massive-scale human environmental impacts...” (Turvey et al. 2007). The baiji, like ETS humpback dolphins, had long enjoyed full protection from hunting and other types of deliberate harm. However, such protection was inadequate and a poorly understood combination of unintended insults proved decisive. Some of these, such as pollution, disturbance, and reduced quality of the prey base, were individually non-lethal but chronic and insidious; others, such as mortality from entanglement in fishing gear or boat strikes, were results of chance encounters with lethal hazards. There are many similarities between the situation faced by the baiji over the past few decades and the circumstances confronting ETS humpback dolphins at present. The near-shore marine and estuarine environment in Taiwan is, like the Yangtze River, intensively used by humans for fishing, sand extraction, land reclamation, transportation, and recreation, and as a recipient of massive quantities of effluent and runoff. Also, just as structures built in the outlets of Yangtze tributary lakes and streams deprived baijis of access to habitat and compromised their prey resources, the upstream abstraction and diversion of water for industrial, agricultural, or municipal consumption in Taiwan has led to reduced freshwater input to estuaries on which humpback dolphins depend.

The first international workshop on humpback dolphins in Taiwan took place in February 2004 (Wang et al. 2004b). It was agreed then that follow-up workshops should occur at regular intervals to assess progress on conservation actions and identify further research and monitoring needs. Therefore, a second international workshop was held in Changhua City on 4-7 September 2007. It was hosted by the National Museum of Marine Biology and Aquarium of Checheng (Pingtung County, Taiwan), co-hosted by *FormosaCetus* Research and Conservation Group (Taiwan and Canada) and Wild At Heart Legal Defense Association (Taiwan), and sponsored by the following: Ministry of Education (Taiwan), Forestry Bureau, Council of Agriculture (Taiwan), National Science Council (Taiwan), Ocean Park Conservation Foundation, Hong Kong (Hong Kong), Winkler Partners (Taiwan), Humane Society International (USA), and Natural Resources Defense Council (USA). Other forms of support were provided by Samuel Hung of the Hong Kong Dolphin Conservation Society.

The 2007 workshop was convened and chaired by John Y. Wang (*FormosaCetus* Research and Conservation Group and National Museum of Marine Biology and Aquarium). Shih Chu Yang (*FormosaCetus* Research and Conservation Group) and Randall R. Reeves (IUCN Cetacean Specialist Group Chair) assisted Wang in preparing and editing this report. Workshop participants included local dolphin researchers, conservation advocates and marine engineers, as well as cetacean experts from Canada, United States, United Kingdom, Japan, Brazil and Hong Kong. Officials from government agencies (Urban and Rural Planning Office, Industrial Development Bureau, Fisheries Agency, Forestry Bureau, Environmental Protection Administration), representatives of academic institutions (National Sun Yat-Sen University, Cheng-Shiu University, National Pingtung University of Science and Technology) and members of local non-governmental organizations (*FormosaCetus* Research and Conservation Group, Wild at Heart Legal Defense Association, Taiwan Academy of Ecology) addressed the workshop. The agenda and list of participants (including observers) are given in Appendices 1 and 2, respectively.

The workshop was conducted in English and the workshop report was drafted in English and reviewed by all invited participants who attended the entire workshop. A Chinese translation has been provided to assist Taiwanese readers in understanding the report. However, the English version should be considered definitive if any discrepancy is found between the English and Chinese versions. (Note: The spelling of place names, personal names, and other proper names in this report generally follow the Tongyong Pinyin system of Romanization adopted by Taiwan's Ministry of Education. Some exceptions are made, such as for personal names of individuals who have indicated a preferred alternate spelling. Where there is a difference in spelling from the 2004 workshop report, the spelling used in 2004 is given in parentheses. Historically, various Romanization systems have been used in Taiwan. Although Taiwan's central government adopted the Tongyong Pinyin system as the national standard in 2002, the system has not been implemented consistently at the local government level (e.g., the Taipei City government uses the Hanyu Pinyin system). Therefore, readers may encounter variants in the spelling of proper names elsewhere).

A field trip to the pier of the Taiwan Power Company's coal-fired power plant on the north side of the Dadu River estuary was arranged for participants following the workshop. This involved a bus ride from Changhua City to the town of Lugang [= Lukang] and then along the coast to observe the Changbin [= Jhangbin] Industrial Area, wind turbines, transportation infrastructure, and other coastal development. No dolphins were seen from the pier on this occasion but the participants nevertheless gained a better sense of the local environment and the challenges that lie ahead in trying to save this dolphin population from extinction. It was agreed that the pier had potential as a site for a land-based dolphin observatory and marine environment information centre.

Contents and Organization of this Report

As in 2004, the workshop report is organized thematically rather than in strict accordance with the meeting agenda. The main body of the report consists of seven sections, as follows:

- Background information on biology and ecology, with emphasis on information obtained since 2004;
- Information presented on known and potential threat factors;

- Information presented on laws, policies, processes and enforcement associated with wildlife conservation and environmental protection in Taiwan;
- Progress on recommendations and priority items identified in the 2004 workshop report;
- Ongoing and future options for mitigation and threat management;
- Formation of a technical advisory working group;
- Recommendations for research, monitoring and conservation action.

Those seven sections provide a record of the workshop findings and the rationales behind recommendations and assignments of priorities. In addition, a Conservation Action Plan is provided as Appendix 3, with the intention that it will serve as a workshop synopsis to be used by government agencies, non-governmental organizations (NGOs), researchers, funding institutions, and other stakeholders to inform the planning process and guide decision-making over the next few years.

Unlike the 2004 workshop, which focused on scientific aspects of humpback dolphin conservation, the 2007 workshop emphasized the threats facing the population and the problem of how to address those threats and organize ongoing oversight and review of actions affecting the dolphins. Greater participation by government agencies, private sector representatives, and local NGOs was a particularly encouraging difference in 2007. International involvement and support is entirely appropriate, given that so much of Taiwan's industrial output serves an export market for consumer goods, and therefore the associated environmental problems are a shared responsibility. Nonetheless, as noted in 2004, although foreign scientists, conservationists, and NGOs can be expected to continue their interest in ETS humpback dolphin conservation, the primary and ultimate responsibility for long-term support (e.g., financial, logistical, managerial) needs to come from within Taiwan. In that regard, workshop participants noted and welcomed signs that the Taiwanese public is becoming increasingly engaged with environmental issues, including the plight of the highly threatened ETS humpback dolphin population.

1. Background

Foreign participants were asked to provide background documents on specific topics and these were circulated on a compact disk (CD) in workshop participants' packets. Abstracts of those documents are included in Appendix 4 of this report. All workshop materials not included as part of this report are available at www.nmmba.gov.tw.

The report of the 2004 workshop (Wang et al. 2004b) contained a thorough discussion of the state of knowledge on biology and ecology of humpback dolphins in Taiwan (also see Jefferson 2004).

1.1. Summary of New Data and Information

J.Y. Wang briefly summarized the results of scientific research on ETS humpback dolphins since 2004. As noted then, these dolphins are estuary-dependent and exhibit a strong preference for shallow near-shore waters. Most sightings are within a kilometre of shore and in water less than 10m deep. Nowhere in its range does the species occur regularly in water deeper than 25-30m and therefore water depth is regarded as a barrier to dispersal.

Systematic boat surveys from 2002 to 2004 provided the basis for a line-transect abundance estimate of 99 (CV=52%, 95% CI=37-266) (Wang et al. 2007). However, since the resighting rate is high and few "new" dolphins are added to the photo-identification catalogue each year, Wang considers it likely that the true number of dolphins in the population is below rather than above the point estimate of 99. At least 33 of the fewer than 50 photo-identified individuals in the catalogue had been resighted in 2007 (through August). Mark-recapture analysis of the 2007 photo-identification data is in progress and is expected to produce a more precise estimate of abundance.

At the 2004 workshop (Wang et al. 2004b, p. 11), attention was drawn to the importance of confirming that dolphins do not occur in the very shallow coastal strip of littoral water inshore of sandbars. Therefore, after 2004, Wang and Yang carried out surveys using a sea-kayak and from land-based observation sites and confirmed that dolphins do not normally occur there (no sightings were made) (see Wang et al. 2007). They further pointed out that such areas are infested with oyster culturing structures that are also often lined with gill nets and trammel nets. The sharp oyster shells on these structures could deter dolphins from going there, especially with the risk of becoming stranded inshore of the sandbars during ebbing tides. The 2007 workshop therefore agreed that this potentially negative bias in abundance estimation (i.e., missing animals inshore of the surveyed area) was no longer a serious concern.

The diet of humpback dolphins in Asian waters consists mainly of fish (Barros et al. 2004). Little direct information is available on the diet of the ETS humpback dolphins but on a few occasions they have been observed feeding on what appeared to be croakers (Sciaenidae), mullets (Mugilidae), threadfins (Polynemidae), and herrings (Clupeidae) (J.Y. Wang, unpublished data).

These dolphins usually occur in small, fluid groups of fewer than 10 individuals although up to 25 are sometimes seen together (Wang and Yang 2007).

No new information was available on life history although Wang noted that two individually identified females were seen with young calves in 2002 and neonates in 2007. It was considered premature to make inferences about calving interval from this small sample of observations.

The currently documented distribution of ETS humpback dolphins is shown in figure 1. They have been confirmed to inhabit a narrow (less than 3 km from shore) segment of coastal waters about 100 km long from the estuary of the Tongsiao [=Tungshiao or Tongshiao] River (Miaoli County) to Taisi [=Taixi] (Yunlin County). Credible sightings have also been reported from the waters around Waishanding Jhou [=Zhou] (Chiayi County) and the mouth of the Houlong and Jhonggang rivers (Miaoli county line) (Wang et al. 2007). Taking these records into account, the core distribution encompasses about 170 km of water along the coastline and an area about 515 km². Single dolphin strandings were reported in Taoyuan County and Cigu [=Chigu] (Tainan County) and a group of about 20 dolphins was observed and videotaped off Jiangjyun [=Jiang-Jyun] Harbour (Tainan County), but all of those records were somewhat outside the range as delineated above. An individual seen and photographed at the entrance of Fugang Harbour (Taitung County, southeastern Taiwan) in 2006 is regarded as a “stray,” pending more observations from that area (Wang and Yang 2007; Wang et al. 2007).

Confirmed sightings in Taiwan have been almost always in water between <1.4 and 15 m deep and within 3 km of shore. The deepest water where dolphins have been observed is about 25m at the entrance of the harbour of the Mailiao Industrial Area and around Taichung (= Wuci [=Wuchi]) Harbour, the seafloors of which are dredged for navigational purposes. The mean depth at sightings is 7-8 m. The dolphins' near-shore occurrence has made it possible for researchers to establish observation posts at several sites where the animals can be observed and studied from shore. They appear to be resident year-round although there has been no survey coverage in winter months (December-March). Commercial and recreational fishermen report seeing dolphins in winter (also see Chou 2006) but species identifications require confirmation.

The observations first reported in 2004 regarding a difference in pigmentation pattern between the ETS dolphins and those of the Chinese mainland have been analyzed through statistical tests (Wang et al. in review). The differences between ETS dolphins and the Jiulong River Estuary (JRE) and Pearl River Estuary (PRE) dolphins, respectively, were highly significant ($p < 0.0001$) whereas there was no significant difference between the JRE and PRE animals. It therefore appears very unlikely that the ETS population is linked with mainland populations, based on this pigmentation analysis. Difference in pigmentation pattern can be a good taxonomic character in cetaceans (Perrin 2002).

More than 30% of the ETS dolphins bear serious wounds or scars (Fig. 2.). The causes of the injuries are uncertain but are likely to include entanglement in fishing gear and vessel collisions.

Finally, a preliminary assessment of the conservation status of the ETS population showed the population is likely to meet the “Critically Endangered” category under the IUCN Red List criteria. A formal proposal is being prepared.

1.2. Discussion on Population Structure

An analysis of DNA sequence data was presented in Chou (2006) (Reference Document 8). Results reported in that document confirmed that the four humpback dolphins studied belonged to the same *species* as the dolphins in mainland China. The analysis provided no information, however, to test the hypothesis that the two ETS dolphins in the study belonged to a population that is genetically similar to, or genetically distinct from, those in mainland China. Such tests would require assessment of the frequencies of the mtDNA haplotypes in the different populations. Too few samples were available from the ETS population and other regions to make such testing possible. Given the limited number of samples, a large number of microsatellite loci would be needed to test the competing hypotheses.

Workshop participants discussed the value and importance of genetic analyses in relation to conservation. It was agreed that there is sufficient evidence to consider the ETS population to be geographically and demographically isolated (see section 1.1), regardless of whether clear genetic differences can be shown to exist between it and the mainland populations. The critical question, from a conservation standpoint, is whether the population, once extirpated, would be replaced by immigration and if so, how long it would take for such replacement to occur. Conservation must be viewed at the scale of decades rather than hundreds or thousands of years. Based on presently available evidence, it is unlikely that the ETS dolphins would be replaced on a timescale of decades, if ever.

Jefferson summarized what is known, based on experience elsewhere, concerning dispersal by humpback dolphins. Distance from shore appears less relevant than the two main features of the species' habitat preference: estuarine influence and water depth. In some areas, humpback dolphins apparently cross deep channels and occur on shallow offshore banks or reefs. In Jefferson's experience with the PRE population, one or two animals occasionally occur in eastern Hong Kong waters, perhaps 25 km away from their usual range. Such wandering, however, usually proves only brief and temporary, with the animals returning to their core area of distribution. Wang noted that although the catalogues of photographs have been compared among the PRE, ETS and JRE populations, no matches between ETS dolphins and the others have been made thus far.

In spite of the lack of appropriate genetic analyses, all workshop participants agreed (as in 2004) that the observed pigmentation differences (see section 1.1) constitute strong evidence that the dolphins in eastern Taiwan Strait (= waters off western Taiwan) comprise a distinct population and that demographic or genetic exchange with neighbouring populations is unlikely.

1.3. Discussion on Abundance Estimation and Population Trend

Although it would be useful to know something about the historical abundance of ETS humpback dolphins as a reference point, there is no obvious way to produce an estimate. In response to a suggestion that it might be possible to infer something about natural historical abundance based on habitat features, Wang suggested that the entire central west coast of Taiwan might have once been, in effect, a single large delta. If that were true, the humpback dolphin population could have been many times larger than it is today. Microsatellite data could provide a means of estimating past population size.

Attention was drawn to the fact that government officials and the public are eager for scientists to provide clear, simple answers to questions such as: How many dolphins are there, and is the population increasing, decreasing, or stable? However, there is little general awareness of the complexities of abundance estimation and of the biases associated with any estimate, regardless of the method or the degree of analytical rigour applied. This means, inevitably, that numbers reported from one survey or one year to the next can be misunderstood, misleading and misinterpreted by those with little or no expertise in abundance estimation.

There was an inconclusive discussion concerning the relative merits of line-transect and photographic mark-recapture techniques for abundance estimation. All participants agreed that it was important to monitor the dolphin population over the long term, but that scientific evidence of a declining trend should not be regarded as a necessary condition before taking conservation action. It was further agreed that before investing in a survey program, it would be important to analyze the statistical power and evaluate cost-effectiveness of any survey regime. In that regard, the workshop noted the example of the critically endangered vaquita (*Phocoena sinus*) in Mexico. An analysis by Barbara Taylor showed that boat surveys of vaquitas over the next few decades would be prohibitively expensive and could not be expected to detect population declines or increases on an acceptable timescale for conservation relevance (Rojas-Bracho et al. 2006). If a power analysis were to show the same to be true of ETS humpback dolphins, it would then be important to convey this to decision-makers and the public. In other words, it should be acknowledged that close monitoring of population trend may be impractical (given the current limits on funding) and that frequent and regular updates on population status are infeasible (and more importantly, unnecessary for conservation action to be taken). The small size of the population and the small extent of its habitat are themselves a cause for conservation concern. It was clear that considerable resources need to be invested in actions to reduce threat levels immediately rather than in more population monitoring to refine estimates of abundance and trend without mitigation actions.

1.4. Discussion on Life History

Although direct estimates of life history parameters for the ETS population (e.g., reproductive rates, age-specific mortality rates) are desirable, the workshop recognized that there was little realistic prospect of obtaining the necessary data, at least in the near term. The next-best option is to assume broad similarity with *Sousa* populations elsewhere, but with the caveat that some rates (e.g., age at first reproduction, calving interval) can be strongly influenced by population status (i.e., whether it is at equilibrium or depleted and recovering) and foraging conditions. Therefore, assumptions by analogy must be made with appropriate circumspection. Jefferson pointed out that even for the relatively well-studied PRE population, data on life history parameters are poor. It was noted that photo-identification data have the potential to provide useful insights on mortality rates.

2. Threats

The 2004 workshop listed numerous known and potential threats to humpback dolphins in Taiwan, and a preliminary effort was made to rank those threats according to their likely conservation significance (Wang et al. 2004b, Table 1). Five broad categories of threat were recognized: decreased/degraded habitat, direct removals of individual dolphins, decreased prey availability, noise/disturbance, and chemical pollution. Four specific threats were flagged as likely having the greatest impact – reduction of freshwater flow, habitat loss, fishery bycatch, and industrial and municipal discharge.

As stated earlier, threats were given particular attention in the 2007 workshop and the presence and participation of government representatives, industry consultants, academics, and members of local NGOs enhanced the group's ability to identify and assess threats. The information provided to the 2007 workshop confirmed that the threats identified in 2004 have increased, not decreased. Major industrial development initiatives are going ahead with little, and usually no, recognition of their potential impacts on dolphins and other marine and estuarine organisms (see Appendix 5 for examples of these industrial development projects).

The information provided in workshop presentations, as well as the highlights of the associated workshop discussions, are summarized in the following sections. This information should be considered as supplemental to that contained in the 2004 workshop report (Wang et al. 2004b).

2.1. “National Land Use Planning and Development – Coastal Zone” by Chih-Ming Chen of the Urban and Rural Planning Office, Construction and Planning Agency, Ministry of the Interior

Of the four zones recognized for planning purposes in Taiwan, Zone B, the Western Coastal Zone, is of interest here. It extends 460 km from the Danshui River estuary to Fonggang. Overall, this depositional coastline presents a relatively smooth and unbroken landscape, characterized by tidal flats, barrier islands or sandbanks, tidal spits, and lagoons, all shaped historically by the influence of large rivers.

Data from 1995 were used to classify Zone B as 25% “natural,” 20 % agriculture, and 43% aquaculture. Chen reported that the percentage devoted to aquaculture had not changed since 1995 but that the percentages classified as agriculture and “public facilities” had increased considerably while the percentage classified as “natural” had declined to about 20%. The category “public facilities” includes the following: roads, fishing ports, dams, coal-fired power plants, waste incinerators, and sea walls for flood control. Fishing ports and power plants are subject to continuing expansion. Chen stated that his department was committed to achieving a “balance” among preservation, protection, and development of coastal lands but it was not clear if that “balance” included stopping the continuing declines of “natural” areas.

2.2. “Development of Different Industries in Taiwan” by Zhen-Wei You of the Industrial Development Bureau, Ministry of Economic Affairs

The first industrial park in Taiwan was constructed in 1960. From 1960-1970, Taiwan pursued a national policy of encouraging investment in industrialization aimed at consumer

exports and the opening of foreign markets. The first export zone was established in 1966. Between 1970 and 1980, the Industrial Development Bureau pursued a policy intended to develop more heavy industry, and 38 industrial parks were established during that decade. Operating regulations began to be put in place between 1980 and 1990.

At the national level, 59 large-scale industrial projects have been completed, 20 more are under development, and approximately 80 are awaiting approval. Taiwanese industries span a wide range that includes the production of plastics, textiles, electronics, and tool machinery. The current supply of industrial land in Taiwan is estimated as ca. 60,000 hectares. Many of the industries occur in geographic clusters and are classified as “combined” or “complex” industries. Another concept is the “offshore development park,” which in Taiwan refers to an industrial park constructed on “reclaimed” land.

The notion of “sustainable development” is brought into the discussion of Taiwan’s industrial development plans primarily via the impact assessment process, which encourages mitigation to reduce environmental impacts.

One of the problems raised by workshop participants was how to get information on industrial development plans. The problem is exacerbated by the fact that not all types of development fall within the jurisdiction of the Ministry of Economic Affairs. For example, plans for port development or expansion are under the authority of the Ministry of Communication and Transportation. Inaccuracy of information provided to decision-making, and the insufficiency of access to information more generally, were recurring themes during the workshop and are further discussed below under item 3.2. (For additional problems, such as project segmentation, see 3.2 and 3.3, below.)

2.3. “Overview of the Utilization of Water Resources of the Rivers of Central Western Taiwan” by Cheh-Shyh Ting of the Department of Civil Engineering, National Pingtung University of Science and Technology

About a third of the island of Taiwan is at elevations greater than 1000m and another third is at 100-1000m. Most of the mountains are composed of sedimentary and metamorphic rocks, which are fragile and heavily weathered. Intense rainfall (annual average precipitation is 2500mm, reaching 3000-5000 in mountainous regions) and rapid water flows, coupled with frequent earthquakes that affect the stability of hillsides, result in a great deal of erosion. Peak discharges per unit drainage area are said to be the largest in the world. Rock piles due to landslides often block rivers. Taiwan’s 129 rivers are all short with small, steep drainage basins. Their downstream reaches tend to be heavily deposited due to poor geologic conditions in watersheds and the concentrated rainfall. Typhoons (mainly from June-August) are a major feature of the local climate and the cause of relatively frequent natural disasters that are exacerbated by modification of the natural environment by human activities (e.g., deforestation, “cementification”).

Water management in Taiwan centres on the problems of flood control, land subsidence, and the uneven spatial and temporal distribution of water resources. The challenge of controlling floods and storing surface water for specific needs is regarded as a central imperative – the foundation of steady economic growth in Taiwan.

Ting listed the following as priorities: enhanced water resources education, more use of reclaimed water, better management of aquifer recharge, re-evaluation of current storage facilities, reconsideration of water resources development policies, and evaluation of the virtual water trade.

2.4. “Present Status of the Water Resources of the Jhuoshuei [= Juoshuei] River System,” by Ching-Chun Chen of the Taiwan Academy of Ecology (Yunlin Branch)

This presentation was supplemented by a paper circulated as background at the workshop (MacFarquhar 2007).

The damming of rivers in Taiwan dates to at least the late 1800s. A proposal was initially made in 1994 to create the Rueifong Reservoir on the upper reaches of the Cingshuei River, a major tributary of the Jhuoshuei River in central western Taiwan, as part of a planned network of water works to supply Yunlin Offshore Industrial Park with water. At the same time, in order to provide additional water for the Offshore Industrial Park, as well as for irrigation, household use and mitigation of severe land subsidence caused by excessive pumping of groundwater, another reservoir, called the Hushan Reservoir or the “Hushan Dam Project”, was to be created in nearby Youcing Valley. This was to be fed by water diverted from a point on the Cingshuei River downstream of the Rueifong Reservoir, effectively further exploiting the remaining flow in this river. A major earthquake in 1999 and subsequent typhoons caused rubble to block the flow of the Cingshuei River, creating a natural “lake” where the Rueifong Reservoir was to have been built, resulting in the temporary postponement of this project. The problem of rapid sedimentation is pervasive throughout the area, and yet another dam, the Jiji Weir on the Jhuoshuei River, which started operating in 2002, was experiencing serious sedimentation problems by 2005 due to landslides in another tributary, the Cheyoulan River (Fig. 3).

The plans for Hushan Dam have become extremely controversial, in part because of endangered wildlife and other natural features at risk and in part because of the questionable duration of benefits, given the short lifespan of any dam built in these conditions (sedimentation, seismicity). Already, very little water is released downstream of the Jiji Weir area, but after the Hushan Dam project is complete, the input of fresh water and sediment into the sea will effectively cease. Chen presented the example of Beigang Township, which was situated on the coastline in 1600 and is now 20km from the sea. The land there and the sandbar offshore were created by sediment from the Jhuoshuei River.

Chen explained that the main purpose of Hushan Dam is to supply water for agriculture, industry, and urban consumption. Groundwater is being over-extracted in Changhua and Yunlin counties, and this will only get worse after the dam is finished because sources that replenish groundwater will also be reduced. Amounts of sand and water reaching the sea area are already insufficient, and once the Tongtong Weir is built on the Cingshuei River (to feed the Hushan Reservoir), freshwater flow from this tributary of the Jhuoshuei River system into the estuary will be drastically reduced and the subsidence problems in Changhua and Yunlin counties will be exacerbated.

Workshop participants noted that in Taiwan, flooding, erosion, and land subsidence are regarded entirely in a negative light as they damage property and threaten human safety. However, these same processes may be responsible for creating and renewing the habitat on

which humpback dolphins and other coastal species depend. Therefore, efforts to mitigate the effects of extreme geoclimatic events on people (e.g., damming and controlling the flow of depositional rivers) could be antithetical to the development and maintenance of humpback dolphin habitat.

2.5. “Fisheries of Inshore Waters of Western Taiwan” by Man-Chuan Wu of the Fisheries Agency, Council of Agriculture

The fishing grounds in the Taiwan Strait are influenced by mixing of the south-flowing China Coastal Current, the warm Kuroshio Current flowing north along the east coast of Taiwan, and a warm current inflowing from the South China Sea.

In Taiwan overall, the number of registered boats has remained fairly stable at around 30,000 since 1997. Also, total landings have been fairly steady in spite of a sharp decline in offshore (i.e., distant-water) catches in recent years due to international regulations. Local fish stocks are over-exploited because the fleet is over-capitalized (a problem exacerbated by the international sanctions that have forced Taiwanese vessels to fish inside rather than beyond territorial waters) and because fishing technology has improved. Additional problems afflicting the Taiwanese fishing industry include pollution, lack of management, loss or degradation of fish habitat, destruction of fish nursery grounds, bycatch, and encroachment by fishing vessels from mainland China.

The Fisheries Agency has contemplated or tried various approaches to mitigation and enhancement: reduced fishing effort, limits on construction of new boats, conversion to aquaculture, algae planting to increase fish habitat, time/area fishing closures, prohibition of certain implements or techniques, quotas (e.g., for whale sharks), and establishment of reserves or other kinds of protected areas. However, it was unclear which of the listed approaches had actually been implemented and at what scale. Some effort has been made to get commercial fishermen to switch from production fishing to recreational (sport) fishing and whale- or dolphin-watching. Also, some fishermen have been encouraged to change their methods to reduce overhead costs and get greater profits from smaller catches.

With regard to cetacean bycatch, Wu pointed out that because humpback dolphins are legally protected, fishermen who catch them accidentally in gill nets or other gear are supposed to release them. They are unlikely to report a catch or to bring back and deliver a carcass to authorities. Although workshop participants noted how a policy of making the accidental killing of cetaceans as a result of bycatch and the possession of bycaught carcasses illegal means the loss of potentially valuable material and data, no progress was made at finding a way to change the present legal status quo.

Workshop participants noted that the principal known threat to small cetaceans globally is bycatch in fisheries. Also, it is generally agreed that reports by fishermen do not constitute a reliable basis for assessing the scale of bycatch or the species affected - fishermen are understandably reluctant to reveal information that could lead to unwanted repercussions. The only way to obtain accurate data on bycatch is to observe fishing operations directly. This can be done either by adding dedicated observers on the fishing vessels (difficult or impossible on small boats) or by observing from a separate vessel.

2.6. “The Environmental Impacts of Cobia Aquaculture’s Wastes and Chemicals” by Chiu Long Chou of the Institute of Marine Affairs, National Sun Yat-Sen University

In Taiwan, there has been a rapid increase in net/cage aquaculture since the mid-1990s, with about 20 sites in operation in the Penghu Archipelago, three around Siaoliouciou Island, and three in Haikou in southwestern Taiwan. The cobia (*Rachycentron canadum*, a valuable, fast-growing finfish) aquaculture industry began in Taiwan about ten years ago. Other popular species are groupers and Japanese sea bream.

There are no national, or for that matter international, guidelines or regulations covering aquaculture operations. Profitability is the guiding determinant of success or failure.

Chou’s studies of the cobia fish farms in the Penghu Islands have provided some evidence of downstream contamination well beyond the cages and their immediate vicinity. In his experience, sediment chemical indicators are valid indices of marine environmental conditions and thus provide a good way to predict impacts from aquaculture.

2.7. “Taiwan’s Marine Pollution and Management” by Cheng Yang Lyu of the Environmental Protection Administration

A long list of pollution sources was presented, encompassing marine-based (e.g., boat repair, fish processing offal, harbour fuelling stations, ship dumping, pipeline leakage) and land-based (e.g., municipal/residential waste, industrial effluent, agricultural/livestock runoff), with much of the latter river-borne. Pollution is a massive problem along Taiwan’s west coast, where 623 factories are located within one kilometre of shore. In Taiwan overall, there are 22,000 factories, 95 oil storage facilities within 25km of the coast, 35 harbour fuelling stations, four boat repair facilities, 12 fish markets, 21 power plants, and 37 waste dumps. An estimated 740,000 tons of waste oil from boats enters the marine environment off Taiwan each year.

Lyu stated that permitting rules apply to many pollution sources, with effluent standards and mitigation requirements in place. Residential waste is supposed to undergo treatment involving three control stages. Boats need insurance and contingency plans to operate in Taiwanese waters. There are five designated sites for marine dumping around Taiwan, including two off the west coast, all at least 100 km from shore.

Factory discharge is regulated by concentration rather than quantity. In a permit application, the polluter is required to explain measures to be taken to meet standards. The Environmental Protection Administration (EPA) uses inspection of day logs and checks on chemical inventories to monitor compliance and enforce regulations. For certain scales of wastewater discharge, there is a legal requirement that an expert technician be onsite to oversee and monitor treatment. Lyu acknowledged that certain factories store waste until a typhoon comes so that releases will be highly diluted. Also, night-time releases are commonly used to avoid detection of illegal discharge levels. He characterized the relationship between the EPA and industry as a cat-and-mouse game.

Workshop participants questioned the effectiveness of the wastewater treatment system, and Lyu agreed that it had shortcomings. Participants also expressed concerns about the arrangement whereby factory owners are responsible for reporting their own discharge

records, which are then used by the EPA as a basis for deciding whether direct sampling is warranted. Neither industry reports nor the results of spot-checks by the EPA are made public; only when fines are levied do violations get reported in the news but the scale of the violations may not be released.

2.8. “The Current State of Cetacean Conservation in Taiwan” by Jung-Sheng Shia of the Forestry Bureau, Council of Agriculture

The Forestry Bureau of the Council of Agriculture (COA) has sponsored or co-sponsored 86 different cetacean projects between 1991 and 2007, investing more than NT\$ 86 million. A symposium/workshop on cetacean ecology and conservation is planned for 10-11 October 2007. Since 1990, a total of 730 stranded whales and dolphins have been reported on Taiwan’s beaches.

Workshop participants suggested that a comprehensive table with all strandings by species, whether alive or dead, etc., should be provided. This table might provide a starting point for investigating problems associated with fisheries, point sources of pollution, and other threat factors. Shia indicated that her agency would be able to provide such a table. Wang confirmed that the system in place in Taiwan for reporting strandings was extremely efficient, probably capturing at least 90% of those that occur.

2.9. Overview on Contaminants – prepared as background by Peter S. Ross of the Department of Fisheries and Oceans, Canada

The release (deliberate and unintentional) of contaminants into the aquatic environment (streams, rivers, lakes, estuaries and coastal waters) presents a direct threat to the quality of humpback dolphin habitat (Fig. 4). The cumulative effects of point source and non-point source discharges of contaminants may have direct impacts on the health and abundance of humpback dolphin prey (food-web impacts) or may lead to contamination of the dolphins themselves (bioaccumulation). A number of study designs can help to characterize the nature of pollution threats to humpback dolphins, such as:

- 1) A risk assessment-based collation of information on land use, contaminant sources, contaminant types, and the environment (e.g., Grant and Ross 2002);
- 2) Measuring contaminant levels and patterns in humpback dolphin prey (guided by existing information on feeding ecology – e.g., Cullon et al. 2005);
- 3) Measuring contaminant levels and patterns in sediments collected from humpback dolphin habitat and reference sites in support of food web-based modeling of contaminants and prediction of contaminants in dolphins (sediments→prey→dolphins) (e.g., Hickie et al. 2007);
- 4) Measuring contaminant levels and patterns in a surrogate animal species that shares a high position in the aquatic food-web with the humpback dolphin (e.g., fish-eating birds such as little egrets *Egretta garzetta* or black-crowned night-herons *Nycticorax nycticorax*) (e.g., Elliott et al. 2005).

3. Laws, Policies, Processes and Enforcement Associated with Wildlife Conservation and Environmental Protection in Taiwan

Three presentations related to this topic were included in the workshop agenda, and they are summarized below.

3.1. “Life in National Marine Policy” by Lee-Shing Fang of Cheng-Shiu University

Palau was cited as an example where a small country faced with challenges in coral reef management invited external experts to provide review and advice, which was then used to good effect by the Palau authorities as they sought to resolve the issue. Fang pointed out that the same approach had been proposed in Taiwan, but never developed and pursued by the authorities there.

The recent national white paper on security, prosperity, and ecology represents an attempt to explain how the conservation of Taiwan’s natural heritage is important not just because it serves an abstract principle, but even more importantly because it is vital to human well-being over the long term.

3.2. “Taiwan’s Environmental Impact Assessment Law and Practice,” by Robin Winkler of Wild at Heart Legal Defense Association

Winkler spoke primarily on the basis of his recent two years of experience as a member of the Environmental Assessment (EA) Commission of Taiwan’s cabinet-level Environmental Protection Administration (EPA). A policy on environmental impact assessment (EIA) was adopted in Taiwan in 1985 (while Taiwan was still under martial law) and this policy was extended in 1991. The law requiring EIA took effect in 1994. The EPA was created in 1987 but was given little actual power because of concerns that it would impede economic development. Extensive infrastructure development did not begin in Taiwan until the early 1970s. Although many large projects (including an offshore industrial park, Beiyi Highway, and Taiwan’s fourth nuclear power plant) were subjected to environmental assessment between 1985 and 1994, in practice any decision calling for further assessment and mitigation tended to be overruled on the grounds that the projects were in the “national interest.” Thus, in the past, EIA in Taiwan has too often been nothing more than a packaging and public relations exercise. Adverse effects on air, water, soils, plants, and animals have been trumped by short-term economics, jobs, and social and cultural considerations.

Membership of the EA Commission has been drawn mainly from the field of environmental engineering, although in recent years some effort has been made to include representation from the natural sciences. By law at least two-thirds of the members are scholars and experts, the intent being that these commissioners will not also be government officials. The number of commissioners is 21 so, in practice, seven members are from government agencies and 14 from academia and NGOs. The term that began 1 August 2007 includes two government officials among the 14 scholars and experts. The role of the commissioners is to offer advice on how environmental impacts can be avoided or mitigated. For nearly all cases, ad hoc committees are formed to deal with them – and in some instances, e.g., in the cases of Formosa Plastics, Hoping Industrial Park, and the Central Science Park, a committee is appointed to supervise the implementation. By law, the EIA Commission decides whether a

project will pass, conditionally pass (conditions do not need to be met in advance, but rather can be met as the project proceeds), be rejected, or go into a second-phase evaluation.

The commission has the legal authority to deny (veto) a project if the environmental impacts are judged to outweigh the project's benefits and an administrative appeal process is available to the proponent whose project is rejected. However, projects that the sixth-term (August 2005-July 2007) commission decided should be rejected or put into a second-phase evaluation, are being reinstated by the newly appointed commission. This is under heavy pressure from government agencies, including the EPA. Winkler's opinion is that the veto authority has never been exercised where to do so would have been in conflict with government policy.

The EPA has an overall supervisory role in the EIA process and is the "competent authority" (CA), although in many instances where the law or regulations stipulate a power or obligation of the CA, the EPA delegates the responsibility to the EIA commission. Participants in an assessment include the competent authority in charge (CAIC), usually not the EPA; the proponent, often a government agency; and consultants acting on the proponent's behalf. The consultants bring in their own experts and scholars. The data from these latter sources are generally not made available to the Commission, and the commissioners are often unable to interview the people who actually did the field work. The CAIC (e.g., Industrial Development Bureau, Port Authority) and the CA have responsibility under the law for supervision and follow-up of approved projects. However, this function is not well developed: the EPA has six persons tasked with following-up on over 1000 approved projects, many of them infrastructure involving multi-billion dollar investments.

There are opportunities for public participation although the realization of participation often depends on the attitude of the developer and the EPA. Prior to filing, the proponent is required to hold a meeting open to the public, but these tend to be per forma with little substantive participation from locals. A formal public explanation meeting is required by law after a first-phase decision has been announced. In the case of a second-phase assessment, a public hearing is required as part of the proceedings and before a decision is made. Public participation in the ad hoc sub committees and plenary commission meetings peaked with the last term. Beginning in August 2007, the EPA instituted a number of measures that have significantly reduced the ability of the public to participate in the EIA process, including new restrictions on reporters and even restrictions on commissioners.

Finally, public participation may come in the form of a lawsuit. The public can compel the EPA to take certain action, failing which for 60 days, the public party can take the case directly to the administrative law courts. Such a case is currently pending on the Hushan Dam project (see above), although such legal challenge has not deterred the developer and construction continues. Winkler emphasized that while in theory there are many opportunities for court challenges in environmental matters, very few cases have been filed.

Access to data and information is a key issue. Taiwan has a freedom-of-government-information act and although a great deal of data and information are available, much of it is neither complete nor current, which, in Winkler's view, is sometimes worse than no data at all as watchdog groups spend much time on what turn out to be non-issues. Again in Winkler's view, the great imbalance in resources (money and time) between developers and public watchdog groups is a fundamental problem that must be addressed. He suggested that one

approach would be to require every developer who submits a project for consideration to contribute to a fund to support an independent group of experts.

Project segmentation is widely practiced in Taiwan. Proponents will often split a project, showing the EIA Commission not the entire project, but the portion that they believe will pass. Additions are later proposed, and it has been the practice of Taiwan's EPA not to look at the cumulative effects of projects, and this practice has been generally adopted by the Commission. The upshot is that development projects are often not assessed in their entirety.

Most of the projects involving major land reclamation in the area inhabited by the humpback dolphins were proposed prior to the enactment of the EIA Act in 1994. Thus, although much of the reclamation has been completed, there are thousands of hectares of potential land reclamation that will proceed without any intervention or review under the EIA Act. From the EA reports of the developers for a Formosa Plastics steel plant, Formosa Plastics PVC plant expansion, a commercial harbour, and a new Kuokuang petrochemical plant (of which a large part is for state-controlled Chinese Petroleum Corporation) the developer does not intend that the reclamation aspects of the projects be reviewed by the EIA Commission. It appears, according to Winkler, that the EPA and the sponsoring government agencies agree that no consideration of the reclamation component of the projects is required.

In the past 20 years that Taiwan has had an EIA process, the quality of Taiwan's natural environment has dramatically declined. According to Winkler, the process has become an exercise in public relations and public/private/academic collusion is taken for granted. Development projects routinely include local government officials speaking on behalf of and promoting the projects. Commissioners and officials who seek to carry out their duties conscientiously often become disoriented or discouraged, or they are intimidated.

3.3. "Biodiversity, Marine Ecological Assessment and Land Reclamation in Taiwan's EIA Process," by Christina MacFarquhar of Wild at Heart Legal Defense Association

MacFarquhar's presentation was based on the results of her recent study consisting of interviews and reviews of six specific Environmental Impact Statements (EISs) for projects involving artificial alteration of the geomorphology of the west coast of Taiwan. Taiwan's Environmental Impact Assessment (EIA) system is intended to include consideration of biodiversity but the legal framework provides little guidance on how this should be done, e.g., thresholds of acceptability, ranking scheme. Regulations covering marine ecological assessment came into effect only in August 2007. Although Taiwan has a Biodiversity Action Plan, it was not mentioned in the six EISs reviewed by MacFarquhar.

The EIA Review Commission has traditionally been dominated by engineering expertise. External scholars and experts can be invited to participate in discussions and in decision-making but the objectivity of some experts is questionable. Normally, consultants are hired by the developers to prepare the EIS, and this is perceived to compromise their objectivity as experts when presenting data or appearing before the Commission. Concerns on the part of some commissioners tend to centre around what is omitted from EISs rather than what is included. Much time is spent trying to verify the authenticity and credibility of information in the documents.

Although EISs are supposed to include quantitative analyses so that the potential significance of effects can be evaluated, MacFarquhar found no evidence of such analyses in the documents she surveyed. References to impacts generally referred to them subjectively as “light” or “limited.” Synergistic or cumulative effects were never mentioned. Indications of “maximum permissible values” of impacts, as required by the new Marine Ecological Assessment Regulations, were never provided. And there were only vague statements that concerned monitoring plans (e.g., if something abnormal is observed, action will be taken).

The EIA screening process does not ensure that projects on tidal flats or ones that involve land reclamation (except those in large harbours) will be subject to full assessment.

MacFarquhar emphasized that commissioners need sufficient time and resources to do their job conscientiously for two reasons: (1) the intrinsic importance of overseeing and validating the EIA process and (2) the fact that their findings can serve an important public education function.

In discussion of the presentations by Winkler and MacFarquhar (2.10 and 2.11), workshop participants expressed concern that land reclamation aspects of projects often are not subject to full EIA and that in practice the EIA process lacks transparency and thus accountability to the public. It was generally understood that Taiwan’s legislative and administrative structure is adequate and that what is most needed is greater public awareness and education, which should result in increased pressure on those in authority to implement the laws and regulations more rigorously. More opportunities are needed for open, complete information transfer, and for public participation in the review processes. Another concern was that no systematic consideration is given to the synergistic or cumulative effects of development. As in most countries, the importance of such effects is recognized and cited in laws and regulations, but with no practical attempt made to characterize, quantify, or address them. Finally, and very importantly, the workshop endorsed the principle that EIA should be applied to entire projects and that laws, regulations, and practices need to be changed to ensure project segmentation does not continue.

4. Progress on 2004 Recommendations and Priorities

4.1. 2004 Recommendations

Three recommendations were included in the 2004 workshop report.

The first was that humpback dolphins and their habitat requirements be routinely considered in EIAs for development in western Taiwan (in both coastal and watershed regions). Some consideration has been given to the dolphins, beginning in 2006, so modest progress has been made, but it is still far from adequate. Land reclamation projects are still not adequately covered by the EIA process (see earlier) and no consideration has been given to the potential impacts of inland developments on watersheds, and in turn the potential indirect impacts on humpback dolphins, as was recommended in 2004.

The second recommendation was that a standing body be established to oversee and monitor humpback dolphin conservation in Taiwan. This recommendation is addressed below under item 6.

The third recommendation was that workshops to assess progress and make further plans for research and mitigation be held at regular intervals and that the next one be in 2007. This recommendation was at least partially implemented with the present meeting.

4.2. Priorities in General

In 2004, an effort was made to identify (a) threats to the ETS humpback dolphin population and (b) the types of information needed to better understand or address those threats (Wang et al. 2004b, Table 1). In addition, the workshop report listed and ranked the various types of biological information needed to help meet conservation goals (Wang et al. 2004b, Table 2). Finally, that report identified various mitigation or management options for addressing the four main threats – reduction of freshwater flow, habitat loss, fishery bycatch, and industrial, municipal and agricultural discharge (Wang et al. 2004b, Table 3).

As one way of assessing progress, the 2007 workshop reviewed the list of mitigation/management options in the 2004 report (Wang et al. 2004b, Table 3) and determined for each item whether progress had or had not been made, recognizing that for some items the information available was insufficient to support a meaningful judgment (Table 1) Unfortunately, there was very little evidence of progress on most items.

4.3. Progress on Research Priorities

As discussed in section 1.1 of this report, good progress has been made on abundance estimation since 2004. Although it is not very precise, at least a credible abundance estimate for the population is now available.

With the exception of rigorous statistical analyses on pigmentation differences, little new information is available on taxonomy (see sections 1.1 and 1.2).

Major progress has been made towards obtaining information on total distribution and habitat (see section 1.1). It was suggested that use of a geographic information system (GIS) approach that incorporates all sightings positions along with data on biophysical features of the environment would be a useful next step for identifying and delineating important habitat for this population. Also, it was noted that Samuel K. Hung is engaged in a habitat-mapping project for the PRE humpback dolphin population, employing the large sightings dataset to estimate densities in small units of area and using these data in a predictive modelling context. A similar approach should be considered for the ETS population although the relatively small number of sightings could make it premature.

With regard to seasonal movements, there are now some sightings records for additional months but a major gap continues to exist for the winter months when sea and weather conditions preclude effective surveys. Obtaining data on winter occurrence and distribution remains a priority. The example was offered of Hector's dolphins in New Zealand where in the absence of detection effort offshore, it was long assumed that the animals only occurred near shore. Offshore surveys eventually showed that Hector's dolphins occur as much as 15nmi from the coast, and this has important implications for protecting them from bycatch in fisheries. In Taiwan, offshore surveys in non-winter months have revealed no sightings of humpback dolphins, and local fishermen claim to see them in the same near-shore areas year-round. Nonetheless, it is uncertain whether ETS humpback dolphins have a different distribution during winter months. Passive acoustic (e.g., PODs) should be considered as a possible approach for detecting dolphins in offshore areas or in conditions unfavourable for visual survey.

No new information has been obtained on feeding ecology despite the recognition that the animals' health and productivity depend on it and that their main route of exposure to contaminants is via the food-web. To a considerable extent, basic diet, food preferences and feeding behaviour can be inferred by analogy with the PRE humpback dolphins although one important difference is that the ETS animals have not been seen feeding in association with trawlers as PRE animals have. The PRE dolphins are mainly piscivorous.

The workshop acknowledged the results of a project carried out by Chou (2006) under sponsorship of the Fisheries Agency, Council of Agriculture. The results are summarized in section 1 of this report, and are for the most part consistent with the information contained in the previous workshop report (Wang et al. 2004b).

4.4. Progress on Understanding Threats

No new information on cetacean bycatch off the west coast of Taiwan has become available although some preliminary data on fishing effort (days at sea) at two ports (Wuci, Taichung County and Waipu, Miaoli County) were presented in the Fisheries Agency report (Chou, 2006, Fig. 2b).

Although considerable information on development along the west coast of Taiwan was presented at the workshop, and this included information on plans for further abstraction and diversion of water upstream of estuaries, no real progress was achieved at improving our understanding of the threat posed by reduced freshwater flow. There remains a clear need for integration of information on humpback dolphin ecology (including feeding ecology) with information on how water development projects and other human activities affecting

Taiwan's rivers will change (or already have changed) conditions in estuaries used by the dolphins.

Apart from recognizing that large-scale shoreline modification is continuing, little further insight has been gained since 2004 as to how the various modifications (notably land reclamation) have affected, or will affect, humpback dolphins.

Much the same must be said about industrial, agricultural and municipal discharge. At the workshop, Ross provided the following update on the Stockholm Convention:

At the 2004 workshop, it was noted that the Stockholm Convention on Persistent Organic Pollutants (POPs) promised to provide some benefits for marine wildlife, including marine mammals. The convention came into force in May 2004 after ratification by 50 of the original signatories. This treaty targets the elimination of the 'dirty dozen' (see Table 2). The basis for the Stockholm Convention (for more information, see <http://www.pops.int/>) consisted of recognition that these chemicals (a) had been detected in remote locations of the world, (b) had reached high levels in aquatic food webs, and particularly in high trophic-level consumers (marine mammals, fish-eating birds and some human consumer groups), and (c) were toxic to biota. In signing the convention, nations are committing themselves to eliminating or reducing the release of these chemicals into the environment. The convention can be expanded in the future to include other chemicals deemed persistent, bioaccumulative, toxic, and subject to long-range transport, such as the flame retardant class of polybrominated diphenylethers (PBDEs).

Taiwan's conformity with the terms of this convention (which remains to be verified) would obviously represent an important step toward improving the health of local and regional marine food webs.

In view of the fact that so few ETS humpback dolphins become available for examination and sampling (e.g., as stranded or bycaught specimens), and the continuing belief of workshop participants (as in 2004; see Wang et al. 2004b, p. 13) that a biopsy program is contraindicated for this population at this time, the group endorsed the idea of carrying out a risk-based assessment of potential effects of contaminants, involving sediment studies, food-web-based modelling, and a food-basket approach.

Since the 2004 workshop, much new information has been generated on the subject of the effects of noise from human activities on cetaceans, partly through research and partly through discussions in a number of fora (e.g., NRC 2005, Wright 2006, Cox et al. 2006, MMC 2007, Wright et al. in press). It has become evident that noise produced by human activities can have biologically significant impacts without necessarily causing obvious behavioural responses. These effects are of special concern when placed in the context of the cumulative and possibly synergistic consequences of other threats. With this new information and in recognition of the pervasiveness of coastal development, shipping, military activities, and terraforming (e.g., land reclamation, channel dredging) within and near the habitat of ETS humpback dolphins, participants at the 2007 workshop concluded that noise should be added to the list of major threats.

5. Mitigation and Threat Management

5.1. Conservation Goals and Objectives

In 2004, a number of options were considered as potential management goals (Wang et al. 2004b, p. 15). After discussing those, participants in the 2007 workshop agreed on the following as goals and objectives for ETS humpback dolphin conservation:

The overarching, long-term **goal** is to ensure the long-term viability and ecological function of this population in its natural environment in eastern Taiwan Strait.

Three **objectives** were identified to serve that goal, as follows:

- Allow the dolphin population to increase.
- Prevent further reduction, and if possible allow expansion, of the population's geographic range.
- Maintain, improve or restore the quantity and quality of *Sousa* habitat along the west coast of Taiwan.

All of these objectives are potentially measurable. The population almost certainly has declined in numbers and its range has diminished in recent decades although we do not know the magnitude of the historical change. As noted earlier in this report, it is likely to take a long time to demonstrate scientifically that there has, or has not, been a significant increase in the population as a result of mitigation measures (should they be implemented). The same is true of changes in the extent of the population's range. With regard to the third objective, it will be necessary to develop appropriate metrics, and examples of guidelines and benchmarks used in other countries may prove helpful for that endeavour (e.g., see Working Paper 20 by White).

5.2. Potential Sources of Funding

Funding for most of the research and conservation of ETS humpback dolphins, thus far, has come from foreign sources (e.g., Ocean Park Conservation Foundation, Hong Kong; Hong Kong Cetacean Research Project; Hong Kong Dolphin Conservation Society) that generally provide small grants as "seed money" in the expectation that major, long-term funding will come from elsewhere (typically government or industry). Thus far, only the Fisheries Agency, Council of Agriculture, has contributed funding to the Taiwan Cetacean Society for research projects in 2005 and 2006. Some support for the 2004 and 2007 workshops came from the following Taiwanese government agencies: National Science Council, Ministry of Education and the Forestry Bureau (Council of Agriculture).

The workshop identified the following potential sources of funds for ETS humpback dolphin research and conservation in the future:

Central Government: Tourism Bureau (Ministry of Transport and Communications), Construction Planning Administration (Ministry of the Interior), Water Resources Agency (Ministry of Economic Affairs), Ministry of Education, Ministry of National Defense, Coast Guard Administration (Executive Yuan), Environmental Protection Administration

(Executive Yuan), National Science Council (Executive Yuan), Forestry Bureau – Council of Agriculture (Executive Yuan), Fisheries Agency – Council of Agriculture (Executive Yuan), Academia Sinica, National Museum of Marine Biology and Aquarium, and Taiwan Power Company.

Regional governments: county governments of Miaoli, Taichung, Changhua, Yunlin, Chiayi and Tainan (the counties where ETS *Sousa* have been sighted in their waters); township governments within each county may also provide some funding.

Other Sources: National Science Council/NSERC Exchange Program, US Marine Mammal Commission, various industries and businesses, domestic and international NGOs, domestic and international foundations, and private contributors

5.3. Designation of a Marine Protected Area

In 2004, area-based approaches to cetacean conservation were considered briefly (Wang et al. 2004b, p. 17). In 2007, more attention was given to this concept and it was agreed some elaboration would be useful.

A marine protected area (MPA) is any marine area designated for the conservation of species or habitats that is supported by local or national legislation (Agardy et al. 2007). Any such designated area must meet a number of requirements if it is to achieve its purpose(s) (Hoyt 2005). These include:

- Scientific background information on habitat requirements of cetaceans and other species;
- Good relationship with local communities and most, if not all, stakeholders;
- Sensible boundaries in view of the species, ecosystems, and ecosystem processes that are supposed to be protected;
- Comprehensive, ecosystem-based management plan that takes socio-economic considerations into account;
- Legal recognition as well as broad public acceptance;
- Interactive, reciprocal educational program for those who use or travel through the MPA;
- Management of pollution, both marine- and land-based;
- Enforcement program; and
- Periodic assessment and re-evaluation (adaptive management).

A thorough search of the literature is required at the early planning stages to identify key habitat requirements and distribution information, as well as to identify possible models through case studies. Field studies should be commissioned if such data are lacking. It is also important to determine funding sources early on for the surveys, research, planning, development, management, and enforcement involved in MPA development and operations. The data sought and planning should consider the need for an ecosystem-based approach, as effective protection of a species or population also requires protection of its prey items and their habitat. All human uses of the area need to be characterized and evaluated and the potential socioeconomic costs (and benefits related to protection - e.g., increased fishing catches outside the area) fully considered. Local ocean processes need to be considered, as they will influence or even determine any effects on the area from ‘upstream’ human activity,

including that on land (e.g., in watersheds of rivers that empty into important estuaries for the dolphins). All of those factors need to be carefully considered in MPA design.

In the light of those requirements and considerations, the workshop concluded that designation of an MPA dedicated to the conservation of ETS humpback dolphins would be ill-advised at present. Given the current state of knowledge with regard to both biology and threats, it seemed unlikely that an MPA encompassing anything less than the entire range of the population would provide biologically meaningful protection. Moreover, human activities ‘upstream’ of such an area, including those influencing the freshwater discharge of rivers flowing into the dolphins’ habitat, would need to be subject to control to maintain certain levels of freshwater discharge that are critical for fish populations and fisheries. Participants were not convinced that the political will existed, or that the requisite funding would be made available, to support effective management, monitoring, and enforcement of such a large portion of the west coast of Taiwan at this time. This is due in part to the general lack of awareness of and knowledge about the dolphin population amongst the Taiwanese public, thus precluding broad public acceptance and local community support. Among the drawbacks to a small ‘postage-stamp’ MPA such as Hong Kong’s Sha Chau and Lung Kwu Chau Marine Park are that it would fail to address continuing threats in other parts of the population’s range and possibly also concentrate displaced activities (e.g., fishing) along the edges of the small protected area and thus increase the risk to dolphins while giving the public false assurance that the animals are being well protected.

In conclusion, designing, establishing, managing, and monitoring an MPA is a time-intensive, expensive proposition. Therefore, it is essential that most, if not all, of the elements listed above are in place from the outset, most importantly that the political and public will exists to support such an initiative. Specific threat mitigation (e.g., banning and enforcing the ban on certain types of fishing gear, changing vessel routing through habitat) often proves quicker and easier to implement. Even if an MPA is to be contemplated for the future, other threat mitigation needs to be pursued immediately if this small dolphin population is to have a chance of survival and recovery.

5.4. Public Education and Awareness

The need for public education and awareness is self-evident, as emphasized in section 3 of this report. It is important to ensure that the information provided to educators, decision-makers, and the public in general is authoritative and up-to-date. The workshop emphasized two further aspects of public awareness campaigns. First, it is critically important that such campaigns include schoolchildren as a principal target audience. Second, such campaigns should incorporate follow-up studies explicitly designed to evaluate effectiveness.

Concern was expressed that in Taiwan, the distinction between conservation and animal welfare is largely unrecognized, and this often leads to disproportionate investment of resources (including those earmarked for conservation) in efforts to rescue live-stranded or otherwise distressed cetaceans. Although the welfare of such animals is a legitimate concern and efforts to reduce their suffering are to be encouraged, the lack of effective education and public awareness has continued to obscure the distinction between conservation and animal welfare in the public arena. The investments in “rescue” work and in studies of the effects of whale-watching are questionable when one considers the conservation significance of those activities compared, for example, to the significance of bycatch as a threat to cetacean

populations. Ironically, some fishermen who operate whale-watching tours during the summer fish with large-mesh pelagic driftnets from the autumn to spring (J.Y. Wang, unpublished data). The large-mesh pelagic driftnet fishery off eastern Taiwan kills considerable numbers of cetaceans each year (see Perrin et al., 2005).

Specifically with regard to whale-watching, the workshop recognized that boat tours aimed at watching humpback dolphins would provide opportunities for the public to engage and learn more about these animals, but participants also expressed concern about the impacts that disturbance from such tourism could have on this very small, resident dolphin population. It was concluded that boat-based tourism targeting ETS humpback dolphins should not be allowed. Fortunately, the dolphins occur very close to shore and can be observed clearly and frequently from several land-based vantage points. Dolphin-watching from shore should be encouraged, and even facilitated by the provision of public access to the observation sites. Increased public access to coastal areas within the dolphins' range was considered essential for raising awareness of the west-coast environment.

6. Technical Advisory Working Group

In 2004, it was suggested that a ‘multi-stakeholder body’ should be considered in Taiwan, similar to Hong Kong’s Marine Mammal Conservation Working Group, to oversee and monitor conservation action and research on behalf of humpback dolphins. No such body had been established prior to the 2007 workshop.

Participants in the 2007 workshop agreed that the first step should be to create a technical advisory working group to develop and provide scientific information on ETS humpback dolphins. A steering committee was established (with Rose appointed as chairman) to carry this initiative forward. The steering committee was expected to meet over the months following the workshop to establish terms of reference, recruit a chairman for the working group, and identify, nominate and invite members for it. Although the target size of the working group was envisaged as 12-15 individuals, no strict limit was to be set and disciplinary breadth was to be encouraged.

It was suggested that the working group should function in both reactive and proactive modes. In other words, it should be able to respond to requests for expert information, advice, or comment from government agencies, NGOs, industry, and others (e.g., on EIAs where there is concern about potentially serious effects on humpback dolphins), but also take the initiative to develop and offer advice on research and conservation.

It was also clear from the discussions that a multi-stakeholder group, as called for in the 2004 workshop report, is highly desirable and should be established as soon as possible. However, the creation of such a group will depend on local (Taiwanese) interest and capacity. One potentially useful model for local governance of habitat restoration – the Bay Area Restoration Council in Hamilton, Ontario, Canada – was described in a working paper by White.

Wang reported that both the Natural Resources Defense Council and the Whale and Dolphin Conservation Society had sent letters, which besides supporting the workshop, had also asked to be involved in either or both the technical advisory working group and the multistakeholder group, described above.

7. Recommendations

The ETS humpback dolphin population is unlikely to persist over the coming decades, and it certainly will not “recover,” unless action is taken immediately to improve the quality of its habitat and to prevent human-caused injury and mortality. It is important to avoid viewing the plight of these dolphins as an isolated concern of little relevance to the everyday life of the people of Taiwan. As fellow mammals, the dolphins should be regarded as sentinels of environmental health in coastal waters and estuaries, living as they do at the interface between land and sea. Stopping environmental neglect and abuse, and indeed reversing the trend towards deterioration and loss, is as urgent for the people and other organisms living along Taiwan’s west coast and in the watersheds flowing into the Taiwan Strait as it is for the dolphins.

We begin this section by identifying priorities for research and monitoring. We then provide recommendations for conservation based on what is known already.

7.1. Priorities for Research and Monitoring

More and better information is needed on dolphin numbers, movements and distribution, habitat characteristics, feeding ecology, and population demographics in Taiwan. However, as emphasized earlier, none of these needs should stand in the way of immediate implementation of conservation action (see 7.2).

Workshop participants generally agreed that long-term monitoring of the dolphin population is important and that photo-identification work, such as that conducted in 2007 by Wang and Yang, should be continued. Also, it was noted that the potential for remote-sensing methods (e.g., passive acoustics) should be explored, especially for use in winter when visual boat- or land-based survey is impractical.

7.2. Recommendations for Conservation Action

Although a great deal more needs to be known about the animals and the nature of the threats facing them, enough is known right now about the urgent state of the dolphins to proceed with a series of actions. The workshop recommended that the central and local governments do the following:

- 1.** Proceed with formal declaration and public announcement of important habitat for ETS humpback dolphins that is based on all available information;

In 2004, the workshop recommended that humpback dolphins and their habitat requirements should be considered routinely in the EIA process for development along the west coast of Taiwan. It was specified that inland developments on watersheds, even though many kilometres from the ocean, also need to be taken into account given their potential indirect impacts on the dolphins. Thus,

- 2.** Carry out public and transparent evaluations of all existing and planned projects and future proposals that may have impacts on ETS humpback dolphins and their habitat (including upstream watershed areas). Such evaluations should employ precautionary

reasoning, i.e., uncertainty should be explicitly acknowledged and incorporated in decision-making to avoid errors in judgment that could put the animals at greater risk. Such projects and proposals may include, but are not limited to:

- Land reclamation and coastal construction
 - Sand and other substrate removal
 - Artificial reef projects
 - Water resource management projects
 - Industry and other pollutant point-sources
 - Noise-generating activities
 - All energy-generation projects
3. Mitigate all existing and planned projects and future proposals that may have impacts on ETS humpback dolphins and their habitat (including upstream watershed areas) using best available methods and based on precautionary reasoning and judgment (see item 2, above);

All laws and regulations regarding disclosure of environmental data should be interpreted in a manner that facilitates, rather than obstructs, the transmittal of information to all interested persons and groups, and their participation in the decision-making process. Without such facilitation, attempts to understand and mitigate threats and ultimately ensure the survival of ETS humpback dolphins will be compromised.

4. Prohibit use of gill nets and trammel nets in all waters inhabited by ETS humpback dolphins;
5. Limit development of tourism focused on humpback dolphin-watching to land-based platforms and ensure that it is integrated with nature-oriented education efforts and encouragement of a “take back the coastline” public spirit;
6. If any marine protected area is proposed for the benefit of humpback dolphins in Taiwan, it will require substantial resources and an open planning and consultation process. Also, it should cover the dolphins’ entire effective range to provide meaningful protection (e.g., strict enforcement).

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Table 1. Mitigation/management options for the four main threats, as identified in 2004, with indications of whether progress has or has not been made since 2004. (EIA = Environmental Impact Assessment; PBT = Persistent, Bioaccumulative, Toxic; + = some progress since 2004; - = no progress since 2004; ? = insufficient information available to judge progress since 2004). (Adapted from Wang et al. 2004b, Table 3).

Threats	Mitigation / Management Options	Progress since 2004?
Reduction of freshwater flow (dams, flood control, other river alterations)	Add humpback dolphins to EIAs (general recommendation)	+
	Allocate minimum water flow to rivers and estuaries (e.g., via compensation to industries / communities for their losses, incentives to reduce usage, water purification and recycling, desalination projects)	-
	Halt construction of and plans for further water diversion or impoundment	-
	Restore flow to rivers of western Taiwan	-
Habitat loss (land reclamation, breakwalls, dredging, alterations of estuaries)	Include consideration of potential dolphin and prey habitat loss in EIAs for new land reclamation and other industrial projects	*
	Minimize land reclamation in areas of dolphin habitat	-
	Establish dolphin protection area (within range of dolphins) where no further land reclamation is allowed	-
	Restore habitat by reversing land reclamation and other developments	-
Fishery bycatch (gillnets, trawls)	Establish dolphin protection area where gillnets and trawls are banned	-
	Prohibit use of gillnets and trawls in area/season of high dolphin occurrence	-
	Prohibit certain types of gillnets (e.g., trammel, large-mesh)	-
	Gear modification (with provisos, see text)	-
	Use of "pingers" (with provisos, see text)	-
	Modify fishing practices (e.g., tending nets constantly)	?
	Compensate fishermen for losses (e.g., "buy-out" program)	-
Industrial, municipal, and agricultural discharge	Regulate chemical design, use, handling, disposal, and transport of PBT compounds (e.g., PCBs, dioxin)	?
	Implement source control measures that target sectors	?
	Reclaim and recycle potentially useful constituents of sewage (e.g., metals)	?
	Upgrade effluent treatment to remove chemicals from sewage or degrade them to inert products (sludge should likely be treated as hazardous waste)	?
	Introduce buffer zones, integrated pest management (IPM) and other practices to prevent or reduce runoff of pesticides	?
	Separate municipal and industrial liquid waste grids to improve source control and waste treatment options	?
	Remove contaminated sediments or soils	-

*Land reclamation projects are not always subject to full assessment under Taiwan's EIA law, but this was not understood by workshop participants in 2004.

Table 2. The priority Persistent Organic Pollutants targeted for elimination under the terms of the Stockholm Convention.

	Common Name	Use	*logK_{ow}	Molecular Weight
Stockholm POPs	ALDRIN	Insecticide; seed treatment	5.17-7.4 ¹	364.92
	CHLORDANE	Insecticide; earthworm control	6.00 ¹	409.78
	DDT	Insecticide - primarily for malaria control	4.89-6.914 ¹	354.49
	DIELDRIN	Insecticide	3.692-6.2 ¹	380.91
	DIOXINS	By-product of manufacturing / combustion	4.75-8.20 ²	218.5-460.0
	FURANS	By-product of manufacturing / combustion	5.44-8.0 ²	237.1-443.8
	ENDRIN	Insecticide; rodenticide	5.2 ³	380.92
	HCB	Pesticide; by-product	5.73 ³	284.78
	HEPTACHLOR	Insecticide; earthworm control	4.40-5.5 ¹	373.32
	MIREX	Insecticide; fire retardant	5.28 ³	545.5
	PCBs	Dielectric fluids	4.3-8.26 ²	188.7-498.7
	TOXAPHENE	Pesticide; control of scabies	3.23-5.50 ¹	413.82

*logK_{ow} is the octanol/water partitioning coefficient and is a proxy value for partitioning of chemicals into either fat (~octanol) or water. Chemicals with values >5.0 are considered problematic in terms of the Stockholm Convention (i.e., they are more likely to accumulate in the fatty component of aquatic food webs and magnify in top predators, like humpback dolphins).

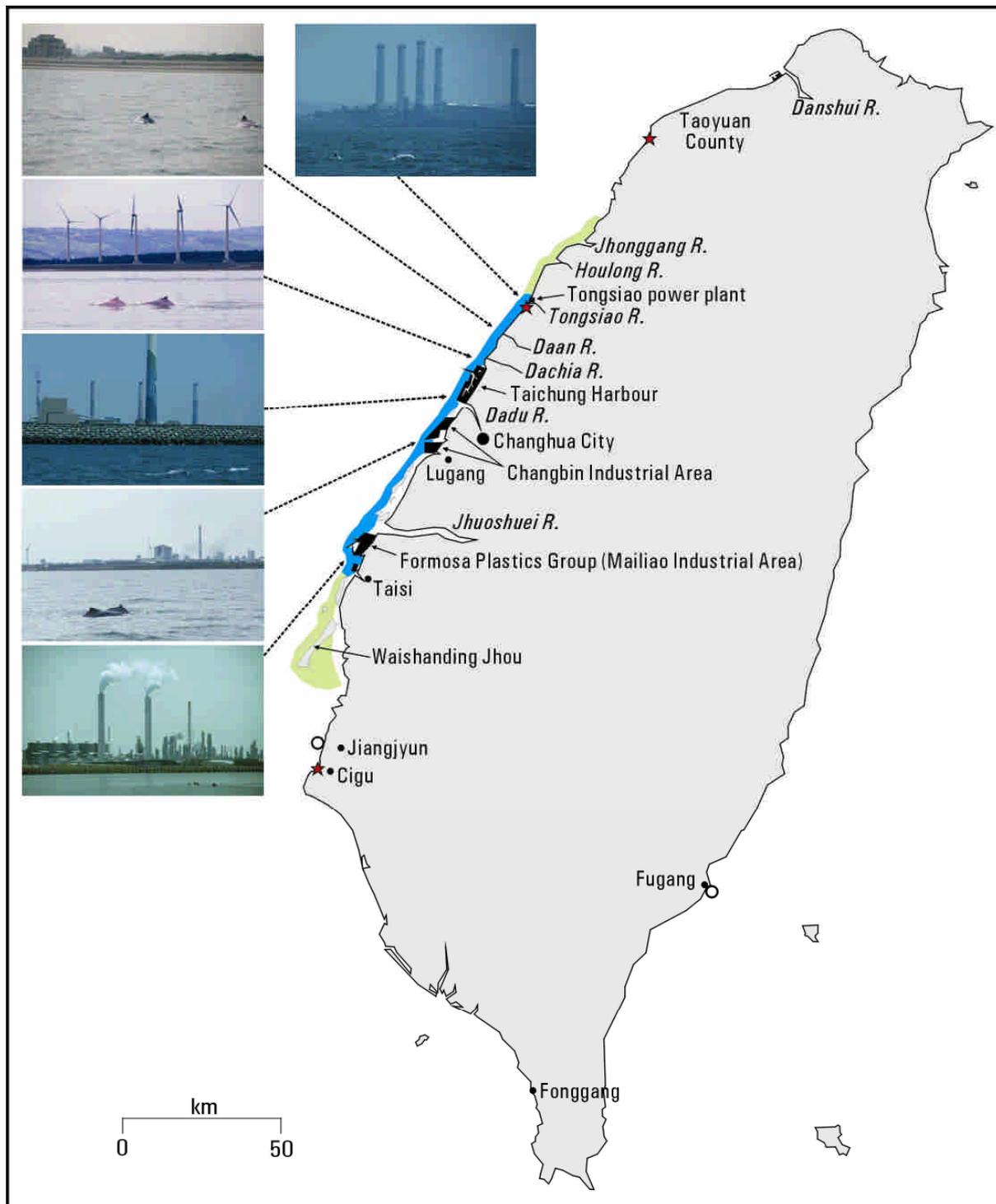


Figure 1. Distribution of the eastern Taiwan Strait population of Indo-Pacific humpback dolphins with photographs illustrating dolphins observed at the locations indicated by the arrows. The primary distribution is shown in blue whereas the light green represents areas where dolphins are observed less frequently. The black polygons represent reclaimed land for industrial purposes. Open circles and red stars represent exceptional sighting records and stranded dolphins, respectively. (All photographs © John Y. Wang / *FormosaCetus* Research and Conservation Group).

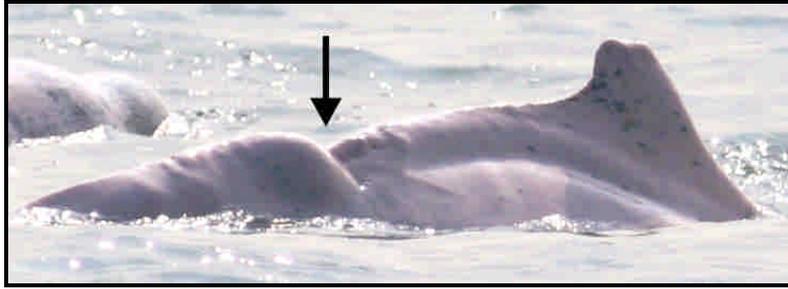


Figure 2. An example of a dolphin with a severe injury to the dorsal aspect of the caudal peduncle (indicated by the arrow). (Photograph © Shih Chu Yang / *FormosaCetus* Research and Conservation Group).

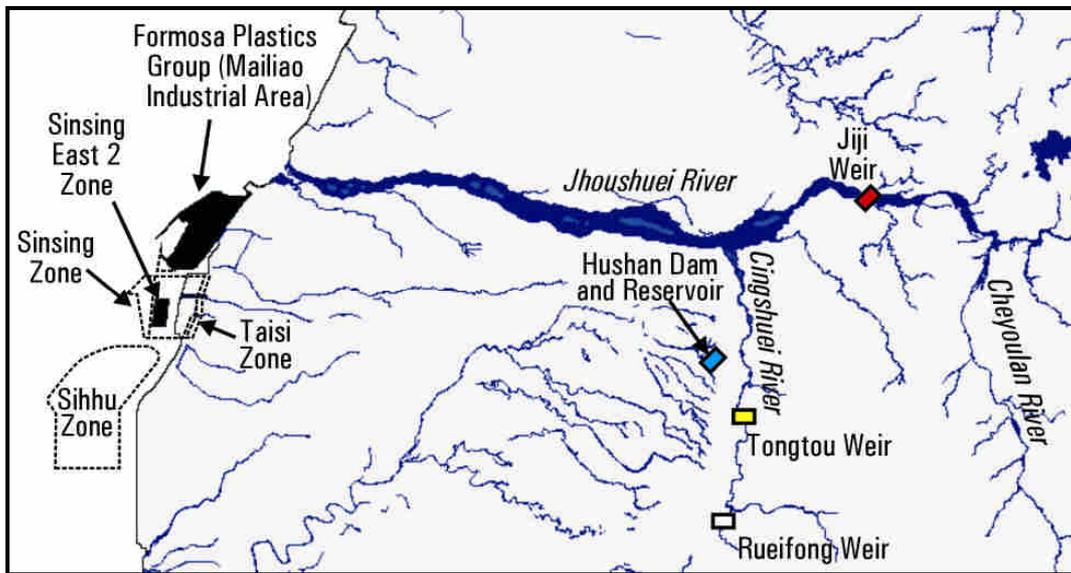


Figure 3. The Jhuoshuei River system with major tributaries, water diversion / extraction projects and existing and proposed parts of the Yunlin Offshore Industrial Park. Red rectangle = completed (in operation); blue rectangle = under construction; yellow rectangle = under planning; and white rectangle = construction temporarily suspended. Black polygons and broken lines represent existing reclaimed land and future land reclamation plans of the Yunlin Offshore Industrial Park.

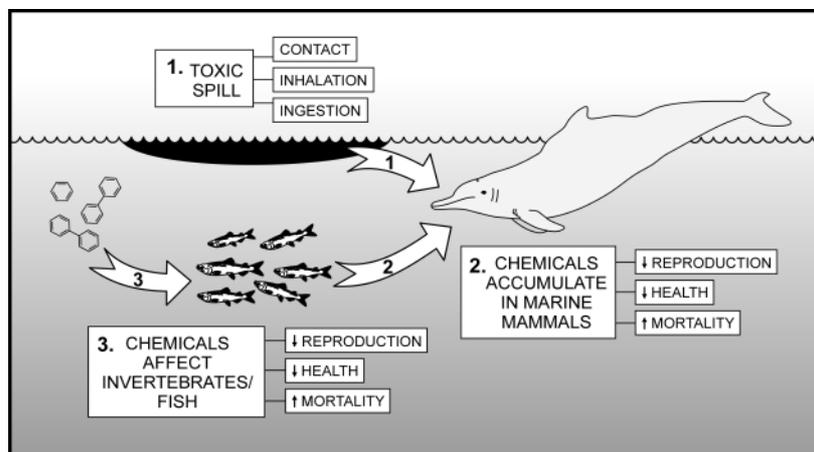


Figure 4. A schematic diagram showing a simplification of the food web for humpback dolphins (provided by Peter S. Ross).

APPENDIX 1

REVISED WORKSHOP AGENDA (5 September 2007)

Venue: Formosa Hotel, Changhua City, Changhua County, Taiwan

Chair/Convener: John Y. Wang

English Rapporteur: Randall R. Reeves

Chinese Rapporteur: Shih Chu Yang

1. WELCOME

2. HOUSE-KEEPING

3. INTRODUCTION OF THE PARTICIPANTS

4. REVIEW AND ADOPTION OF THE AGENDA

5. INTRODUCTION (Chair)

5.1. History of Taiwan's *Sousa* and other background information

5.2. Purpose, goals and procedures of the 2007 workshop

6. REVIEW INFORMATION ON *SOUSA* BIOLOGY AND THEIR THREATS

6.1. *Biology of the eastern Taiwan Strait (ETS) population of Indo-Pacific humpback dolphins (Sousa chinensis): an update since 2004* – John Y. Wang (FormosaCetus Research and Conservation Group / National Museum of Marine Biology & Aquarium) (30 minutes)

6.1.1. Group discussion on the biology of the ETS *Sousa*

6.1.1.1. **Evaluation** (of progress on 2004 recommended research priorities)

6.1.1.2. **Identify and prioritize future research needs** (as in 2004; including other needs?)

6.1.1.3. **Potential future research funding sources and the importance of independent research**

6.2. **Current knowledge of the potential threats:** changes from the past to present and future projections

6.2.1. *National land use planning and development - coastal zone* – Chih-Ming Chen (Urban and Rural Planning Office, Construction and Planning Agency, Ministry of the Interior) (20 minutes)

6.2.2. *The current industrial development of Taiwan* – Zhen-Wei You (Industrial Development Bureau, Ministry of Economic Affairs) (20 minutes)

6.2.3. *An overview of the utilization of water resources of the rivers of central western Taiwan* – Cheh-Shyh Ting (Department of Civil Engineering, National Pingtung University of Science and Technology) (20 minutes)

6.2.4. *Present status of the water resources of the Jhuoshuei River system* – Ching-Chun Chen (Taiwan Academy of Ecology) (20 minutes)

6.2.5. *Fisheries of inshore waters of western Taiwan* – Man-Chuan Wu (Fisheries Agency, Council of Agriculture) (20 minutes)

6.2.6. *The environmental impacts of cobia aquaculture's wastes and chemicals* – Chiu Long Chou (Institute of Marine Affairs, National Sun Yat-Sen University) (20 minutes)

- 6.2.7. *Taiwan's marine pollution and management* – Cheng Yang Lyu
(Environment Protection Agency)
- 6.2.8. **Group discussion on threats**
 - 6.2.8.1. **Evaluation** (of progress on understanding threats highlighted in 2004)
 - 6.2.8.2. **Identify and prioritize threats and information needs on threats** (as in 2004; including discussion of other or new threats)
 - 6.2.8.3. **Potential future research funding sources and the importance of independent research**

7. CONSERVATION

7.1. Laws, policies, processes and enforcement associated with wildlife conservation and environmental protection in Taiwan

- 7.1.1. *The current state of cetacean conservation in Taiwan* –Jung-Sheng Shia
(Forestry Bureau, Council of Agriculture) (20 minutes)
- 7.1.2. *Life in national marine policy* – Lee-Shing Fang (Cheng-Shiu University)
(20 minutes)
- 7.1.3. *Taiwan's environmental impact assessment law and practice* – Robin Winkler (Wild At Heart Legal Defense Association) (20 minutes)
- 7.1.4. *Biodiversity, marine ecological assessment and land reclamation in Taiwan's EIA process* – Christina MacFarquhar (Wild At Heart Legal Defense Association) (20 minutes)

7.2. Review of the progress on the general recommendations of 2004

7.3. Group Discussion

- 7.3.1. **Evaluation** of progress on general recommendations and possible mitigation actions identified in 2004
- 7.3.2. **List of conservation needs for the ETS *Sousa* and goal setting**

7.4. Some potential tools/mitigation methods to achieve the conservation goals

- 7.4.1. Multi-stakeholder international advisory committee
- 7.4.2. A conservation action plan
- 7.4.3. Marine Protected Area(s)
- 7.4.4. Fisheries (e.g., gear ban, modification, seasonal/area closures, etc.)
- 7.4.5. Reduce all pollution
- 7.4.6. Restoration of “clean” freshwater to important river estuaries
- 7.4.7. Halt habitat destruction
- 7.4.8. Amend, implement or enforce present existing legislation
- 7.4.9. Improve the credibility of the EIA process
- 7.4.10. Others?

7.5. Recommendations of what can or has to be done to mitigate the most serious and emerging threats

7.6. Establishment of a Technical Advisory Working Group

- 7.6.1. Mission
- 7.6.2. Role of committee members
- 7.6.3. Size and composition of membership
- 7.6.4. Rules governing committee members and conflicts of interest
- 7.6.5. Regularity of meetings
- 7.6.6. Appointment of Steering Committee to establish the technical advisory working group and its chair
- 7.6.7. Other

7.7. The CONSERVATION ACTION PLAN for the ETS population of *Sousa chinensis*

- 7.7.1. Goals (from item 7.3.3)

- 7.7.2. Recommendations for conservation actions (general, specific, immediate, long-term, etc.)
- 7.7.3. Priorities for research on biology of and threats to the ETS population (taken from items 6.1.3.2 and 6.2.8.3)
- 7.7.4. Public awareness (is it effective? How do we know?)
- 7.7.5. Other

8. OTHER ISSUES

9. FUTURE MEETINGS

10. WORKSHOP REPORT AND CONSERVATION ACTION PLAN

10.1. The final workshop report

- 10.1.1. Main elements and structure
- 10.1.2. Post-workshop review process
- 10.1.3. Review and translation schedule

10.2. The conservation action plan

- 10.2.1. Main elements and structure
- 10.2.2. Post-workshop review process
- 10.2.3. Review and translation schedule

10.3. Schedule of availability of the workshop final report and conservation action plan (hard and electronic versions)

10.4. Posting of workshop materials onto a website?

10.5. Drafting of short summary of the *Workshop Report* and Conservation AP (for press release; needs to be completed on-site!)

11. CONCLUSION OF WORKSHOP (final comments)

12. MEET THE PRESS & PUBLIC

12.1. Presentation of the press release (including material in the Executive Summary)

12.2. Q&A session

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APPENDIX 3

CONSERVATION ACTION PLAN

FOR THE

EASTERN TAIWAN STRAIT POPULATION OF INDO-PACIFIC HUMPBACK DOLPHINS*

The very small (< 100 individuals), isolated population of Indo-Pacific humpback dolphins (*Sousa chinensis*) that lives in the eastern Taiwan Strait, ETS (=waters of western Taiwan), close to shore along the western coast of Taiwan, is in serious trouble. Like the baiji (*Lipotes vexillifer*), a species of river dolphin that inhabited the Yangtze River until only a few years ago but is now likely extinct, the ETS humpback dolphins are mostly victims of unintentional or indirect harm caused by human activities. The river mouths where they congregate are severely polluted. Most – in fact nearly all – of the fresh water that once flowed into these estuarine ecosystems, cleansing and replenishing them, is now taken away upstream for industrial, agricultural and municipal consumption. In addition, the dolphins' coastal and estuarine habitat is now clogged with fishing nets, aquaculture facilities and boat traffic – all posing risks to the animals. Land reclamation for massive industrial projects has reduced, and continues to reduce, the limited habitat of these dolphins.

For many years, the international conservation and scientific community had been urging China to take immediate, decision action to save the baiji. It is now too late. It will also soon be too late for the vaquita (*Phocoena sinus*), a tiny porpoise confined to Mexico's Gulf of California that is being driven extinct by accidental entanglement in fishing nets. In both of those cases, the science was clear and unequivocal – what was needed was action by government officials to protect the animals, not more research. The same is now true of the ETS humpback dolphins. Unless tough management action is taken immediately to protect them and improve the quality of their habitat, this small group of animals unique to Taiwan will be lost forever.

The ETS humpback dolphins were the focus of an international workshop held in Changhua City (Taiwan) on 4-7 September 2007. Participants included local dolphin researchers, conservationists and marine engineers, as well as experts from Canada, the United States, Japan, Brazil, United Kingdom and Hong Kong. Officials from government agencies, representatives of academic institutions and members of local conservation groups presented a grim picture of the state of the coastal marine environment along the west coast of Taiwan (for the report of the workshop, see Wang et al. 2007a). This Conservation Action Plan for the ETS humpback dolphins summarizes the main results of the workshop deliberations: the over-arching conservation goal; the objectives to serve the goal; and the recommendations for immediate conservation action.

* This Conservation Action Plan was drafted in English and reviewed by all invited participants who attended the entire workshop. A Chinese translation has been provided to assist Taiwanese readers in understanding the plan. However, the English version should be considered definitive if any discrepancy is found between the English and Chinese versions.

New Information on the ETS Population of Humpback Dolphins

Some new information provided to the 2007 workshop (see Wang et al. 2007b) supplements what was known in 2004 and was summarized in the 2004 Research Action Plan (Wang et al. 2004). This includes the following:

- Based on clear differences in pigmentation patterns, ETS humpback dolphins are distinct from those of other nearby provisional populations and therefore represent a separate population;
- From data collected between 2002 and 2005, the number of ETS humpback dolphins was estimated to be 99 individuals (CV = 51.6%; 95% CI = 37 to 266);
- The core range of ETS humpback dolphins appears to consist of only about 515 km² of coastal water, from the estuarine waters of the Houlong and Jhonggang rivers in the north to the waters of Waishanding Jhou in the south (about 170 km in linear distance) with the main concentration of dolphins between the Tongsiao River estuary (Miaoli County) and Taisi (Yunlin County). This latter area encompasses the estuaries of the Dadu and Jhuoshuei rivers, the two largest river systems in western Taiwan;
- Humpback dolphins are found in shallow waters (< 25 m deep) within 3 km of shore but mostly within 1 km of shore and in water 7-8 m deep (dolphins have been observed in water shallower than 2 m);
- ETS dolphins have been confirmed in the above waters from April to November but interviews with fishermen suggest year-round residency;
- Approximately 30% of individually recognizable dolphins bear serious injuries, possibly caused by fishing gear or vessel collisions;
- A preliminary examination showed the ETS humpback dolphin population meets the IUCN Red List criteria for “Critically Endangered”.

New and Recent Information on Threats

The information provided to the 2007 workshop confirmed that the threats identified in 2004 have increased, not decreased. Major industrial development initiatives are going ahead with little, and usually no, recognition of their potential impacts on dolphins, other marine and estuarine organisms, and their habitats. In addition, the environmental protection policies and legal framework in Taiwan have been minimally effective and have continued to neglect the environment in favour of short-term economic gains.

Five major threats to the dolphins were identified: reduced river flow into estuaries, habitat loss (e.g., due to land reclamation), entanglement in fishing gear, industrial, agricultural and municipal pollutant discharges, and underwater noise.

Conservation Goals and Objectives

The ETS humpback dolphin population is unlikely to persist over the coming decades, and it certainly will not recover, unless action is taken immediately to improve the quality of its habitat and to prevent human-caused injury and mortality. It is important to avoid viewing the plight of these dolphins as an isolated concern of little relevance to the everyday life of the people of Taiwan. As fellow mammals, the dolphins should be regarded as sentinels of environmental health in coastal waters and estuaries, living as they do at the interface between land and sea. Stopping environmental neglect and abuse, and indeed reversing the trend towards deterioration and loss, is as urgent for the people and other organisms living along Taiwan's west coast and in the watersheds flowing into the Taiwan Strait as it is for the dolphins.

The overarching, long-term **goal** is to ensure the long-term viability and ecological function of the ETS humpback dolphin population in its natural environment.

Three **objectives** must be pursued to serve that goal:

- Allow the dolphin population to increase.
- Prevent further reduction, and if possible allow expansion, of the population's geographic range.
- Maintain, improve or restore the quantity and quality of *Sousa* habitat along the west coast of Taiwan.

Measures that Must Be Taken Immediately

Although a great deal more needs to be known about the animals and the nature of the threats facing them, enough is already known about the urgent state of the dolphins to proceed with a series of actions. The workshop therefore recommended that the central and local governments do the following:

1. Proceed with formal declaration and public announcement of important habitat for ETS humpback dolphins that is based on all available information;

In 2004, the workshop recommended that humpback dolphins and their habitat requirements should be considered routinely in the EIA process for development along the west coast of Taiwan. It was specified that inland developments on watersheds, even though many kilometres from the ocean, also need to be taken into account given their potential indirect impacts on the dolphins. Thus,

2. Carry out public and transparent evaluations of all existing and planned projects and future proposals that may have impacts on ETS humpback dolphins and their habitat (including upstream watershed areas). Such evaluations should employ precautionary reasoning, i.e., uncertainty should be explicitly acknowledged and incorporated in decision-making to avoid errors in judgment that could put the animals at greater risk. Such projects and proposals may include, but are not limited to:
 - Land reclamation and coastal construction

- Sand and other substrate removal
 - Artificial reef projects
 - Water resource management projects
 - Industry and other pollutant point-sources
 - Noise-generating activities
 - All energy-generation projects
3. Mitigate all existing and planned projects and future proposals that may have impacts on ETS humpback dolphins and their habitat (including upstream watershed areas) using best available methods and based on precautionary reasoning and judgment (see item 2, above);

All laws and regulations regarding disclosure of environmental data should be interpreted in a manner that facilitates, rather than obstructs, the transmittal of information to all interested persons and groups, and their participation in the decision-making process. Without such facilitation, attempts to understand and mitigate threats and ultimately ensure the survival of ETS humpback dolphins will be compromised.

4. Prohibit use of gill nets and trammel nets in all waters inhabited by ETS humpback dolphins;
5. Limit development of tourism focused on humpback dolphin-watching to land-based platforms and ensure that it is integrated with nature-oriented education efforts and encouragement of a “take back the coastline” public spirit;
6. If any marine protected area is proposed for the benefit of humpback dolphins in Taiwan, it will require substantial resources and an open planning and consultation process. Also, it should cover the dolphins’ entire effective range to provide meaningful protection (e.g., strict enforcement).

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APPENDIX 4

ABSTRACTS OF WORKING PAPERS PREPARED FOR THE SECOND INTERNATIONAL WORKSHOP ON THE CONSERVATION AND RESEARCH NEEDS OF THE EASTERN TAIWAN STRAIT POPULATION OF INDO-PACIFIC HUMPBAC DOLPHINS, *SOUSA CHINENSIS*

Working Paper #1

Biology of the eastern Taiwan Strait (ETS) population of Indo-Pacific humpback dolphins (*Sousa chinensis*): an update since 2004 – John Y. Wang and Shih Chu Yang

In 2002, a small population of Indo-Pacific humpback dolphins was discovered in the nearshore waters of central western Taiwan (=eastern Taiwan Strait - ETS). The serious threats to the future existence of this suspected unique population led to an international workshop on the conservation and research needs of these dolphins in 2004. The main research priorities identified during this meeting included understanding population distinctness, abundance and distribution of these dolphins and the threats they are facing. Continued studies since 2004 showed that the dolphins of the ETS are: 1) distinctly different from those of adjacent provisional populations in Chinese waters; 2) have a highly restricted main distribution with preferred their habitat being centred around major river estuaries; 3) are found within 3 km (but usually within 1 km) from shore; 4) almost certainly year-round residents; 5) comprised of a small group of likely less than 100 individuals; and 6) a large proportion of dolphins possess serious physical injuries from interactions with human activities. Based on these data, we propose that this unique population should be listed under the “Critically Endangered” category of the IUCN Red List. This is the most serious and urgent category before extinction.

Working Paper #5

Report on the state of Jhuoshuei River water resources (translated from Chinese) – Ching-Chun Chen

The Jhuoshuei River has its source in the Sakuma Saddle between the Main and East Peak of Mt. Hehuan. At its uppermost reaches lies the Wushe River, a confluence of waters from the Western Slope of Mt. Hehuan that flows in a south southwesterly direction down through a north northeasterly oriented longitudinal valley, joins with the Taluowan River near Lushan, and then further joins with the Wanda River near Wanda. It subsequently bends to the west and is fed by rivers including the Danda, Jyunda, and Chenyoulan before finally joining with the Cingshuei River in Linnei and bending onto the Changhua-Yunlin Plain, from which it flows out into the Taiwan Strait between Dacheng Township in Changhua County and Mailiao Township in Yunlin County. It has a stream length of 186 kilometers, and its catchment area extends across four counties: Nantou, Chiayi, Changhua, and Yunlin.

Because of strong headward erosion at the upper reaches of the Jhuoshuei River and over-cultivation of its shores, its water has a high silt content that, washing downstream, has formed an extensive alluvial plain at the river's lower reaches. Since the Jiji Diversion Weir went into formal operation in 2001, though, the weir has intercepted large volumes of sediment. The sediment load has decreased from an average 9,053,000 MT/year in 1999 (the year of the Jiji earthquake) to 2,900,000 MT/year in 2001, which is lower also than the 10-year average sediment load of 4,200,000 MT/year. This shows that the lower reaches of the Jhuoshuei River are failing to receive sufficient alluvial wash, resulting in exposed bedrock in the river stream. In terms of the distribution of water resources from the Jiji Weir diversion works, the diversion works is capable of providing 9,184,000 tons of water per day, of which the riverbed ecology base flow of 51,800 cubic meters stands at only some 0.6 percent of the total stream flow. Clearly, insufficient water is being provided to the lower reaches.

The annual flow of the Cingshuei River is approximately 600 million cubic meters. Following the Jiji earthquake, approximately 120 million tons of mud has accumulated at the upper reaches in the Caoling-Fengshan area. Some of this may wash downstream to help supplement the alluvium at the lower reaches. But after the Tongtou Weir is constructed, the Cingshuei River will be required not only to supply 210,000 tons of water daily to the Hushan Reservoir, but also to supply irrigation water to the Nantou and Yunlin areas. The construction of the Weir will also block alluviation downstream. Sandstorms have already begun occurring at the lower reaches of the Jhuoshuei River, and in the future the coastline and biota of the Yunlin-Chiayi-Nantou region will also be affected.

Working Paper #7

The environmental impacts of cobia aquaculture's wastes and chemicals (translated from Chinese) – Chiu Long Chou

Fast growth trends of marine aquaculture worldwide have drawn the attention to the impacts on marine environment. Fin fish farming is the most rapidly growing segments of aquaculture. It is considered by non-governmental organizations (NGO) as being one of the potentially huge waste generators in the coastal zone that interferes with the development of numerous activities such as fisheries, tourism, and rural settlements. This image of aquaculture persists despite the fact that serious attempts to minimize and control environmental impacts have been made in many countries and have achieved impressive results (Black et al., 1997; Rosenthal et al., 1987). They range from predictive modeling of waste dispersal impacts, to drastic reductions in the use of antimicrobials and substantially reduced output of nutrients per unit biomass of fish produced (Read et al., 2000). Despite this improvement, there has been a lack of understanding the wastes and chemicals that enter the complicated marine environment, specifically the variations of physical and geochemical oceanographic conditions that contribute to the difficulties in monitoring the effects of wastes and produced chemicals from these activities.

Working Paper #8

Taiwan's environmental impact assessment law and practice – Robin Winkler

Taiwan has had a formal system in place for environmental impact assessment (EIA) since at least October 1985, although a legal basis did not come into effect until 1995. Taiwan's EIA regime in theory, intent, and on paper, lays out a framework for an effective check on short-term economic development at the expense of sustainable development, and includes what may be unique in developed countries, a mechanism for denying approval of projects that threaten species and habitat. Historical, political, social and cultural factors, as well as determined, if possibly misguided, efforts of a coalition of Taiwan's Environmental Protection Administration, other government agencies, the developers and their consultants, have resulted in the distortion of the system's initial purposes and underlying justification. Nevertheless, opportunities remain for participation in the process by conservationists and others interested in promoting biodiversity and sustainable development, and it should be seen as a potentially powerful means for protection of coastal habitat in western Taiwan.

Working Paper #9

The need to increase the importance of wildlife in Taiwan's National Marine Policy (translated from Chinese) – Lee-Shing Fang

Taiwan's national marine policy needs expansion to consider not only the welfare and well-being of humans but of all living organisms. In the past, Taiwan's national marine policy has only considered maritime safety, national security and the exploration and economic development of resources. Environmental concerns have only recently been included, but the reason and focus of most of this attention have been from the perspective of the benefits for or impacts on humans. With the rapid loss of biodiversity and increasing changes in the environment globally, it is time Taiwan also expands its attention to environmental issues as they pertain to other living organisms as well as how these issues will affect humans. Wildlife should also be considered as possessing rights as permanent or seasonal

residents of this nation, just like humans. Taiwan's marine policy must have a broader scope to conserve the future of wildlife and cannot continue to be selfishly anthropocentric.

The tenet of the current national marine policy of Taiwan emphasizes "security, prosperity and ecology". However, my participation in drafting Taiwan's national marine policy resulted in limited satisfaction on its treatment of ecology. Even though utilization of living resources is unavoidable, more generous considerations should be given to other living organisms when developing and drafting marine policies related to the marine environment.

Working Paper #11

Commonly applied method in marine pollution response in Taiwan – Eilif T.C. Wang

Marine Pollution Control Act was legislated on 2000.10.13, publicly announced and became effective on 2000.11.01. Then, on 2001.01.14 the Greek cargo ship "M.V. Amorgos" incidence caused oil pollution in the Kenting National Park conservation area and brought the issue of marine ecology conservation to the attention of the public in Taiwan. Currently, the main response organizations are E.P.A. and Coast Guard Administration from the government, and from the industry are China Petroleum Company (CPC) and Formosa Petro Chemical Company (FPCC). In the past 5 years, learning experience from U.K., USA, Canada and Japan in order to establish capacity in responding marine pollution, over 400 million NT dollars (approximate US\$13 million) has been invested and more than 2000 personnel received professional training. This article will introduce the equipments been setup, command & communication system, and structure of the respond organization; also provide suggestions on areas need to be further improved.

Working Paper #12

A brief introduction to protected areas and protection acts in Taiwan and a previous approach on legal conservation strategy to *Sousa chinensis* to governments and NGOs (translated from Chinese) – Huan-Yu Chen

Because of its particular geographical features, geological and natural history, Taiwan has a variety of natural resources that make people feel proud. It is estimated that there are 150,000 species on the whole island, making up 1.5% of all species in the world. About a quarter of these species are endemic to Taiwan. This precious natural capital should receive attention and concern from the Government, as a special feature in the country's development. This paper reviews the history, basis, zoning, procedures, characteristics and characteristics of the establishment of the protected areas delineated under Taiwan's four main conservation laws and related regulations. It also discusses the 'friendliness' of current regulations towards public participation. Finally, it attempts to offer the central and local governments and the public an analysis, on the basis of current laws, of a way in which the *Sousa chinensis* may be protected.

At the moment, Taiwan has four main, important nature conservation Acts: the Cultural Heritage Preservation Act; the Wildlife Conservation Act; the National Park Act and the Forestry Act. In terms of marine resource conservation and coastal land protection there is the resolved upon by the Executive Yuan; meanwhile, the Fisheries Act relates to the exploitation and management of fishery resources. Nature Reserves, Important Wildlife Habitats, National Parks, National Forest Nature Conservation Areas, Taiwan Coastal Protection Areas and Fishery Resource Protection Areas have been set up on the basis of these Acts and regulations respectively. The conservation areas set up on the basis of the four main Acts alone total 81, covering an area of 10,559.94 square km (19% of the area of Taiwan).

In general, the National Park act and the Forestry Act are inapplicable, with only their spirit being useful for reference. The Coastal Nature Conservation Areas delineated under Administrative Plans must tie in with other laws, and if their own laws are inapplicable, they are non-binding. The central competent authority can voluntarily delineate independent protected areas according to the Wildlife Conservation Act, the Cultural Heritage Preservation Act; local governments can voluntarily delineate

protected areas according to the Cultural Heritage Preservation Act and the Fisheries Act, or can passively cooperate with the Central Government's Wildlife Conservation Act by designating Wildlife Conservation Areas or reviewing private proposals under the Cultural Heritage Preservation Act. The only rights for private proposals are under the Cultural Heritage Preservation Act. However, public movements are strong, and can exert this strength through social movements and education to influence the government.

In principle, the area delineated should be large and complete, with the reproductive and feeding areas at its core, and buffer zones around each core area, to allow the dolphins to move around freely within them. This area should be used sustainably for cetacean watching (or tourist fishing) activities, with accompanying measures for delineating areas and management being based on biological scientific research.

New development projects continue to compete for space with the dolphins, and the establishment of this protected area, which is of a higher priority than these projects, is extremely urgent. Action needs to be taken, whether by government or the public, in the hope that we may see the establishment of a *Sousa chinensis* Protection (Conservation) Zone in the near future.

Working Paper #13

We are standing at the crossroads (translated from Chinese) – Ken-Cheng Lee

Conservation groups are at this moment scurrying to rally support for the lives of a population of white dolphins that inhabits the neritic waters off Taiwan's western coast. Most of Taiwan's large-scale development projects are concentrated in the coastal areas. Among those with the heaviest environmental impact are steelworks (the Formosa Plastics steel mill), petrochemical works (Kuokuang Petrochemical), and coal-fired power plants. We are very concerned that these projects, aggressively promoted by governmental economic development agencies, threaten to bring about the wholesale collapse of Taiwan's coastal fishery, as well as destruction of the marine ecology. Completing these development projects will put the white dolphins on the path to extinction. This paper analyzes and gives some views on the daunting crossroads that Taiwan's petrochemical industry and all of us are now facing. For the white dolphin, this moment of wrangling in the human world is crucial to the survival of its kind. It is a matter demanding everyone's urgent attention and concern.

Working Paper #14

Critical area for conservation of franciscana in southern Brazil – Eduardo R. Secchi, Sandro Klippel, Monica B. Peres, Daniel Danilewicz, Paulo H. Ott and Ignacio B. Moreno

Extensive fishing during the last 40 years off southern Brazil has led to the decline of several species of marine megafauna either due to direct exploitation or incidental catches. Some species are severely depleted while others are threatened by extinction. Together with other management measures, the establishment of marine protected areas based on scientific data can potentially conserve important components of the local biodiversity. Areas of higher risk of incidental catches of franciscana, *Pontoporia blainvillei* and three threatened demersal elasmobranchs, the Brazilian guitarfish, *Rhinobatos horkelii*, the Angel shark, *Squatina guggenheim*, and the striped smooth-hound, *Mustelus fasciatus* were considered critical areas. For each species, data on distribution and relative density were integrated using GIS and the criteria and conservation goals were defined. For franciscana, data on frequency of bycatch by area obtained from 1,771 gillnetting sets between 1999 and 2005 and on distribution data from aerial surveys that were conducted in 2004 were used. For the elasmobranchs, data on relative density from 1,664 bottom trawling operations that took place on research cruises between 1972 and 2005 were used. Common critical areas were selected using MARXAN. This software's algorithm attempts to reach the established conservation goals of minimising the cost of the total selected area while searching for adjacent blocks to minimise border effects. The software also supplies an irreplaceability index for each unit, which allows one to define essential areas for target species conservation. Based on conservation goals to protect 20 to 70% of the priority areas (depending upon the needs of certain species) and a standard cost which increases with depth and

distance from ports, the software selected only one essential area between Conceição (31°44' S) and Albardão (33°12' S) lighthouses, from the coastline to the 100m isobath. This area would cover a wide range of the franciscana habitat in southern Brazil.

Working Paper #15

Bycatch – William F. Perrin

Whales and dolphins die in fishing nets and other fishing gear, as unwanted *bycatch*. The bycatch can be substantial and can cause damage to the cetacean population. For example, in the eastern tropical Pacific (ETP), bycatch in a purse-seine fishery for tuna has reduced the population of one dolphin stock to ¼ of the original level. I here give more examples and suggest some ways to address the problem.

In another example, dolphins and small whales of several species are killed in a tuna driftnet fishery in the Philippines. The bycatches in one region of the eastern Sulu Sea amount to several thousand annually, mostly spinner dolphins. This is more than 2% of the estimated population of the spinner dolphin and is almost certainly unsustainable; the population is declining.

A third example is the former Taiwanese driftnet fishery for sharks in Australian waters. That fishery killed about 14,000 dolphins over a 4-year period in the 1980s. Because of that, the fishery was ejected from Australian waters. It simply moved north into the waters of Indonesia. The bycatch undoubtedly continued, but we don't have any idea of how large it is or what the impact on the dolphin populations has been.

There are more examples from Asia: the extinction of the baiji in China was partly caused by bycatch in rolling hooks and electrofishing, and the likely kill or injury of humpback dolphins by net fisheries in western Taiwan are only two. A very important point in the above two examples is that a kill or harming of only a few animals from small populations can have a great impact and lead to eventual extinction.

Some suggestions for addressing bycatch problems are offered: inventory fisheries, prioritize them for research, collect bycatch data, assess impact, increase public awareness, connect with international programs. In some extreme cases when populations are very small and on the brink of extinction, the above programs may be too slow to be effective. In these situations, immediate banning (temporary or permanent) of known and suspected harmful fishing activities or gear may be the only effective measure.

Working Paper #16

Decline and likely demise of the baiji: lessons for Taiwan's humpbacked dolphins? – Randall R. Reeves

Recent news that the baiji, or Yangtze River dolphin, is probably extinct (Turvey et al. 2007) has galvanized the conservation community. Not just a high-profile species, but an entire mammalian family, the Lipotidae, almost certainly has been lost forever. Cetacean scientists and conservationists were ineffectual in our efforts to publicize the baiji's plight, marshal support for intervention, and provide clear guidance on what kinds of action were needed to reverse the baiji's rapid slide into extinction. While sailing down, and then back up, the lower reaches of the Yangtze River last winter, it was difficult for me to imagine how any reasonably large wild species dependent on natural processes or conditions could possibly persist there. The natural landscape had been transformed from what it must have been as recently as a few decades before. The river had become a commercial freeway on its surface and a churning source of sand (a key ingredient for concrete) and human sustenance (edible fish and invertebrates) below the surface. The upstream portions of the expedition visited the mouth of Dongting Lake, where other scientists on the survey team described a depressing scene of congested ship traffic and rampant sand mining in the lake – even worse than the lower reaches of the main river channel.

I was asked to consider in this brief paper whether any useful lessons from the baiji experience might be applicable in efforts to conserve Indo-Pacific humpback dolphins in eastern Taiwan Strait (ETS). I begin by summarizing some of the initiatives that were taken over the past quarter-century to help stave off the baiji's extinction. I then make a few comments about similarities and differences between baijis and ETS humpback dolphins. I end by attempting to stimulate some discussion of lessons learned from the baiji experience that could be relevant to Taiwan's challenge of preventing extirpation of ETS humpback dolphins.

Working Paper #17

Conservation of Indo-Pacific humpback dolphins *Sousa chinensis* in Hong Kong – Thomas A. Jefferson and Samuel K. Hung

Since the mid-1990s, the Hong Kong Government has been intensively managing human impacts on the local population of Indo-Pacific humpback dolphins, which is shared between Hong Kong, Macau, and Guangdong Province of the PRC. Several threats have been identified, and most current management is geared towards mitigating habitat loss and disturbance caused by massive development around Lantau Island (often involving reclamation, dredging, and piling operations). Hong Kong has an effective legal framework for protecting dolphins, including the establishment of an interdisciplinary working group of stakeholders that meets periodically to advise the government on pertinent issues (Marine Mammal Conservation Working Group). The Hong Kong Environmental Impact Assessment Ordinance, although not perfect, provides for a transparent process to address potential impacts of developments on dolphins, and minimize their effects. These various measures and legal articles have been used effectively in the past to minimize impacts of individual projects, but cumulative impacts are still difficult to assess and mitigate.

Working Paper #18

An updated review of the biology of the Indo-Pacific humpback dolphin *Sousa chinensis* (Osbeck, 1765) – Thomas A. Jefferson

The Indo-Pacific humpback dolphin (*Sousa chinensis*) is one of two species of humpback dolphins currently recognized by most marine mammal biologists. The taxonomy is unresolved, and it is possible that multiple species exist in the Indo-Pacific. It is a moderate-sized dolphin, with a robust body and a distinct dorsal hump in the western portion of its range. Coloration is highly variable, both geographically and by sex and age. The species is found in a coastal band from South Africa to central China and northern Australia. Reproduction has been poorly-studied, but calving generally appears to occur year-round, and sexual maturity is reached at ages of about 9-13 years. They occur in nearshore waters, especially in estuaries and around reefs. The animals feed on a variety of nearshore fish and cephalopod species (and occasionally crustaceans). Predation by sharks is known for some areas. Behavior patterns are similar to those of other coastal dolphins, but humpback dolphins generally do not bowride. Group sizes tend to be small (<10) in most areas, and group composition is fluid. Abundance or density has only been estimated for a few areas, and most populations are thought to be small (tens to low hundreds). Threats include a variety of human activities, including incidental catches in fisheries and shark nets, vessel collisions, habitat loss, and detrimental effects of environmental contaminants. Several populations are thought to be declining, although the status of most remains completely unknown. Clearly, humpback dolphins are highly vulnerable to the effects of human activities, and much more attention is needed to ensure the health and viability of populations in developed areas, such as Taiwan.

Working Paper #19

Taiwan's Indo-Pacific humpback dolphins: at risk from pollution? – Peter S. Ross

Environmental pollution is recognized as a serious threat to the world's oceans and its inhabitants. Taiwan's Indo-Pacific humpback dolphin (*Sousa chinensis*) is particularly vulnerable to the effects of environmental pollution. These small cetaceans are vulnerable because of their long lifespan, limited

ability to metabolize many chemicals, high position in marine food chains, and the nature of their habitat use. By relying on estuarine and coastal habitat for feeding and reproducing, *Sousa* live in areas that humans use for the deliberate and inadvertent disposal of chemicals, human, and domestic animal wastes. These wastes take the form of agricultural pesticides and nutrient runoff, industrial chemicals (e.g. phthalates, PCBs, metals), chemical by-products (e.g. dioxins and furans), pharmaceuticals, and antibiotics. In addition, biological pollutants and noise pollution threaten *Sousa* habitat. The number and diversity of pollutants renders it difficult to adequately characterize the nature of pollution, and to design steps to reduce inputs into freshwater, estuaries, coastal waters or the open ocean. However, scientific research has identified a number of pollutant types of concern, leading to the development of promising steps on national and international scales. Progress to protect the critical habitat of *Sousa* can only be effective when a partnership of individuals, conservation and trade organizations, industrial sectors, regional and national governments, and the international community work together.

Working Paper #20

Governance model for environmental restoration and stewardship: implementation and monitoring of Canadian Great Lakes Remedial Action Plans (RAPs) – Bradley N. White

Following “The Great Lakes Water Quality Agreement” between the US and Canada in 1978 a number of highly polluted Areas of Concern (AOC) were identified and listed. Each area was required to develop a Remedial Action Plan (RAP) to clean up its environment and eventually be de-listed. Each area developed customized local governance systems depending on the nature of the environmental situation and size of the community involved. Hamilton Harbour at the west end of lake Ontario represented one of the largest and most polluted regions as it had been the centre of the Canadian steel industry for over a century. A large part of the harbour was filled in and many of the streams and rivers feeding the harbour were covered to provide space for the large steel plants. A considerable amount of fish habitat for spawning and nursery use was lost and the water had high levels of heavy metals and PAHs. The initial step in the process was a RAP Forum that involved all the stakeholders including businesses, land-owners, the University, NGOs and three levels of government. This Forum developed a governance structure that comprised two groups: the Bay Area Implementation Team (BAIT) led jointly by the Provincial and Federal governments and whose function was to implement the remedial and restoration actions: Bay Area Restoration Council (BARC) a stakeholder group which receives a small amount of government funding and which acts as a watch-dog and provides report cards on the status of the plan. This RAP was studied by a large multi-university, multi-disciplinary research team that was funded by the federal government. The successes of the RAP were judged to have been based on several components but the good-will among all the parties to implement the RAP, creative joint funding programs and the vigorous community activity and BARC have been important factors.

Working Paper #21

The U.S. National Environmental Policy Act, Marine Mammal Protection Act, and Endangered Species Act: background information – Naomi A. Rose and Michael Jasny

The National Environmental Policy Act (NEPA) requires major federal actions, including permitting, to undergo an analysis of the environmental impacts of those actions. A NEPA environmental review must examine the environmental impact of the proposed action, any adverse environmental effects that cannot be avoided should the action go forward, reasonable alternatives to the proposed action, and mitigation to reduce the action’s impacts. NEPA allows citizens to examine the details of major federal actions, to comment on the environmental impacts they might have, and to seek judicial review when agencies proceed without taking a hard look at their proposed actions.

The Marine Mammal Protection Act (MMPA) recognizes that marine mammals, which are difficult to study, require a unique degree of protection. The MMPA requires marine mammals to be maintained as “a functioning element in the ecosystem of which they are a part.” Its purpose is to maintain marine mammals at their optimum sustainable population levels, so its protections extend to all marine

mammals, regardless of their conservation status. The MMPA prohibits the harassment, hunting, capturing, or killing of marine mammals. It allows certain exceptions, such as commercial fishing (which must be conducted so that marine mammal mortalities are insignificant and approach zero) and scientific research. Most of these exceptions require permits or authorizations, under strict conditions. The permitting process under the MMPA is transparent, requiring public notice and opportunity to comment.

The Endangered Species Act (ESA) requires the recovery of species that are endangered or threatened with extinction. A relatively small number of marine mammals are covered under this statute as well as the MMPA. The ESA has similar prohibitions as are found in the MMPA and similar exceptions and permitting requirements. However, some of its protections are stronger than the MMPA's and do not allow actions that might jeopardize the survival or recovery of a species. The ESA also allows for the designation of critical habitat (which cannot be adversely modified by any federal action) and requires species recovery plans to be developed.

Civil legal action is an important factor in these three statutes' success. The availability of judicial review and the transparency of the public notice and comment process provide accountability and ultimately improve the quality of agency decisions that affect marine mammals.

Working Paper #22

A global scientific workshop on spatio-temporal management of noise (Puerto Calero, Lanzarote, Canary Islands (Spain, 4 – 6 June 2007) – Tundi Agardy, Natacha Aguilar Soto, Ana Cañadas, Marcia Engel, Alexandros Frantzis, Laila Hatch, Erich Hoyt, Kristin Kaschner, Erin LaBrecque, Vidal Martin, Giuseppe Notarbartolo di Sciara, Gianni Pavan, Antonella Servidio, Brian Smith, John Wang, Lindy Weilgart, Brendan Wintle and Andrew Wright

Marine fauna, especially cetaceans, rely on sound for a range of biological functions and are susceptible to the effects of marine noise pollution (e.g., Richardson et al. 1995). However noise, despite its implicit classification as a pollutant by the United Nations Convention on the Law of the Sea (UNCLOS), is not subject to the same level of regulation as other pollutants.

Spatio-temporal restrictions (STRs), including marine protected areas (MPAs), offer one of the most effective means to protect cetaceans and their habitat from the cumulative and synergistic effects of noise as well as from other anthropogenic stressors (Weilgart, 2006) as the various threats confronting cetaceans do not occur in isolation. For example, there is evidence that anthropogenic noise could interact with cetacean by-catch or ship collisions, preventing animals from sensing fishing gear or oncoming vessels and making them more vulnerable to injury or death (Todd et al., 1996; Andre et al., 1997). However, despite great potential, at present very few MPAs are large enough to reduce ensonification (i.e., exposure) of cetaceans to noise from human activities in the ocean (Hoyt, this report). This consensus report aims to create a conceptual foundation for utilising marine protected areas and other STRs to help improve this situation.

Working Paper #24

Biodiversity, marine ecological assessment and land reclamation in Taiwan's EIA process – Christina MacFarquhar

The level of consideration of certain issues within the Environmental Impact Assessment (EIA) process is influenced by laws and guidelines, the composition of the EIA review commission, the nature of consultation of external scholars and experts, the content of environmental impact statements and other reports, and other factors such as the decision-making process. This paper briefly describes, in terms of some of these factors, the consideration of biodiversity, marine ecology and the ecological impacts of projects involving alteration or disturbance of coastal geology in Taiwan's EIA system. This includes a brief outline of some aspects of the Regulations for Marine Ecological Assessment promulgated by Taiwan's Environmental Protection Administration (EPA) in July 2007, with examples or past practice from the six Environmental Impact Statements (EIS) submitted for

review to the EPA's Environmental Impact Assessment Review Commission during the previous term (August 2005-July 2007) involving direct impacts on west coastal and marine area geology (i.e. land reclamation, harbour construction and the installation of pipelines and cables under the sea bed)). The paper also draws on information gathered during interviews with twelve of the fourteen scholars and experts on the Review Commission in July and August 2007.

Note: Two working papers were presented orally but were not accompanied by abstracts. These were: *Working Paper#4: Overview of the utilization of water resources of the rivers of central western Taiwan* by Cheh-Shyh Ting; and *Working paper#10: The current state of cetacean conservation in Taiwan* by Jung-Sheng Shia. Five oral presentations with no written papers or abstracts included: *Working Paper#2: National land use planning and development – coastal zone* presented by Chih-Ming Chen; *Development of different industries in Taiwan* by Zhen-Wei You; *Fisheries of inshore waters of western Taiwan* by Man-Chuan Wu; and *Taiwan's marine pollution and management* by Cheng Yang Lyu. *Working Paper#23: Finless porpoises in the Inland Sea of Japan, an example of coastal habitats at risk* by Toshio Kasuya) was presented as a paper only and did not include an abstract. Working papers 3 and 6 were withdrawn. Only working papers that were submitted as documents can be downloaded from www.nmmba.gov.tw. However, these working papers were provided specifically for the reference of the workshop and have not been through peer-review. Citation of information in any working paper requires permission from the author(s).

ADDITIONAL INFORMATION

Poster

Threats to Taiwan's Chinese white dolphins – Bing-Hen Chen

Reference Documents

The following reference documents were also available to the workshop participants:

Ref Doc 1

Wang, J.Y., Yang, S.-C. and Hung, S.K. 2004. Records of Indo-Pacific humpback dolphins, *Sousa chinensis* (Osbeck, 1765), from the waters of western Taiwan. *Aquatic Mammals* 30: 189-196.

Ref Doc 2

Wang, J.Y., Yang, S.-C., and Reeves, R.R. 2004b. *Report of the first workshop on conservation and research needs of Indo-Pacific humpback dolphins, Sousa chinensis, in the waters of Taiwan*. 25-27 February 2004, Wuchi, Taiwan. National Museum of Marine Biology & Aquarium, Taiwan. 37 pp. (Chinese) + 43 pp. (English).

Ref Doc 3

Wang, J.Y., Yang, S.-C. and Reeves, R.R. (Editors). 2004c. *Research action plan for the humpback dolphins of western Taiwan*. National Museum of Marine Biology and Aquarium, Checheng, Pingtung County, Taiwan. 4 pp (English) + 3 pp (Chinese).

Ref Doc 4

Jefferson, T.A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. *Wildlife Monographs* 144: 1-65.

Ref Doc 5

Jefferson, T.A. and Karczmarski, L. 2001. *Sousa chinensis*. *Mammalian Species* 655: 1-9.

Ref Doc 6

Environmental Protection Administration (Executive Yuan). August 2007. *Regulations for marine ecological assessment*. (Translation provided by C. MacFarquhar)

Ref Doc 7

Jefferson, T.A. and Hung, S.K. 2004. A review of the status of the Indo-Pacific humpback dolphin (*Sousa chinensis*) in Chinese waters. *Aquatic Mammals* 30: 149-158.

Ref Doc 8

Chou, L.-S. 2006. *Cetacean bycatch in coastal waters of Taiwan and ecology of Chinese white dolphins* *Sousa chinensis*. Report to the Fisheries Agency, Council of Agriculture (Taiwan). 68 pp.

Ref Doc 9

Chou, L.-S. *The treasure of the Taiwan Strait – the future of the Chinese white dolphin?* (Title translated from Chinese document submitted to the workshop).

APPENDIX 5

EXAMPLES OF DEVELOPMENT PROJECTS THAT ARE BEING PLANNED, UNDER CONSTRUCTION OR IN OPERATION, WHICH WILL OR WILL LIKELY IMPACT THE EASTERN TAIWAN STRAIT POPULATION OF INDO-PACIFIC HUMPBACK DOLPHINS

Case name and information source	Date of commencement of operation / anticipated date of completion	State of completion	Aspects of project for which impacts on ETS <i>Sousa</i> are anticipated*	Location of anticipated point of impact
Central Taiwan Science Park (Phases 1 & 2) ^{1,2}	Gradual construction and operation of various facilities since July 2003	Completed and operating	Water pollution: hi-tech industrial waste - 145,000 tons/day	Dachia [= Dajia] River and Daan River estuaries
Central Science Park (Park Phase 3) ³	Partial operation started on 12 October 2007; remaining part still in planning	Partial	Water pollution: hi-tech industrial waste - 60,000 tons/day (Houli Farm site); 52,000 tons/day (Cising Farm site)	Dachia River and Daan River estuaries
Yunlin Offshore Industrial Park ^{4,5}	Plans set and approved in June 1991; planned date of completion: 2015**	1/4 complete (Mailiao); 1/4 in planning/construction phase (Taisi, for Kuokuang Petrochemical Science Park and Formosa Plastics Steel Plant); 1/2 temporarily halted (Sihu)	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution Total area of latest proposal: 17,188 ha (total area of land reclamation 11,045 ha) includes 3 ports.	Jhuoshuei River estuary, Yunlin coastal regions
Formosa Plastics Group - Sixth Naptha Cracker Plant (Phase 1) ^{6,7,8}	**	Completed	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution Planned Area: 2,593 ha (part of the reclaimed land for Yunlin Offshore Industrial Park – see above); area completed: 2002 ha Effluent: 103,000tons/day Air pollution: SOx: 21,286 tons/year; NOx: 19,622 tons/year; TSP: 3,340 tons/year; VOCs: 4,302 tons/year Water consumption: 257,000 tons/day	Jhuoshuei River estuary, Yunlin coastal regions Note: the plant is situated in the Mailiao Zone of Yunlin Offshore Industrial Park

Formosa Plastics Group – Sixth Naptha Cracker Plant (Phase 2)^{6,7} **	Completed	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution Area: 2,603 ha (part of the reclaimed land for Yunlin Offshore Industrial Park – see above) Effluent: 152,000 tons/day Air pollution: SOx: 21,286 tons/year; NOx: 19,622 tons/year; TSP: 3,340 tons/year; VOCs: 4,302 tons/year Water consumption: 296,000 tons/day	Jhuoshuei River estuary, Yunlin coastal regions Note: the plant is situated in the Mailiao Zone of Yunlin Offshore Industrial Park
Formosa Plastics Group - Sixth Naptha Cracker Plant (Phase 3)^{6,7} **	Completed	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution Area: 2,603 ha (part of the reclaimed land for Yunlin Offshore Industrial Park – see above) Effluent: 188,000 tons/day Air pollution: SOx: 16,000 tons/year; NOx: 19,622 tons/year; TSP: 3,340 tons/year; VOCs: 4,302 tons/year Water consumption: 353,000 tons/day	Jhuoshuei River estuary, Yunlin coastal regions Note: the plant is situated in the Mailiao Zone of Yunlin Offshore Industrial Park
Formosa Plastics Group - Sixth Naptha Cracker Plant (Phase 4)^{6,7} **	Completed	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution Area: 2,603 ha (part of the reclaimed land for Yunlin Offshore Industrial Park – see above) Effluent: 246,000 tons/day Air pollution: SOx: 16,000 tons/year; NOx: 19,622 tons/year; TSP: 3,340 tons/year; VOCs: 4,302 tons/year Water consumption: 424,000 tons/day	Jhuoshuei River estuary, Yunlin coastal regions Note: the plant is situated in the Mailiao Zone of Yunlin Offshore Industrial Park

Note: CO₂ emissions from Formosa Plastics Group – Sixth Naptha Cracker Plant (Phases 1 to 4) produces 67,570,000 tons/year

Kuokuang Petrochemical Science Park⁹	Estimated construction period 10 years, to start full capacity operation in 2015**	In planning	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution	Jhuoshuei River estuary, Yunlin coastal regions
			Capability to refine 300,000 barrels of crude oil per day; ethylene production of 1,200,000 tons/year by a light oil cracking plant; annual production of 150 tons of aromatics by an aromatic hydrocarbon center; 23 downstream petrochemical factories; 11 cogeneration facilities	Note: the Science park situated in the Sinsing and Taisi zones of Yunlin Offshore Industrial Park
			Area: 2,121.3 ha (Sinsing Zone); 1,407.75 ha (69% of the Zone area; Kuokuang petrochemical factory)	
			Effluent: industrial & human waste water - 73,598 m ³ /day; surface runoff - 4,726 m ³ /day	
			Air pollution: SOx: 6,636 tons/year; NOx: 9332 tons/year; TSP: 1,048 tons/year; VOCs: 3,169 tons/year	
			CO ₂ : 7,120,692 tons/year	
			Water consumption (whole zone): 228,506 tons/day	
Note on liquefaction: Taisi Zone is close to the coast and is classified as an area of medium to serious potential for liquefaction				
Formosa Plastics Group - Steel Plant¹⁰	Planned to start furnace operation 55 months after construction begins and to start production 6 years after construction begins. Dates of construction are not yet known**	In planning	Land reclamation (habitat reduction and degradation); construction noise; river flow reduction due to usage; water pollution; air pollution	Jhuoshuei River estuary, Yunlin coastal regions
			Project budget: \$137,300,000,000 NTD (~\$4,300,000,000 USD)	Note: the plant site is situated in the East Zones 1 and 2 of Yunlin Offshore Industrial Park
			To produce 7,500,000 tons of refined steel per year	
			Area: 630 ha (of which 521 is reclaimed land)	
			Effluent: 28,000 m ³ /day	
			CO ₂ emissions 14,896,000 tons/year	
			Water consumption: 4,124,192 m ³ /day	

Chunglung Steel Plant¹¹	Estimated construction dates: December 2007 to 2011; start of operation 2011.	In planning	Construction noise; river flow reduction due to usage; water pollution; air pollution To produce 3,768,000 tons/year of crude steel (original plan); currently applying to increase this by 2,451,000 tons/year to a total of 6,219,000 tons/year Area: 202.5 ha (original plan); now applying to add an extra 77.5 ha; total 280 ha. Effluent: 21,000 tons/day (to be treated to meet effluent standards before discharged into the Dadu River and being diluted along the way before entering the sea) Air pollution: SOx: 13,851 kg/day; NOx: 16,945 kg/day; VOCs: 2,030 kg/day; Particulates: 7,811 kg/day; CO2: 11,718,000 tons/year Water consumption: 105,000 tons/day	Dadu River, Dachia River and Daan River estuaries
Tianhuahu Reservoir¹²	Unknown	In planning, EIS sent to the EIA Review Commission in April 2007	River flow reduction to estuary To divert and supply 261,400 m ³ /day to the big six industrial science and technology “parks” until 2021	Houlong River estuary Note: reservoir located on the Houlong River tributary, Sha River
Babao Weir (=barrage)¹²	Unknown	In planning	River flow reduction to estuary Estimated diversion and supply of water to residents and industries of Greater Taichung: 280,000 tons/day	Dachia River estuary
Dadu Weir¹³	Unknown	In planning, currently undergoing feasibility review (May 2007)	River flow reduction to estuary to supply water to Changbin and Yunlin offshore industrial parks: 800,000 tons/day (estimated)	Dadu River estuary
Jiji Weir¹²	Operation started December 2001	Completed and operating	River flow reduction to estuary to supply offshore industrial park	Jhuoshuei River estuary
Hushan Reservoir¹²	Estimated date of completion and start of operation 2014	Under construction (now in second year of construction; third year construction budget not yet approved by Legislative Yuan)	River flow reduction to estuary To divert and supply water for residents, agriculture and industry but conflicting reports suggest the main purpose of the water is for the industrial sector: 394,000 tons/day	Jhuoshuei River estuary Note: water for the reservoir will be drawn from the Cingsheui River (a tributary of the Jhuoshuei River)

¹National Science Council. July 2003. Central Taiwan Science Park Taichung Base Development Project, Environmental Impact Statement (final version)

²National Science Council. June 2004. Central Taiwan Science Park Taichung Base Phase 2 Development Zone Expansion Project (including changes to Phase 1), Environmental Impact Statement.

³Central Taiwan Science Park Development Preparatory Office. June 2004. Central Taiwan Industrial Park Phase 3 Development Area "Houli Base" Development Project Environmental Impact Statement.

⁴Ministry of Economic Affairs. June 1991. Yunlin Offshore Industrial Park, Environmental Impact Assessment Report.

⁵Sinotech. December 2006. Environmental Impact Discrepancy Report for Changes made to Yunlin Offshore Industrial Park.

⁶Nanya Plastics Corporation Environmental Engineering and Work Safety Management Centre. May 2004. Phase Four of the Sixth Naptha Cracker Plant Construction Project, Environmental Impact Statement (final version).

⁷Nanya Plastics Corporation Environmental Engineering and Work Safety Management Centre. September 2006. Environmental Impact Discrepancy Report Phase Four of the Sixth Naptha Cracker Plant Construction Project (final version).

⁸Chinese Petroleum Corporation. July 2004. Yunlin Petrochemical Technology Park Site Feasibility Analysis)

⁹CICI Corporation. February 2007. Kuokuang Petrochemical Company Limited Factory Construction, Environmental Impact Statement.

¹⁰Nanya Plastics Corporation Environmental Engineering and Work Safety Management Centre. March 2006. Formosa Plastics Steel Ltd. Factory Construction Project, Environmental Impact Statement.

¹¹Chunglung Steel Company Limited. Second stage of the second phase of the Chunglung Steel Plant Construction Project, Environmental Impact Statement.

¹²Water Resources Agency, Ministry of Economic Affairs. 2005. Plan for Integrated Water Resources Management.

¹³Central Region Water Resources Office, Water Resources Agency, Ministry of Economic Affairs. 2007. Planning Results for the Dadu Weir Project.

*Where data in this column are based on information provided by developers (e.g., in Environmental Impact Statements and other Environmental Impact reports) and in the absence of confirmation by independent analysis, the values should be treated with caution, and potentially as an underestimate. Likewise, the chemical composition of effluent should be treated as the minimum range of chemicals emitted.

**Yunlin Offshore Industrial Park includes a north section (Mailiao Zone and Harbour), a middle section (Taisi Zone, Sinsing Zone and Harbour) and a south section (Sihu Zone and Harbour). Land reclamation for the north section is almost complete, including Mailiao Harbour, which started operating in March 2001 and includes twenty jetties (CPC, 2004). The middle section is partially complete (including the East 2 Zone, which was completed in December 2004 (*Ibid.*)) and currently undergoing review for design changes, including changes to land reclamation for the Formosa Plastics Group Steel Plant and Kuokuang Petrochemical Science Park which are planned for the site. Two construction phases are anticipated for Sinsing Industrial Harbour, starting after permit approval and ending in 2022. Land reclamation for the south section has not yet begun. The total planned area is 17,783 ha (including 11,045 ha of reclaimed land), with the three sections comprising 24%, 18% and 58% of the total, respectively (Sinotech, 2006; IDB, 2007). (Sources: Chinese Petroleum Corporation (CPC). July 2004. *Yunlin Petrochemical Technology Park Site Feasibility Analysis*; Industrial Development Bureau (IDB), Ministry of Economic Affairs. February 2007. *Yunlin Offshore Industrial Park Sinsing Industrial Harbour Environmental Impact Statement*; Sinotech. December 2006. *Environmental Impact Discrepancy Report for Changes made to Yunlin Offshore Industrial Park*).

