CONSERVATION OF THE IRRAWADDY DOLPHIN,
__ORCAELLA BREVIROSTRIS__ (OWEN IN GRAY, 1866)
IN THE MEKONG RIVER: BIOLOGICAL AND SOCIAL
CONSIDERATIONS INFLUENCING MANAGEMENT

Thesis submitted by
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for the degree of
Doctor of Philosophy
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Townsville, Australia
This thesis is dedicated to the memory of:

*Dr. Peter William Arnold*

*(14 May 1949 – 07 March 2006)*

A treasured friend, colleague and mentor,

whom I miss dearly
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PUBLICATIONS ASSOCIATED WITH THIS THESIS

The following peer reviewed journal articles have been published during my candidature:


Information from this thesis has resulted in the following management strategy being adopted as national policy in Cambodia (January 2005):

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**POPULAR ARTICLES ASSOCIATED WITH THIS THESIS**

The following popular articles have been published during my candidature:


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ASSOCIATED WITH THIS THESIS

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2005: Stephen Leatherwood Award, Society for Marine Mammalogy

NEW SPECIES DESCRIBED

ASSOCIATED WITH THIS THESIS

While undertaking this thesis, I contributed to the discovery of a new dolphin species:

The Australian Snubfin dolphin, *Orcaella heinsohni*

ABSTRACT

The goal of my study was to contribute to the effective conservation of the Irrawaddy dolphin population that inhabits the lower Mekong River. To achieve my goal, I developed objectives based on a conceptual framework of conservation principles and strategies that guide management of endangered species. The results of my study provide significant new information relevant to the taxonomic status of *Orcaella* and ecology and conservation of the Irrawaddy dolphin population inhabiting the Mekong River, with broader application to other freshwater dolphin populations.

Previously, the genus *Orcaella* was considered to consist of only one species, the Irrawaddy dolphin (*Orcaella brevirostris*). However, two colleagues and I discovered that what were previously considered Irrawaddy dolphins occurring in Australian/Papua New Guinean waters are instead a separate species, which we named the Australian snubfin dolphin (*Orcaella heinsohni*).

Freshwater Irrawaddy dolphin populations and their habitats are highly susceptible to anthropogenic threats. As a result of small population sizes, strict habitat preferences, apparent high site fidelity, slow maturation rate, long calving intervals and most importantly, their close proximity to human activities in freshwater ecosystems, Irrawaddy dolphins are highly susceptible to anthropogenic impacts. Most freshwater populations of Irrawaddy dolphins are small and declining; nevertheless, there has been a notable lack of on-the-ground conservation measures to conserve these populations. Flora and fauna along the river, as well as local subsistence communities, are facing threats similar to those faced by freshwater Irrawaddy dolphins. Irrawaddy dolphins should therefore be considered an effective flagship species for freshwater biodiversity conservation.

My study area encompassed the lower Mekong River of southern Laos, Cambodia and Vietnam and focused on the population of freshwater Irrawaddy dolphins that inhabit this river system. The natural environment of the lower Mekong River had previously been shielded from major development by war and political upheaval. However, all the lower Mekong countries are now developing quickly, and are experiencing significant human population growth. Based on conservation lessons learned from other countries, community involvement in habitat and species conservation is imperative for conservation efforts to be successful. Preservation of habitat is essential, not only to the conservation of endangered species, but also to the survival
of subsistence rural human communities, and other flora and fauna that rely on the river ecosystem.

I conducted 497 interviews with local villagers throughout the lower Mekong River to investigate local perceptions and knowledge relevant to dolphin conservation. Information from these interviews suggests a major decline in dolphin occurrence and abundance throughout most of the river. Reports affirm that dolphins previously occurred regularly south of Kratie Township to the Vietnamese Delta, but they are now virtually never sighted there. Interviewees identified the Kratie to Khone Falls river segment as the most important habitat remaining for dolphins in the lower Mekong River. Local communities hold very positive attitudes towards Irrawaddy dolphins. These attitudes significantly assist with securing local cooperation for management strategies. My study confirms that interviews with local people can provide detailed information about changes in species’ distribution and abundance over time, as well as about local perceptions towards riverine flora and fauna. Such information may take scientists many decades to obtain.

The absolute abundance of Irrawaddy dolphins in the Mekong River was estimated using capture-recapture analysis of photo-identified individuals, line-transect, and direct count methodologies. I compared these three survey methodologies to ascertain the most appropriate survey technique for accurate and precise long-term monitoring. Ninety-nine dolphins were individually identified during my study period, with 83% of the population estimated to be photographically-identifiable. A closed population model was used for capture-recapture analysis. I estimated that a minimum of 127 dolphins (range: 108-146), inhabited the Mekong River, as of April 2005. With the highest level of precision obtained from capture-recapture abundance estimates (CV=0.07), I estimated that with a CV of 0.07, it would take six years to detect a 5% per annum decline, and only two years to detect a 20% per annum decline.

A total of 13,200 km of boat surveys were undertaken throughout the lower Mekong River to provide estimates of abundance to compare with capture-recapture estimates. Dolphins were sighted only in the Kratie to Khone Falls river section – no dolphins were sighted south of Kratie Township. The largest number of dolphins sighted during upriver direct count surveys was 68 (range: 54-88), in May 2001. The largest number of dolphins sighted during downriver pool counts was 69 (range: 57-84), in May 2003. Direct counts were deemed an imprecise and inaccurate survey method, and not recommended for future monitoring purposes. Line-transect analyses estimated 161 dolphins (range: 89-289) inhabited the Mekong River, as of April 2005. Based on a combination of photo-identification and line-transect methodologies, I estimated that the total Irrawaddy dolphin population in the Mekong River was between 127–161 individuals.
Comparisons of survey techniques indicate photo-identification is the preferred methodology for population monitoring because of its efficiency and precision. Irrespective of the differences between survey methodologies, the total number of Irrawaddy dolphins inhabiting the Mekong River is very small and the population is now facing a very uncertain future.

Individual Irrawaddy dolphins exhibit extremely high site fidelity. By analysing ranging patterns for the 15 most frequently sighted photo-identified individuals, I estimated a mean area ranged of only 16.0 km² in the dry season (range = 0.7–73.0 km²) and 42.0 km² in the wet-season (range 0.9–99.0 km²).

Average group sizes during the dry and wet seasons were 6.8 dolphins ± s.e. 0.20 (range=1-19, n=405) and 5.7 dolphins ± s.e. 0.41 (range=1-34, n=107), respectively. School dynamics and social structure were investigated using photo-identified individuals. Analysis of association patterns revealed that individuals were seen with a particular companion significantly more often than would be expected by chance. The relationship between the lagged association rates and time lag suggests a ‘constant companions model’ i.e., the population is highly structured with the majority of individuals having preferred, long-term associates. Association analyses indicated four, somewhat discrete, sub-populations. From a management standpoint, my research suggests that it is critical that conservation efforts are now focused on the four sub-populations and associated critical habitats.

My study provides the first reliable estimates of mortality rates for the Irrawaddy dolphin population in the Mekong River and potential causes for these mortalities. Fifty-four dolphin carcasses were recovered and/or confirmed between January 2001 and April 2005. Forty-three percent of all carcasses recovered were newborns and only two newborns were known to have survived longer than six months. The cause of the high number of newborn deaths is unknown. Entanglement in gillnets and direct deaths through destructive fishing practices (e.g., dynamite fishing) are known causes of anthropogenic mortality. Other potential indirect causes of dolphin mortality include: contaminants, boat harassment and noise, boat collision, reduced fish stocks, and inbreeding depression. The Irrawaddy dolphin population appears to be declining at a yearly rate of at least 4.8%. The most conservative allowable Potential Biological Removal (PBR) from anthropogenic mortality is less than one individual/year. Anthropogenic mortality must therefore be reduced to zero as a primary management goal, if the population has any chance of survival in the river.
I initiated an integrated conservation development project named Dolphins for Development, which aimed to provide tangible benefits to the community in exchange for their cooperation with conservation efforts. Project components included: (1) rural development and diversification of livelihoods; (2) community-based ecotourism; (3) education and awareness raising; and (4) strengthening stakeholder relationships. Various project limitations were encountered; nevertheless, observable measures of success were evident. To conserve endangered species in developing countries, some incentive must be provided to local communities. ‘Community-conscious conservation’ is a term that I developed to describe multidisciplinary, on-the-ground conservation programs that work towards involving communities with conservation of endangered species and habitats. Further efforts are also required to integrate local conservation efforts with regional and national conservation priorities and decision-making.

Based on the preliminary results obtained (i.e., before comprehensive analyses of most data), I developed a conservation and management strategy for the Irrawaddy dolphin population in the Mekong River, which was adopted as national policy in Cambodia in January 2005. The five management goals of this strategy are to: (1) reduce threats and mortality rates; (2) increase local education and awareness; (3) effectively manage dolphin-watching tourism; (4) continue research and monitoring; and (5) clarify regional and national management responsibilities. Based on a comprehensive analysis of my data and acknowledgement of biological and social considerations affecting conservation, I developed recommendations built on my original MDCP strategy. These recommendations acknowledge that the Irrawaddy dolphin population that inhabits the Mekong River is very small, declining, and is in urgent need of effective management. The recommendations identify the high priority activities urgently required to contribute towards the dolphins’ immediate and long-term conservation.
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