CHAPTER 1

A general introduction into the phenomenon of facultative river dolphins and the species *Orcaella brevirostris*

Behaviours displayed by coastal Irrawaddy dolphins in captivity (Laem Sing, Thailand) such as this spy-hopping behaviour, has also been observed in wild Irrawaddy dolphins in the Mahakam River.
(Facultative) river dolphins and river wanderers

The order of Cetacea is composed of a variety of 85 recognized species and 41 subspecies of baleen whales and toothed whales and dolphins (Perrin et al., 2002; Reeves et al., 2003). Cetaceans have originally successfully spread out over vast areas of the world’s oceans and inner seas. The freshwater habitat has been “conquered” at first by four “older” river dolphin (sub)species, the Amazon dolphin or boto *Inia geoffrensis*, the Yangtze dolphin or baiji *Lipotes vexilifer*, the Ganges dolphin or shushuk *Platanista gangetica gangetica* and the Indus dolphin or bhulan *P. gangetica minor* where they adapted even further to “microhabitats”; lakes, confluence areas, rapid stream areas (Best & da Silva, 1993) and flooded forests (Layne, 1958). The boto has been suggested to have entered the Amazon basin from the Pacific some 15 million years ago (Grabert, 1983) or more recently (1.8-5 million years ago) from the Atlantic Ocean (Brooks, et al.; Gaskin, 1982).

Occasional river wanderers include representatives of several families of toothed whales: Within the Delphinidae family, the Indo-Pacific humpbacked dolphin *Sousa chinensis* has been recorded in the Fuchow River (now: Fuchung Jiang) and rivers flowing to Canton (Guangzhou) and 750 miles up the Yangtze, at least as far as Hankow (now: Hankou, near Wuhan) (True, 1889). In Indonesia, they are reported to occur about 30 km upstream the Kapuas River in western Kalimantan (information of local fishermen) and in the Dali River in north-eastern Sumatra (Suwelo, 1988). In Australia, they are found in the Brisbane River in Queensland (Klinowska, 1991). The Atlantic hump-backed dolphin *Sousa teuszii* is known to enter the Niger River and the Baniala River in Nigeria (Klinowska, 1991). This species is also known to occur in the Rio Géba in Guiné Bissau (Spaans, 1990). The common dolphin *Delphinus delphis* has been observed in the Hudson River, north-eastern USA, as far as 230 km (Stoner, 1938). Bottlenose dolphins *Tursiops truncatus* have been reported in the Casamance River in Senegal and in the Rio Géba in Guinea-Bissau (Spaans, 1990). They are expected to occur on other rivers in western Africa as well (Hazevoet, pers. comm. 1997). Two representatives of the Cephalorhynchinae, the Chilean or black dolphin *Cephalorhynchus eutropia* and the New-Zealand dolphin *Cephalorhynchus hectori*, occur in rivers. The first one moves at least 5 km up the Valdavia River (Goodall et al., 1988). The latter often enters and travels some distance upstream in several turbid rivers in flood during their northwards summer ‘migrations’ (Watson 1981). Within the family of Phocoenidae, the harbour porpoise *Phocoena phocoena*, can also be found in tidal rivers (Klinowska, 1991). One individual was described to have reached Paris after entering the Seine River and in the 17th century harbour porpoises could be found in the canals of Amsterdam (Delsman, 1922; van Bree, pers. comm. 1997). Even two species of baleen whales might occasionally wander upstream rivers. The minke whale *Balaenoptera acutorostrata* and the humpback whale *Megaptera novaeangliae*, have been recorded respectively 16 km upstream the Snohomish River in Washington State (Scheffer & Slipp, 1948) and 16 km up the Sacramento River in northern California (Warhol, 1986).
Although the cetaceans above may move very far upstream and even remain there for weeks, they are most likely temporary visitors. Their usual range includes river mouths, bays, lagoons, estuarine complexes and virtually any shallow water marine region. However, the most conspicuous river ‘wanderer’ is the white whale or beluga *Delphinapterus leucas*. This large, white dolphin moves regularly and sometimes in groups, very far upstream rivers. Below follows a list of those rivers where Belugas have been recorded very far upstream, or where they have been reported more often. In Alaska, one individual was found at 1500 km from the Bering Sea upstream the Yukon river near the Kuskokwim River and Nulato (Nelson & True, 1887). According to Lee (1878) the Beluga occurs, during the summer months, in all the mouths and in nearly all bigger rivers at the west coast of the Hudson bay as well as the Greenland coast. The St. Lawrence Beluga population in Quebec is regularly found at Ile de Coudres, about 600 km upstream the mouth. In almost all big river mouths and rivers in Russian-Siberian waters, groups of Belugas were regularly seen some hundred up to two thousand km upstream. Kleinenberg et al. (1969) provided an overview of their Russian-Siberian distribution. The most extreme wanderings included a record of 2000 km upstream the Amur River in eastern Siberia until the Argun River in China. In Europe, their river wanderings are very occasional and therefore caused much excitement and publicity. The occurrence of a Beluga in the Schelde River in Belgium until Dendermonde (c. 100 km from the mouth) in 1711 caused so much excitement that a statue of 2.5 meter length was made and is carried like a trophy around the town at each 25th anniversary. (Gewalt, 1976). The one-month wandering of a Beluga in 1966 up the river Rhein until Bad Honnef (c. 400 km from the mouth) made world wide news in press (Gewalt, 1976).

Underlying factors of these riverine migrations are explained in terms of the riverine migration of prey species. For example, salmons are one of their prey species, which move upstream to lay their eggs and they become an easier prey in the shallow waters where they cannot swim so fast. Other reasons were proposed by Mohr (1952 in Gewalt, 1976) in terms of dolphins having lost their direction and in terms of their active curiosity to explore. The fact that they also occur as groups in the river and that this happens frequently might also indicate that their riverine occurrence is probably based on more than an error.

Three species of cetaceans, which have established separate populations in rivers and in near-shore, marine waters include the species Irrawaddy dolphin *Orcaella brevirostris*, the tucuxi *Sotalia fluviatilis* and the finless porpoise *Neophocaena phocaena* (Smith & Jefferson, 2002). These represent more recent colonizers of freshwater habitats, in comparison to the obligate river dolphins, and they have been described as “facultative” river cetaceans, due to their species’ flexibility to inhabit marine and freshwater environments (Leatherwood & Reeves, 1994). Nevertheless, the freshwater populations may actually represent obligate freshwater populations. The time period of invasion or process of adaptation of these relative newcomers in rivers are unknown and some hypothesis are offered in Chapter 11. The tucuxi is sympatrically occurring throughout much of its range with the boto and inhabits rivers and lake
systems of Amazonia, the lower Orinoco River, and coastal marine waters from the Florianópolis region of Brazil, north to at least Nicaragua (Carr & Bonde, 2000; IWC, 2001). The finless porpoise occurs sympatrically with the baiji in the Yangtze River and lakes system. Additionally, they inhabit shallow nearshore marine waters along the coasts of southern and eastern Asia, from the Persian Gulf east to Sendai Bay, Japan, and south to Java (Reeves et al., 1997, 2000; Parsons & Wang, 1998; Kasuya, 1999). Just like the finless porpoise, Irrawaddy dolphins have a wide, but patchily distribution occurring in shallow, near-shore tropical and subtropical marine waters of the Indo-Pacific, from north-eastern India in the west, northeast to the Philippines and south to northern Australia, including most of the Indonesian archipel (Dolar et al., 2002; Rudolph et al., 1997; Stacey & Leatherwood, 1997; Stacey & Arnold, 1999). Their coastal distribution is mostly concentrated in estuaries and mangrove bay areas (Chapter 3). Their freshwater distribution is limited to three major river systems: the Mahakam in Indonesia, the Ayeyarwady in Myanmar, and the Mekong in Laos, Cambodia and Vietnam. Besides, they also occur in two completely or partially isolated brackish water bodies, including Chilka Lake in India and Songkhla Lake in Thailand (Beasley et al., 2002; Smith & Jefferson, 2002).

Although the concept of stocks was already commonly applied in conservation and management of whales by the International Whaling Commission, in the 1988-1992 Action Plan of the IUCN/SSC Cetacean Specialist Group a rationale was provided by Perrin (1988), for also including endangered populations besides species in conservation action plans. In the next action plan of the IUCN/SSC Cetacean Specialist Group (Reeves & Leatherwood, 1994) two projects were proposed involving the investigation of the riverine status of facultative river dolphins, namely: “Investigation of status and conservation of Irrawaddy dolphins in southern Asia” and “Investigation of status and establishing protected areas for pesut in Indonesia”. Following the latter recommendation a preliminary survey was initiated in 1997 to assess threats, distribution range and densities of the Irrawaddy dolphin in the Mahakam, locally referred to as pesut (Chapter 2), after which a more intensive research was carried out in the form of this Ph.D study.

Whether cetacean species are estuarine and/or occasional river visitors, or are obligate riverine, it is clear that many species depend on the river or the river run-off in estuaries and are very vulnerable to the effects of habitat degradation. Therefore, a holistic approach of protection of the entire riverine ecosystem is of utmost importance within the conservation of (facultative) river dolphins. However, the key will lie in effective conservation of manageable sites, in which positive results for the local community may serve as exemplary for other sites so that gradually a large proportion of the river may be effectively protected (Chapter 6).

**Orcaella brevirostris** (Gray, 1866)

Type species: *Ora (Orcaella) brevirostris* Gray, 1866: 285. Type locality:
“East coast of India in the harbour of Vizagapatam (presently named Vishakhapatnam).”

*Orcaella fluminalis* Anderson, 1871:80. Type locality: “1500 km from the mouth in the formerly named Irrawaddy River in Burmah (presently named Ayeyarwady River, Myanmar).”


Common name: Irrawaddy dolphin; local name in the Mahakam River: pesut.

The most recent systematic placement of the species is within the Order of Cetacea, Suborder Odontoceti, Superfamily Delphinoidea, Family Delphinidae, Subfamily Orcininae. Although, *Orcaella* has been placed in other families, i.e., Delphinapteridae together with the beluga *Delphinapterus leucas* (Kasuya, 1973); Monodontidae together with the beluga and narwhal *Monodon monoceros* (Barnes, 1984; Gaskin, 1982; Pilleri et al., 1989); Orcaellidae (Nishiwaki, 1973), the most recent morphological and molecular data suggest that Irrawaddy dolphins belong to the family of Delphinidae (Arnold & Heinsohn, 1996; Le Duc et al., 1999). They have been placed in the following subfamilies based on morphological data: Orcininae (Fraser & Purves, 1960); Globicephalinae (de Muizon, 1988); the monotypic Orcaellinae (Perrin, 1989). Most recent research involved the use of molecular data, which placed the Irrawaddy dolphin closest to the killer whale *Orcinus orca* (Arnason & Gullberg, 1996) and into the Orcininae (LeDuc et al., 2002), although the relationship was relatively distant and bootstrap support was low. The taxonomic status at the intraspecific level remains unclear (Stacey & Arnold, 1999). However, recent studies of skull morphology suggest possible specific differences between Australia/New Guinea and Southasian forms (Beasley et al., 2002).

Earlier a short account of the marine and freshwater distribution of Irrawaddy dolphins was given. Figure 1 shows locations of actual records, which are mostly based on Mörzer Bruyns, 1966, Stacey & Leatherwood, 1998, and some derived from various other sources. In Indonesian waters they were found some 16 km upstream the Belawan Deli River (north-eastern Sumatra); Surabaya (northeast coast Java); Cilacap, Segara Anakan (south coast of Central Java); Makassar (southwest coast Sulawesi); between Pulo Superiori and Pulo Biak; mouths of muddy waters (south coast West Papua), Mahakam River, Belitung Island (Möhrzer Bruyns, 1966); coastal area of Kumai River (Central Kalimantan) (Kartasana & Suwelo, 1994); Seribu Islands (Java Sea); delta Kendawangan River (south coast West Kalimantan) (Rudolph et al., 1997), c. 380 km upstream the Barito River below Puruk Cahu (South Kalimantan); Kajen River (north East Kalimantan) (Delsman, 1922); Balikpapan and Sangkulirang Bay and coastal areas in between (coast East Kalimantan); Mahakam Delta (Kreb, this thesis, chapter 3); confluence of Sekonjer River and Kumai River (Central Kalimantan); delta Sesayap River (north East Kalimantan) (Erik Meijaard, *in litt.*, 1997).
Figure 1. Map with Irrawaddy dolphin distribution in South East Asia. Black dots representing actual records from literature and own observations.
Aims of the study

The general aims of this study were to investigate the conservation biology, social organization, social communication, and marine and freshwater distribution patterns (stock identification) of the freshwater and coastal Irrawaddy dolphin populations in south East Asia with special reference to the Mahakam River in East Kalimantan and adjacent coastal areas. The study’s ultimate goal is to contribute to the conservation of Indonesia’s only freshwater dolphin population that inhabits the Mahakam River and lakes in East Kalimantan, Indonesia, to fill in the gap in literature on social systems within (facultative) river dolphins and to an appropriate action plan to ensure the survival of the pesut.

Detailed objectives involved: Conducting a preliminary survey prior to the Ph.D study to assess total dolphin distribution range and dolphin densities in different river areas, as well as to obtain an indication of threats to the population (Chapter 2); to assess cetacean diversity and distribution of coastal Irrawaddy dolphins along the coast of East Kalimantan (Chapter 3); to assess total population abundance through different seasons and by aid of several survey techniques, i.e., direct counts, density sampling, and mark-recapture analysis through photo-identification (Chapters 4, 5); to study habitat use and preferences, site fidelity, short-and long-term movement patterns, threat analysis and developing a conservation program to protect the pesut population and its habitat in the Mahakam River (Chapter 6); to study specifically the effects of boats on dolphins’ (surfacing) behaviour (Chapter 7); to provide an overview of status and threats of Irrawaddy dolphins throughout South East Asia (Chapter 8); to compare the social structures and breeding strategies of coastal and freshwater populations of Irrawaddy dolphins and additionally, study association patterns of individual dolphins in the Mahakam (Chapter 9); to compare vocalizations of coastal and freshwater populations of Irrawaddy dolphins and among different sites within the river; to investigate whether whistle shapes and frequencies are more determined by ecological, genetic or social factors; and to compare the vocalizations of all populations in East Kalimantan with those from Irrawaddy dolphins in Australian coastal waters and in the Mekong River to investigate whether the acoustics of the Irrawaddy dolphin follow an ecological (freshwater/ coastal) and/or geographical separation (Asia/ Indonesia/ Australia) (Chapter 10); to study the process of isolation of distinctive river and coastal Irrawaddy dolphins through their distribution patterns, (social) biology, historical biogeography, comparisons with other facultative riverine dolphin species. Although genetic material of both riverine and coastal populations were collected, unfortunately, only the skin cell material of the riverine populations yielded enough DNA to be used in the genetic analysis (Chapter 11); finally, to conduct a population viability analysis for a long-term prognosis of survival of the pesut population and assess the direction where conservation effort is mostly required and which events determine the viability of the population (Chapter 12).
Chapter 1

References

Anderson, J. 1871. Description of a new cetacean from the Irrawaddy River, Burma


Hohenwarsleben, Westarp-Wiss. [In German].


IWC. 2001a. Report of the standing sub-committee on small cetaceans. *Journal of
Cetacean Research and Management* (Special Issue) 2: 1-60.

Kartasana, G.F. & Suwelo, I.S. 1994-. *The existence of Irrawaddy dolphins at Kumai
Bay, Central Kalimantan, Indonesia.* Unpublished Manuscript.

Kasuya, T. 1999. Finless porpoise *Neophocaena phocaenoides* (G. Cuvier, 1829). Ridgeway,

(Delphinapterus leucas). Investigation of the species.* Wiener Bindery, Ltd., Jerusalem.
Pp. 376. Translated from Russian.


141-146.


phocaenoides*) from the South China Sea. Proceedings of the Third International
Conference on the Marine Biology of the South China Sea, Hong Kong, 28


phocaenoides* (G. Cuvier 1829): a summary of current knowledge and

conservation Action Plan for the Yangtze River finless porpoise, Ocean Park,


Vlaykov, V.D. (1944) *Chasse, biology et valeur économique du Marsouin Blanc ou Béluga (Delphinapterus leucas) du fleuve et du golfe Saint-Laurent.* Ph.D. Département des pêcheries, Quebec, contribution No. 14: 194 p.[ In French].
