1. Introduction

In general, the conservation of amphibians and reptiles depends either on their incidental presence in Protected Areas (PAs) which have been set up for other reasons or on individual-species action (Gogger *et al.* 2004). The case in Nepal is not different as conservation focus has been towards large vertebrates. The turtles are killed for food and medicinal uses (Shah 1997), their eggs are collected (Shrestha 2001) despite the fact that their status and current distribution of populations is poorly known (CEPF 2005). Since freshwater turtles in Nepal have received little scientific attention (Mitchell & Rhodin 1996; Schleich & Kastle 2002), the available taxonomic information in most of the cases are tentative and speculative. Neither references nor records are available for a detailed taxonomical identification of turtles. Confirmed records are extremely rare and information from earlier publications must be taken cautiously (Schleich & Kastle 2002).

All the turtle species more or less depend on wetlands except the land tortoise *Indotestudo elongata*. The terms 'turtle' and 'tortoise' are used, in many cases, interchangebly. The major differences arise from the feet (webbed or not), habitat (water or land), shell shape (flat or domed), feeding (herbivore or not). This less concerned species are in peril owing to encroachment, draining, deforestation, pollution, siltation; which are the major problems to the wetlands of Nepal (Bhandari 1995) ultimately affecting turtle population and their habitats. Although, trade and exploitation of turtles are documented (Mitchell & Rhodin 1996; Shrestha 2001; Schleich & Kastle 2002) and even the populations are said to be in decline, demographic studies are lacking, creating information gap in conservation assessment for which basic biological data are required including status survey, ecology, conservation systematic, threats determination among others (Rhodin 2005).

Turtles are adaptive as they are adapted with delayed sexual maturity, high juvenile mortality, and long adult life-span with low natural mortality. But, they are now vulnerable to new, potentially devastating threats posed by human exploitation and development related pressures (Turtle Conservation Fund 2002). In this regard, there was an urgent need in Nepal to have baseline information on the population status and distribution of turtles and voucher biota so that appropriate decisions would be made for the conservation of this important group of animal.

1.1 Turtle Species in Nepal: Diversity and Occurrences

The diversity of turtles and tortoises in the world that have existed in modern times, and currently generally recognized as distinct, consists of approximately 324 species and additional sub-species, or 464 total taxa. Of these, 10 taxa have gone extinct (Rhodin *et al.* 2008). The approximately 300 living species of freshwater turtles and tortoises worldwide are distributed over 7 major geographic regions. Asia is the most speciouse area as well as having the greatest percentage of threatened species, with more than 75% Critically Endangered (CR), Endangered (EN), or Vulnerable (VU), and 91% included in the IUCN Red List (Turtle Conservation Fund 2002).

Tortoises and freshwater turtles inhabit a great variety of habitats including terrestrial, semi-aquatic and aquatic systems (Bedoya-Gaitan & Godoy 2008). Rivers and *tals* in the Nepal

Tarai support a freshwater turtle fauna characteristic of north India (Mitchell & Rhodin 1996). So far records only exist from the lowland areas of the Tarai including the Inner Tarai where altitudes do not exceed 1,000 m (Schleich & Kastle 2002). Turtle research greatly lagged behind other large animal species. Little information is available about the other aspects of the turtle species and habitats. The information about the localities and species occurrence are hard enough to evaluate. Due to confusion of turtle species records even among zoologists and conservationists (Schleich & Kastle 2002), the communications and documentations remained varied and liable to erroneous information. Such reporting, despite not being based on scientific approaches, were incorporated in the important documents; national and international.

Gunther first listed five species of freshwater turtles from central Nepal without specific locality. It was based on Brain H. Hodgson's collection of *Kachuga kachuga*, *Kachuga dhongoka*, *Aspideretes gangeticus* and *Chitra indica* with *Testudo horsfieldii* listed as questionable, evidently based on misidentified drawing of *Indotestudo elongata*. Since then several studies have reported on the occurrence of turtles in Nepal (Moll 1986 &1987; Moll and Vijay 1986; Dinerstein *et al.* 1988; Das 1991; Iverson 1992 cited in Mitchell & Rhodin 1996).

Nine species of turtles were recorded, including the Endangered Red Crowned- Roofed Turtle (*Kachuga kachuga*) and Elongated Tortoise (*Indotestudo elongata*) during the biodiversity inventory of Tarai wetlands. During the survey, Brown- Roof Turtle (*Kachuga smithii*) and Indian- Eyed Turtle (*Morenia petersi*) were recorded for the first time in Nepal (Shah1995). Mitchell and Rhodin (1996) described ten of the eleven species that were reported from Nepal confirming the occurrences of *A. gangeticus* and *Melanochelys tricarinata*. Their fieldwork and observations were from Bardia, Chitwan and survey of curio shops in Kathmandu. The potential occurrence of six more species (*Cyclemys dentata*, *Geoclemys hamiltonii*, *Hardella thurjii*, *Kachuga tentoria*, *Morenia petersi* and *Pyxidea mouhotii*) was also mentioned from Nepal, that consist of two exotic species. With uncertainity, DNPWC/WWF (2005) among others reported Ghodaghodi area supported populations of *Kachuga kachuga* and *Kachuga dhongoka*.

Shrestha (2001) reported occurrence of 16 species of turtles including the occurrence of *Geoclemys hamiltonii* and *Aspideretes leithi*, without specific locality and included *Kachuga kachuga* in Koshi Tappu Wildlife Reverse. *Cyclemys oldhamii* was recorded for the first time in Nepal in 2001 from eastern Nepal (Rai *et al.* 2002). Altogether, 4 records (2 live specimens and 2 shells) of *Cyclemys oldhamii* were made during the research period of 4 years (Rai 2004). The localities, morphometrics and ecology were described for the species.

After the most comprehensive work till date on turtles till date, Schleich & Kastle (2002) described the occurrence of 15 turtle species (Bataguridae-10, Testudinidae -1 and Trionychidae-4) in Nepal. The list comprises the following genus with species number: *Cyclemys*-1, *Kachuga*-2, *Melanochelys*-2, *Morenia*-1, *Pangshura*-4, *Indotestudo*-1, *Aspideretes*-2, *Chitra*-1 and *Lissemys*-1 species. The publication contains color photographs of specimens and the type locality mapped on grid map. Shah & Tiwari (2004) published occurrence of 17 species (including two subspecies) of turtles in Nepal based on the field records as well as relying on the past records and literatures along with the district based

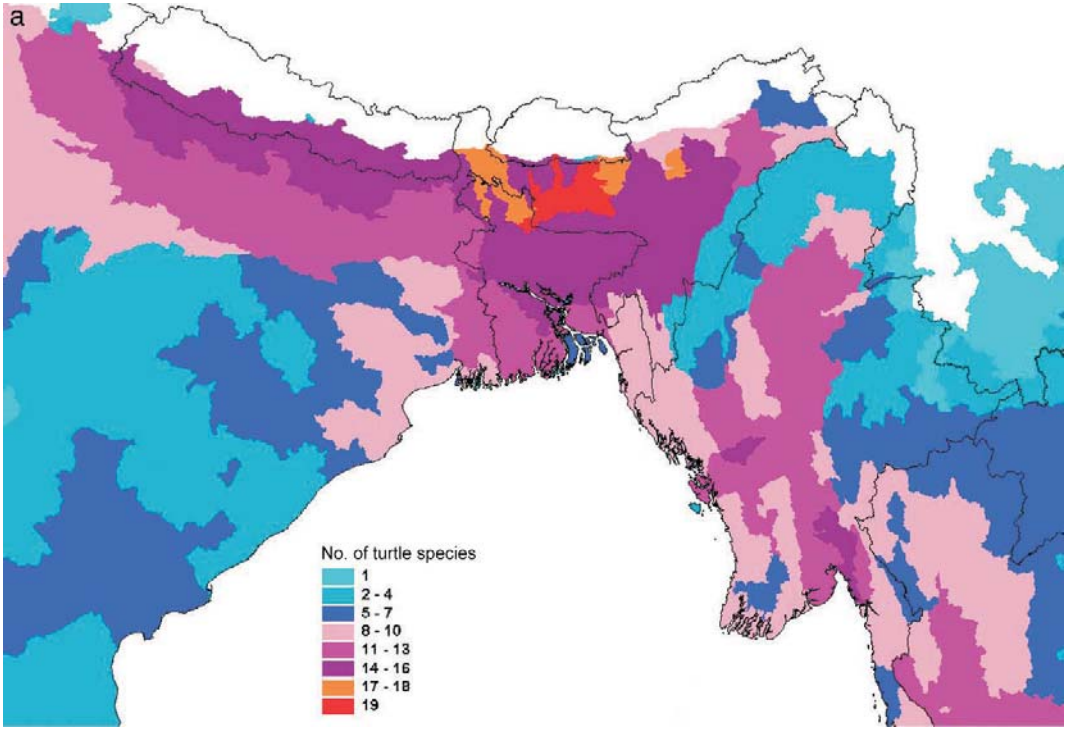

Figure 1: Based on the co-occurrence of species in hydrologic unit compartments in the Ganges Brahmaputra river basin of India and Bangladesh in South Asia appears to have highest number of turtle species (Source: Bhulmann et al. 2009).

distribution mapping. CFH/MCBT (2006) also mentioned the occurrences of *Kachuga kachuga*, *Kachuga dhongoka* and *Chitra indica* in Nepal. The present study covers all Tarai districts (161 sites including wetlands, forests inside and outside protected areas, and sites having turtles in captivity) with a record of 16 species, including sub-species from 138 sites. Not all records were live specimen. Some species were inferred from local knowledgeable people (Aryal *et al.* 2009).

Confirmation of species occurrences has not been sought in many cases (Bhuju *et al.* 2007) like occurrence of three turtle species in Bedkot Tal, Kanchanpur *Kachuga kachuga* in Koshi Tappu Wildlife Reserve (Thapa & Dahal 2009), as freshwater turtles have remained poorly researched (Mitchell & Rhodin 1996). Although *K. dhongoka* was reported to occur in Chitwan National Park and Kailali District as, Schleich & Kastle (2002) mentioned no proven records of the species from Nepal. The occurrence of *Hardella thurjii* was not confirmed (no live specimen record) from Nepal but recent study made observations of *H. thurjii* in Koshi River and a live specimen was caught in Pyara Tal, Kanchanpur, Nepal (Aryal *et al.* 2009).

The occurrence of *Melanochelys tricarinata* is reported by many studies (Shah 1995; HMGN/MFSC 2002; Schleich & Kastle 2002; Shah & Tiwari 2004; Shrestha 2001) with proven records from different parts but questioned at other times as of Asian Turtle Trade

Working Group 2000 (2008b). The range extension of *M. tricarinata* was observed. Shah & Tiwari (2004) showed the eastern range of this species to Chitwan, but shell records from Bara district confirmed the extension of eastern distribution in a recent study (Aryal *et al. 2009*). Furthermore, two specimen were collected by a graduate student from Chatara area near Koshi Tappu Wildlife Reserve few years ago (personal comn. Prof. Kalu Ram Rai) also extended the eastern distribution.

Asian Turtle Trade Working Group 2000 (2008a) was uncertain about the occurrence of *Morenia petersi* in Nepal although it was recorded by Shah (1995) and appeared in literature afterwards (Bhuju *et al.* 2007; CEPF 2005; HMGN/MFSC 2002; Shah & Tiwari 2004; Shrestha 2001) without second attempt to provide the backup information. During recent study 2008-2009, despite great search efforts in the area mentioned for its occurrence, Gainda Tal, Rupandehi, no individual and/or shell was observed. Moreover, the local people around the Gainda Tal could not confirm its presence. Hence, the species is confirmed locally extinct from the only site of its previous occurrence and was not recorded elsewhere (Aryal *et al*. 2009). The population of *M. petersi* recorded through single shell by Shah (1995) team from Gainda Tal, Rupandehi might have undergone the same fate. The national conservation policies have not paid attention on the species status and priorities.

1.2 Threats

1.2.1 Trade and Exploitation

Turtles and their eggs are hunted for food (Schleich & Kastle 2002; Shrestha 2001; Shah 2004). They are exploited in large numbers for meat and medicinal uses as well as local trade (Shah & Tiwari 2004). Turtles make a part of wildlife commodities traded through Nepal (DNPWC 2005) but quantity is never mentioned. In 1995, 120 live turtles and in 1997, 190 turtles on the way to China were confiscated in Bhaktapur, Nepal (Shakya 2004). In some areas turtle hunting has shown a drastic increase as a result of the higher demand of a growing human population and more efficient techniques of capture (Schleich & Kastle 2002). Mitchell & Rhodin (1996) recorded masks made from 11 turtle species in Kathmandu during a survey of curio stores. Some of the shells were of species not recorded from Nepal.

Biological populations are by definition renewable (Reynolds & Peres 2006) but turtles with low reproductive capacity, cannot quickly rebound after a severe setback caused by any number of factors (Noss *et al.* 2006). Exploitation of turtles and tortoises is generally considered to be unsustainable (Zhou & Jiang 2008) and turtle populations simply cannot withstand high levels of exploitation pressure (Rhodin 2005). Exploitation tends to be a direct problem and one with complex socio-political origin (Gogger *et al*. 2004).

In the absence of a separate CITES bill, the conservation activities governed by NPWC Act and other existing laws are inadequate in dealing with wildlife related illegal activities in the country (DNPWC 2004). Although laws have been enacted to protect the habitat of aquatic animals, they do not address the illegal exploitation of turtles (Shrestha 2001). Until legislative provisions are not enough to control wildlife trade due to lack of and stern actions against the illegal traders (Aryal 2004) for flagships species, enforcement for turtles and other reptiles as well as amphibians, which were never a priority group (Schleich & Kastle 2002), can not be expected. Since the law enforcement for turtle trade is not experienced and

expected outside PAs, local markets near turtle sites are potential markets for turtles trade. Indo- Nepal trade of turtles is common in many districts.

Every potential turtle site has potential of exploitation. All the sites are frequented by the fishermen, in fishing flocks many times, particularly outside the PAs. The pressure of exploitation has increased with expanding human population, settlements and agriculture land. The increased mobility of people around the turtle habitat, particularly outside PAs, has increased the encounter and exploitation. Indifferent contractors and contracting authorities, without considering the turtles and aquatic biodiversity in wetlands under fishing contract or fish farming contract throughout, have increased the exploitation of turtles during fishing and fish stock clearance. The lack of information regarding exploitation and trade- volume quantification and species involved has left clouded future of turtles in Nepalese Tarai.

1.2.2 Habitat Threats

The most critical threat is habitat destruction. While direct exploitation can be estimated, other causes for the decline of individual numbers are more difficult to control and to quantify (Schleich & Kastle 2002) since turtles occupy wide range of habitats (Rhodin 2005). Habitat degradation is an increasing threat to the survival of turtles (Schleich & Kastle 2002). Turtles are very sensitive to modifications of their environment, and are among the first vertebrates to disappear with disturbance (Bour 2008). There are several problems to the wetlands of Nepal (Bhandari 1995) thus ultimately affecting the turtle populations. The draining of wetlands, for irrigation or harvesting fish, leads to rapid drying out when at best they undergo vegetation changes and at worst are encroached upon for grazing or reclaimed for agriculture. The excessive doses of agro-chemicals applications in the agriculture land entering aquatic habitats increase the concentration of toxic chemicals (Jha 2008). Aquatic Animals Protection Act, 1961 clearly mentioned introduction of poisonous, noxious and explosives materials in water bodies is offense (HMGN/MFSC 2002). However, the offense is intentionally practiced in the Tarai wetlands whenever contracted for aquaculture, as if it is a legal activity.

The aquaculture practices have included so far, stocking of exotic fish species, in wetlands. Other large wetlands including the large river sections are leased to catch wild fishes. Introduction of exotic fishes, unsustainable fishing methods and management practices have rendered aquatic species and ecosystem under sheer pressure. The authorities, ranging from district to local level and government to community and private, have not paid attention on the procedures adopted in the fish farming. Nutrient enrichment along vegetation clearance and plowing using the tractors are common practices. Use of herbicides to clear the vegetation and even pesticides to clear the fish stock from a site, as the particular contract period ends, have been a common practice.

Grazing is common practices in wetlands and forests. The grazing impact depends on the intensity, timing, and duration of grazing (Kazmaier *et al*. 2001). Cattle grazing reduces the vegetation cover (Schleich & Kastle 2002), trampling by cattle causes turtle mortality (Leuteritz *et al*. 2005). The effects like mutilation and other bodily injuries and even reduction in survivorship of both adults and juveniles (Leuteritz *et al.* 2005; Saumure *et al.* 2007) are evident when the machinery is used in wetlands. Commercial sand mining also

destroys nesting sites for sand nesting species (Schleich & Kastle 2002). Fires are frequent in forests of the Tarai. Fires eliminate the vegetation cover, food and cause death of the terrestrial tortoises (Schleich & Kastle 2002); juvenile turtles are more susceptible (Hailey 2000).

The biotic connection through dispersal mechanisms among wetlands is of primary importance to wetland management and policies (Amezaga *et al.* 2002). Most of the wetlands are located amongst the agriculture land or settlements with less chance of connectivity to other wetlands/ habitats if not isolated. Moreover, the nesting and basking behaviour of turtles are altered by human disturbances (Moore & Seigel 2006).

1.3 Conservation Opportunities

Nepal has agreed on several conservation treaties and formulated its own conservation regulations (DNPWC 2007; HMGN/MFSC 2002). There have been several examples of successful conservation practices, particularly community based conservation practices. However, Tarai being the most populous region with the highest rate of population growth, rapid urbanization, agricultural expansion and loss of natural areas posing challenges to conservation of turtle populations and their habitat.

Protection of turtle species and habitat singly can not be a priority among competitive conservation agenda. Thus, alignment of issues regarding species and population conservation along with wetland and forests, community and private partnership can be genuine combination. The local communities are needed to be aware about turtles and their habitat through participatory studies and conservation programs. After all "communities" do not conserve or spoil: at least, they do not act as simple, isolated agents. Rather they are imbedded in larger systems, and they respond to pressures and incentives (Berkes 2004).

The conservation initiatives through the local bodies can be effective in conserving turtles. Moreover, the private and organizational contractors in fish farming, if informed and brought into legal obligations, can work for conservation. There is an evident gap in information collection about the wetland biodiversity and providing science-based guidance for management. Thus, the scientific information through research on policy impacts is prerequisite. The dealing of contemporary scientific and socioeconomic issues remains crucial challenge. For example, awareness among local communities regarding the population status and threats can be of great value in turtle conservation.

Science-based planning that incorporates variability of a landscape including digital turtle habitats, is crucial to the successful conservation of biodiversity (Svancara *et al*. 2005). Thus impetus of awareness to the people living around the turtles regarding conservation, threats and policy implications are required if the turtles are to survive in times to come.