

## Chapter 2

### Literature Review

Turtles (Testudines) are reptiles, armored with shell above and below, and capable of withdrawing the head, neck, limbs, and tails either partially or fully within the armor. No other tetrapod has a bony shell that encloses both the pectoral and pelvic girdles. The upper shell, the carapace, is formed from fusion of the eight trunk vertebrae and ribs to an overlying set of dermal bones; the lower shell, the plastron, arises from the fusion of parts of the sternum and pectoral girdle with external dermal bones. The shell is robust in some taxa, such as in tortoises and mud turtles, with only small openings for the head and appendages. In other turtles, such as leatherback sea turtles and softshell turtles, the shell is lightly built and has lost or reduced bony elements. The neck, whether long or short, is extremely flexible and consists of eight cervical vertebrae in all turtles. Extant turtles are divided into two clades based on the movement or retraction pattern of the neck. The Pleurodira or sideneck turtles retract the head and neck by laying it to the side; thus, the sides of the neck and head are exposed in the gap between the carapace and plastron. The Cryptodira or hidden-neck turtles retract the neck posteriorly into a medial slot within the body cavity; the neck forms a vertical S-shape when viewed laterally, and only the tip of the nose is exposed between the shielding forearms. In spite of the different mechanics of neck retraction, the structure of the cervical vertebrae in the two groups is very similar (Zug et al., 2001).

The turtle shell is composed of dermal bony elements that are covered externally by keratinous scutes or, in a few instances, leathery skin (Trionychidae, Dermochelyidae, Carettochelyidae). The scutes do not have the same pattern as the underlying bony elements, and the misalignment of

sutures in the bony and keratinous portions of the shell adds strength to the structure (Pough, 2001).

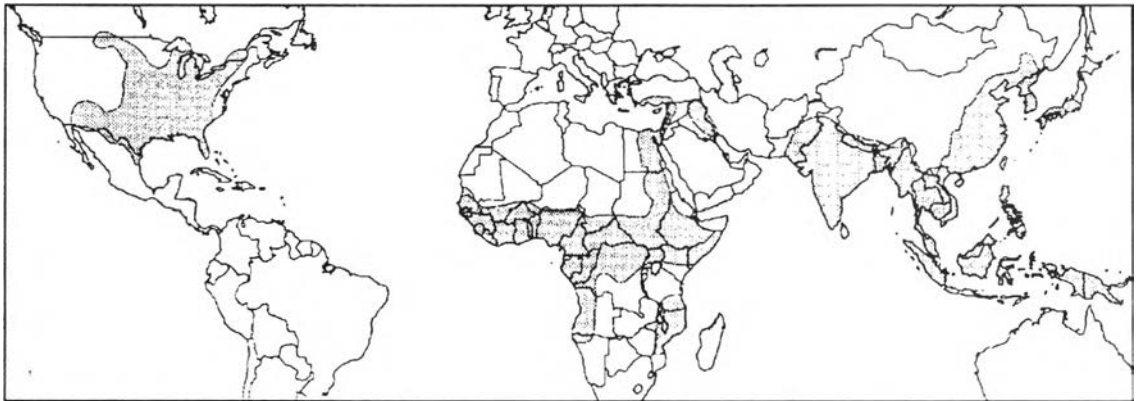
All turtles are oviparous. The number of eggs deposited by females of different species ranges from one to more than a hundred. The number of eggs in a clutch is generally positively associated with female size; small turtles lay one or two eggs and larger turtles lay a dozen or more. Most turtles possess a stereotypic nest-digging behavior. Egg chambers are dug with the hindlimbs, which work alternately to scoop out a flask-shaped chamber as deep as the hindlimbs can reach. Fertilization is internal and, because the shell surrounds the body in both sexes, copulation can be hazardous to the male, who must balance his plastron on top of the female's carapace. Males of many species have a slightly concave plastron to facilitate mating (Zug et al., 2001).

The softshells of the family Trionychidae are a group of turtles that lack epidermal laminae and their bony shell is somewhat reduced. The shell is low, usually nearly circular in outline, and covered with a leathery skin. The neck is long and retractile, the lips are fleshy (not covered with a horny beak as in other turtles), and the snout is drawn into a fleshy proboscis with the nostrils at the tip. The limbs are paddlelike, with three claws on each foot (Goin and Goin, 1962).

Softshell turtles are one of the most ancient of living families, having a fossil record extending at least as far back as the Cretaceous. Even fragmentary remains can usually be assigned to this family since the bones of both carapace and plastron are usually heavily pitted in a characteristic fashion. Early representatives include the genus Plastomenus, known from about eleven species from the Cretaceous and Eocene of North America, with a single newly-discovered form (P. mlynarskii) from the Eocene of eastern Kazakhstan (Pritchard, 1979). While Ernst and Barbour (1989) state that

softshells' fossil record indicates they were previously more widespread, once occurring in Europe and South America. The oldest known fossil trionychid is Sinaspideretes wimani, which dates possibly from the Late Jurassic.

There are more than 285 turtle species world wide (Zug et al., 2001). Modern Softshell turtles are found in North America, Africa, southern and eastern Asia, and the East Indies to New Guinea (Figure 2.1). There are 23 species world wide, nine species are found in Southeast Asia (Iverson, 1992). Saemathong and Thirakhupt (1994) recorded that there are five native species, Amyda cartilaginea, Dogania subplana, Lissemys scutata, Pelochelys cantorii, Chitra chitra, and one introduced species, Pelodiscus sinensis, in Thailand.



**Figure 2.1** Distribution of softshell turtles in the world (after Pough, 2001)

A diagnosis of Genus Chitra was provided by Taylor (1970) who found that the orbits are very close to each other (the distance between them is about half their diameters). The skull is narrow and its length is twice that of its width. The outer part of the nuchal plate overlies the second dorsal rib; 8 neural plates form a continuous series; 8 costal scales are on each side and the last pair medially in contact. Hyoplastron and hypoplastron are distinct from each other. A post orbital arch is about double the diameter of the orbit; the posterior border of pterygoid is free, without an ascending process.

There are 3 species currently recognized, Chitra indica Gray, 1831, Chitra chitra Nutphand, 1986, and Chitra burmanica Jaruthanin, 2002 or Chitra vandijki McCord & Pritchard, 2002, in this genus. The distribution of the Genus Chitra is widespread across southern Asia (occurring in the rivers Indus, Ganga, Godavari, Padma, Mahanadi, and Coleroon, as well as in Pakistan, Nepal, India and Bangladesh) and Southeast Asia (Myanmar, Thailand, Malaysia and Indonesia) (Liat and Das, 1999).

Smith (1931) and Taylor (1970) recorded Chitra sp. in Thailand as Chitra indica. In 1986, it was described as a new species, Chitra chitra, by Nutphand. He stated that it was probably the largest softshell turtle in the world and was known only from the Mae Klong river (Ratburi Province), and Khwae Noi and Khwae Yai Rivers (Kanchanaburi Province). Their dimensions could reach or exceed 110 cm in carapace width, 140 cm in carapace length, 150 kg in weight, and females could lay clutches of 60-100 eggs. C. chitra has many dark stripes on a yellow-brown carapace and neck with white plastron (Nutphand, 1990). More recently Chitra populations in Malaysia and western Indonesia have been considered to represent this species also (McCord and Pritchard, 2002).

In Thailand, Chitra chitra occurs only in broad, deep sections of the Mae Klong Basin, from the Vajiralongkorn (formerly called Khao Laem) and Srinagarind Reservoirs to Ratburi Province and the Mae Ping River, both upper and lower Bhumipol Dam (Kitimasak and Thirakhupt, 2002). C. chitra is severely threatened here by hunting, water pollution, reservoir construction and other forms of habitat destruction and alteration (Thirakhupt and van Dijk, 1994).

In 2000, The International Union for the Conservation of Nature and Natural Resources (IUCN) listed C. chitra as one of 27 Critically Endangered

Species (CR) of turtles in the world (Hilton-Taylor, 2000). Its status is classified from the criteria CR A1cd, B1+2c as below:

CR; A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria:

A1cd; Population reduction in the form of either of the;

1; An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) either

c; a decline in area of occupancy, extent of occurrence and/or quality of habitat ; or

d; actual or potential levels of exploitation

Taechachareonsukchera (1991) dissected a dead female C. chitra on 15 March 1990. This female contained 97 white hard-shell eggs and 270 enlarged follicles. Eggs were incubated in a glass-box at 25-35 °C., and 80-100 % relative humidity. The incubation period was 62 days. The mean of hatchling carapace length was 4.5 cm and 4.0-4.2 cm carapace width. Hatchling groups, ten per group, were raised in 60 cm diameter tanks, with 5-7 cm water depth and without sand at the bottom. Within ten days, many baby softshell turtles were injured by their kin. There were 50 % which survived.