Conservation Biology of Freshwater Turtles and Tortoises:
A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group
A.G.J. Rhodin, P.C.H. Pritchard, P.P. van Dijk, R.A. Saumure, K.A. Buhlmann, and J.B. Iverson, Eds.
Chelonian Research Monographs (ISSN 1088-7105) No. 5, doi:10.3854/crm.5.008.mccordi.v1.2008

Chelodina mccordi Rhodin 1994 – Roti Island Snake-Necked Turtle, McCord's Snake-Necked Turtle, Kura-Kura Rote

Anders G.J. Rhodin[1], Bonggi R. Ibarrondo[2,4], and Gerald Kuchling[3]

[1]*Chelonian Research Foundation,*
168 Goodrich Street, Lunenburg, Massachusetts 01462 USA [RhodinCRF@aol.com];
[2]*Indonesian Turtle Conservation Group, Kelompok Konservasi Kura-kura Indonesia,*
Bogor 16000, Indonesia [bongui72@hotmail.com];
[3]*Department of Zoology, University of Western Australia,*
Nedlands, Western Australia, 6009 Australia [kuchling@cyllene.uwa.edu.au]
[4]*Present Address: Barrio Valcaba No. 18, 39807 Soba, Cantabria, Spain*

Summary. – *Chelodina mccordi* (Family Chelidae) is a moderate-sized snake-necked turtle endemic to the tiny island of Roti (= Rote) in southeastern Indonesia. It has an extremely limited distribution and has been subjected to intense collection pressure for the international pet trade market, which has driven it into virtual commercial extinction. Recent field surveys have documented extremely depleted remaining populations still being impacted by persistent collection efforts, with remaining habitat areas also being reduced by agricultural development and conversion of swamps and marshland to rice fields. No major protected areas exist on Roti in *C. mccordi* habitat, but a previously proposed area, Tanjung Pukuwatu on the Tapuafu Peninsula, provides significant potential for critical habitat protection for some remnant turtle populations, and we strongly urge that Tanjung Pukuwatu be formally gazetted as a Wildlife (Game) Reserve (*Suaka Margasatwa*). Captive breeding efforts through *ex-situ* assurance colonies also provide some hope for saving the species, but improved control of persistent illegal trade and creation of secure protected areas on Roti are urgently needed to prevent *C. mccordi* from becoming extinct in the wild.

Distribution. – Indonesia. Restricted to the small island of Roti southwest of Timor in the Lesser Sunda islands.

Synonymy. – *Chelodina mccordi* Rhodin 1994b, *Chelodina mccordi mccordi*.

Subspecies. – Two currently recognized: *Chelodina mccordi mccordi* (Western Roti Island Snake-Necked Turtle) and *Chelodina mccordi roteensis* McCord, Joseph-Ouni, and Hagen 2007b (Eastern Roti Island Snake-Necked Turtle). A third taxon from Timor-Leste, described as the subspecies *Chelodina mccordi timorlestensis* Kuchling, Rhodin, Ibarrondo, and Trainor 2007 was also described a few months earlier as the species *Chelodina timorensis* McCord, Joseph-Ouni, and Hagen 2007a; the systematic relationships of *C. mccordi* with this new taxon remain unresolved.

Status. – IUCN 2007 Red List: Critically Endangered (CR A1d, B1+2e) (assessed 2000); CITES: Appendix II.

Figure 1. Adult male *Chelodina mccordi* (CL = 180 mm) from mid-central Roti Island, Indonesia, near Busalangga, April 1993. Photo by Anders G.J. Rhodin.

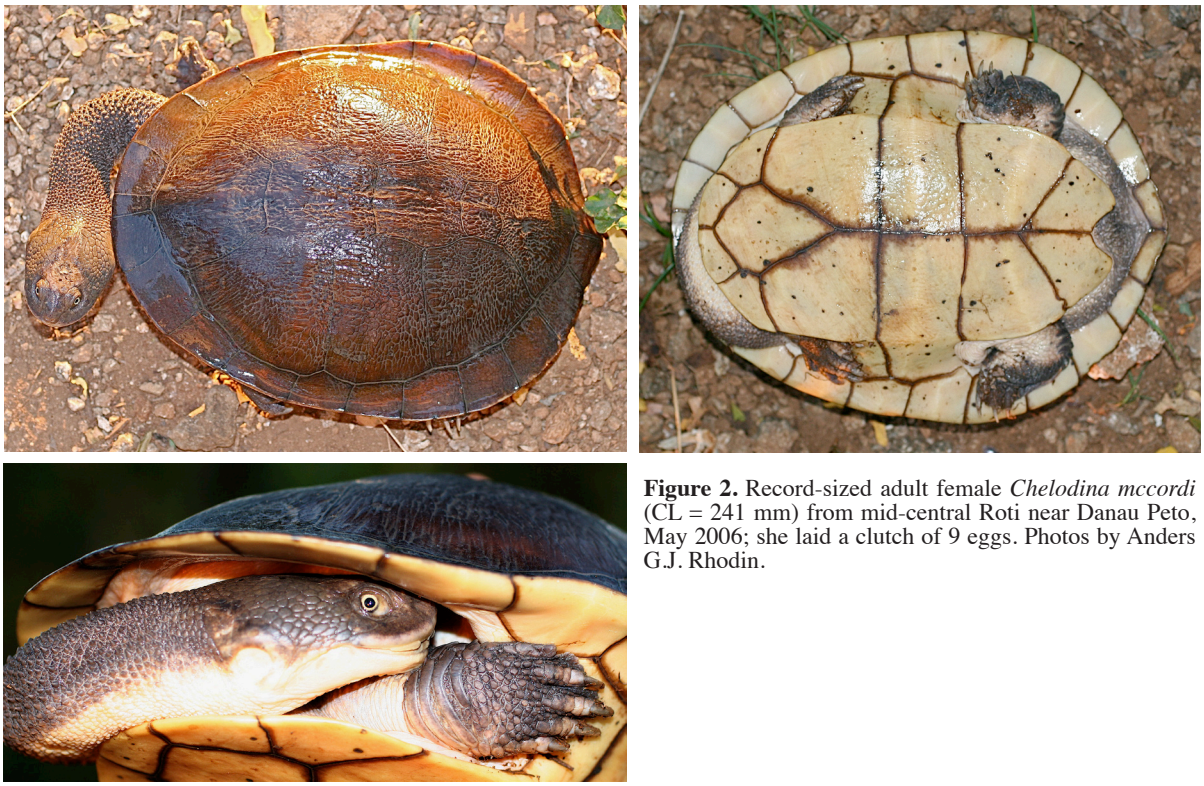

Figure 2. Record-sized adult female *Chelodina mccordi* (CL = 241 mm) from mid-central Roti near Danau Peto, May 2006; she laid a clutch of 9 eggs. Photos by Anders G.J. Rhodin.

Taxonomy. — Turtles of this taxon were first collected on Roti Island in 1891 by the Dutch explorer Ten Kate (1894), and assigned to the widespread taxon *Chelodina novaeguineae* Boulenger 1888 by Lidth de Jeude (1895). Roti was for a long time considered part of the overall range of *C. novaeguineae*. No further specimens were collected until Indonesian pet dealers began to export specimens in the 1970s and 1980s. Some of these specimens and Ten Kate's original series were analyzed by Rhodin (1994b) and described as a new and distinct species, *Chelodina mccordi*.

Further data on distribution, morphology, ecology, threats, status, systematics, and biogeography have subsequently been added by Rhodin (1994c, 1996), Iskandar (2000), Georges et al. (2002), McCord and Thomson (2002); Ibarrondo (2004a,b,c), Rhodin et al. (2004), Shepherd and Ibarrondo (2005), and McCord et al. (2007b). Recent field work by Ibarrondo (unpubl. data) and Rhodin, Ibarrondo, and Kuchling (unpubl. data) has provided additional information presented here for the first time.

The species is a medium-sized member of *Chelodina* subgeneric group "A" (Goode 1967; Burbidge et al. 1974), characterized by relatively narrow heads, shorter necks, and wider plastra than species of subgeneric group "B" — which is now often recognized as the separate genus *Macrochelodina* (see Turtle Taxonomy Working Group 2007). Rhodin (1994b), using osteological characters, considered *C. mccordi* to be most closely related to *C. pritchardi* Rhodin 1994a of southeastern Papua New Guinea and *C. longicollis* of Australia, and less closely related to *C. novaeguineae* and *C. reimanni* of New Guinea. However, Georges et al. (2002), using electrophoretic analysis, demonstrated that *C. mccordi* was most closely related to *C. novaeguineae* and *C. reimanni*, and McCord and Thomson (2002) added their new species *C. canni* to the same grouping based on osteology.

Chelodina mccordi is geographically isolated from all other *Chelodina* species, and represents a relictual form endemic to the small island of Roti. Its biogeographic origin

Figure 3. Small juvenile *Chelodina mccordi* (CL = 67 mm) from mid-central Roti near Danau Peto, May 2006. Photos by Anders G.J. Rhodin.

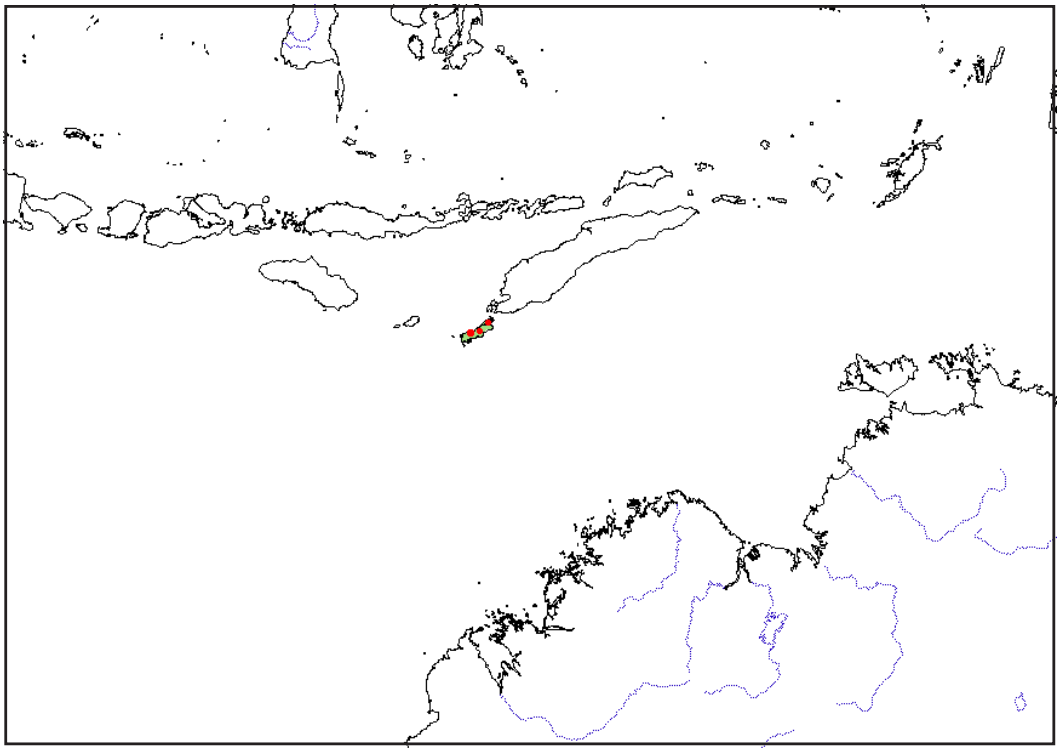

Figure 4. Distribution of *Chelodina mccordi* in southeastern Indonesia on Roti Island (enlarged below in Fig. 5). Red points = museum and literature occurrence records based on published records plus more recent and authors' data; green shading = projected distribution based on authors' data.

appears to have been by vicariant dispersal from northwestern Australia, with Roti originally having formed a part of the splintered edge of the Gondwanan tectonic plate (Rhodin 1994c; Rhodin et al. 2004).

Description. — The carapace is moderately rugose and broadly oval, somewhat wider posteriorly (widest around marginals 6–7), with slight expansion of marginals 6–8. Some prominent lateral marginal recurving occurs from about marginals 4 through 7, often partially involving marginals 3 and 8 as well. Recurving is less prominent in smaller specimens. Supracaudal ridge moderate with slight adjacent concavity of each marginal 11. No vertebral knobs, keel, or ridging. Slight vertebral flattening or shallow midline furrow in larger females; carapace smoothly convex in smaller females and males. No supracaudal notch or marginal serrations. Dorsal aspect of nuchal long and broad, but not projecting anterior to carapace margin. Ventral underlap of nuchal also relatively long and broad. Many individuals with deviant vertebral and costal scute configurations, with supernumerary, missing, or fused scutes.

Width relationships of marginal scutes 1 and 2 diagnostic, with M1 typically half as wide as M2 as measured along the inner border of each. In *C. pritchardi* M1 is wider or subequal to M2, and in *C. novaeguineae* M1 averages about 80% of the width of M2. Carapace slightly less broad in *C. mccordi* than in *C. pritchardi*, but significantly broader than in *C. novaeguineae*. Lateral marginal recurving typical for *C. mccordi*, not present in *C. pritchardi*, not present or only very minimally developed in *C. novaeguineae*. Supracaudal ridging with adjacent slight marginal concavities also typical for *C. mccordi*, not present in *C. pritchardi* or *C. novaeguineae*.

Carapace moderately deep in larger specimens, relatively flat in younger ones. No sexual dimorphism in carapace depth between like-sized males and females, but the largest females (larger than any males) have strikingly deep shells.

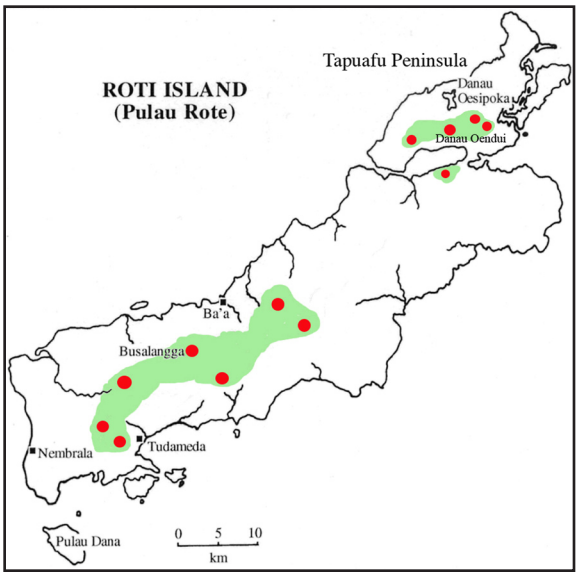

Figure 5. Distribution of *Chelodina mccordi* on Roti Island, showing the disjunct southwestern and northeastern populations. Distributional data based partly on recent field work by Ibarrondo (unpubl. data). The type locality of *C. m. mccordi* is at Busalangga in the southwestern central portion of the island; the type locality of *C. m. roteensis* is at Danau Oendui on the Tapuafu Peninsula in the northeast.

Carapace depth in *C. mccordi* slightly greater than in either *C. pritchardi* or *C. novaeguineae*. Color variable, with most specimens having a distinctive light grayish-brown carapace unusual for *Chelodina* subgeneric group "A". Some specimens darker chestnut brown, more typical of the color seen in *C. novaeguineae* and *C. pritchardi*. Carapace scutes moderately rugose with retention of concentric growth lines only in small specimens. Mature females often with carapacial pits and striations.

Plastron relatively broad, with anterior lobe as broad as that of *C. novaeguineae*, but not as broad as in *C. pritchardi*. Slight expansion of anterior plastral lobe at posterior edge of humeral scutes, as in *C. pritchardi*. Anal notch moderately deep, not sexually dimorphic. Intergular broad, long, and recessed behind anterior plastral margin. No axillary or inguinal scutes. Plastron light yellowish-white, many specimens with thin irregular light brown areas along the plastral sutures. Some specimens with rust-colored staining. Plastron most similar to *C. pritchardi*, but generally with more pigment. Hatchlings with an ornate orange and gray pattern covering plastron and ventral aspect of soft parts, gradually fading with growth.

Head with small irregular scales covering temporal skin, smooth over parietal and interorbital roof. Neck with low soft tubercles, generally more similar to *C. pritchardi* than the slightly more prominent and firmer tubercles in *C. novaeguineae*. Soft parts light to moderate gray dorsally, whitish ventrally, in general lighter than either *C. pritchardi* or *C. novaeguineae*. Hands and feet with four claws each (one specimen with five claws on one hand). Head width moderate, slightly less than in the relatively broad-headed *C. novaeguineae*, significantly wider than in the narrow-headed *C. pritchardi* and *C. longicollis*, and narrower than in the broad-headed *C. reimanni*. Head width not as great as in the broad-headed members of *Chelodina* subgeneric group "B". Relative narrowing of the head occurs with growth.

Osteology characterized by a relatively wide skull, intermediate width of triturating surfaces, intermediate skull depth, parallel pterygoid processes, and intermediate to mildly increased skull robusticity. Most similar to *C. pritchardi*, but differentiated from it by the slightly wider and very slightly more robust skull. Skull markedly divergent from *C. novaeguineae* and *C. reimanni*, both of which have markedly robust skulls with broad triturating surfaces. The neural bones do not reach the external surface of the bony carapace.

Body size of *C. mccordi* is sexually dimorphic, with females larger than males. A series of 15 females averaged 191 mm carapace length (CL) (range 150–214 mm), whereas 9 males averaged 167 mm CL (range 150–202 mm) (Rhodin 1994b). The largest *C. mccordi* recorded has been a female of 241 mm CL from Danau Peto in the mid-central part of Roti (Rhodin, Ibarrondo, and Kuchling, unpubl. data) (see Fig. 2). In general, and for most specimens representing typical mature adults, *C. mccordi* is significantly larger than New Guinean *C. novaeguineae*, slightly smaller than *C. pritchardi*, and significantly smaller than Australian *C. canni*.

Distribution. — *Chelodina mccordi* is known only from Roti (= Pulau Rote), an island of 1214 km^2 located about 20 km southwest of the southwestern end of Timor in the Lesser Sunda Islands in the Province of East Nusa Tenggara of the southeastern Indonesian Archipelago (Rhodin 1994b). The distribution on Roti is disjunct, with two separate populations. Early survey work (Rhodin, unpubl. data; Rhodin et al. 2004) had indicated the possible presence of three separate populations, but subsequent surveys (Ibarrondo, unpubl. data; Rhodin, Ibarrondo, and Kuchling, unpubl. data) indicate that the two western populations are contiguous and not disjunct from each other.

This larger western population (now designated as *C. m. mccordi* by McCord et al. 2007b) is distributed in the relatively mesic southwestern and mid-central inland plateau portions of the main part of the island that extend between Ombok and Batoengalo, centered on the type locality of Danau Naloek at Busalangga. The distribution also extends sparsely to the southwest to include the slightly lower elevation areas around Danau Toea and Danau Anak.

The smaller eastern population (now designated as *C. m. roteensis* by McCord et al. 2007b) is disjunct and occurs on the relatively isolated northeastern Tapuafu Peninsula around Danau Oendui (= Lake Enduy; McCord et al. 2007b) and along the southeastern edge of the marine bay that partially separates the Tapuafu Peninsula from the rest of Roti (Ibarrondo, unpubl. data). Most of the rest of the island is xeric or hilly (highest elevation 444 m) and has little suitable freshwater habitat. No specimens have yet been recorded from coastal areas or brackish estuarine or mangrove habitat.

In view of the limited habitat on Roti available for *C. mccordi*, its area of occupancy was previously calculated to be ca. 70 km^2 (Rhodin 1996), but based on more recent survey data, this is probably somewhat higher, possibly as high as 200 km^2 (Ibarrondo, unpubl. data). However, much of this area has been depleted of its turtle populations, or is marginal and only used sporadically by turtles wandering away from wetlands, and the total area of current occupancy with relatively intact populations in good habitat could be as low as under 20 km^2 (Ibarrondo, unpubl. data).

Chelodina mccordi has also been recorded in the literature has having been collected on Timor in eastern Timor-Leste (Middleton et al. 2006), but this record was based on a preliminary identification of the subsequently described new taxon *Chelodina timorensis* McCord, Joseph-Ouni, and Hagen 2007a, also described a few months later as *Chelodina mccordi timorlestensis* Kuchling, Rhodin, Ibarrondo, and Trainor 2007. The systematic relationships of *C. mccordi* from Roti and this new closely related taxon from Timor-Leste remain unresolved.

Habitat and Ecology. — The habitat of *C. mccordi* consists of small, shallow, eutrophic inland lakes, swamps, marshlands, and adjacent agricultural rice paddies and fields (*sawah*). The species is not known to occur in the ephemeral seasonal streams that run to the coast. There are distinct wet and dry seasons on Roti, with a short wet season extending from December to March, and a long, intensely dry season

from April to November. Most of the small rivers and many of the shallow lakes are seasonally dry, and much of the island is quite xeric. According to local people, *C. mccordi* does not aestivate in the mud during the dry season, but seeks refuge under boulders, rocks, or leaves in the forest surrounding dried-out lakes. In lakes that retain some water during the dry season animals remain active, and can be caught in fish traps set in the shallow water. Activity of *C. mccordi* is said by local people to be entirely nocturnal except during rains in the wet season, when the turtles are sometimes encountered wandering on land.

When nesting occurs in the wild is unknown, but eggs are said to be produced between February and September, with hatchlings emerging at about the end of November, in conjunction with the onset of the wet season (Rhodin, unpubl. data; Ibarrondo, unpubl. data; J. Pelo, pers. comm.). A 241 mm CL female from Danau Peto in the central part of Roti laid a clutch of 9 eggs around February or March (J. Pelo, pers. comm.), two of which averaged 29.8 x 20.5 mm (Rhodin, Ibarrondo, and Kuchling, unpubl. data).

Reproduction in captivity has been documented by Maran and Coutard (2003) and Symanski (2004). Average clutch size was 12.2 (range 7–16) in the first study and 9.9 (range 7–15) in the second. The oval eggs are slightly larger than those of *C. longicollis* and *C. pritchardi* but similar in shape. They are slightly smaller than the more rounded eggs of *C. reimanni*. Maran and Coutard (2003) recorded that eggs measured 26.4–39.3 x 18.4–21.7 mm (mean 29.8 x 20.1 mm) and hatched in 66–122 days (mean 86.5) when incubated at 29-32ºC during the daytime and 24–26ºC at night. Symanski (2004) recorded that eggs measured 27.5–35.0 x 18.5–20.5 mm and hatched in about 120 days when incubated at 28ºC or in 90 days at 29ºC. Hatchling size was recorded by Maran and Coutard (2003) as 23–29 mm CL (mean 25.5) and by Symanski (2004) as 25 mm CL.

One wild-caught 99.5 mm CL juvenile had three growth annuli on each scute, with a calculated possible CL of ca. 32 mm at hatchling, 51 mm at the end of one growing season, and 73.5 mm at the end of two seasons (Rhodin 1994b). No annuli are visible in adults.

The dietary preference of *C. mccordi*, as suggested by the non-specialized osteology of the skull in both this species and in *C. pritchardi*, is apparently generalized carnivory or piscivory, with little dependence on hard-shelled bivalves and snails. Local people on Roti report the diet of *C. mccordi* as consisting of small fish, tadpoles (but not frogs), insects and other small animals, as well as water weeds. Though locally abundant, freshwater gastropods were not noted by local people as being part of the diet. Diet in captivity has been noted to be exclusively carnivorous, consisting mainly of fish (alive or dead), worms, meat, and snails (Maran and Coutard 2003; Symanski 2004).

Population Status. — Prior to its description as a new species in 1994, specimens of this turtle from Roti (classified back then as *C. novaeguineae*) were collected in significant quantities from the early 1970s through the late 1980s (Shepherd and Ibarrondo 2005). By the late 1980s many of these animals were obtained via a dealer in Kupang in Timor and then by F. Yuwono, the international dealer from Jakarta (Rhodin 1994b). Field surveys in 1993 (Rhodin, unpubl. data) indicated that in the early 1990s the main mid-central island population was still reasonably robust, but had begun to be affected by these collecting pressures from the international pet trade. At that time the turtles on Roti were still considered to be *C. novaeguineae* and they were more easily obtained and exported from Roti to Jakarta than from New Guinea to Jakarta, resulting in a moderate-volume, low-priced trade (Rhodin, unpubl. data; Shepherd and Ibarrondo 2005).

Since the mid-1990s (and since the description of *C. mccordi* as a new species), all known populations on Roti appear to have suffered disastrous population declines, leading quickly to commercial extinction and extremely few finds of any animals at all (Samedi and Iskandar 2000; Ibarrondo 2004a,b,c; Rhodin et al. 2004; Shepherd and Ibarrondo 2005; Stuart et al. 2006). Where populations were once robust and animals easily found and collected, now they are rarely if ever encountered. Ibarrondo (unpubl. data) has spent many months on Roti searching for wild *C. mccordi*, but has never encountered any except a few in the hands of traders and locals.

The current situation on Roti is that there appear to be only about four persistent, though severely depleted, populations of *C. mccordi*: three in the main part of the island (one near Danau Peto, one around Danau Toea and Danau Anak, and one in some of the small lakes around Busalangga), and one around Danau Oendui in the northeast (Ibarrondo, unpubl. data). Elsewhere on the island there appear to be only a few small relictual populations with only solitary individuals and little hope of viability.

Threats to Survival. — *Chelodina mccordi* was reportedly eaten by local people when first collected in the 1890s, but at the present time there is no threat from human consumption. Prior to its description as a new species in the 1990s, most local people who caught turtles in their fishing nets threw them back in the water due to their reported unpalatability and resemblance to snakes (Rhodin, unpubl. data).

Habitat conversion of swamps and marshlands into agricultural rice fields has gradually eliminated much of the turtle's original habitat (Ibarrondo, unpubl. data). However, the turtle often utilized these rice field habitats as well, where it unfortunately became easily collectable for the international pet trade. Increasing use of agricultural chemicals and pesticides may now also be affecting the species (Shepherd and Ibarrondo 2005; McCord et al. 2007b). The loss of wetlands through dessication as a result of deforestation, erosion, and climate change with decreasing rainfall has also eliminated much habitat (Ibarrondo, unpubl. data).

However, the exotic animal trade has been by far the most significant threat to this species, leading directly and quickly to its Critically Endangered status (Samedi and Iskandar 2000; Shepherd and Ibarrondo 2005; Stuart et al. 2006). As a result of its description in 1994 as a restricted endemic species, rapid and intense pressure developed

from international pet markets and a systematic exploitative trade in the species resulted, leading quickly to decimation of the population and virtual commercial extinction within five years (Samedi and Iskandar 2000; Rhodin and Genorupa 2000; Shepherd and Ibarrondo 2005; Stuart et al. 2006). As a result of this trade, the species was listed on CITES Appendix II in 2004 (Rhodin 2003; CITES 2004) and restrictions on trade in Indonesia enacted to prevent its exploitation. However, collecting efforts have continued on Roti, where only a handful of animals are now found per year, and illegal export still apparently occurs (Ibarrondo 2004b; Shepherd and Ibarrondo 2005; Rhodin, Ibarrondo, and Kuchling, unpubl. data). Unless these illegal activities are curtailed, *C. mccordi* faces likely extinction in the wild in the near future.

Conservation Measures Taken. — The IUCN Red List has classified *C. mccordi* as Threatened since 1996, first assessing it as Vulnerable (Baillie and Groombridge 1996) and then uplisting it quickly to Critically Endangered as evidence of the intense commercial exploitation emerged (IUCN/SSC Tortoise and Freshwater Turtle Specialist Group and Asian Turtle Trade Working Group 2000; Hilton-Taylor 2000; IUCN 2007). This was followed by listing on CITES Appendix II in 2004 as the first taxon of the wide-spread genus *Chelodina* to be listed on the appendices (Rhodin 2003; CITES 2004, 2007).

The Turtle Conservation Fund (2002, 2003) has identified the species as one of its top conservation action priorities, and listed it as one of the Top 25 Turtles on Death Row, indicating its very high threat level on a global basis. Later, the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group (2007) ranked the species as number 11 on its list of global Top 25 turtle species most threatened with the risk of exinction. The Alliance for Zero Extinction (2006) listed *C. mccordi* as one of the world's most vulnerable species facing extinction as a result of its endangerment and single small site distribution.

The IUCN Turtle Survival Alliance (2007) and European Studbook Foundation (2007) have both targeted *C. mccordi* as a species in urgent need of *ex-situ* captive breeding efforts, and various assurance colonies for the species have been established both in the US and Europe, with good initial results (Zwartepoorte 2005; Burke 2006).

Indonesia has legally restricted the trade of *C. mccordi* since 1997, but enforcement has been essentially non-existent, and except for a few permitted exports under a limited quota system between 1997 and 2001, all exports since 2002 have been illegal (Shepherd and Ibarrondo 2005).

Conservation Measures Proposed. — Continued detailed surveys of the current range and population status of the species are still urgently needed, with a specific focus on identifying one or more suitable sites with intact habitat and remnant populations of *C. mccordi* that could be designated as protected areas (Rhodin et al. 2004).

Roti currently has no major protected areas, such as National Parks (*Taman Nasional*) or Wildlife (Game) Reserves (*Suaka Margasatwa*), on its main island where *C. mccordi* occurs. There are several Protection Forests (*Hutan Lindung*) on Roti that receive some protection from commercial logging and development, but these generally provide only the lowest level of legal protection, and primarily encompass relatively dry forest where no *C. mccordi* occur, though a few of these areas may harbor some small turtle populations.

There is a Wildlife (Game) Reserve on one of Roti's offshore islands, Pulau Dana (= Ndana), off the southwest coast, which has a reserve focused on rusa deer. Unfortunately, *C. mccordi* does not appear to occur in the extremely limited brackish water habitat that exists on this xeric and low-elevation island (salinity 7.5 ppt in the single small inland pond; Rhodin, Ibarrondo, and Kuchling, unpubl. data). Interestingly, current online databases of world protected areas (UNEP-WCMC 2007; Wood 2007) erroneously indicate the location of the Pulau Dana Game Reserve as being on the island of Pulau Ndao off the northwest coast of Roti, rather than on Pulau Dana itself.

The establishment of a large and major protected area on the northeast Tapuafu Peninsula of Roti was proposed long ago by UNDP/FAO (MacKinnon et al. 1982) with the recommendation that a 60 km^2 Wildlife (Game) Reserve, called Tanjung Pukuatu (= Pukuwatu), be created to incorporate Danau Oendui (= Undui or Oendoei) and its surrounding undisturbed and protected forests. Tanjung Pukuwatu has remained a proposed Wildlife (Game) Reserve, still listed by UNEP-WCMC (2007), Wood (2007), and many other online databases, and much of the surrounding forest remains under some protection from commercial logging, as Protection Forests (*Hutan Lindung*) (Rhodin, Ibarrondo, and Kuchling, unpubl. data). However, the original proposal for a formal protected area at Tanjung Pukuwatu has never been actualized.

Two other sites on the Tapuafu Peninsula, Danau Usipoka (= Oesipoka) and Danau Undun, both within the originally proposed Tanjung Pukuwatu boundaries, have also been recorded by Wetlands International Indonesia Programme (2007) in their database of significant wetlands with conservation value. Unfortunately, *C. mccordi* does not appear to occur anywhere in or close to the very large Danau Oesipoka itself, which is an inland saline lake with possible marine connections (depth 245 m, Indonesian Fisheries Dept., unpubl. data; salinity 18.8 ppt, surface elevation 20 m, Rhodin, Ibarrondo, and Kuchling, unpubl. data).

However, *C. mccordi* does occur in some areas within the boundaries of the originally proposed Tanjung Pukuwatu Wildlife Reserve. These include Danau Oendui (= Undui, Oendoei, or "Lake Enduy") which was described as the type locality for *C. m. roteensis* by McCord et al. (2007b), but where the turtles are apparently nearly extirpated (Ibarrondo, unpubl. data). Unfortunately, the map in McCord et al. (2007b) erroneously labels the large saline Danau Oesipoka as being their "Lake Enduy". There is also a remnant population of *C. mccordi* at Danau Undun (Ibarrondo, unpubl. data; Rhodin, Ibarrondo, and Kuchling, pers. obs.), an important wetland recognized by Wetlands International Indonesia Programme (2007).

A concerted effort to establish a suitable protected area for *C. mccordi* is desperately needed, and the Tanjung Pukuwatu site, including Danaus Oesipoka, Oendui, and Undun, offers an attractive potential for safeguarding these critical habitats on Roti. Additionally, the Tanjung Pukuwatu and Danau Oesipoka area, and the Tapuafu Peninsula in general, warrants an intensive assessment of its biodiversity, as based on our initial surveys, it may harbor many undescribed and potentially isolated endemic species, in addition to the isolated endemic freshwater turtle (Trainor 2005; Rhodin, Ibarrondo, and Kuchling, unpubl. data).

The creation of a major protected area at Tanjung Pukuwatu would have significant ecotourism potential. Danau Oesipoka is a beautiful, isolated, pristine, and biologically unusual and diverse saline lake that would easily become the crown jewel of a major protected area on Roti (Rhodin, Ibarrondo, and Kuchling, pers. obs.). Extending such an area to include freshwater turtle habitats east and south of the lake would also provide critical protected habitat for *C. mccordi*. We therefore support the original recommendation of MacKinnon et al. (1982) and strongly urge that Tanjung Pukuwatu be formally gazetted as a Wildlife Reserve (*Suaka Margasatwa*).

Concerted efforts also need to be made to enforce trade regulations and curtail the persistent illegal export of turtles from Roti, most notably by targeting middlemen dealers in Kupang and Jakarta. Improved engagement of local Forestry Dept. personnel on Roti in turtle surveys and conservation activities would also be helpful (Shepherd and Ibarrondo 2005). The possibility of establishing an *in-situ* captive breeding and public educational facility on Roti to promote conservation for the species would also help raise local awareness and generate regional pride and ecotourism interest in this endemic and rare turtle species which could become an iconic symbol of Roti's natural heritage.

Initiation of a university- or NGO-supported research program to study the ecology and conservation biology of the species is also urgently needed. There are no data on population demographics or life history traits, and status and distributional data need more detailed investigations. The presence of researchers and students on Roti investigating the ecology, distribution, and status of *C. mccordi* would help significantly to protect the species and raise local awareness, while also providing critical data for sound conservation management.

Captive Husbandry. — Schulz (2000), Maran and Coutard (2003), and Symanski (2004) have reported on husbandry and captive breeding of *C. mccordi*, and Zwartepoorte (2005) and Burke (2006) have compiled studbooks. The species has been successfully bred in captivity and assurance colonies have been established by the IUCN Turtle Survival Alliance and the European Studbook Foundation as a hedge against potential extinction in the wild for the species. The numbers of animals in these programs appear to be growing.

Current Research. — Additional field studies are being planned by Rhodin, Ibarrondo, and Kuchling, and Alacs et al. (2008) are pursuing genetic analysis of the various native populations and captive animals.

Acknowledgments. — We thank Arthur Georges, Colin Trainor, and Joseph Pelo for various contributions to this work, as well as Chelonian Research Foundation and Turtle Conservation Fund for support of field work.

LITERATURE CITED

Alacs, E., Georges, A., Kuchling, G., and Rhodin, A.G.J. 2008. Phylogenetics and genetic guidelines for the captive breeding of the critically endangered snake-necked turtle *Chelodina mccordi*. Unpublished proposal to Turtle Conservation Fund.

Alliance for Zero Extinction. 2006. Pinpointing and conserving epicenters of imminent extinctions. Roti Island. http://www.zeroextinction.org/sitedata.cfm.

Baillie, J. and Groombridge, B. 1996. The 1996 IUCN Red List of Threatened Animals. Gland, Switzerland: IUCN, 368 pp.

Boulenger, G.A. 1888. On the chelydoid chelonians of New Guinea. Ann. Mus. Civ. Stor. Nat. Genova (2)6:449-452.

Burbidge, A.A., Kirsch, J.A.W., and Main, A.R. 1974. Relationships within the Chelidae (Testudines: Pleurodira) of Australia and New Guinea. Copeia 1974:392-409.

Burke, E. 2006. Roti Island snake neck turtle studbook *Chelodina mccordi* North America. Columbus Zoo and Aquarium, 40 pp.

CITES. 2004. Consideration of proposals for amendment of Appendices I and II. CITES Document CoP13 Prop. 23, 6 pp., http://www.cites.org/eng/cop/13/prop/E13-P23.pdf.

CITES. 2007. Appendices I, II and III valid from 13 September 2007. http://www.cites.org/eng/app/index.shtml/.

European Studbook Foundation. 2007. www.studbooks.org.

Georges, A., Adams, M., and McCord, W. 2002. Electrophoretic delineation of species boundaries within the genus *Chelodina* (Testudines: Chelidae) of Australia, New Guinea and Indonesia. Zoological Journal of the Linnean Society 134:401-421.

Goode, J. 1967. Freshwater Tortoises of Australia and New Guinea (in the Family Chelidae). Melbourne: Lansdowne Press, 154 pp.

Hilton-Taylor, C. 2000. 2000 IUCN Red List of Threatened Species. Gland, Switzerland: IUCN, 61 pp.

Ibarrondo, B.R. 2004a. Trade on the critically endangered Rote snake-necked turtle, *Chelodina mccordi,* and state of the last remaining populations. Unpublished report to Chelonian Research Foundation.

Ibarrondo, B.R. 2004b. Trade and status of the Critically Endangered Rote snake-necked turtle (*Chelodina mccordi* Rhodin 1994). Unpublished report to Chelonian Research Foundation.

Ibarrondo, B.R. 2004c. The Rote snake-necked turtle (*Chelodina mccordi* Rhodin 1994): the Action Plan for its preservation. Unpublished proposal to Chelonian Research Foundation and Turtle Conservation Fund.

Iskandar, D.T. 2000. Turtles and Crocodiles of Insular Southeast Asia and New Guinea. Bandung, Indonesia: PALMedia Citra, 191 pp.

IUCN. 2007. 2007 IUCN Red List of Threatened Species. http://www.iucnredlist.org/.

IUCN Turtle Survival Alliance. 2007. www.turtlesurvival.org.

IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. 2007. Turtles in Trouble: The World's Most Endangered Tortoises and Freshwater Turtles - 2007. http://www.iucn-tftsg.org/trouble/.

IUCN/SSC Tortoise and Freshwater Turtle Specialist Group and Asian Turtle Trade Working Group. 2000. Recommended changes to 1996 IUCN Red List status of Asian turtle species. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian

Research Monographs No. 2, pp. 156-164.

KUCHLING, G., RHODIN, A.G.J., IBARRONDO, B.R., AND TRAINOR, C.R. 2007. A new subspecies of the snakeneck turtle *Chelodina mccordi* from Timor-Leste (East Timor) (Testudines: Chelidae). Chelonian Conservation and Biology 6(2):213-222.

LIDTH DE JEUDE, T.W. VON. 1895. Reptiles from Timor and the neighbouring islands. Notes Leyden Mus. 16:119-127.

MACKINNON, J., BEUDELS, R., ROBINSON, A., AND ARTHA, M.B. 1982. National Conservation Plan for Indonesia. Vol. IV. Nusa Tenggara (Lesser Sundas). Bogor: UNDP/FAO National Parks Development Project INS/78/061, Field Report 44.

MARAN, J. AND COUTARD, C. 2003. Note sur la reproduction en captivité de la chélodine de McCord, *Chelodina mccordi* Rhodin, 1994. Manouria 6(19):24-29.

MCCORD, W.P. AND THOMSON, S.A. 2002. A new species of *Chelodina* (Testudines: Pleurodira: Chelidae) from northern Australia. Journal of Herpetology 36(2):255-267.

MCCORD, W.P., JOSEPH-OUNI, M., AND HAGEN, C. 2007a. A new species of *Chelodina* (Testudines: Chelidae) from Timor. Reptilia (GB) 52:53-57.

MCCORD, W.P., JOSEPH-OUNI, M., AND HAGEN, C. 2007b. A new subspecies of *Chelodina mccordi* (Testudines: Chelidae) from eastern Rote island, Indonesia. Reptilia (GB) 52:58-61.

MIDDLETON, G., WHITE, S., AND WHITE, N. 2006. Hydro-electric power proposal for the Iralalaro-Paitchau karst, Timor-Leste. Australasian Cave and Karst Management Association Journal 63, 12 pp., http://www.ackma.org/journal/63/.

RHODIN, A.G.J. 1994a. Chelid turtles of the Australasian Archipelago: I. A new species of *Chelodina* from southeastern Papua New Guinea. Breviora 497:1-36.

RHODIN, A.G.J. 1994b. Chelid turtles of the Australasian Archipelago: II. A new species of *Chelodina* from Roti Island, Indonesia. Breviora 498:1-31.

RHODIN, A.G.J. 1994c. Biogeography of *Chelodina mccordi* in relation to the Gondwanaland-Laurasia margin in southeastern Indonesia. The Herpetologists' League and Society for the Study of Amphibians and Reptiles Joint Meeting, University of Georgia, July 28 - August 1, 1994, Abstracts, p. 68.

RHODIN, A.G.J. 1996. Status and conservation of *Chelodina mccordi*, an isolated and restricted freshwater turtle from Roti Island, Indonesia. In: Devaux, B. (Ed.). Proceedings – International Congress of Chelonian Conservation. Gonfaron, France: Editions SOPTOM, p. 67.

RHODIN, A.G.J. 2003. Conservation and trade of Asian freshwater turtles and tortoises: updated review of status and threats with recommendations for CITES listings. In: CITES. Conservation and trade in freshwater turtles and tortoises. Addressing recommendations from the Kunming Workshop. CITES AC19 Doc. 15.1, pp. 3-38, http://www.cites.org/eng/com/AC/19/E19-15-1.pdf.

RHODIN, A.G.J. AND GENORUPA, V.R. 2000. Conservation status of freshwater turtles in Papua New Guinea. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs No. 2, pp. 129-136.

RHODIN, A.G.J., ISKANDAR, D.T., KUCHLING, G., GEORGES, A., AND FITZSIMMONS, N. 2004. Initiation of a species recovery plan for the Critically Endangered endemic Roti snake-neck turtle (*Chelodina mccordi* Rhodin, 1994), Roti Island, Indonesia. Phase 1. Population status, systematic relationships, and preliminary protected areas assessments. Unpublished proposal to Disney Wildlife Conservation Fund, 7 pp., http://www.chelonian.org/rhodin-reprints/.

SAMEDI AND ISKANDAR, D.T. 2000. Freshwater turtle and tortoise conservation and utilization in Indonesia. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs No. 2, pp. 106-111.

SCHULZ, D. 2000. Schlangenhalsschildkröten der Gattung *Chelodina* - eine unwiderstehliche Faszination. In: Artner, H. and Meier, E. (Eds.). Schildkröten: Grosses Schildkrötensymposium, 5 Jahrestagung der Schildkrötenfreunde Österreich. Münster: Natur und Tier Verlag, pp. 129-135.

SHEPHERD, C.R. AND IBARRONDO, B. 2005. The Trade of the Roti Island Snake-Necked Turtle *Chelodina mccordi*. Perdagangan Kura-Kura Berleher Ular Pulau Roti *Chelodina mccordi*. TRAFFIC Southeast Asia, 51 pp.

STUART, B.L., RHODIN, A.G.J., GRISMER, L.L., AND HANSEL, T. 2006. Scientific description can imperil species. Science 312:1137.

SYMANSKI, D. 2004. Keeping and breeding McCord's snake-necked turtle *Chelodina mccordi* Rhodin, 1994. Radiata 13(2):10-16.

TEN KATE, H.F.C. 1894. Verslag eener reis in de Timorgroep en Polynesië. IV. Roti.–Savoe. Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap (2)11:659-700.

TRAINOR, C.R. 2005. Birds of Tapuafu Peninsula, Roti Island, Lesser Sundas, Indonesia. Forktail 21:121-131.

TURTLE CONSERVATION FUND. 2002. A Global Action Plan for Conservation of Tortoises and Freshwater Turtles. Strategy and Funding Prospectus 2002-2007. Washington, DC: Conservation International and Chelonian Research Foundation, 30 pp., http://www.turtleconservationfund.org/global-action-plan/.

TURTLE CONSERVATION FUND. 2003. Top 25 Turtles on Death Row. New List Spotlights Most Endangered Turtles and Action Plan to Save Them. http://www.turtleconservationfund.org/top-25/.

TURTLE TAXONOMY WORKING GROUP [Bickham, J.W., Iverson, J.B., Parham, J.F., Philippen, H.D., Rhodin, A.G.J., Shaffer, H.B., Spinks, P.Q., and van Dijk, P.P.]. 2007. An annotated list of modern turtle terminal taxa with comments on areas of taxonomic instability and recent change. In: Shaffer, H.B., FitzSimmons, N.N., Georges, A., and Rhodin, A.G.J. (Eds.). Defining Turtle Diversity: Proceedings of a Workshop on Genetics, Ethics, and Taxonomy of Freshwater Turtles and Tortoises. Chelonian Research Monographs No. 4, pp. 173-199.

UNEP-WCMC. 2007. World Database on Protected Areas. [Pulau Dana; Tanjung Pukuwatu]. http://www.unep-wcmc.org/wdpa/.

WETLANDS INTERNATIONAL INDONESIA PROGRAMME. 2007. Wetlands database. Danau Usipoka–Danau Undun. http://www.wetlands.or.id/wdb/siteinfo.php?SITE_COD=NUT20/.

WOOD, L.J. 2007. MPA Global: a database of the world's marine protected areas. Sea Around Us Project, UNEP-WCMC and WWF. www.mpaglobal.org.

ZWARTEPOORTE, H. 2005. Annual report 2005 *Chelodina mccordi*. European Studbook Foundation, 31 pp.

Citation Format for this Account:

RHODIN, A.G.J, IBARRONDO, B.R., AND KUCHLING, G. 2008. *Chelodina mccordi* Rhodin 1994 – Roti Island snake-necked turtle, McCord's snake-necked turtle, kura-kura rote. In: Rhodin, A.G.J., Pritchard, P.C.H., van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., and Iverson, J.B. (Eds.). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs No. 5, pp. 008.1-008.8, doi:10.3854/crm.5.008.mccordi.v1.2008, http://www.iucn-tftsg.org/cbftt.