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Aboriginal Tribe's Knowledge of the Endangered Freshwater Turtle *Cuora amboinensis* in Car Nicobar, a Remote Oceanic Island in the Bay of Bengal

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Abstract: Freshwater turtles are among the least studied faunas in the Andaman and Nicobar Islands, India. Here, we report the presence of freshwater turtles (*Cuora amboinensis*) from Car Nicobar, a small remote island in the Nicobar archipelago comprising the Andaman and Nicobar Islands. Semi-structured interviews were conducted with the people belonging to Nicobarese tribes (n = 233) to gather their local ecological knowledge as supportive information to obtain a better understanding of the status of turtles in Car Nicobar. Most interviewees (90%) opined that freshwater turtles are found to be rare or very rare on the Island. All the respondents (100%) expressed willingness to contribute to future conservation projects. Community-level awareness emerged as a prominent issue for future conservation using the Garrett ranking method. A stream network map was prepared using the digital elevation model to visualize streams and potential habitats of turtles. This report on the freshwater turtles is essential from an ecological perspective since information is scarce on the freshwater turtles in Car Nicobar. This study emphasizes the importance of the engagement of stakeholders in conservation projects and recommends providing adequate attention to the conservation and protection of freshwater turtle diversity in Car Nicobar.

Keywords: local ecological knowledge; fishers; distribution; habitat awareness; conservation

Key Contribution: The presence of the endangered freshwater turtle *Cuora amboinensis* is reported from the remotely located Car Nicobar Island. Our study suggests that suitable monitoring and conservation measures should be implemented in collaboration with the local tribal people to conserve and sustain turtle populations. These findings also provide a foundation for formulating future research strategies on freshwater turtles in Car Nicobar Island.

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1. Introduction

Tortoises and turtles have remained an integral part of ecosystems for millions of years [1] and are well recognized as an important component of biodiversity [2,3]. *Cuora amboinensis* (Daudin, 1801) (family: Geoemydidae), the Southeast Asian box turtle, is the most diverse and widespread taxon in the genus *Cuora* [4,5]. The species is found in the Nicobar Islands of India, the hills of Eastern Bangladesh, and Southeast Asian ranges [4–6]. This turtle species is divided further into four subspecies [4,5,7], namely, *C. a. amboinensis*, (Daudin, 1802), known as the East Indian box turtle or Wallacean box turtle, *C. a. couro*, (Schweigger, 1812), the Indonesian box turtle, *C. a. kamaroma*, (Rummler and Fritz, 1991),

the Malayan box turtle, and *C. a. lineata* (McCord and Phillipen, 1998), the Burmese box turtle. About 356 species of turtles and tortoises have been reported around the world to exist in a wide range of habitats [8], out of which India also constitutes a major portion. Subspecies of *C. amboinensis* exhibit different distribution ranges in South Asia (Supplementary Figure S1) [4–6,9]. In the reported distribution ranges, the population of *C. amboinensis* has declined from 50 to 80% in the past 54 years due to collection for trade [5]. Around 34 species of Chelonians, of which 25 are freshwater, 5 are marine, and 4 are land tortoises, have been reported in India [10].

The Southeast Asian box turtle is a semi-aquatic freshwater turtle in the lowland tropical rainforest of Southeast Asia [11]. This is the species most sought after by East Asian consumers and traditional Chinese medicine markets [12], and it also has a good trade value in Asian markets [5,13]. The sluggish reproductive cycle of the Southeast Asian box turtle is characterized by late maturity and a small number of eggs [14]. The species was initially listed as "Low Risk: Near Threatened" on the IUCN Red List of Threatened Species in 1996 [15] before being upgraded to "Vulnerable" in 2000, and at present, it is known to be endangered [5].

All members of the genus *Cuora* were added to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Appendix II) making any trade in the species subject to legal provenance and sustainable management requirements [5,13]. *C. amboinensis* belongs to the family Geomydidae and is distributed from Eastern India to Indonesia and the Philippines [11]. The Southeast Asian box turtle has been reported in various parts of India, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, the Andaman and Nicobar Islands, and Tripura [16–19]. Although their distribution in Andaman and Nicobar is predominantly attributed to the Nicobar Islands, records are mostly known from Great Nicobar Island.

Car Nicobar, a small tropical oceanic island, remains isolated from the other parts of the islands, and entry into the island is regulated and governed under the Protection of Aboriginal Tribes Regulation Act of 1956. This island is well known for its biodiversity and its pristine marine ecosystems like corals, mangroves, etc. Freshwater streams are very limited and often less explored compared to other parts of the Andaman and Nicobar Islands. In this study, we hereby report the occurrence of Southeast Asian box turtles in freshwater streams of Car Nicobar Island. *C. amboinensis* individuals have been captured by local Nicobarese tribes as a bycatch in freshwater streams located in deep forests. Considering the alarming scenario of the declining turtle population in known distribution ranges, the present study calls for a closer collaboration with indigenous tribes to determine the status of box turtles and promote appropriate conservation measures for their sustainability in the wild.

2. Materials and Methods

2.1. Field Sampling of C. amboinensis Individuals

The Andaman and Nicobar Islands of India are divided into three districts, namely North and Middle Andaman, South Andaman, and Nicobar. The surveys were undertaken from 31 March to 30 April 2023 on Car Nicobar Island, the headquarters of the Nicobar district (Figure 1).

On 4 April 2023, three live turtles (Figure 2A) were spotted as a bycatch during a mass fish harvesting event from the small freshwater stream in Kimious village on Car Nicobar Island. The inland fish were harvested by the indigenous people from the local Nicobarese tribes using a funnel-shaped nylon net with a bamboo handle. Standard morphometric measurements of the turtles were taken, and the water salinity was measured using a salinity refractometer. The GPS location of the water body and photographs of the habitat were also recorded. The turtles were identified by following [7,14,19]. A total of 100–150 fishers were observed collecting fish across the stretch of the stream using indigenous methods. The stream is located amidst a dense forest located 3–4 km approximately from the Kimious village community area towards the southwest. The water body is lentic (standing water)

in nature and is known among the indigenous people to be a popular spot for inland fishing practices (Figure 2B). In general, the streams in Car Nicobar are located within dense vegetation, which makes them difficult to access to undertake surveys (Figure 2C).

After encountering the turtles as bycatch in the Kimious freshwater body, we expanded our surveys to include other water bodies (lotic and lentic) based on the knowledge of indigenous people. The streams in Kinmai, Kimious, Perka, and Passa were surveyed to locate the possible presence of turtles. The hapa, hand net, and cast net, were used for surveys in the streams. The land area adjoining the water bodies was also surveyed visually to locate the presence of turtles. The water level in the streams was relatively low (less than 2 m), which allowed for our surveys. The small water bodies that exhibited estuarine conditions were excluded from the surveys.

2.2. Stakeholder Surveys

To gather an understanding of the distribution of *C. amboinensis* turtles, we prepared a semi-structured questionnaire and collected the following information on indigenous knowledge of the local communities, such as (i) the tribal fishers' understanding of the turtles; (ii) the places where they had spotted the turtles, the time since the last sighting, and the frequency of sighting; (iii) the seasonal sighting details; and (iv) the traditional uses of these turtles as pets or food. The interviews were conducted in the Nicobarese language through a person from Car Nicobar acting as a translator. The respondents surveyed from different villages of Car Nicobar are shown in Figure 3. Garrett's ranking technique was used to rank the suggestions and conservation measures outlined by the respondents following [20].

$$\text{Percentage score} = -(100\ (R_{ij} - 0.5))/N_j$$

wherein

R_{ij} = rank given for the i^{th} item by j^{th} individual.

N_j = number of items ranked by the j^{th} individual.

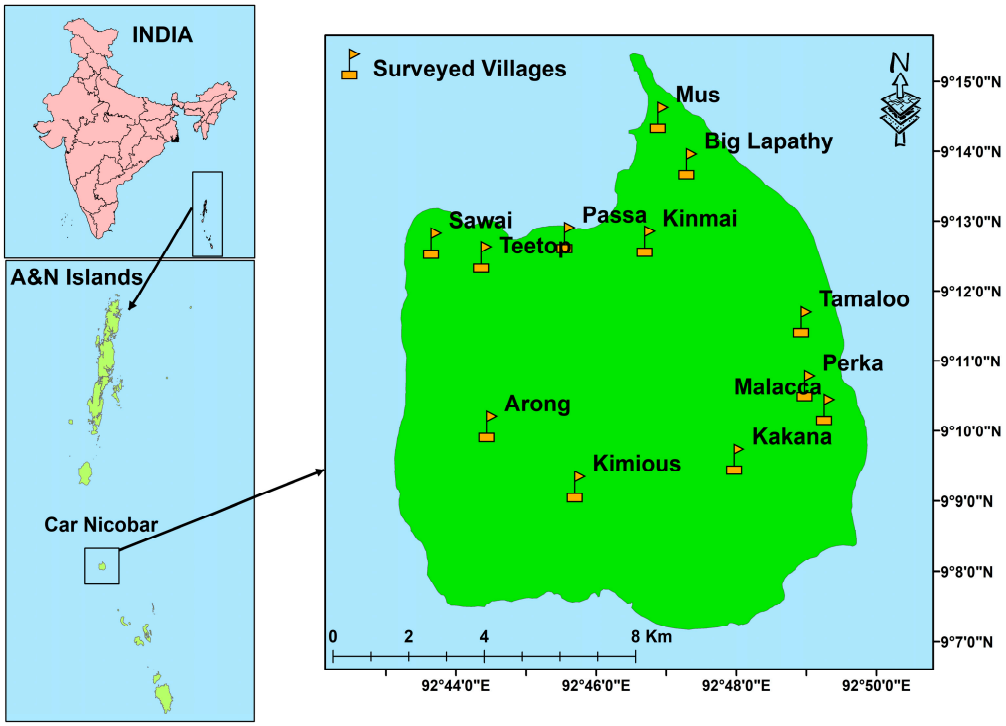

Figure 1. Map showing the location of the study area, Car Nicobar Island, India.

The site Passa, situated between Kinmai and Teetop village, was not included in the stakeholder surveys since no residents are found nearby the site, as the location is mostly used by fishermen from nearby villages for fishing purposes.

Figure 2. Sampling of turtles. (**A**) Live turtles are being collected from Kimious village stream. (**B**) Type locality of Kimious stream. (**C**) A narrow stream inside a dense forest in Car Nicobar.

2.3. Mapping and Statistical Analysis

The potential differences among different regions and social groups (gender, profession, and age) were tested for analysis of variance (ANOVA) and Duncan's multiple range test, fixing the type I error rate (α) at 5%. The response to freshwater turtle distribution in Car Nicobar was analyzed with respect to respondent age using generalized linear modeling (GLM) in R Studio version 4.2.1 [21]. The stream network and study area maps were depicted using ArcGIS 10.8 software [22]. The ArcGIS 10.8 version and Shuttle Radar Topography Mission (SRTM) based digital elevation model (DEM) 2014 data were used to simulate and analyze water flow patterns in a landscape map and accurately extract the stream network. Garmin eTrex 32X GPS was used for the field survey to mark the occurrence of habitat suitable for the freshwater turtle. To extract the streams, the hydrological modeling process involved several steps such as the SRTM DEM preprocessing to remove any anomalies or artifacts along with ArcGIS tools such as Fill, Flow Direction, and Flow Accumulation to delineate the stream network.

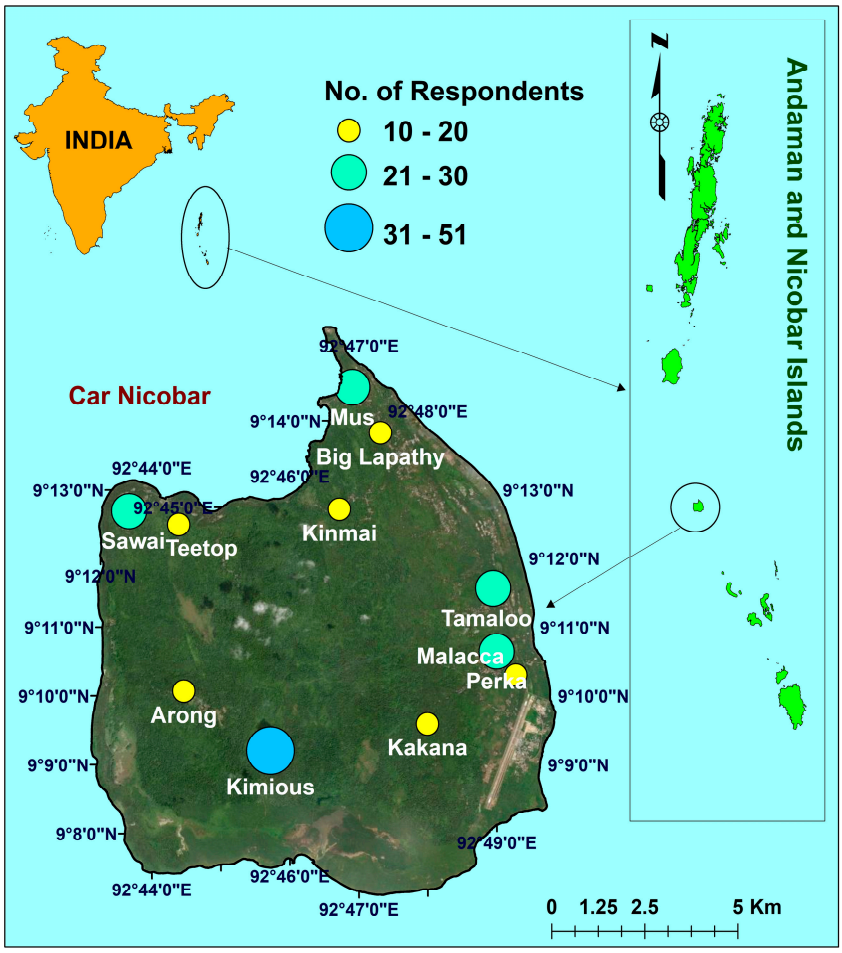

Figure 3. Number of the respondents from Car Nicobar villages who participated in the surveys (n = 233).

3. Results

3.1. Species Identification

The species was identified as *Cuora amboinensis*, commonly known as the 'Malayan box turtle' or 'Southeast Asian box turtle'. It presents a distinctive hinge across the middle of the plastron that helps the animal to shelter into the shell completely. The head is dark brown or green above and yellow below, with three yellow or orangish-yellow bands [7,14,19,23]. Carapace sizes (CCL $_{MAX}$, CCL $_{MIN}$, SCL $_{MAX}$, SCL $_{MIN}$, CCW, and SCW) were substantially different among the three sampled individuals (Table 1).

Table 1. Carapace measurements of the collected freshwater turtles. The diagnostic characteristics were used for species identification, and their body was measured in inches.

S. No.	CCL $_{MAX}$	CCL $_{MIN}$	SCL $_{MAX}$	SCL $_{MIN}$	CCW	SCW
1.	2.21 ^{a,C}	1.92 ^{c,C}	2.11 ^{b,C}	1.74 ^{d,C}	2.13 ^{b,C}	1.70 ^{d,C}
2.	3.50 ^{b,B}	3.00 ^{d,B}	3.13 ^{c,B}	2.82 ^{e,B}	3.73 ^{a,B}	2.70 ^{f,B}
3.	3.95 ^{a,A}	3.40 ^{c,A}	3.65 ^{b,A}	3.10 ^{d,A}	3.95 ^{a,A}	3.05 ^{e,A}

Note: Superscripts (a–f) in columns and (A–C) in rows represent statistically significant at $p < 0.05$. CCL $_{MAX}$—maximum curved carapace length, CCL $_{MIN}$—minimum curved carapace length. SCL $_{MAX}$—maximum straight carapace length, SCL $_{MIN}$—minimum straight carapace length. SCW—straight carapace width, CCW—curved carapace width.

All the live species investigated had a dark brownish or olive-yellowish head with three orangish-yellow stripes running across the sides of the head. The carapace was substantially dome-shaped and dark olive in color, with a pale vertebral keel; the plastron

had a yellowish tinge in it, with dark spots on the marginal and outer edges of the plastral scute. Its limbs were olive in color, and its digits were completely webbed (Figure 4). During our surveys of other streams of Car Nicobar viz. Passa, Perka, and Kinmai, we did not encounter any turtles. Despite our best efforts, other streams could not be accessed due to their remote location and uncertain pathways.

Figure 4. (**A**) Southeast Asian box turtle with retracted limbs. (**B**) Characteristic coloration of its head, which is dark brown or olive above and yellow below, with three yellow or orangish-yellow stripes running across the sides of the head. Its limbs are olive in color, and its digits are completely webbed. (**C**) Characteristic dome-shaped carapace with a pale vertebral keel.

3.2. Stakeholder Response

We conducted personal interviews with 233 respondents on Car Nicobar Island from different villages (Table 2). It is inferred that all villages except Malacca and Kakana represented a good proportion of active female participation in this study, and Sawai and Kimious represented a high percentage of female participation in this survey compared to other villages. Moreover, the highest percentage of diversified professions (fishers, homemakers, and others) volunteered from Kimious village for the freshwater turtle survey. The female population involved in fishing activities from Kimious village actively participated in the interviews as they have better access to the freshwater bodies than other villagers. It is observed that respondent age from Kimious village shows high variation in terms of standard deviation (SD = 13.2). The age group of the respondents varied from 18 to 75 years and around 52.36% of the respondents belonged to the age group of 25–45 years whereas 7.29% of the respondents were under 25 years, 30.90% belonged to the 45–60 years age group and 9.44% of respondents were above 60 years of age. Overall, the statistical

analysis revealed that the different groups, in terms of gender, age, and profession from eleven different villages, participated in the surveys. Among the respondents, 99.6% were aware of the freshwater turtles and 82% informed that the turtles were collected as bycatch during fishing activities. All the respondents (100%) unanimously agreed and showed their interest in conservation projects if approached and educated on the importance of those projects.

Our surveys revealed that 50.6% of the respondents had spotted the turtles within a span of less than a month, whereas 20.6% were spotted in less than a week, and 12.9% were seen between 1 month and 6 months (Figure 5A). The turtle was reported to be found rarely (49%), very rarely (41%), and commonly (10%) as per stakeholder knowledge (Figure 5B). Around 83% of the respondents informed that they keep the turtles as pets if collected and 17% mentioned 'others' who clarified that they use the turtles for their traditional medicinal purposes such as boiling turtles with water and using the water to bathe the newborn infants. GLM analysis revealed that the AIC (Akaike's information criteria) values were found to be lowest in this study in understanding the distribution against the age group of the respondents, whereas the other cases, like bycatches and use after catches, gave a high AIC value. Hence, it can be inferred from Table 3 that the respondents surveyed in our study had a fair understanding of the distribution of the turtles. The details on the utilization of the turtles after catch (pets and others) also gave a better AIC value (Table 3).

Table 2. Details of the respondents and their villages, professions, and age groups who participated in the interviews. Note: superscripts (a–j) in columns and (A–C) in rows represent statistically significant at $p < 0.05$. Statistical analysis was performed using analysis of variance (ANOVA) and Duncan's multiple range test was performed at a nominal type I error rate (α) of 5%.

Villages	Teetop	Arong	Perka	Kimious	Malacca	Big Lapathy	Kinmai	Mus	Sawai	Tamaloo	Kakana
No. of Respondents	18	15	22	51	12	20	20	22	22	21	10
Gender (%)											
Male	77.8 ^{c,A}	66.7 ^{h,A}	68.2 ^{g,A}	62.7 ^{I,A}	100.0 ^{a,A}	80.0 ^{b,A}	70.0 ^{f,A}	77.3 ^{d,A}	59.1 ^{j,A}	76.2 ^{e,A}	100.0 ^{a,A}
Female	22.2 ^{h,B}	33.3 ^{c,B}	31.8 ^{d,B}	37.3 ^{b,B}	0.0 ^{j,B}	20.0 ^{i,B}	30.0 ^{e,B}	22.7 ^{g,B}	40.9 ^{a,B}	23.8 ^{f,B}	0.0 ^{j,B}
Profession (%)											
Fishermen	77.8 ^{c,A}	66.7 ^{h,A}	68.2 ^{g,A}	56.9 ^{j,A}	100.0 ^{a,A}	80.0 ^{b,A}	70.0 ^{f,A}	77.3 ^{d,A}	59.1 ^{i,A}	71.4 ^{e,A}	100.0 ^{a,A}
Homemakers	22.2 ^{h,B}	33.3 ^{c,B}	31.8 ^{d,B}	35.3 ^{b,B}	0.0 ^{j,B}	20.0 ^{i,B}	30.0 ^{e,B}	22.7 ^{g,B}	40.9 ^{a,B}	23.8 ^{f,B}	0.0 ^{j,B}
Others	0.0 ^{c,C}	0.0 ^{c,C}	0.0 ^{c,C}	7.8 ^{a,C}	0.0 ^{c,B}	0.0 ^{c,C}	0.0 ^{c,C}	0.0 ^{c,C}	0.0 ^{c,C}	4.8 ^{b,C}	0.0 ^{c,B}
Age (Years)											
Mean	40 ^{h}	42 ^{f}	40 ^{h}	41 ^{g}	34 ^{i}	44 ^{d}	51 ^{a}	46 ^{c}	49 ^{b}	43 ^{e}	42 ^{f}
Range (Min–Max)	23–52	20–60	25–65	20–68	22–55	18–61	35–71	20–75	29–67	20–72	24–60
Std. Dev.	10.1	10.5	12.2	13.2	9.4	10.9	12.1	14.7	11.2	10.4	12.8
Std. Error	2.4	2.7	2.6	1.8	2.7	2.4	2.7	3.1	2.4	2.3	4.1

3.3. Known Habitats of Box Turtle

Figure 6 shows the well-known locations of the freshwater turtles in Car Nicobar Island based on the local knowledge of the respondents. Kimious freshwater bodies were reported as an important location to spot the turtle followed by water bodies in Arong, Sawai, Mus, Big Lapathy, Kinmai, etc. However, during our surveys, we could spot the turtle only in the Kimious water body. There were several small streams that were quite inaccessible to us to conduct further surveys. From the stakeholder information, it was evident that there could be several small freshwater streams in remote locations of Car Nicobar that might be a potential habitat for the freshwater turtle.

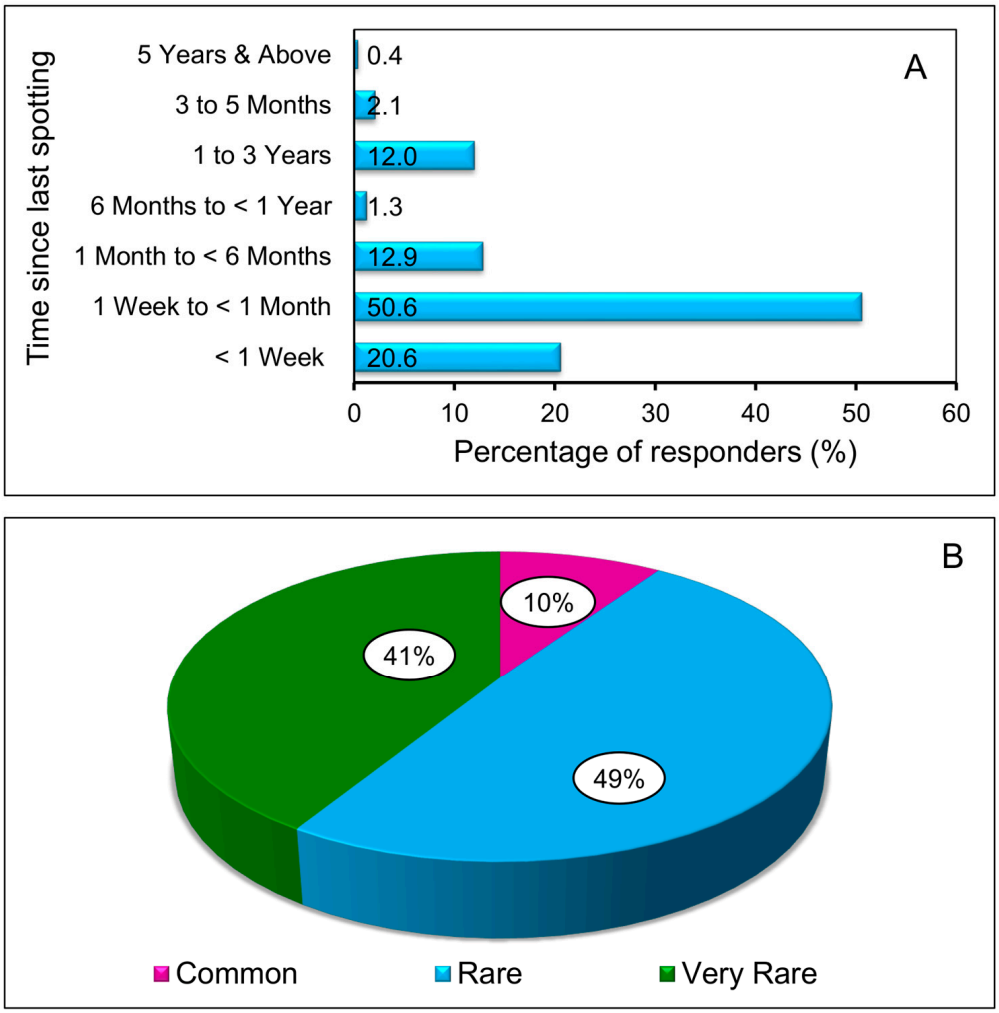

Figure 5. Spotting and distribution of turtles. (**A**) Time since the last spotting of the turtles by the respondents. (**B**) Distribution status of turtles based on the stakeholder response.

Table 3. Generalized linear model (GLM) of age groups. These data show the response of surveyed age groups on different factors (status of distribution, bycatch during fishing, and use after catch) of freshwater turtles. * Chi-square test significance (*p*-value at alpha < 0.05).

Factor	Group	Intercept	*p*-Value	AIC
Status of distribution	Common	−4.27	0.000003 *	143.8
	Rare and very rare	−4.23	0.0168 *	
Bycatch during fishing	Rerelease in water	−0.61	0.2165	308.6
	Retain	−0.58	0.0231 *	
Use after catch	As a pet animal	2.99	0.000009 *	212.5
	Others	2.96	0.0243 *	

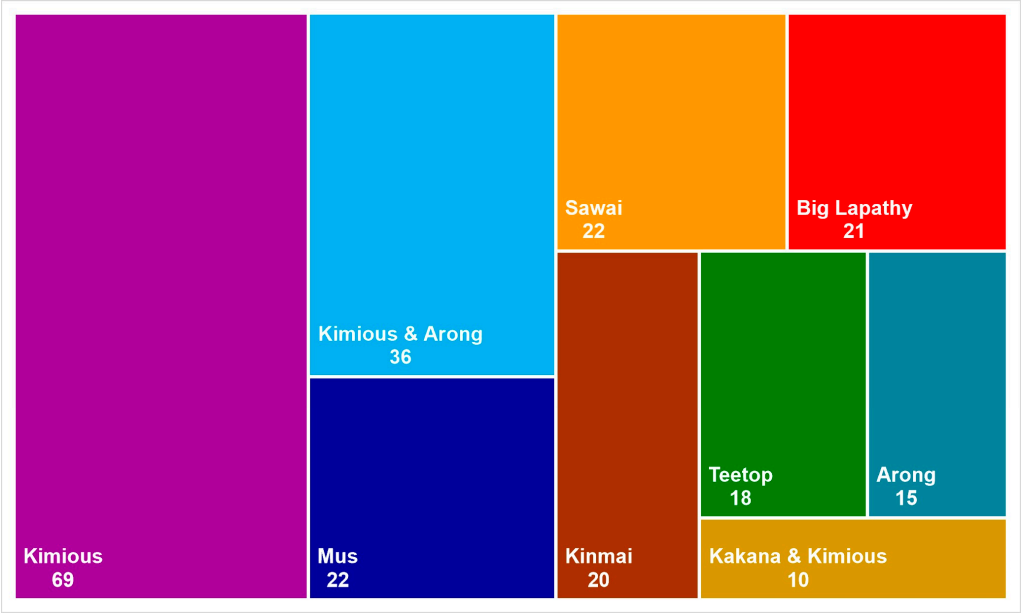

Figure 6. Respondents (No.) knowledge of the sites where the turtles can be spotted in Car Nicobar. The location Kimious topped the sites, followed by Arong and Sawai.

3.4. Stream Network Map

Figure 7 shows the streams on Car Nicobar Island that could potentially be a habitat for freshwater turtles and the sites that we have surveyed in Car Nicobar. It was also evident from Figure 7 that all the regions in Car Nicobar had some freshwater bodies. The map developed could also aid in future research programs to delineate the streams and survey the water bodies. As we have extensively surveyed the accessible streams on the entirety of Car Nicobar Island, it was understood that streams were quite inaccessible in several instances due to the limited population that resides in a large geographical area, and many of the areas were undeveloped and remained a dense forest, which made the access to the streams difficult.

3.5. Garrett's Ranking of Future Conservation

The respondents were asked to rank the responses that would be helpful in the freshwater turtle conservation and management on Car Nicobar Island. The respondents agreed and ranked the generation of awareness in the local communities as a top priority through the ranking method, followed by the will for self-interest in conservation projects and educating the young people to prefer to release the turtles back into the waters if caught, and to avoid disturbing the turtles during the breeding season (Table 4). Other than the options provided, several others have also suggested that an enforced ban can also be brought into effect if the species population shows a decline in the wild.

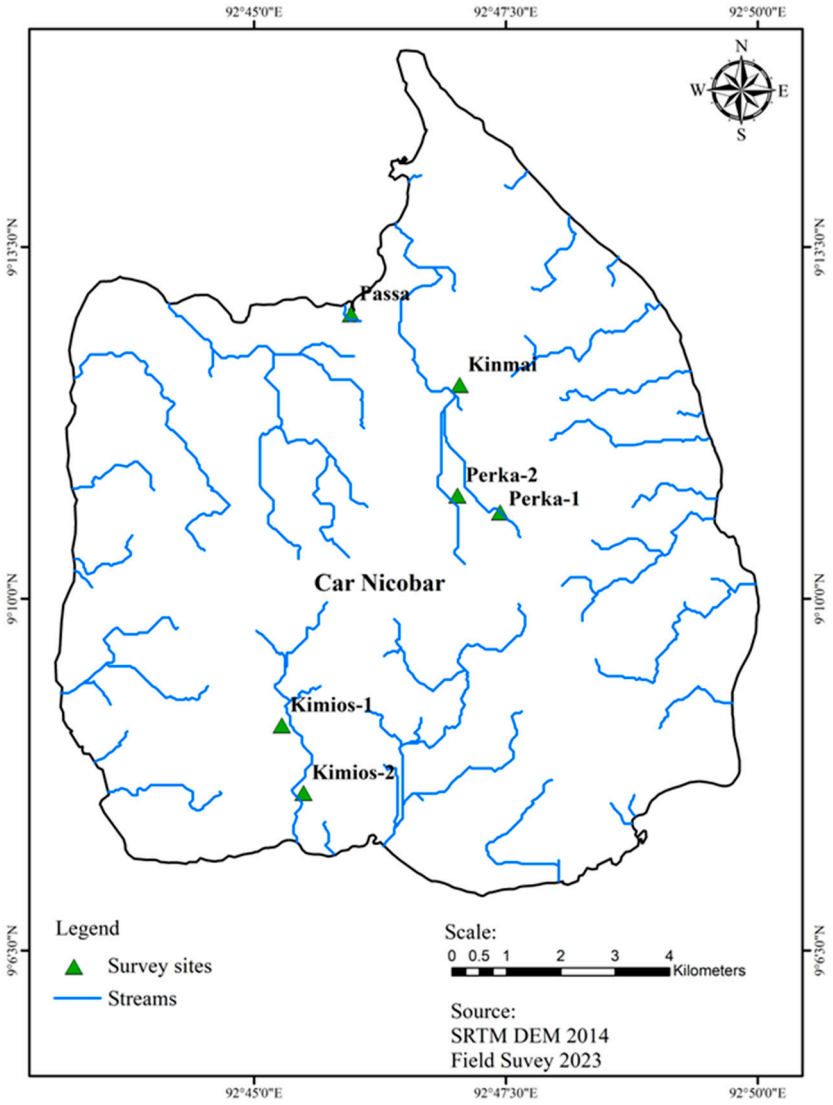

Figure 7. Stream network map prepared based on Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM). The sites surveyed in this study are highlighted and the streams possibly situated in other parts of the island are also located.

Table 4. Options ranked by the respondents based on Garrett's ranking technique for the future conservation of freshwater turtles on Car Nicobar Island.

Options	Garrett Mean Score	Rank
Generating awareness at the community level on the conservation importance	77	I
To avoid interaction and collection during the breeding season of the turtles	48.2	V
Promotion of self-interest in conservation projects	52.8	II
Education towards rerelease in waters if caught accidentally	48.3	IV
Educating young people to assist and mentor future generations in conservation	50.7	III
Regulation of collection from the wild	23	VI

4. Discussion

Turtles, being an integral part of ecosystems, are remarkable organisms that are most threatened globally [1,24,25]. The Southeast Asian box turtles inhabit lowland water bodies including marshes, swamps, ponds, and pools in streams, as well as artificially flooded rice paddies and plantations of oil palm, rubber, and orchards [26]. The diet of the box turtle includes plant and animal matter, and it feeds on land as well as in water [7]. When it is disturbed or feels threatened, it closes its shells tightly. It is often found basking on banks or on logs of trees and is reported to breed during early monsoon season in Northeast India (monsoon season—June to September); it lays one to six eggs [23]. Turtles play an important role in the food chain of the ecosystem as they are predators of several invertebrates as well as prey and hence their loss would probably impact the food web structure of the ecosystems [12,26]. Conservation and protection of *Cuora amboinensis* populations could also be important in sustaining the trophic linkages that benefit biodiversity [26,27].

Based on the data collected, our findings match the other reports that turtles are usually found in marshes, swamps, muddy waters, streams, and ponds. The limited number of species encountered during our surveys, along with the local ecological knowledge of Nicobari tribal fishers who reported that the turtles are found to be rare also coincides with the previous reports that their population is declining throughout the known distribution range [5,23]. Although the fishers did not have much input regarding the turtles' breeding season, they mentioned that the season they mostly harvest in is the dry season, i.e., from January to May, probably due to the slow-moving streams that make it easier to collect the turtles. The rate of sighting of freshwater turtles is different in different seasons [28]. In the monsoon and the pre-monsoon seasons, freshwater turtles tend to be more active, probably due to wet climatic conditions and high prey availability. Similar reports were mentioned in the study conducted on another type of reptile, viz. pit viper snakes (*Trimeresurus gramineus*, *T. malabaricus*, and *Hypnale hypnale*) [29].

The utility of molecular tools to detect species populations in the wild could be helpful for monitoring endangered species [30,31]. Such molecular studies could provide further valuable insights into the species as well as sub-species variations since the morphology of subspecies like *C.a. lineata* and *C.a. kamaroma* overlap significantly [4]. The sub-specific attribution of Indian sub populations is also unclear [5]. In our surveys, we did not collect the turtles for molecular studies considering the limited number of samples that were obtained in our surveys and other environmental factors. Environmental DNA (eDNA) tools are also becoming a familiar approach to monitor species populations in the wild as a non-invasive, rapid, and cost-effective molecular tool [32,33]. In India, eDNA tools were also applied to detect freshwater turtle species such as *Chitra indica*, *Nilssonia gangetica,* and *N. nigricans* [34]. Detailed molecular phylogeography study of this taxon is needed for further protection [7]. Hybridization of distantly related turtle species is also reported in Southeast Asian turtles [35–37] and hence, detailed molecular studies should be undertaken to study the turtle diversity and sub-species variations to assess the future threats associated with genetic diversity-related complexities. Other than molecular tools, the use of citizen science in monitoring their wild population could be effective on a small island like Car Nicobar. The tribal fishers in Car Nicobar can be motivated and trained on the data collection of wild turtles, which could be an important step in envisaging future conservation plans. Even in our surveys, the local ecological knowledge (LEK) of tribal fishers gave a fair idea of the status turtle population in the wild. If initiated in a systematic manner, the ecological data from tribal fishers could offer valuable insights into conservation measures for the future.

In India, the reports of freshwater turtles are documented from Northeast India and Nicobar Island [11,19,23,38,39]. On 3 April 2023, we spotted live turtles in the Kimious stream of Car Nicobar Island, which makes an important addition to box turtle habitat from a lesser-known island in the Nicobar archipelago. In the Nicobar archipelago, this species is widely known for its presence in Galathea Bay, Great Nicobar [19,39]. In Northeast India, freshwater turtles are used for various traditional practices [40–42]. The scenario in

our study site (Car Nicobar) is similar to the rest of Northeast India. Almost 83% of the respondents claimed to use turtles as pets and for other traditional purposes. However, there was not much information available on the use of freshwater turtle carapaces. A few of the respondents in this survey also reported about a traditional practice of boiling these turtles in the water and using that water to bathe their infants, which, according to them, has certain medicinal properties.

Freshwater turtles are well known as popular pets globally [43–46], and this species is also being exploited illegally in the trade. In our study area, there are reports of natives often keeping them as pets since they are relatively harmless and are often easy to take care of. These turtles are sometimes tethered or kept in a small enclosure. Even though it is found in some tribal homes as pets, such habits, if unsensitized in the long term, could also pose a threat to their wild population. Bycatch mortality could impact wild turtle populations [47]. Wild pigs could also devour the habitat of freshwater turtles [48], whereas feral dogs, and monitor lizards are also known to be a threat in the case of marine turtles [49–51] however, further studies are required to confirm such threats to the freshwater turtle population in Car Nicobar.

The Nicobarese tribes have their hunting rights reserved as per the Wildlife Act 1972, India. The hunting activities of Nicobarese tribes on the terrestrial and marine fauna for food security are also an integral part of their cultural setting and values [52–55]. Similarly, Atlantic walrus hunting plays a key role in reproducing the cultural values and livelihoods of the people of northwest Greenland [56]. In the case of walrus, local communities target them for hunting; however, in Car Nicobar, turtles are not a targeted catch based on the information provided by the interviewees. Rather, these turtles are caught as a bycatch during fish harvesting practices in the inland streams. Since caught as bycatch, a few tribes retain them and rear them as pet animals in their backyards. Many traditional practices exist among the Car Nicobarese tribes related to health and sickness [57,58]. A few other tribes reported the turtles were boiled in water and the water was used to bathe the infants, because they believed the water to have certain medicinal values. A study on the gut bacteria of *Cuora amboinensis* also revealed the production of broad-spectrum antibacterial molecules against several Gram-positive and Gram-negative pathogenic bacteria [59]. Hence, there could be a possible ancestral knowledge of the traditional medicinal use of these turtles in Car Nicobar. Further studies should focus on understanding the traditional use of these turtles as medicine among the Nicobarese tribes of Car Nicobar and identifying suitable alternatives that would also aid in species restoration projects. Building awareness, community-level engagement, and understanding the socio-cultural drivers of indigenous communities could play a successful role in conservation programs [60].

Our study has also suffered from certain shortcomings like sampling issues, limited streams surveyed, impossibility of access to several streams, dense forest areas, and time of surveys which should be considered while interpreting the results. In general, the streams are situated amidst dense forest areas, which have practically hindered the surveys. It is also practically impossible to reach any stream inside the forest without the assistance of local tribal people, and even the tribal people often get lost in forest areas. Some of the local tribes showed disinterest when we requested they lead us, and a few also warned that it is too difficult and unsafe for sample collection. Future studies should take these factors into account. However, the information provided on the freshwater turtle species in this study is relevant for a small island like Car Nicobar. There is an urgent need for ex-situ conservation of this species to counterbalance severe threats like fragmentation of habitats, shifting cultivation, illegal hunting, trade, etc. [11,39]. Engaging the traditional community in conservation projects will be an important step since most Nicobar tribal people are not aware of the current need for conserving this turtle species. Generating awareness is the first step towards any conservation program, and hence, in our study, along with collecting data, we tried to sensitize the need for judicious management of resources like rereleasing the turtles safely back to the water when they are captured as bycatches. These turtles have been included under 'Appendix II' in the Convention on International Trade in

Endangered Species of Wild Fauna and Flora [61]. The species was reassessed in 2018 and was then included in the 'Endangered' category instead of the 'Vulnerable' category by the IUCN [62]. This species is not listed in the Wildlife Act, 1972, India, but further assessment and revisions are required to consider the species under scheduled status [5,23].

The Andaman and Nicobar Islands face various threats to their aquatic ecosystems due to natural disasters [63–65]. The climate-related impacts could also pose a threat to species diversity, particularly on a small island like Car Nicobar. There is a need to understand the impact of climate change and pollution. Turtles are also known as a good indicator of climate change [66], as climate change could possibly impact turtle populations [67–69]. The wetlands, which are important habitats of such species, should also be conserved and managed as they provide a permanent habitat for turtles [70]. Such habitats are vulnerable to anthropogenic impacts hence habitat management should be a key priority in future conservation efforts [71], along with the understanding of the spatial ecological information of the species [72]. Habitat loss due to urbanization also impacts the turtle populations [73] however, threats related to urbanization are not an issue in the present study considering the tribal population and nature of Car Nicobar Island.

5. Conclusions

Small, remote, and sparsely populated islands like Car Nicobar can represent important reservoirs of turtle populations, as well as those of other endangered or otherwise fragile populations. The lack of information on freshwater turtles on Car Nicobar Island was addressed through this study. There is currently an urgent need to intensify further surveys and establish baseline information on the habitats and population status of freshwater turtles on Car Nicobar Island. For future studies, molecular approaches should be prioritized in further understanding of the species diversity in the Nicobar Archipelago. Local fishers, if properly engaged, can effectively implement initiatives for the conservation of turtles. Furthermore, there is a need for sensitization on the importance of conservation measures as the tribal population might adopt some judicious measures to protect and conserve turtle habitats. Conservation efforts coupled with the support and cooperation of the local community could aid in the conservation and restoration of this species compatible with the sustainable development on Car Nicobar Island.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/fishes8100517/s1, Figure S1: Distribution of *Cuora amboinensis* sub-species populations. The map shows the country-wise distribution, however for more location-specific details the references linked in the text shall be referred.

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Institutional Review Board Statement: The surveys were conducted in situ and all animals were released back unharmed in their wild habitats after being examined. This study was conducted according to the guidelines of care and use of animals by the Institute Animal Ethics Committee of the Indian Council of Agricultural Research-Central Island Agricultural Research Institute (ICAR-CIARI), Port Blair, India.

Informed Consent Statement: Informed consent was obtained from the respondents for the personal interviews and data collection through the office of the tribal council, Car Nicobar. The first author fulfilled the necessary requirements to visit Car Nicobar Island as entry into the Island is restricted under the Andaman and Nicobar Islands (Protection of Aboriginal Tribes Regulation, 1956). We also obtained the necessary permission from the Chief Captain, Office of the Tribal Council Car Nicobar to carry out the surveys.

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