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DISTRIBUTION, POPULATION STATUS AND ENVIRONMENTAL IMPACTS ON REPTILES IN MANORA, SANDSPIT, HAWKESBAY AND CAPE MONZE AREAS OF KARACHI COAST

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ABSTRACT

In this study, total twenty seven reptilian species including three turtle species, Green Turtle (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), and Hawksbill Turtle (*Eretmochelys imbricata*), nine lizard species such as Common Tree Lizard (C*alotes versicolor versicolor*), Spotted Barn Gecko (*Hemidactylus brooki*), Yellow Bellied Common House Gecko (*Hemidactylus flaviviridis*), Persian House Gecko (*Hemidactylus persicus*), Blotched House Gecko (*Hamidactylus triedrus*), Mediterranean House Gecko (H*amidactylus turcicus*), Blue Tail Sand Lizard (*Acanthodactylus cantoris*), Spotted Lacerta (*Mesalina watsonana*), and Bengal Monitor (*Varanus bengalensis*) were recorded from Manora, Sandspit, Hawksbay and Cape Monze areas during 2001-2009. Fifteen snakes species viz Beaked Sea Snake (*Enhydrina schistosa*), Blue Green Sea Snake (*Hydrophis caerulescens*), Annulated Sea Snake (*Hydrophis cyanocinctus*), Persian Sea Snake (*Hydrophis lapemoides*), Broad Band Sea Snake (*Hydrophis mamillaris*), Reef Sea Snake (*Hydrophis ornatus*), Yellow Sea Snake (*Hydrophis spiralis*), Pygmy Sea Snake (*Lapemis curtus*), Spotted Small Headed Sea Snake (*Microcephalophis cantrois*), Pelagic Sea Snake (*Pelamis platurus*), Spotted Viperine Sea Snake (*Praescutata viperina*), and Blotched Diadem Snake (*Sphalerosophis diadema diadema*) were recorded, while three species Cliff Racer (*Platyceps rhodorachis*), Saw-scaled Viper (*Echis carinatus*) and Black Cobra (*Naja naja*) were recorded from Manora, Hawkesbay and Cape Monze area only. There are several habitat degradation threats especially to marine turtles, Lizards are also affected by habitat degradation and disturbance, but it is a very minor threat. There is some mortality of Bengal Monitor during the road crossing. Human activities that directly or indirectly threaten marine turtles include the exploitation of eggs and turtles, fishery-related mortality, inappropriate management practices, destruction or modification of habitats, pollution, and recreation activities.

Keywords: Karachi coast, reptilian fauna, distribution, status.

INTRODUCTION

Asia is rich in habitats and biodiversity, and correspondingly rich in turtle species. Asia's highest turtle diversity occurs in four hotspot regions, the Indo-Gangetic Plain, mainland Southeast Asia, the South China coastal region, and New Guinea, but almost any area outside the extreme deserts and the altitude and latitude regions is home to some turtle species. At least 100 species of tortoises and freshwater turtles are native to Asia, and new species continue to be described (Van Dijk and Palasuwan, 2000).

According to IUCN (2009), there are now 1,677 reptiles species have been included on the IUCN Red List, with 293 added in 2009. In total, 469 are threatened with extinction and 22 are already Extinct or Extinct in the wild.

Pakistan derives its marine resources from the Arabian Sea, which has a coastline of 1050km and lying in the Sindh and Balochistan provinces (Fig. 1). The part of the coast in Sindh is 250km, while the one in Balochistan is 800km. Sindh and Balochistan coasts have different physical and climatic characteristics. The coast of Sindh is the tail end of the southwest monsoon, and the coast of Balochistan has a Mediterranean climate (IUCN, 2004). Karachi coast is an important area for reptiles. It has the marine, muddy, sandy and rocky habitats having special significance in the distinct natural environment in the tropical region of' southern Pakistan. The important sites on this coast for the reptiles are Manora, Sandspit, Hawkesbay and Cape Monze areas.

Pakistan has 179 species of reptilian fauna consisting of turtles, tortoises, crocodile, gavial, lizards and snakes (Rehman and Iffat, 1997). Six families of Lizards are found in Pakistan viz. Geckonidae, Agamidae, Chameleonidae, Scincidae, Lacertidae and Varanidae. Auffenberg *et al.* (1989, 1991), Boulenger (1890), Ghalib *et al.* (1981), Iffat and Auffenberg (1988), Khan (2006), Khan and Mirza (1977), Khan and Nazia (2003), Khan *et al.* (2005), Mertens (1969), Minton (1966), Rahman *et al.* (2002), Rahman and Papenfuss (2005) and Iffat (2006, 2009) have been contributed some work in the field of herpetofauna of Pakistan.

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Pakistan has long been known to support a large population of Green Turtles (*Chelonia mydas*) with a lesser number of Olive ridleys (*Lepidochelys olivacea*), nesting primarily at Hawkes Bay and Sandspit near Karachi, Sindh province (Ghalib and Zaidi, 1976; Kabraji and Firdous, 1984). In 1976 Pakistan became a signatory to the Convention of International Trade in Endangered Species of Fauna and Flora (CITES), which lists all sea turtles on its Appendix 1, which includes species prohibited from international trade (Firdous, 2005). Seventy four species of snakes have been recorded in Pakistan, out of which 26 species are poisonous comprising 14 species of Sea Snakes and 12 species of Land Snakes, while 48 species are non- poisonous. Of 55 species of the sea Snakes distributed in the world, 14 species has been recorded from the coasts of Pakistan, while two species *Hydrophis faciatus* (Schneider) and *Astrotia stokesi* (Grey) have not been collected in Pakistan since their original records. The objective of the present study was to investigate the distribution, population status and environmental impacts on reptiles in the Manora, Sandspit, Hawkesbay, and Cape Monze areas of Karachi coast.

MATERIALS AND METHODS

Study Sites

Along Karachi coastal sites viz. Manora, Sandspit, Hawkesbay, and Cape Monze (Table 1) were selected as study areas (Fig. 2). The observations were recorded quarterly on the four sites during the years 2001 to 2009. During each visit to the study areas, the population of each species of reptiles was recorded. Identification of the reptilian species in the field was carried out with the help of field guides Minton (1966) and Khan (2006).

COUNTING METHODS

A. DIRECT METHODS

1. Habitat Searching /Transact Method

At each site several hours search was carried out to detect as many reptiles as possible with in a circular central zone along the coastal habitat at each site. This searching consists of approximately 20ha. (within a 250m radius of the observation/ sampling points). This method is very suitable for counting the number of reptiles. At first a suitable place with suitable habitat was chosen. Nearly 100m above the high tide mark was taken up for study of the coastal fauna. It was noted that the lizards are mostly active at day time, while the terrestrial snakes are seen both in the days as well as at night. Female marine turtles are observed at night, visiting or nesting at the beach.

Track counts along with direct observations were made on the beaches of Karachi coast for marine turtles which species is nesting of which species returned without laying eggs, as different turtle species have different types of track sign / crawls made in the sand when they emerge to nest or only for strolling.

2. Incidental Sightings

Incidental sightings are also helpful to determine the presence and population status of the species. In this way number of species, date, time, location and habitat types was recorded on data sheet.

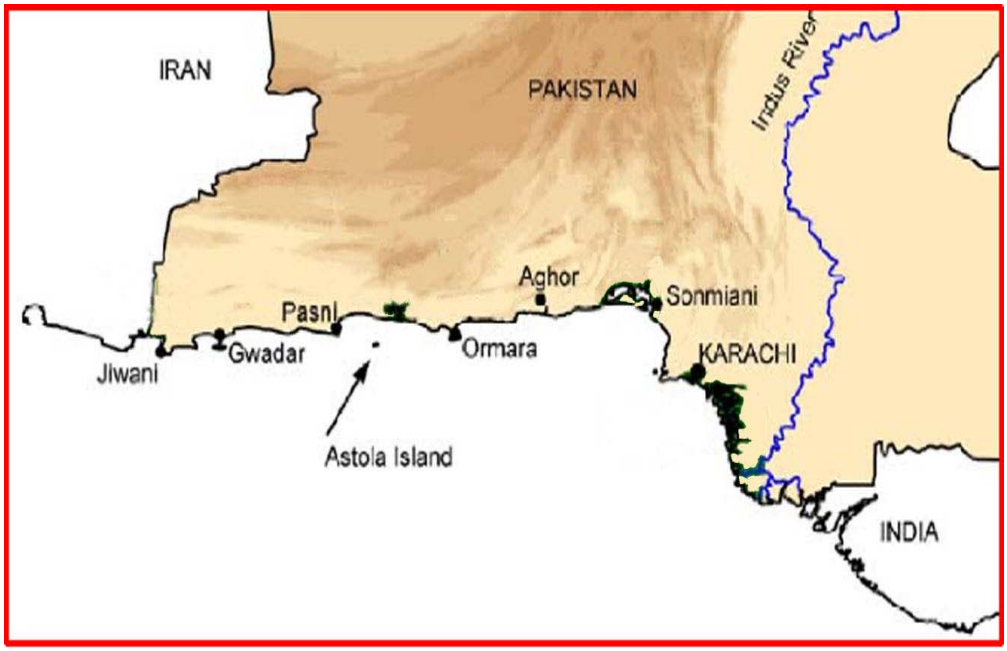

Fig. 1. Coastal areas of Pakistan.

Direct method

3. Hand Capturing

Hand Capturing was used for small terrestrial snakes, lizards and turtles. The simplest method used to capture lizards is to search intensively in micro-habitats which they are known to frequent, and to catch them by hand. Small lizards are found most easily by looking in potential shelter, for example by turning over rocks, or by stripping bark from trees. A small hand –held torch was used for looking into cracks or holes in search of reptiles at night. Reptiles were also searched for in holes and crevices.

Many lizards and snakes were counted or captured during this study period. For many diurnal species, mid- morning was a good time to search, while the reptiles were basking to elevate its body temperature. Nocturnal species were often found by torchlight.

Having located a lizard, the easiest way to catch it is simply to pounce on it with an open, cuffed hand, taking care not to crush it. Care should also be taken with species that practice to drop their tails. When a venomous snake was located, it was caught by pinning it behind the head, using a Y- shaped stick with some padding in the fork. The snake is then picked up, with the neck held firmly. "Snake tongs" 'large forceps manipulated by a trigger-grip' is also useful when catching snakes.

4. Noosing

Noosing is used to catch most of the lizards. Many lizards are most visible when they are active. However, they are wary when approached, and evade hand- capture by running away. Also, some lizards, such as varanids, and agamas, may sleep or bask in places that are difficult to reach, such as in the canopy and large stones, or in burrows. In these situations, a noose may be used to capture lizards without having to approach the lizards too closely. Nooses consist of a long pole, with a loop of string at the tip, which can be tightened around the neck of lizard and pulled tight in order to capture the animal.

5. Trapping

Trapping was used to catch many small reptiles. For terrestrial reptiles, the most commonly used trap is a pitfall trap, consisting of a bucket sunk into the ground so that the lip is flush with the surface. A small layer of leaf-litter or some other cover should be provided for animals that fall in. This also has the benefit of attracting arthropods to the trap, which can act as bait for lizards.

Marine snakes were sometimes observed, both during day and night at the edge of water and in back waters of Sandspit. The lizards were seen moving or resting just near shelters and they became alert to see the observers, some of them ran away very fast and were lost in the burrows of sand. But finally were caught with the help of two or three persons. This practice was done at least for one hour to find the different species of lizards. All species were counted and identified in the field. This method also helped to determine the distribution and occurrence of species. Similarly night surveys were done using the search lights and torches.

B. INDIRECT COUNTING METHODS

1. Information from different sources

Information was collected from the field staff of Sindh Wildlife Department, local fishermen, boatmen and members of local community/ villagers of different villages.

2. Presence of signs like tracks and footprints etc

Impressions of finger or foot prints, track, or tails, were observed for finding the existence, range and rough population of the species and range of the species.

The study was based mainly on direct observation and results calculated by the following formula:

$$P = \frac{AZ}{2YX}$$

P population
A total area
Z number observed
Y average flushing distance
X length of strip

RESULTS AND DISCUSSION

In Pakistan, reptiles are a blend of Palearctic, Indo-Malayan and Ethiopian forms (Fatima, 2008). During the present study, 2001-2009, total twenty seven reptilian species was recorded including 3 turtles, 9 lizards and 15 snakes.

Turtles

Three turtles species were found on Karachi coast, Green Turtle (*Chelonia mydas*) was recorded from all the four study sites Manora, Sandspit, Hawkesbay and Cape Monze, while Hawksbill Turtle (*Eretmochelys imbricata*) was recorded from Cape Monze area only, and Olive Ridley (*Lepidochelys olivacea*) was recorded from Sandspit only.

Green Turtle (*C. mydas*) was rated as common throughout study period i.e. 2001-2009 at Karachi coast (see Fig. 3), while Hawksbill Turtle (*E. imbricata*), and Olive Ridley (*L. olivacea*) were rated as rare. Olive Ridley (*L. olivacea*) was not found during years 2005 – 2009, while Hawksbill Turtle (*E. imbricata*) was recorded only in 2001 and 2003 from Cape Monze area, and after in the year 2003, it was not seen on Karachi coast.

Based on data of 2001, Green Turtle was rated as 30.06%, Hawksbill Turtle 0.02%, and Olive Ridley 0.02% (see Table 2). In year 2002, Green Turtle rated as 31.06%, Hawksbill Turtle 0%, Olive Ridley 0.02% (see Table 3).

In year 2003, Green Turtle rated as 30.32%, Hawksbill Turtle 0.02%, Olive Ridley 0.02% (see Table 4). In year 2004, Green Turtle rated as 30.42%, Hawksbill Turtle 0%, Olive Ridley 0.02% (see Table 5). In year 2005, Green Turtle rated as 28.92%, Hawksbill Turtle 0%, Olive Ridley 0% (see Table 6). In year 2006, Green Turtle rated as 28.37%, Hawksbill Turtle 0%, Olive Ridley 0% (see Table 7). In year 2007, Green Turtle rated as 27.80%, Hawksbill Turtle 0%, Olive Ridley 0% (see Table 8). In year 2008, Green Turtle rated as 27.20%, Hawksbill Turtle 0%, Olive Ridley 0% (see Table 9). In year 2009, Green Turtle rated as 27.56%, Hawksbill Turtle 0%, Olive Ridley 0% (see Table 10).

Lizards

Nine lizard species viz. Common Tree Lizard (C*alotes versicolor versicolor*), Spotted Barn Gecko (*Hemidactylus brooki*), Yellow Bellied Common House Gecko (*Hemidactylus flaviviridis*), Persian House Gecko (*Hemidactylus persicus*), Blotched House Gecko (*Hamidactylus triedrus*), Mediterranean House Gecko (H*amidactylus turcicus*), Blue Tail Sand Lizard (*Acanthodactylus cantoris*), Spotted Lacerta (*Mesalina watsonana*), and Bengal Monitor (*Varanus bengalensis*) were recorded from Manora, Sandspit, Hawkesbay and Cape Monze (see Fig. 4).

During 2001-2009, Blue Tail Sand Lizard (*Acanthodactylus cantoris*) was rated as common, Spotted Barn Gecko (*Hemidactylus brooki*), Yellow Bellied Common House Gecko (*Hemidactylus flaviviridis*), Persian House Gecko (*Hemidactylus persicus*), Spotted Lacerta (*Mesalina watsonana*) were rated as less common, while Bengal Monitor (*Varanus bengalensis*), Common Tree Lizard (C*alotes versicolor*), Mediterranean House Gecko (H*amidactylus turcicus*), and Blotched House Gecko (*Hamidactylus triedrus*) were rated as rare. In year 2002 and 2003, Common Tree Lizard (C*alotes versicolor*) was not recorded from Hawkes Bay area.

Table 1. Study areas of Karachi Coast with GPS position and habitat types.

S. No.	Location	GPS Position	Approx. Area of Surveyed (Km)	Habitat
1.	Manora	N 24 47 547 E 066 58 592	5	Sandy and Rocky Area
2.	Sandspit	N 24 50 723 E 066 54 104	5	Sandy Area
3.	Hawkes-bay	N 24 51 288 E 066 52 726	5	Sandy Area
4.	Cape monze	N 24 50 091 E 066 39 393	5	Rocky and Sandy Area

Based on data during 2001, Common Tree Lizard (*C. versicolor*) was rated as 5.29%, Spotted Barn Gecko (*H. brookii*) 5.83%, Yellow-bellied Common House Gecko (*H. flaviviridis*) 6.17%, Persian House Gecko (*H. persicus*) 4.31%, Blotched House Gecko (*H. triedrus*) 4.36%, Mediterranean House Gecko (*H. turcicus*) 4.75%, Blue Tail Sand Lizard (*A. cantoris*) 17.03%, Spotted Lacerta (*M. watsonana*) 15.55%, and Bengal Monitor (*V. bengalensis*) 1.47 % (see Table 2).

In the year 2002, Common Tree Lizard was rated as 5.22%, Spotted Barn Gecko 6.55%, Yellow-bellied Common House Gecko 6.41%, Persian House Gecko 4.40%, Blotched House Gecko 4.42%, Mediterranean House Gecko 4.89%, Blue Tail Sand Lizard 16.09%, Spotted Lacerta 16.59%, and Bengal Monitor 1.49% (see Table 3).

In the year 2003, Common Tree Lizard was rated as 5.08%, Spotted Barn Gecko 6.55%, Yellow-bellied Common House Gecko 6.41%, Persian House Gecko 0.51%, Blotched House Gecko 4.55%, Mediterranean House Gecko 5.20%, Blue Tail Sand Lizard 16.26%, Spotted Lacerta 15.68%, and Bengal Monitor recorded 1.51% (see Table 4).

In the year 2004, Common Tree Lizard was rated as 5.35%, Spotted Barn Gecko 6.53%, Yellow-bellied Common House Gecko 6.44%, Persian House Gecko 4.20%, Blotched House Gecko 4.72%, Mediterranean House Gecko 5.42%, Blue Tail Sand Lizard 16.04%, Spotted Lacerta 15.75%, and Bengal Monitor 1.22 % (see Table 5).

In the year 2005, Common Tree Lizard was rated as 5.19%, Spotted Barn Gecko 6.82%, Yellow-bellied Common House Gecko 6.71%, Persian House Gecko 4.46%, Blotched House Gecko 4.95%, Mediterranean House Gecko 5.28%, Blue Tail Sand Lizard 16.06%, Spotted Lacerta 15.95%, and Bengal Monitor 1.45% (see Table 6).

In the year 2006, Common Tree Lizard was rated as 5.11%, Spotted Barn Gecko 5.79%, Yellow-bellied Common House Gecko 6.95%, Persian House Gecko 4.37%, Blotched House Gecko 4.96%, Mediterranean House Gecko 5.37%, Blue Tail Sand Lizard 17.56%, Spotted Lacerta 15.58%, and Bengal Monitor 1.51% (see Table 7).

In the year 2007, Common Tree Lizard was rated as 4.88%, Spotted Barn Gecko 6.44%, Yellow-bellied Common House Gecko 6.87%, Persian House Gecko 4.56 %, Blotched House Gecko 1.17%, Mediterranean House Gecko 5.05%, Blue Tail Sand Lizard 17.45%, Spotted Lacerta 15.21%, and Bengal Monitor 1.75% (see Table 8).

Table 2. Population of Reptiles at Karachi Coast in 2001.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	20	881	309	18	1228	30.06
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	1	1	0.02
3	*Lepidochelys olivacea*	Olive Ridley	0	1	0	0	1	0.02
4	*Calotes versicolor versicolor*	Common Tree Lizard	158	2	0	56	216	5.29
5	*Hemidactylus brookii*	Spotted Barn Gecko	153	35	47	3	238	5.83
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	147	41	53	11	252	6.17
7	*Hemidactylus persicus*	Persian House Gecko	119	29	11	17	176	4.31
8	*Hemidactylus triedrus*	Blotched House Gecko	127	21	19	11	178	4.36
9	*Hemidactylus turcicus*	Mediterranean House Gecko	128	31	14	21	194	4.75
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	146	167	179	203	695	17.03
11	*Mesalina watsonana*	Spotted Lacerta	177	176`	133	149	635	15.55
12	*Varanus bengalensis*	Bengal Monitor	19	9	15	17	60	1.47
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	0	0	0
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	3	0	0	0	3	0.06
15	*Naja naja*	Black Cobra	0	0	1	0	1	0.02
16	*Echis carinatus*	Saw-scaled Viper	2	0	0	0	2	0.04
17	*Enhydrina schistosa*	Beaked Sea Snake	5	2	1	9	17	0.41
18	*Hydrophis caerulescens*	Blue Green Sea Snake	3	2	1	10	16	0.39
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	8	3	2	11	24	0.58
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	2	1	8	0.19
21	*Hydrophis mamillaris*	Broad Band Sea Snake	2	0	0	11	13	0.31
22	*Hydrophis ornatus*	Reef Sea Snake	8	3	1	17	29	0.71
23	*Hydrophis spiralis*	Yellow Sea Snake	7	9	8	11	35	0.85
24	*Lapemis curtus*	Pygmy Sea Snake	2	1	0	5	8	0.19
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	3	2	2	7	14	0.34
26	*Pelamis platurus*	Pelagic Sea Snake	3	1	0	9	13	0.31
27	*Praescutata viperina*	Spotted Viperine Sea Snake	8	3	1	12	24	0.58
	Total		1251	1421	799	610	4081	

In the year 2008, Common Tree Lizard was rated as 4.93%, Spotted Barn Gecko 6.49%, Yellow-bellied Common House Gecko 6.92%, Persian House Gecko 4.60%, Blotched House Gecko 5.11%, Mediterranean House Gecko 5.09%, Blue Tail Sand Lizard 17.60%, Spotted Lacerta 15.34%, and Bengal Monitor 1.77% (see Table 9).

In the year 2009, Common Tree Lizard was rated as 4.90%, Spotted Barn Gecko 6.46%, Yellow-bellied Common House Gecko 6.89%, Persian House Gecko 4.58%, Blotched House Gecko 5.08%, Mediterranean House Gecko 5.06%, Blue Tail Sand Lizard 17.51%, Spotted Lacerta 15.26%, and Bengal Monitor 1.76% (see Table 10).

Snakes

Out of the 15 species of sea snake rated from the Karachi coast, 12 species viz. Beaked Sea Snake (*Enhydrina schistosa*), Blue Green Sea Snake (*Hydrophis caerulescens*), Annulated Sea Snake (*Hydrophis cyanocinctus*), Persian Sea Snake (*Hydrophis lapemoides*), Broad Band Sea Snake (*Hydrophis mamillaris*), Reef Sea Snake (*Hydrophis ornatus*), Yellow Sea Snake (*Hydrophis spiralis*), Pygmy Sea Snake (*Lapemis curtus*), Spotted Small Headed Sea Snake (*Microcephalophis cantrois*), Pelagic Sea Snake (*Pelamis platurus*), Spotted Viperine Sea Snake (*Praescutata viperina*), and Blotched Diadem Snake (*Sphalerosophis diadema diadema*) were recorded from all the four study sites viz. Manora, Sandspit, Hawkesbay and Cape Monze areas and all were rated as rare (see Fig. 5).

Table 3. Population of Reptiles at Karachi Coast in 2002.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	25	948	319	21	1313	31.06
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	1	0	0	1	0.02
4	*Calotes versicolor versicolor*	Common Tree Lizard	156	3	0	62	221	5.22
5	*Hemidactylus brookii*	Spotted Barn Gecko	150	59	48	20	277	6.55
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	151	46	57	17	271	6.41
7	*Hemidactylus persicus*	Persian House Gecko	123	31	13	19	186	4.40
8	*Hemidactylus triedrus*	Blotched House Gecko	129	23	21	14	187	4.42
9	*Hemidactylus turcicus*	Mediterranean House Gecko	132	35	16	24	207	4.89
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	146	163	174	197	680	16.09
11	*Mesalina watsonana*	Spotted Lacerta	186	148	139	159	632	14.59
12	*Varanus bengalensis*	Bengal Monitor	21	11	13	18	63	1.49
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	0	0	0
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	3	0	0	0	3	0.06
15	*Naja naja*	Black Cobra	0	0	0	0	0	0
16	*Echis carinatus*	Saw-scaled Viper	1	0	0	0	1	0.02
17	*Enhydrina schistosa*	Beaked Sea Snake	3	1	1	11	16	0.37
18	*Hydrophis caerulescens*	Blue Green Sea Snake	2	4	1	5	12	0.28
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	4	2	3	14	23	0.54
20	*Hydrophis lapemoides*	Persian Sea Snake	2	2	0	1	5	0.11
21	*Hydrophis mamillaris*	Broad Band Sea Snake	1	0	0	9	10	0.23
22	*Hydrophis ornatus*	Reef Sea Snake	3	1	2	15	21	0.49
23	*Hydrophis spiralis*	Yellow Sea Snake	3	6	7	12	28	0.66
24	*Lapemis curtus*	Pygmy Sea Snake	2	2	0	3	7	0.16
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	4	3	2	9	18	0.42
26	*Pelamis platurus*	Pelagic Sea Snake	2	2	1	11	16	0.37
27	*Praescutata viperina*	Spotted Viperine Sea Snake	9	2	2	15	28	0.66
	Total		1258	1493	819	656	4226	

Three species of terrestrial snakes viz. Cliff Racer (*Platyceps rhodorachis*) Saw-scaled Viper (*Echis carinatus*) and Black Cobra (*Naja naja*) were recorded from Manora, Hawkesbay and Cape Monze area only. The main reason for their absence from Sandspit seems to be large scale disturbance due to human population and visitors in the area.

During 2001-2009, Persian Sea Snake, Annulated Sea Snake, Blotched Diadem Snake, Yellow Sea Snake, Blue Green Sea Snake, Reef Sea Snake, Broad Band Sea Snake, Beaked Sea Snake, Pygmy Sea Snake, Spotted Viperine Sea Snake, Spotted Small Headed Sea Snake, and Pelagic Sea Snake were rated as rare, and Saw-scaled Viper was rated as rare during 2001, 2002, 2005 to 2007, while in years 2003 - 2004, it was not recorded. Black Cobra was rated as rare in year 2001, 2005 to 2009, but in year 2002 to 2004, it was not observed. Cliff Racer was not recorded during 2001 and 2002, while during 2003 to 2009 at Cape Monze, and in year 2006, at Monera and Sandspit, it was rated as rare.

In the year 2001 Cliff Racer was rated as 0%, Blotched Diadem Snake 0.06%, Black Cobra 0.02%, Saw-scaled Viper 0.04%, Beaked Sea Snake 0.41%, Blue Green Sea Snake 0.39%, Annulated Sea Snake 0.58%, Persian Sea Snake 0.19%, Broad Band Sea Snake 0.31% , Reef Sea Snake 0.71%, Yellow Sea Snake 0.85%, Pygmy Sea

Table 4. Population of Reptiles at Karachi Coast in 2003.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	27	931	325	22	1305	30.32
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	1	1	0.02
3	*Lepidochelys olivacea*	Olive Ridley	0	1	0	0	1	0.02
4	*Calotes versicolor versicolor*	Common Tree Lizard	147	1	0	71	219	5.08
5	*Hemidactylus brookii*	Spotted Barn Gecko	153	61	47	21	282	6.55
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	149	49	59	19	276	6.41
7	*Hemidactylus persicus*	Persian House Gecko	127	33	15	22	197	0.51
8	*Hemidactylus triedrus*	Blotched House Gecko	131	27	23	15	196	4.55
9	*Hemidactylus turcicus*	Mediterranean House Gecko	136	38	21	29	224	5.20
10	*Acanthodactylus cantoris*	Blue- Tail Sand Lizard	142	177	185	196	700	16.26
11	*Mesalina watsonana*	Spotted Lacerta	202	164	144	165	675	15.68
12	*Varanus bengalensis*	Bengal Monitor	18	8	15	24	65	1.51
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	1	1	0.02
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	2	0	0	3	5	0.11
15	*Naja naja*	Black Cobra	0	0	0	0	0	0
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	0	0	0
17	*Enhydrina schistosa*	Beaked Sea Snake	1	0	0	9	10	0.23
18	*Hydrophis caerulescens*	Blue Green Sea Snake	3	2	1	7	13	0.30
189	*Hydrophis cyanocinctus*	Annulated Sea Snake	3	1	3	12	19	0.44
20	*Hydrophis lapemoides*	Persian Sea Snake	3	1	1	1	6	0.13
21	*Hydrophis mamillaris*	Broad Band Sea Snake	0	0	0	9	9	0.20
22	*Hydrophis ornatus*	Reef Sea Snake	2	1	1	13	17	0.39
23	*Hydrophis spiralis*	Yellow Sea Snake	4	5	3	15	27	0.62
24	*Lapemis curtus*	Pygmy Sea Snake	1	0	0	5	6	0.13
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	2	2	1	4	9	0.20
26	*Pelamis platurus*	Pelagic Sea Snake	6	3	1	12	22	0.51
27	*Praescutata viperina*	Spotted Viperine Sea Snake	5	0	0	13	18	0.41
	Total		1264	1505	845	689	4303	

Snake 0.19%, Spotted Small Headed Sea Snake 0.34%, Pelagic Sea Snake 0.31%, and Spotted Viperine Sea Snake 0.58% (see Table 2).

In the year 2002, Cliff Racer was rated as 0%, Blotched Diadem Snake 0.06%, Black Cobra 0%, Saw-scaled Viper 0.02%, Beaked Sea Snake 0.37%, Blue Green Sea Snake 0.28%, Annulated Sea Snake 0.54%, Persian Sea Snake as 0.11%, Broad Band Sea Snake 0.23%, Reef Sea Snake 0.49%, Yellow Sea Snake 0.66%, Pygmy Sea Snake 0.16%, Spotted Small Headed Sea Snake 0.42%, Pelagic Sea Snake 0.37%, and Spotted Viperine Sea Snake recorded 0.66% (see Table 3)

In the year 2003, Cliff Racer was rated as 0.02%, Blotched Diadem Snake 0.11%, Black Cobra 0%, Saw-scaled Viper 0%, Beaked Sea Snake 0.23%, Blue Green Sea Snake 0.30%, Annulated Sea Snake 0.44%, Persian Sea Snake 0.13%, Broad Band Sea Snake 0.20%, Reef Sea Snake 0.39%, Yellow Sea Snake 0.62%, Pygmy Sea Snake 0.13%, Spotted Small Headed Sea Snake 0.20%, Pelagic Sea Snake 0.51%, and Spotted Viperine Sea Snake 0.41% (see Table 4).

In the year 2004, Cliff Racer was rated as 0.06%, Blotched Diadem Snake 0.18%, Black Cobra 0%, Saw-scaled Viper 0%, Beaked Sea Snake 0.13%, Blue Green Sea Snake 0.31%, Annulated Sea Snake 0.15%, Persian Sea Snake 0.13%, Broad Band Sea Snake 0.33%, Reef Sea Snake 0.49%, Yellow Sea Snake 0.47%, Pygmy Sea Snake 0.24%, Spotted Small Headed Sea Snake 0.27%,

Table 5. Population of Reptiles at Karachi Coast in 2004.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	30	955	340	21	1346	30.42
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	1	0	0	1	0.02
4	*Calotes versicolor versicolor*	Common Tree Lizard	150	3	1	83	237	5.35
5	*Hemidactylus brookii*	Spotted Barn Gecko	145	65	56	23	289	6.53
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	153	52	57	23	285	6.44
7	*Hemidactylus persicus*	Persian House Gecko	118	27	18	23	186	4.20
8	*Hemidactylus triedrus*	Blotched House Gecko	134	32	26	17	209	4.72
9	*Hemidactylus turcicus*	Mediterranean House Gecko	141	42	25	32	240	5.42
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	153	175	183	199	710	16.04
11	*Mesalina watsonana*	Spotted Lacerta	209	152	152	184	697	15.75
12	*Varanus bengalensis*	Bengal Monitor	15	5	13	21	54	1.22
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	3	3	0.06
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	3	0	1	4	8	0.18
15	*Naja naja*	Black Cobra	0	0	0	0	0	0
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	0	0	0
17	*Enhydrina schistosa*	Beaked Sea Snake	0	0	1	5	6	0.13
18	*Hydrophis caerulescens*	Blue Green Sea Snake	2	1	2	9	14	0.31
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	2	0	1	4	7	0.15
20	*Hydrophis lapemoides*	Persian Sea Snake	2	1	1	2	6	0.13
21	*Hydrophis mamillaris*	Broad Band Sea Snake	1	0	1	13	15	0.33
22	*Hydrophis ornatus*	Reef Sea Snake	3	2	2	15	22	0.49
23	*Hydrophis spiralis*	Yellow Sea Snake	2	5	3	11	21	0.47
24	*Lapemis curtus*	Pygmy Sea Snake	2	1	0	8	11	0.24
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	3	1	1	7	12	0.27
26	*Pelamis platurus*	Pelagic Sea Snake	5	2	3	16	26	0.58
27	*Praescutata viperina*	Spotted Viperine Sea Snake	3	1	0	15	19	0.42
	Total		1276	1523	887	738	4424	

Pelagic Sea Snake 0.58%, and Spotted Viperine Sea Snake 0.42% (see Table 5).

In the year 2005, Cliff Racer was rated as 0.08%, Blotched Diadem Snake 0.15%, Black Cobra 0.02%, Saw-scaled Viper 0.06%, Beaked Sea Snake 0.17%, Blue Green Sea Snake 0.37%, Annulated Sea Snake 0.19%, Persian Sea Snake 0.17%, Broad Band Sea Snake 0.39%, Reef Sea Snake as 0.48%, Yellow Sea Snake as 0.39%, Pygmy Sea Snake 0.28%, Spotted Small Headed Sea Snake 0.28%, Pelagic Sea Snake 0.59%, and Spotted Viperine Sea Snake 0.46% (see Table 6).

In the year 2006, Cliff Racer was rated as 0.10%, Blotched Diadem Snake 0.21%, Black Cobra 0.02%, Saw-scaled Viper 0.21%, Beaked Sea Snake 0.12%, Blue Green Sea Snake 0.42%, Annulated Sea Snake 0.23%, Persian Sea Snake 0.12%, Broad Band Sea Snake 0.51%, Reef Sea Snake 0.49%, Yellow Sea Snake 0.38%, Pygmy Sea Snake 0.31%, Spotted Small Headed Sea Snake 0.23%, Pelagic Sea Snake 0.38%, and Spotted Viperine Sea Snake 0.57% (see Table 7).

In the year 2007, Cliff Racer was rated as 0.10%, Blotched Diadem Snake 0.20%, Black Cobra 0.16%, Saw-scaled Viper 0.14%, Beaked Sea Snake 0.42%, Blue Green Sea Snake 0.48%, Annulated Sea Snake 0.24%, Persian Sea Snake 0.14%, Broad Band Sea Snake 0.42%, Reef Sea Snake 0.52%, Yellow Sea Snake 0.42%, Pygmy Sea Snake 0.36%, Spotted Small Headed Sea Snake 0.36 %, Pelagic Sea Snake 0.50%, and Spotted Viperine Sea Snake 0.46% (see Table 8).

Table 6. Population of Reptiles at Karachi Coast in 2005.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	29	935	331	19	1314	28.92
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	148	2	5	81	236	5.19
5	*Hemidactylus brookii*	Spotted Barn Gecko	142	72	66	30	310	6.82
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	159	57	61	28	305	6.71
7	*Hemidactylus persicus*	Persian House Gecko	121	29	27	26	203	4.46
8	*Hemidactylus triedrus*	Blotched House Gecko	137	36	29	23	225	4.95
9	*Hemidactylus turcicus*	Mediterranean House Gecko	131	45	27	37	240	5.28
10	*Acanthodactylus cantoris*	Blue- Tail Sand Lizard	170	178	182	200	730	16.06
11	*Mesalina watsonana*	Spotted Lacerta	214	158	156	197	726	15.95
12	*Varanus bengalensis*	Bengal Monitor	18	8	17	23	66	1.45
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	4	4	0.08
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	1	0	1	5	7	0.15
15	*Naja naja*	Black Cobra	0	0	0	1	1	0.02
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	3	3	0.06
17	*Enhydrina schistosa*	Beaked Sea Snake	1	0	1	6	8	0.17
18	*Hydrophis caerulescens*	Blue Green Sea Snake	2	3	1	11	17	0.37
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	3	1	0	5	9	0.19
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	2	1	8	0.17
21	*Hydrophis mamillaris*	Broad Band Sea Snake	2	1	0	15	18	0.39
22	*Hydrophis ornatus*	Reef Sea Snake	2	1	2	17	22	0.48
23	*Hydrophis spiralis*	Yellow Sea Snake	1	3	1	13	18	0.39
24	*Lapemis curtus*	Pygmy Sea Snake	1	1	2	9	13	0.28
25	*Microcephalophis cantoris*	Spotted Small Headed Sea Snake	1	2	1	9	13	0.28
26	*Pelamis platurus*	Pelagic Sea Snake	3	3	4	17	27	0.59
27	*Praescutata viperina*	Spotted Viperine Sea Snake	2	2	0	17	21	0.46
	Total		1291	1539	916	797	4543	

In the year 2008, Cliff Racer was rated as 0.10%, Blotched Diadem Snake 0.20%, Black Cobra 0.16%, Saw-scaled Viper 0.14%, Beaked Sea Snake 0.42%, Blue Green Sea Snake 0.48%, Annulated Sea Snake 0.24%, Persian Sea Snake 0.14%, Broad Band Sea Snake 0.42%, Reef Sea Snake 0.52%, Yellow Sea Snake 0.42%, Pygmy Sea Snake 0.36%, Spotted Small Headed Sea Snake 0.36 %, Pelagic Sea Snake 0.50%, and Spotted Viperine Sea Snake 0.46% (see Table 9).

In the year 2009, Cliff Racer was rated as 0.10%, Blotched Diadem Snake 0.20%, Black Cobra 0.16%, Saw-scaled Viper 0.14%, Beaked Sea Snake 0.42%, Blue Green Sea Snake 0.48%, Annulated Sea Snake 0.24%, Persian Sea Snake 0.14%, Broad Band Sea Snake 0.42%, Reef Sea Snake 0.52%, Yellow Sea Snake 0.42%, Pygmy Sea Snake 0.36%, Spotted Small Headed Sea Snake 0.36 %, Pelagic Sea Snake 0.50%, and Spotted Viperine Sea Snake 0.46% (see Table 10). The population of reptiles at Manora, Sandspit, Hawkesbay, and Cape Monze has been also summarized in appendix 1-4.

Environmental Impacts

Habitat Degradation

According to field surveys during 2002 – 2009, serious threats especially to marine turtles have been observed, while lizards are also affected by habitat degradation and disturbance, but it is a very minor threat. There are instances of some mortality of Bengal Monitor during the road crossing. Sea snakes are least affected by these factors as they are seldom encountered along the sea

Table 7. Population of Reptiles at Karachi Coast in 2006.

S. No.	Scientific name	Common name	Manora	Sands-pit	Hawkes bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	32	937	341	21	1331	28.37
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	146	3	2	89	240	5.11
5	*Hemidactylus brookii*	Spotted Barn Gecko	136	59	56	21	272	5.79
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	165	63	65	33	326	6.95
7	*Hemidactylus persicus*	Persian House Gecko	118	31	29	27	205	4.37
8	*Hemidactylus triedrus*	Blotched House Gecko	141	32	26	34	233	4.96
9	*Hemidactylus turcicus*	Mediterranean House Gecko	149	48	23	32	252	5.37
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	177	203	209	235	824	17.56
11	*Mesalina watsonana*	Spotted Lacerta	217	152	157	205	731	15.58
12	*Varanus bengalensis*	Bengal Monitor	21	11	14	25	71	1.51
13	*Platyceps rhodorachis*	Cliff Racer	1	0	1	3	5	0.10
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	1	2	0	7	10	0.21
15	*Naja naja*	Black Cobra	0	0	1	0	1	0.02
16	*Echis carinatus*	Saw-scaled Viper	2	0	0	8	10	0.21
17	*Enhydrina schistosa*	Beaked Sea Snake	1	0	0	5	6	0.12
18	*Hydrophis caerulescens*	Blue Green Sea Snake	1	4	0	15	20	0.42
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	4	0	1	6	11	0.23
20	*Hydrophis lapemoides*	Persian Sea Snake	2	2	1	1	6	0.12
21	*Hydrophis mamillaris*	Broad Band Sea Snake	0	2	1	21	24	0.51
22	*Hydrophis ornatus*	Reef Sea Snake	1	0	3	19	23	0.49
23	*Hydrophis spiralis*	Yellow Sea Snake	1	0	2	15	18	0.38
24	*Lapemis curtus*	Pygmy Sea Snake	1	0	1	13	15	0.31
25	*Microcephalophis cantoris*	Spotted Small Headed Sea Snake	2	1	1	7	11	0.23
26	*Pelamis platurus*	Pelagic Sea Snake	2	1	0	15	18	0.38
27	*Praescutata viperina*	Spotted Viperine Sea Snake	1	0	2	24	27	0.57
	Total		1322	1551	936	881	4690	

coast. They are entangled in fishermen nets but are released when found in fish catch.

Human activities that directly or indirectly threaten marine turtles include the exploitation of eggs and turtles, fishery-related mortality, inappropriate management practices, destruction or modification of habitats, pollution, and recreation activities. Khan *et al*. (2009) conducted a baseline study to evaluate the estrogenic activities using *in-vitro* yeast estrogenic screen in selected Ramsar sites and Creek areas, and reported that highest estrogenic activity has been recorded at creek area. The sewage discharge from Malir and Layri Rivers is causing big loss to fish nursery ground and the mangrove forest.

Table 8. Population of Reptiles at Karachi Coast in 2007.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	47	951	351	27	1376	27.80
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	151	2	3	86	242	4.88
5	*Hemidactylus brookii*	Spotted Barn Gecko	135	64	65	55	319	6.44
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	167	67	67	39	340	6.87
7	*Hemidactylus persicus*	Persian House Gecko	124	35	33	34	226	4.56
8	*Hemidactylus triedrus*	Blotched House Gecko	138	35	29	44	251	1.17
9	*Hemidactylus turcicus*	Mediterranean House Gecko	140	32	48	30	250	5.05
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	185	215	219	245	864	17.45
11	*Mesalina watsonana*	Spotted Lacerta	215	172	165	201	753	15.21
12	*Varanus bengalensis*	Bengal Monitor	30	8	12	37	87	1.75
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	5	5	0.10
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	1	1	0	8	10	0.20
15	*Naja naja*	Black Cobra	1	0	0	7	8	0.16
16	*Echis carinatus*	Saw-scaled Viper	0	0	1	6	7	0.14
17	*Enhydrina schistosa*	Beaked Sea Snake	8	0	1	12	21	0.42
18	*Hydrophis caerulescens*	Blue Green Sea Snake	1	2	1	20	24	0.48
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	2	1	0	9	12	0.24
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	1	1	7	0.14
21	*Hydrophis mamillaris*	Broad Band Sea Snake	1	1	0	19	21	0.42
22	*Hydrophis ornatus*	Reef Sea Snake	2	1	0	23	26	0.52
23	*Hydrophis spiralis*	Yellow Sea Snake	2	0	1	18	21	0.42
24	*Lapemis curtus*	Pygmy Sea Snake	2	0	1	15	18	0.36
25	*Microcephalophis cantoris*	Spotted Small Headed Sea Snake	3	2	2	11	18	0.36
26	*Pelamis platurus*	Pelagic Sea Snake	3	2	3	17	25	0.50
27	*Praescutata viperina*	Spotted Viperine Sea Snake	2	0	2	19	23	0.46
	Total		1363	1593	1005	988	4949	

Industrial pollutants are also discharged in the marine water, which produce high concentration of lead and iron in water and fishes. The oil spills with increased oil tankers traffic, spills caused by negligence and marine transport in the area pose dangerous state to our marine biodiversity.

The Hawkesbay and Sandspit beaches, concentrated along 5km stretch represent the largest nesting habitat for marine turtles in Pakistan. Due to various recreational activities and construction of huts, this habitat is now threatened. In the absence of any effective and regular beach cleanup and garbage disposal system, beaches often contain large amounts of beach litter. Green turtles eat a wide variety of marine litter such as plastic bags, plastic styro-foam pieces, balloons and plastic pellets. Effects of consumption include interference in metabolism or gut function, even at low levels of ingestion as well as absorption of toxic by-products. In addition, garbage attracts predators like dogs and crows/gulls in large numbers that then pose a direct threat to the turtle eggs / hatchlings.

Presently, beachfront development is limited to the construction of beach huts. However, land use violations have been observed with a number of huts exceeding the limits of land usage as described in law. This is resulting in the reduction of available nesting habitat of Green

Table 9. Population of Reptiles at Karachi Coast in 2008.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	31	939	344	21	1335	27.20
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	151	2	3	86	242	4.93
5	*Hemidactylus brookii*	Spotted Barn Gecko	135	64	65	55	319	6.49
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	167	67	67	39	340	6.92
7	*Hemidactylus persicus*	Persian House Gecko	124	35	33	34	226	4.60
8	*Hemidactylus triedrus*	Blotched House Gecko	138	35	29	44	251	5.11
9	*Hemidactylus turcicus*	Mediterranean House Gecko	140	32	48	30	250	5.09
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	185	215	219	245	864	17.60
11	*Mesalina watsonana*	Spotted Lacerta	215	172	165	201	753	15.34
12	*Varanus bengalensis*	Bengal Monitor	30	8	12	37	87	1.77
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	5	5	0.10
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	1	1	0	8	10	0.20
15	*Naja naja*	Black Cobra	1	0	0	7	8	0.16
16	*Echis carinatus*	Saw-scaled Viper	0	0	1	6	7	0.14
17	*Enhydrina schistosa*	Beaked Sea Snake	8	0	1	12	21	0.42
18	*Hydrophis caerulescens*	Blue Green Sea Snake	1	2	1	20	24	0.48
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	2	1	0	9	12	0.24
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	1	1	7	0.14
21	*Hydrophis mamillaris*	Broad Band Sea Snake	1	1	0	19	21	0.42
22	*Hydrophis ornatus*	Reef Sea Snake	2	1	0	23	26	0.52
23	*Hydrophis spiralis*	Yellow Sea Snake	2	0	1	18	21	0.42
24	*Lapemis curtus*	Pygmy Sea Snake	2	0	1	15	18	0.36
25	*Microcephalophis cantoris*	Spotted Small Headed Sea Snake	3	2	2	11	18	0.36
26	*Pelamis platurus*	Pelagic Sea Snake	3	2	3	17	25	0.50
27	*Praescutata viperina*	Spotted Viperina Sea Snake	2	0	2	19	23	0.46
	Total		1347	1581	998	982	4908	

turtles. Most of the land previously used by turtles for nesting has been built upon and hence space for turtle nesting is now severely restricted. Night use of beach huts is common in Karachi coast. Use of lightening in the night discourages females from nesting and cause hatchlings to become disoriented because they intensively head towards the brightest horizon, which should be the moonlit ocean. Beach front lightening instead cause them to disorient and wander inland, where they often die of dehydration or predation.

Of great concern these days is the issue of construction debris from newly constructed and unused/unprotected huts that has been noticed at various locations on the beaches. The debris can alter the beach habitat, hamper or deter nesting attempts as well as interfere with the incubation of eggs and the emergence of hatchlings. Sand excavated during the process also has shown that when beaches are nourished by pumping, trucking or otherwise depositing sand on a beach to replace what has been lost due to natural erosion process or physical removal, it can negatively impact sea turtles. If the sand is too compacted for the turtles to nest in or if the sand imported is drastically different from native beach sediments, the nest-site selection, digging behavior, incubation, temperature and the moisture content of nests is affected. Therefore, it is felt that activities such as sand removal could have irreversible adverse impacts on the turtle nesting habitat at the Haweksbay and Sandspit beaches. These land use practices are also affecting the lizards of the area, but this is a minor threat as the lizards are more restricted to landward site. The population of reptiles on

Table 10. Population of Reptiles at Karachi Coast in 2009.

S. No.	Scientific name	Common name	Manora	Sandspit	Hawkes-bay	Cape monze	Total	%
1	*Chelonia mydas*	Green Turtle	43	953	339	25	1360	27.56
2	*Eretmochelys imbricate*	Hawksbill Turtle	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	151	2	3	86	242	4.90
5	*Hemidactylus brookii*	Spotted Barn Gecko	135	64	65	55	319	6.46
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	167	67	67	39	340	6.89
7	*Hemidactylus persicus*	Persian House Gecko	124	35	33	34	226	4.58
8	*Hemidactylus triedrus*	Blotched House Gecko	138	35	29	44	251	5.08
9	*Hemidactylus turcicus*	Mediterranean House Gecko	140	32	48	30	250	5.06
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	185	215	219	245	864	17.51
11	*Mesalina watsonana*	Spotted Lacerta	215	172	165	201	753	15.26
12	*Varanus bengalensis*	Bengal Monitor	30	8	12	37	87	1.76
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	5	5	0.10
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	1	1	0	8	10	0.20
15	*Naja naja*	Black Cobra	1	0	0	7	8	0.16
16	*Echis carinatus*	Saw-scaled Viper	0	0	1	6	7	0.14
17	*Enhydrina schistosa*	Beaked Sea Snake	8	0	1	12	21	0.42
18	*Hydrophis caerulescens*	Blue Green Sea Snake	1	2	1	20	24	0.48
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	2	1	0	9	12	0.24
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	1	1	7	0.14
21	*Hydrophis mamillaris*	Broad Band Sea Snake	1	1	0	19	21	0.42
22	*Hydrophis ornatus*	Reef Sea Snake	2	1	0	23	26	0.52
23	*Hydrophis spiralis*	Yellow Sea Snake	2	0	1	18	21	0.42
24	*Lapemis curtus*	Pygmy Sea Snake	2	0	1	15	18	0.36
25	*Microcephalophis cantoris*	Spotted Small Headed Sea Snake	3	2	2	11	18	0.36
26	*Pelamis platurus*	Pelagic Sea Snake	3	2	3	17	25	0.50
27	*Praescutata viperina*	Spotted Viperine Sea Snake	2	0	2	19	23	0.46
	Total		1359	1595	993	986	4933	

the Karachi coast is more or less stable except that of Olive Ridley Turtle which has not been recorded from 2005 and onwards.

Appendix 1. Population of Reptiles at Manora, Karachi Coast in 2001 to 2009.

S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
1	*Chelonia mydas*	Green Turtle	20	25	27	30	29	32	47	31	43	284
2	*Eretmochelys imbricata*	Hawksbill Turtle	0	0	0	0	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	158	156	147	150	148	146	151	151	151	1358
5	*Hemidactylus brookii*	Spotted Barn Gecko	153	150	153	145	142	136	135	135	135	1284
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	147	151	149	153	159	165	167	167	167	1425
7	*Hemidactylus persicus*	Persian House Gecko	119	123	127	118	121	118	124	124	124	1098
8	*Hemidactylus triedrus*	Blotched House Gecko	127	129	131	134	137	141	138	138	138	1213
9	*Hemidactylus turcicus*	Mediterranean House Gecko	128	132	136	141	131	149	140	140	140	1237
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	146	146	142	153	170	177	185	185	185	1489
11	*Mesalina watsonana*	Spotted Lacerta	177	186	202	209	214	217	215	215	215	1850
12	*Varanus bengalensis*	Bengal Monitor	19	21	18	15	18	21	30	30	30	202
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	0	0	1	0	0	0	1
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	3	3	2	3	1	1	1	1	1	16
15	*Naja naja*	Black Cobra	0	0	0	0	0	0	1	1	1	3
16	*Echis carinatus*	Saw-scaled Viper	2	1	0	0	0	2	0	0	0	5
17	*Enhydrina schistosa*	Beaked Sea Snake	5	3	1	0	1	1	8	8	8	35
18	*Hydrophis caerulescens*	Blue Green Sea Snake	3	2	3	2	2	1	1	1	1	16
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	8	4	3	2	3	4	2	2	2	32
20	*Hydrophis lapemoides*	Persian Sea Snake	3	2	3	2	3	2	3	3	3	24
21	*Hydrophis mamillaris*	Broad Band Sea Snake	2	1	0	1	2	0	1	1	1	9
22	*Hydrophis ornatus*	Reef Sea Snake	8	3	2	3	2	1	2	2	2	25
23	*Hydrophis spiralis*	Yellow Sea Snake	7	3	4	2	1	1	2	2	2	24
24	*Lapemis curtus*	Pygmy Sea Snake	2	2	1	2	1	1	2	2	2	15
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	3	4	2	3	1	2	3	3	3	24
26	*Pelamis platurus*	Pelagic Sea Snake	3	2	6	5	3	2	3	3	3	30
27	*Praescutata viperina*	Spotted Viperine Sea Snake	8	9	5	3	2	1	2	2	2	34
	Total		1251	1258	1264	1276	1291	1322	1363	1347	1359	11731

Appendix 2. Population of Reptiles at Sandspit, Karachi Coast in 2001 to 2009.

S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
1	*Chelonia mydas*	Green Turtle	881	948	931	955	935	937	951	939	953	8430
2	*Eretmochelys imbricata*	Hawksbill Turtle	0	0	0	0	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	1	1	1	1	0	0	0	0	0	4
4	*Calotes versicolor versicolor*	Common Tree Lizard	2	3	1	3	2	3	2	2	2	20
5	*Hemidactylus brookii*	Spotted Barn Gecko	35	59	61	65	72	59	64	64	64	543
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	41	46	49	52	57	63	67	67	67	509
7	*Hemidactylus persicus*	Persian House Gecko	29	31	33	27	29	31	35	35	35	285
8	*Hemidactylus triedrus*	Blotched House Gecko	21	23	27	32	36	32	35	35	35	276

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S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
9	*Hemidactylus turcicus*	Mediterranean House Gecko	31	35	38	42	45	48	32	32	32	335
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	167	163	177	175	178	203	215	215	215	1708
11	*Mesalina watsonana*	Spotted Lacerta	176`	148	164	152	158	152	172	172	172	1290
12	*Varanus bengalensis*	Bengal Monitor	9	11	8	5	8	11	8	8	8	76
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	0	0	0	0	0	0	0
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	0	0	0	0	0	2	1	1	1	5
15	*Naja naja*	Black Cobra	0	0	0	0	0	0	0	0	0	0
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	0	0	0	0	0	0	0
17	*Enhydrina schistosa*	Beaked Sea Snake	2	1	0	0	0	0	0	0	0	3
18	*Hydrophis caerulescens*	Blue Green Sea Snake	2	4	2	1	3	4	2	2	2	22
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	3	2	1	0	1	0	1	1	1	10
20	*Hydrophis lapemoides*	Persian Sea Snake	2	2	1	1	2	2	2	2	2	16
21	*Hydrophis mamillaris*	Broad Band Sea Snake	0	0	0	0	1	2	1	1	1	6
22	*Hydrophis ornatus*	Reef Sea Snake	3	1	1	2	1	0	1	1	1	11
23	*Hydrophis spiralis*	Yellow Sea Snake	9	6	5	5	3	0	0	0	0	28
24	*Lapemis curtus*	Pygmy Sea Snake	1	2	0	1	1	0	0	0	0	5
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	2	3	2	1	2	1	2	2	2	17
26	*Pelamis platurus*	Pelagic Sea Snake	1	2	3	2	3	1	2	2	2	18
27	*Praescutata viperina*	Spotted Viperine Sea Snake	3	2	0	1	2	0	0	0	0	8
	Total		1421	1493	1505	1523	1539	1551	1593	1581	1595	13801

Appendix 3. Population of Reptiles at Hawkesbay, Karachi Coast in 2001 to 2009.

S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
1	*Chelonia mydas*	Green Turtle	309	319	325	340	331	341	351	344	339	2999
2	*Eretmochelys imbricata*	Hawksbill Turtle	0	0	0	0	0	0	0	0	0	0
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	0	0	0	1	5	2	3	3	3	17
5	*Hemidactylus brookii*	Spotted Barn Gecko	47	48	47	56	66	56	65	65	65	515
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	53	57	59	57	61	65	67	67	67	553
7	*Hemidactylus persicus*	Persian House Gecko	11	13	15	18	27	29	33	33	33	212
8	*Hemidactylus triedrus*	Blotched House Gecko	19	21	23	26	29	26	29	29	29	231
9	*Hemidactylus turcicus*	Mediterranean House Gecko	14	16	21	25	27	23	48	48	48	270
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	179	174	185	183	182	209	219	219	219	1769
11	*Mesalina watsonana*	Spotted Lacerta	133	139	144	152	156	157	165	165	165	1376
12	*Varanus bengalensis*	Bengal Monitor	15	13	15	13	17	14	12	12	12	123
13	*Platyceps rhodorachis*	Cliff Racer	0	0	0	0	0	1	0	0	0	1
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	0	0	0	1	1	0	0	0	0	2
15	*Naja naja*	Black Cobra	1	0	0	0	0	1	0	0	0	2
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	0	0	0	1	1	1	3
17	*Enhydrina schistosa*	Beaked Sea Snake	1	1	0	1	1	0	1	1	1	7

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S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
18	*Hydrophis caerulescens*	Blue Green Sea Snake	1	1	1	2	1	0	1	1	1	9
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	2	3	3	1	0	1	0	0	0	10
20	*Hydrophis lapemoides*	Persian Sea Snake	2	0	1	1	2	1	1	1	1	10
21	*Hydrophis mamillaris*	Broad Band Sea Snake	0	0	0	1	0	1	0	0	0	2
22	*Hydrophis ornatus*	Reef Sea Snake	1	2	1	2	2	3	0	0	0	11
23	*Hydrophis spiralis*	Yellow Sea Snake	8	7	3	3	1	2	1	1	1	27
24	*Lapemis curtus*	Pygmy Sea Snake	0	0	0	0	2	1	1	1	1	6
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	2	2	1	1	1	1	2	2	2	14
26	*Pelamis platurus*	Pelagic Sea Snake	0	1	1	3	4	0	3	3	3	18
27	*Praescutata viperina*	Spotted Viperine Sea Snake	1	2	0	0	0	2	2	2	2	11
	Total		799	819	845	887	916	936	1005	998	993	8198

Appendix 4. Population of Reptiles at Cape Monze, Karachi Coast in 2001 to 2009.

S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
1	*Chelonia mydas*	Green Turtle	18	21	22	21	19	21	27	21	25	195
2	*Eretmochelys imbricata*	Hawksbill Turtle	1	0	1	0	0	0	0	0	0	2
3	*Lepidochelys olivacea*	Olive Ridley	0	0	0	0	0	0	0	0	0	0
4	*Calotes versicolor versicolor*	Common Tree Lizard	56	62	71	83	81	89	86	86	86	700
5	*Hemidactylus brookii*	Spotted Barn Gecko	3	20	21	23	30	21	55	55	55	283
6	*Hemidactylus flaviviridis*	Yellow-belly Common House Gecko	11	17	19	23	28	33	39	39	39	248
7	*Hemidactylus persicus*	Persian House Gecko	17	19	22	23	26	27	34	34	34	236
8	*Hemidactylus triedrus*	Blotched House Gecko	11	14	15	17	23	34	44	44	44	246
9	*Hemidactylus turcicus*	Mediterranean House Gecko	21	24	29	32	37	32	30	30	30	205
10	*Acanthodactylus cantoris*	Blue-Tail Sand Lizard	203	197	196	199	200	235	245	245	245	1965
11	*Mesalina watsonana*	Spotted Lacerta	149	159	165	184	197	205	201	201	201	1662
12	*Varanus bengalensis*	Bengal Monitor	17	18	24	21	23	25	37	37	37	239
13	*Platyceps rhodorachis*	Cliff Racer	0	0	1	3	4	3	5	5	5	26
14	*Sphalerosophis diadema diadema*	Blotched Diadem Snake	0	0	3	4	5	7	8	8	8	43
15	*Naja naja*	Black Cobra	0	0	0	0	1	0	7	7	7	22
16	*Echis carinatus*	Saw-scaled Viper	0	0	0	0	3	8	6	6	6	29
17	*Enhydrina schistosa*	Beaked Sea Snake	9	11	9	5	6	5	12	12	12	81
18	*Hydrophis caerulescens*	Blue Green Sea Snake	10	5	7	9	11	15	20	20	20	117
19	*Hydrophis cyanocinctus*	Annulated Sea Snake	11	14	12	4	5	6	9	9	9	79
20	*Hydrophis lapemoides*	Persian Sea Snake	1	1	1	2	1	1	1	1	1	10
21	*Hydrophis mamillaris*	Broad Band Sea Snake	11	9	9	13	15	21	19	19	19	135
22	*Hydrophis ornatus*	Reef Sea Snake	17	15	13	15	17	19	23	23	23	165
23	*Hydrophis spiralis*	Yellow Sea Snake	11	12	15	11	13	15	18	18	18	131
24	*Lapemis curtus*	Pygmy Sea Snake	5	3	5	8	9	13	15	15	15	88

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S. No.	Scientific name	Common name	2001	02	03	04	05	06	07	08	09	Total
25	*Microcephalophis cantrois*	Spotted Small Headed Sea Snake	7	9	4	7	9	7	11	11	11	76
26	*Pelamis platurus*	Pelagic Sea Snake	9	11	12	16	17	15	17	17	17	131
27	*Praescutata viperina*	Spotted Viperine Sea Snake	12	15	13	15	17	24	19	19	19	153
	Total		610	656	689	738	797	881	988	982	986	7327

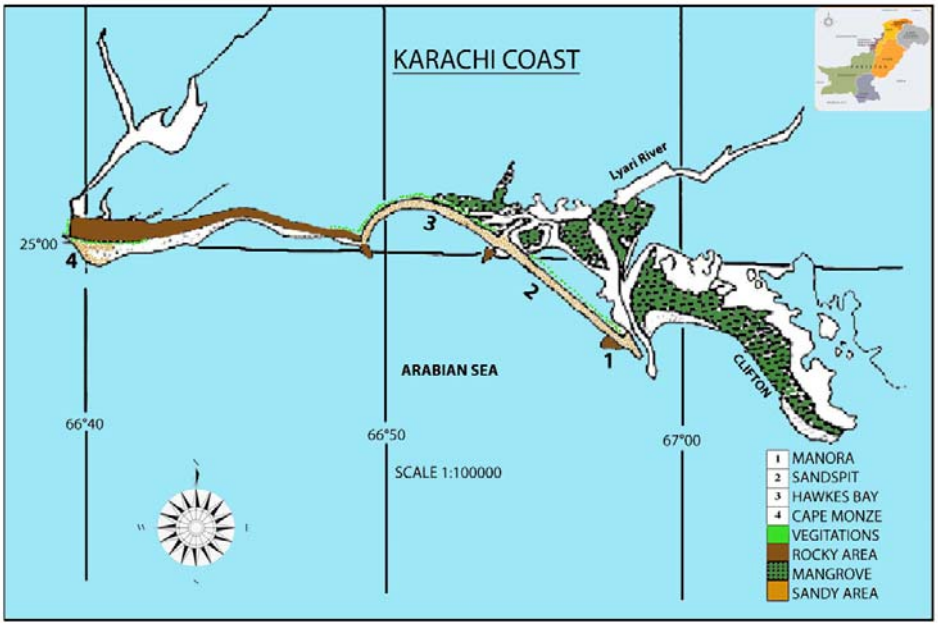

Fig. 2. Study areas of Reptiles on Karachi Coast.

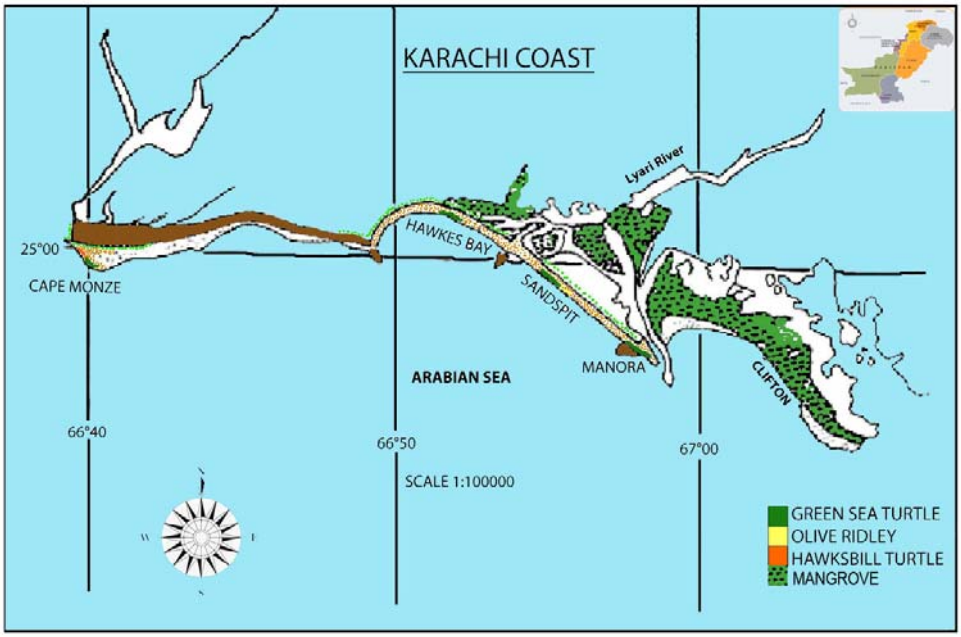

Fig. 3. Distribution of Marine Turtles at Karachi Coast.

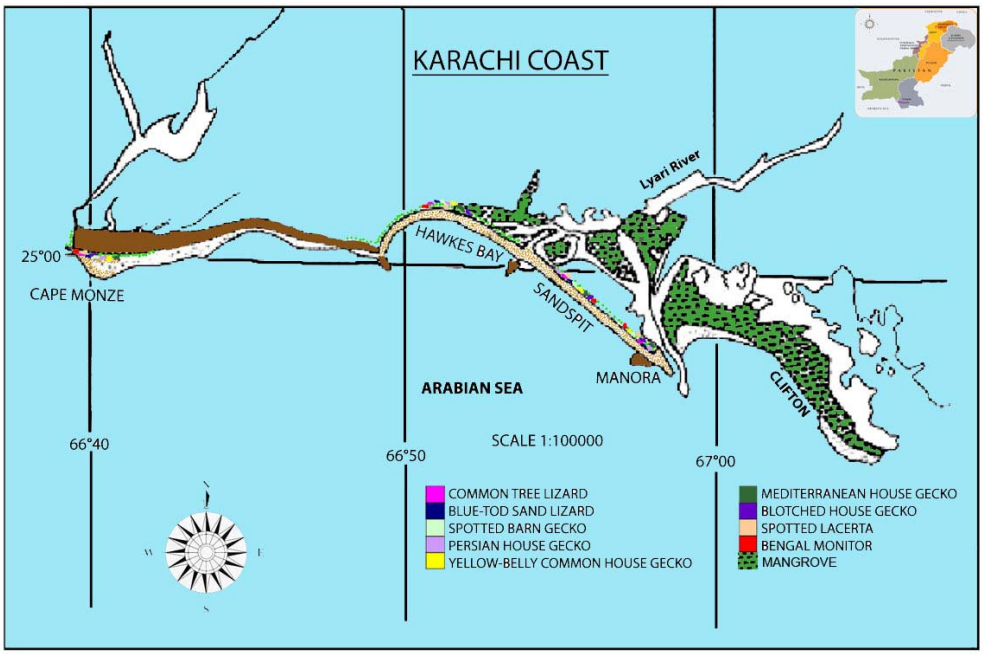

Fig. 4. Distribution of Lizards at Karachi Coast.

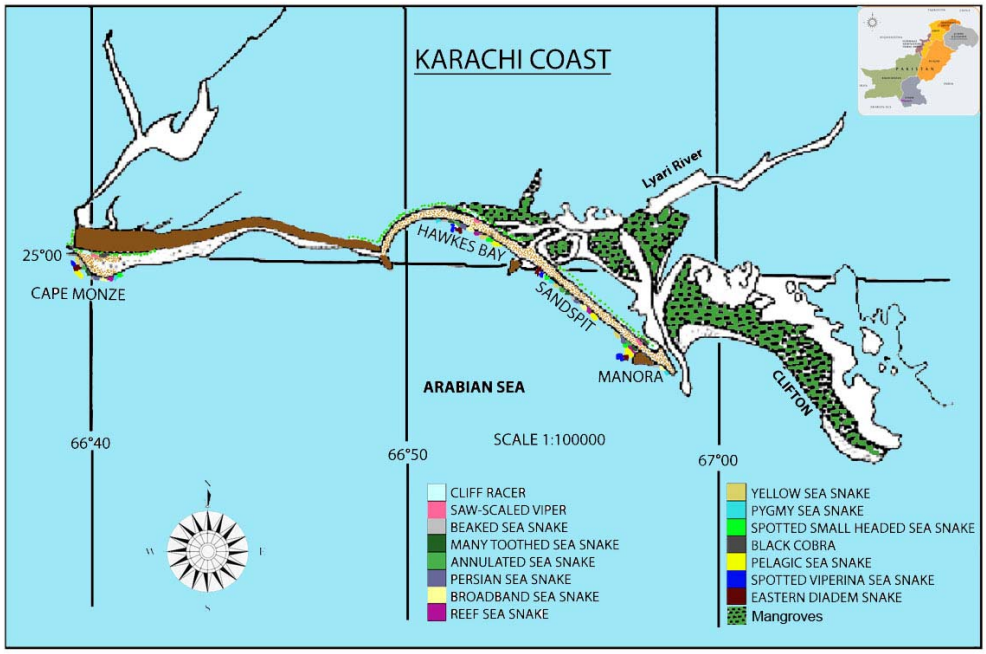

Fig. 5. Distribution of Snakes at Karachi Coast.

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