

STUDY OF FRESHWATER TURTLES IN SELECTED DISTRICTS OF SINDH-PAKISTAN: THREATS, ILLEGAL TRADE AND CONSERVATION

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ABSTRACT

Population estimation of freshwater turtles was conducted in selected localities from seven selected districts of Sindh. Two years surveys were carried out from 2015 to 2016. Eight species of freshwater turtles were recorded from Sindh. In 2015, population of *Lissemys punctata* (16.93%) was found as abundant in most of the districts of Sindh. *Pangshura tecta* (13.05%) and *Geoclemys hamiltonii* (13.49%) were recorded as common while population of *Nilssonina hurum* (11.56%) was estimated as less common. *Chitra indica* (9.23%) was recorded as rare. In 2016, slight decline in most of the turtle's populations were observed as *Lissemys punctata* (15.08%), *Pangshura tecta* (12.74%), *Geoclemys hamiltonii* (12.02%), *Nilssonina hurum* (12.6%). Highest ratio of Shannon diversity index (2.07) was recorded from Sukkur District while Evenness index was also high in Sukkur district (0.406). Hunting and Illegal trading were recorded as major threats for their survival. Other factors include their usage in pharmaceutical, food industries and as pets. Several measures have been taken for their conservation by IUCN, Sindh Wildlife Department, Zoological Survey Department, and Department of Zoology (Wildlife Section), University of Karachi.

Key words: Freshwater turtles, Sindh, Population distribution.

INTRODUCTION

Turtles play an important role in ecological balance of an aquatic ecosystem. They act as natural recyclers maintaining a healthy environment in wetlands by scavenging and filtering water contents and remove debris and other contaminants from a wetland (Prestridge, 2009).

Eight species of freshwater turtles are inhabitants of Indus river system and its tributaries. These species includes Spotted Pond turtle (*Geoclemys hamiltonii*), Crowned river turtle (*Hardella thurjii*), Brown roofed turtle (*Pangshura smithii*), Indian roofed turtle (*Pangshura tectum*), Indian narrow-headed soft-shell turtle (*Chitra indica*), Indian soft-shell turtle (*Nilssonina gangeticus*), Indian peacock soft-shell turtle (*Nilssonina hurum*) and Indian flapshell turtle (*Lissemys punctata*).

Lack of knowledge about freshwater turtles has affected their conservation and several species are included in the IUCN and CITES Appendix I and Appendix II (Table 1). The population of freshwater turtles in Pakistan has been extensively declining because

of deterioration of natural habitats, environmental degradation, unlawful capture, urbanization, human wildlife conflict, human population extension, anthropogenic factors, and modification in riverbanks. In Pakistan, the illegal trade of *Geoclemys hamiltonii* (Black spotted Turtle) has increased up to high levels during past few years. Seizure data records show that Pakistan, Bangladesh and India are the major hubs for exportation of illegal shipments of freshwater turtles. The major receiver markets in South Asia are Bangkok, Thailand, Hong Kong, China and Indonesia (Chng, 2014). China is the biggest consumer market for freshwater turtles which are demanding them for food industry, pet trade and pharmaceutical industries.

Pakistan is facing shortage of quantitative data about turtle's population. The objective of present study is to highlight the distribution, threats and population status of freshwater turtles and to provide a conservation model for securing their survival and conservation. The baseline information about the occurrence of freshwater turtle population and hotspots for their abundance has also indicated.

Table 1. IUCN and CITES Appendix I and Appendix II status of Freshwater Turtles.

No	Family	Scientific Name	Common Name	IUCN Status	CITES Appendix I	CITES Appendix II
1	Geoemydidae	<i>Geoclemys hamiltonii</i>	Spotted Pond Turtle	Vulnerable (VU)	+	-

2	<i>Pangshura smithii</i>	Brown Roofed Turtle	Near Threatened/Low Risk (NT/LR)	-	+
3	<i>Pangshura tecta</i>	Indian Roofed Turtle	Least Concern (LC)	+	-
4	<i>Hardella thurjii</i>	Crowned River Turtle	Vulnerable (VU)	-	-
5	Trionchidae	<i>Nilssononia gangeticus</i>	Ganges Soft shell Turtle	Vulnerable (VU)	-
6		<i>Nilssononia hurum</i>	Peacock Soft shell Turtle	Vulnerable (VU)	-
7	<i>Lissemys punctata</i>	Indus Flapshell Turtle	Least Concern/low Risk (LC/LR)	-	+
8	<i>Chitra indica</i>	Indian narrow headed soft shell Turtle	Endangered (E)	-	+

MATERIALS AND METHODS

Study Sites: In this study, seven districts of Sindh have been selected as hotspots study areas including Thatta District, Sujawal District, Dau District, Khairpur District, Badin District, Sanghar District and Sukkur District.

The important areas selected for study in Thatta district (Fig. 1) were Keenjhar lake, Haleji lake, Hadero lake, Mehboobshah dhand, Karo dhand, Jabho lagoon, Chabo mori, Barrage mori, Mirpur sakro canal, Ghorabari Fish farms and Deh Janghisar.

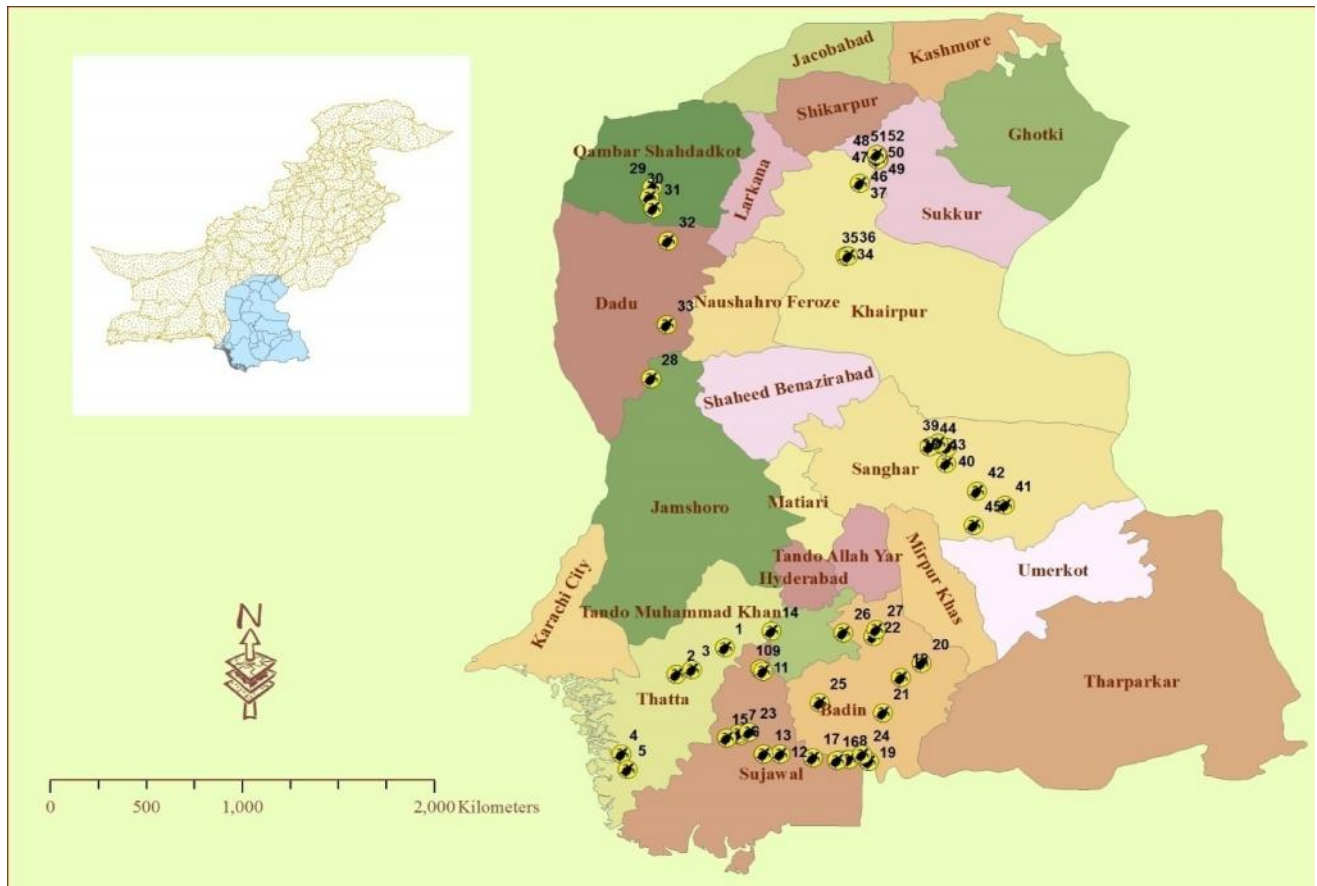


Fig. 1. Distribution of Freshwater Turtles in selected districts of Sindh.

Legend 1. Keenjhar lake, 2. Haleji lake, 3. Hadero lake, 4. Mehboobshah dhand, 5. Karo dhand, 6. Jabho lagoon, 7. Chabo mori, 8. Barrage mori, 9. Mirpur sakro canal, 10. Ghorabari Fish farms, 11. Deh Janghisar, 12. Jhal dhand, 13. Amerji dhand, 14. Theri dhand, 15. Thari

dhand, 16. Ohtko dhand, 17. Ameerji Dhand, 18. Jaffarali lake, 19. Phoosna lake, 20. Tandobago, 21. LBOD, 22. Buhri lake, 23. Andhalo Fish farm, 24. Lakhi dhand, 25. Fuleli Guni drain, 26. Kadhan lagoon, 27. Rice field Matli, 28. Rajo khanani Dhand, 29. Manchar lake, 30.

Badram dhand, 31. Daba dhand, 32. Katchri dhand, 33. Unheri dhand, 34. Sanjri dhand, 35. Bakriwalo lake, 36. Vero lake, 37. Wadisim lake, 38. Mirwah Canal, 39. Nara canal (Sanghar), 40. Chotiari wetlands, 41. Kharoro Dhand, 42. Khipro Dhand, 43. Bakar lake, 44. Soonhari lake, 45. Mehmoodwari Dhand, 46. Nara canal, 47. Mirwah canal, 48. Rohri canal, 49. Abulwah canal, 50. Khirthar canal, 51. Dadu canal and 52. Rice canal.

In Sujawal district selected study areas were Jhal dhand, Amerji dhand, Theri dhand and Ohtko dhand. In Badin district study areas were Jaffarali lake, Phoosna lake, Tandobago, LBOD, Buhri lake, Andhalo Fish farm, Lakhi dhand, Fuleli Guni drain, Kadhan lagoon, Rice field Matli and Rajo khanani Dhand, while in Dadu district, selected study sites were Manchar lake, Badram dhand, Daba dhand, Katchri dhand, Unheri dhand and Sanjri dhand. The important lakes selected in Khairpur district were Bakriwalo lake, Vero lake, Wadisim lake and Mirwah canal, In Sanghar district selected study areas were Nara canal, Chotiari wetlands, Kharoro Dhand, Khipro Dhand, Bakar lake, Soonhari lake, and Mehmoodwari Dhand. In Sukkur district study sites included Nara canal, Mirwah canal, Rohri canal, Abulwah canal, Khirthar canal, Dadu canal and Rice canal (Fig. 1).

Following techniques were used for data collection.

Active Captures: We caught turtles with the assistance of a local hunters. Active Captures includes visual surveys, hand captures, view scopes, night spotting, tracking, blind capture and straining aquatic vegetation.

Visual Surveys: Lindemann (1996) suggested the visual survey technique supportive to study basking turtles. Visual survey method was used to identify the presence of turtles in a specific location. This technique facilitates the study of population richness, type of habitat, species identification, and ecological variation. Basking turtles were also observed by help of binocular and spotting telescopes.

- i. **Hand Captures:** Mills (2002) described that hand capturing is a wonderful tool for turtle identification during diversified habitat. Hand capture technique was used during study for sampling and identification of turtle's species. Dip nets and hoop nets were also used for this purpose.
- ii. **View Scopes:** Akre (2002) recommended the use of view scope as very helpful tool in viewing submerged turtle in ponds. Aquatic view scope (Aqua scope II) was used to observe the movement of turtles in shallow wetlands.
- iii. **Night Spotting:** Turtles movement was observed during night time by the help of Spotlight having high powered lamp. McDiarmid *et al.* (2012)

described the use of night spotting for viewing the eye shine of reptiles during night surveys.

- iv. **Tracking:** Tracking was used for detecting the presence of turtles by signs and tracks. They include trails, fecal material, dens, tunnels, pieces of flippers and egg laying excreta.
- v. **Blind Capture:** According to McDiarmid *et al.* (2012), Blind capture technique was used when turtle was not visible in shallow or muddy water so it could be felt by blindly probing hand or feet into mud.
- vi. **Trapping:** Trapping method was also adopted by Gamble and Simons (2004). Trapping was done with the help of hoop nets, fyke nets and dip nets for investigating the abundance and identification of species. Different baits were used like shrimps, small fish and aquatic weeds.
- vii. **Line Transact Method:** Line transact method was used for turtle surveys. Area of 6 km was selected and transact walks were made to record the data about population and status of freshwater turtles while ecology, threats and environmental conditions were also monitored.

Indirect Data Collection: Information which was collected by indirect ways including the interviews of associated people like fishermen, wildlife officials, traders, hunters and local communities and reviewing of the scientific published literature.

Data Analysis: The diversity index was calculated which is called "Shannon-wiener" index of diversity, which combines the number of species present and evenness into a single index. The formula used as: $H = - \sum p_i \ln p_i$, where

"i" stands for an index number for each species present in a sample, "pi" can be calculated through " n_i/N " in which " n_i " represents the number of individuals within a species divided by the total number of individuals. "N" represent the entire sample and "ln" stands for natural log.

The Evenness Index (E) = $H / \ln(S)$ was also calculated, where H is the Shannon-Wiener Diversity Index and S is the number of species. Based on the data, non-parametric tests were applied using SPSS 18.0 and M.S Excel 2007.

RESULTS

Globally, freshwater turtles are among the most conspicuous and ecologically important components of aquatic ecosystems. In this study, seven districts of Sindh have been selected and data were collected about distribution, population status and threats. Based on our study, in the year 2015, population of *Lissemys punctata* was recorded as abundant (16.93%), while *Pangshura tecta* was recorded in second level of abundance (13.50%). The population of *Geoclemys hamiltonii* was

(13.49%), *Pangshura smithi* (11.98%), *Nilssonina gangeticus* (11.89), *Nilssonina hurum* (11.56%), *Hardella thurji* (11.35%) and *Chitra indica* (9.23%) (Table 2).

In Thatta district the minimum number of freshwater turtles was found in Hadero lake. The percentage was 0.18%, while the maximum number of freshwater turtles was recorded from Mirpur Sakro Canal and the percentage was 2.64% (Table 2).

In Sujawal district minimum population was recorded from Fish Farm area Theri dhad having 2.04%, while maximum population was recorded from Guni mori area having 2.97% (Table 2).

In Badin district, minimum population was observed from Left Bank Outfall Drain (LBOD). The percentage of population was 0.47%, while maximum population was recorded from Fuleli Guni drain area i.e. 2.07% (Table 2).

In Dadu district, minimum number of freshwater turtles was recorded from Kachri Dhand i.e. 0.53%, while maximum number of freshwater turtles was recorded from Unheri dhand having 2.86% of population (Table 2).

In Khairpur district minimum population was recorded from Vero lake i.e.1.63%, while maximum population was recorded from MirWah canal i.e. 3.07% (Table 2).

In Sanghar district, minimum number of freshwater turtles was recorded from Kharoro dhand i.e. 1.16 %, while maximum numbers of freshwater turtles population were recorded from Nara canal having 3.56% (Table 2).

In Sukkur district, minimum population was recorded from Mirwah canal i.e 2.19%, while maximum population was recorded from Nara canal i.e 4.08% (Table 2).

The overall minimum population of freshwater turtles recorded from Sindh in year 2015 were from Hadero lake Thatta (0.18%) and LBOD in Badin (0.47%), while the overall maximum population of freshwater turtles were observed from Nara canal (4.08%) from Sukkur district (Table 2).

Table 3 demonstrated the recorded population of freshwater turtles in selected districts of Sindh in year 2016. The population of *Lissemys punctata* was again recorded as abundant (15.08%), while the population of *Pangshura smithii* was recorded in second level of abundance (13.02%). The populations of *Pangshura tecta* recorded (12.74%), *Nilssonina hurum* (12.60%), *Nilssonina gangeticus* (12.20), *Geoclemys hamiltonii* (12.02%), *Hardella thurji* (11.24%) and *Chitra indica* recorded (11.02%).

In Thatta district, minimum number of freshwater turtles was found in Hadero lake (0.03%), while the maximum number was recorded from Mirpur Sakro canal i.e. 2.52%.

In Sujawal district minimum number recorded from Thari dhand having 1.63%, while maximum number were recorded from Amerji dhand having 2.70% of population (Table 3).

In Badin district, minimum numbers were observed from Buhri lake. The percentage of population was 0.58%, while maximum number of freshwater turtles were recorded from Phoosna lake i.e. 2.0% (Table 3).

In Dadu district, minimum number was recorded from Manchar lake i.e. 1.42%, while maximum number was recorded 2.03% from Kachhri dhand (Table 3).

In Khairpur district minimum number of freshwater turtles was recorded again from Vero lake i.e.1.97%, while maximum numbers 3.07% recorded from Mirwah canal (Table 3).

In Sanghar District, Minimum number 0.74% were recorded from Baandho lake, while maximum numbers 3.56% recorded from Nara canal (Table 3).

In Sukkur District, minimum number of freshwater turtles were recorded from Mirwah canal i.e 1.96%, while maximum numbers were recorded 4.28% from Nara canal (Table 3).

The overall minimum population of freshwater turtles recorded from Sindh in year 2016 were again from Hadero lake Thatta (0.19%) and Buhri lake in Badin (3.17%), while the overall maximum population of freshwater turtles were again observed from Khirthar canal (37.66%) from Sukkur district (Table 3).

Table 2. Population Distribution of Freshwater turtles in different districts of Sindh in 2015.

Population Distribution of Freshwater turtles in different districts of Sindh in 2015											
District	Location	H.T	P.S	P.T	G.H	L.P	N.H	C.I	N.G	Total	%
Thatta	Keenjhar Lake	3	33	11	53	21	23	55	33	232	2.59%
	Haleji Lake	22	21	23	12	19	65	Nil	16	178	1.99%
	Hadero Lake	1	0	4	1	0	5	3	2	16	0.18%
	Mehboob Shah Dhand	34	16	38	2	21	23	1	13	148	1.65%
	Karo Dhand	23	18	21	19	25	17	12	16	151	1.69%
	Jubho Lagoon	17	3	37	12	13	12	2	19	115	1.28%
	Chabo Mori	12	5	14	6	8	8	11	5	69	0.77%
	Barrage Mori	6	12	18	11	6	3	6	12	74	0.83%
	MirPur Sakro Canal	15	29	34	39	22	76	2	19	236	2.64%
	Ghora Bari Fish Farm	21	3	23	21	18	Nil	Nil	26	112	1.25%
Sujawal	Deh Janghisar	12	18	14	19	6	3	2	13	87	0.97%
	Theri Dhand	33	24	18	21	45	17	12	13	183	2.04%
	Thari Dhand	16	23	nil	34	66	23	27	10	199	2.22%
	Ohtko Dhand	43	45	26	16	54	35	5	12	236	2.64%
	Amerji Dhand	24	55	15	21	37	16	38	6	212	2.37%
	Jhal Dhand	21	45	34	25	76	23	24	16	264	2.95%
	Guni Mori	31	33	23	66	44	22	16	31	266	2.97%
	Fish Farm Badh Mori	4	32	24	55	22	11	nil	13	161	1.80%
	Jaffarali Lake	4	46	5	36	5	5	35	6	142	1.59%
	Phoosna Lake	6	5	8	32	24	17	7	37	136	1.52%
Badin	Tando Bago	6	36	36	5	35	34	8	6	166	1.85%
	LBOD	7	4	7	nil	9	6	9	nil	42	0.47%
	Buhri Lake	5	7	nil	7	3	37	35	6	100	1.12%
	Andhalo Fish Fram	24	8	3	28	9	4	8	47	131	1.46%
	Laakhi Dhand	8	4	6	7	9	17	3	16	70	0.78%
	Fuleli guni drain	35	26	35	45	8	4	8	24	185	2.07%
	Kadhan Lagoon	7	3	8	8	7	8	35	7	83	0.93%
	Rice field Matli	35	4	5	36	6	nil	32	16	134	1.50%
	Rajo Khanani Dhand	6	16	34	9	35	24	7	5	136	1.52%
	Manchar Lake	34	7	8	6	46	nil	36	5	142	1.59%
Dadu	Badram Dhand	6	38	5	7	35	9	6	24	130	1.45%
	Daba Dhand	17	9	4	56	7	48	8	38	187	2.09%
	Kachhri Dhand	6	3	9	7	6	8	nil	8	47	0.53%
	Unheri Dhand	37	6	35	4	75	34	9	56	256	2.86%
	Sanjri Dhand	0	nil	8	35	4	6	7	9	69	0.77%
	Bakriwalo Lake	54	7	9	34	35	8	16	46	209	2.33%
Khairpur	Vero Lake	8	46	34	7	4	35	7	5	146	1.63%
	Wadi Sim Lake	9	35	45	nil	24	36	2	8	159	1.78%

Sanghar	Mir Wah Canal	37	nil	25	35	98	nil	44	36	275	3.07%
	Nara Canal	35	23	67	36	98	7	6	47	319	3.56%
	Chotiari wetlands	7	15	56	8	46	34	34	nil	200	2.23%
	Kharoro Dhand	26	8	34	6	9	8	9	4	104	1.16%
	Baandho Lake	2	34	6	38	34	6	7	34	161	1.80%
	Khipro Lake	20	3	35	9	nil	24	30	8	129	1.44%
	Bakar Lake	8	39	8	37	35	9	nil	45	181	2.02%
	Soonhari Lake	34	7	nil	23	7	34	36	5	146	1.63%
	Mehmoodwari Dhand	nil	34	56	9	56	12	4	27	198	2.21%
Sukkur	Nara Canal	58	41	85	43	67	38	2	31	365	4.08%
	MirWah Canal	nil	38	19	29	27	26	23	34	196	2.19%
	Rohri Canal	53	22	38	nil	17	34	22	35	221	2.47%
	Abul Wah Canal	26	14	59	19	28	25	24	13	208	2.32%
	Khirthar Canal	14	25	15	57	28	19	36	14	208	2.32%
	Dadu Canal	32	12	12	31	23	16	22	65	213	2.38%
	Rice Canal	12	33	15	26	54	21	34	23	218	2.44%
	Total	1016	1073	1211	1208	1516	1035	827	1065	8951	100.00%
	%	11.35%	11.98%	13.50%	13.49%	16.93%	11.56%	9.23%	11.89%		

Key. HT (*Hardella thurji*), PS (*Pangshura smithi*), PT (*Pangshura tecta*), GH (*Geoclemys hamiltoni*), LP (*Lissemys punctata*), NH (*Nilssononia hurum*), CI (*Chitra indica*), NG (*Nilssononia gangeticus*).

Table 3. Population Distribution of Freshwater turtles in different districts of Sindh in 2016.

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District	Location	H.T	P.S	P.T	G.H	L.P	N.H	C.I	N.G	Total	%
Thatta	Keenjhar Lake	23	6	43	24	44	39	12	12	203	2.30%
	Haleji Lake	7	44	6	34	24	27	4	23	169	1.92%
	Hadero Lake	0	0	0	0	0	1	0	2	3	0.03%
	Mehboob Shah Dhand	6	24	33	32	25	5	12	32	169	1.92%
	Karo Dhand	23	5	4	4	25	18	3	24	106	1.20%
	Jubho Lagoon	33	22	23	23	33	5	2	32	173	1.96%
	Chabo Mori	5	45	2	4	45	24	3	11	139	1.58%
	Barrage Mori	2	23	4	2	13	15	nil	15	74	0.84%
	MirPur Sakro Canal	41	45	32	22	23	23	4	32	222	2.52%
	Ghora Bari Fish Farm	44	2	25	32	17	45	2	22	189	2.14%
Sujaawal	Deh Janghisar	3	31	32	13	23	23	nil	19	144	1.63%
	Theri Dhand	16	6	19	36	37	24	18	nil	156	1.77%
	Thari Dhand	27	35	6	6	15	23	6	37	155	1.76%
	Ohtko Dhand	5	44	22	28	38	41	24	8	210	2.38%
	Amerji Dhand	38	31	24	43	26	17	35	24	238	2.70%
	Jhal Dhand	3	27	36	22	7	25	33	43	196	2.22%
	Guni Mori	18	21	nil	44	36	14	29	23	185	2.10%

Badin	Fish Farm Badh Mori	16	14	24	nil	33	19	21	nil	127	1.44%
	Jaffarali Lake	6	18	5	36	12	11	6	34	128	1.45%
	Phoosna Lake	35	33	8	4	8	27	28	33	176	2.00%
	Tando Bago	6	4	6	nil	34	36	36	9	131	1.49%
	LBOD	8	5	8	12	7	26	5	5	76	0.86%
	Buhri Lake	9	7	7	8	3	4	8	5	51	0.58%
	Andhalo Fish Fram	nil	34	5	35	31	nil	36	5	146	1.66%
	Laakhi Dhand	9	8	36	6	9	3	6	8	85	0.96%
	Fuleli guni drain	4	34	34	11	8	6	7	8	112	1.27%
	Kadhan Lagoon	7	45	25	9	4	6	3	6	105	1.19%
	Rice field Matli	35	7	7	8	8	3	24	24	116	1.32%
	Rajo Khanani Dhand	8	23	33	12	4	37	7	9	133	1.51%
Dadu	Manchar Lake	6	39	9	7	45	9	4	6	125	1.42%
	Badram Dhand	17	7	6	39	8	35	12	6	130	1.47%
	Daba Dhand	3	8	9	33	37	21	nil	16	127	1.44%
	Kachhri Dhand	7	5	46	44	9	29	9	30	179	2.03%
	Unheri Dhand	34	4	8	8	25	10	46	nil	135	1.53%
Khairpur	Sanjri Dhand	9	7	25	46	43	2	9	9	150	1.70%
	Bakriwalo Lake	37	47	16	34	28	23	28	16	229	2.60%
	Vero Lake	nil	21	17	15	34	15	56	16	174	1.97%
	Wadi Sim Lake	18	35	38	34	27	nil	27	44	223	2.53%
	Mir Wah Canal	21	11	27	19	33	24	45	56	236	2.68%
	Nara Canal	47	8	7	nil	66	28	8	47	211	2.39%
Sanghar	Chotiari wetlands	23	11	4	6	13	26	10	14	107	1.21%
	Kharoro Dhand	14	5	77	14	34	25	nil	9	178	2.02%
	Baandho Lake	21	6	10	7	5	4	4	8	65	0.74%
	Khipro Lake	45	9	32	4	34	34	39	nil	197	2.23%
	Bakar Lake	5	41	8	16	63	8	7	38	186	2.11%
	Soonhari Lake	3	18	1	3	57	23	34	74	213	2.42%
	Mehmoodwari Dhand	45	4	9	5	8	1	56	nil	128	1.45%
Sukkur	Nara Canal	63	25	98	35	34	44	23	55	377	4.28%
	MirWah Canal	14	nil	34	33	25	27	24	16	173	1.96%
	Rohri Canal	25	76	26	59	13	57	15	14	285	3.23%
	Abul Wah Canal	25	51	37	36	16	53	29	24	271	3.07%
	Khirthar Canal	34	27	12	15	45	15	33	25	206	2.34%
	Dadu Canal	23	14	34	24	36	11	27	32	201	2.28%
	Rice Canal	15	26	25	14	nil	44	53	16	193	2.19%
Total		991	1148	1124	1060	1330	1115	972	1076	8816	100.00%
%		11.24%	13.02%	12.74%	12.02%	15.08%	12.60%	11.02%	12.20%		

Key. HT (*Hardella thurji*), PS (*Pangshura smithi*), PT (*Pangshura tecta*), GH (*Geoclemys hamiltoni*), LP (*Lissemys punctata*), NH (*Nilssononia hurum*), CI (*Chitra indica*), NG (*Nilssononia gangeticus*).

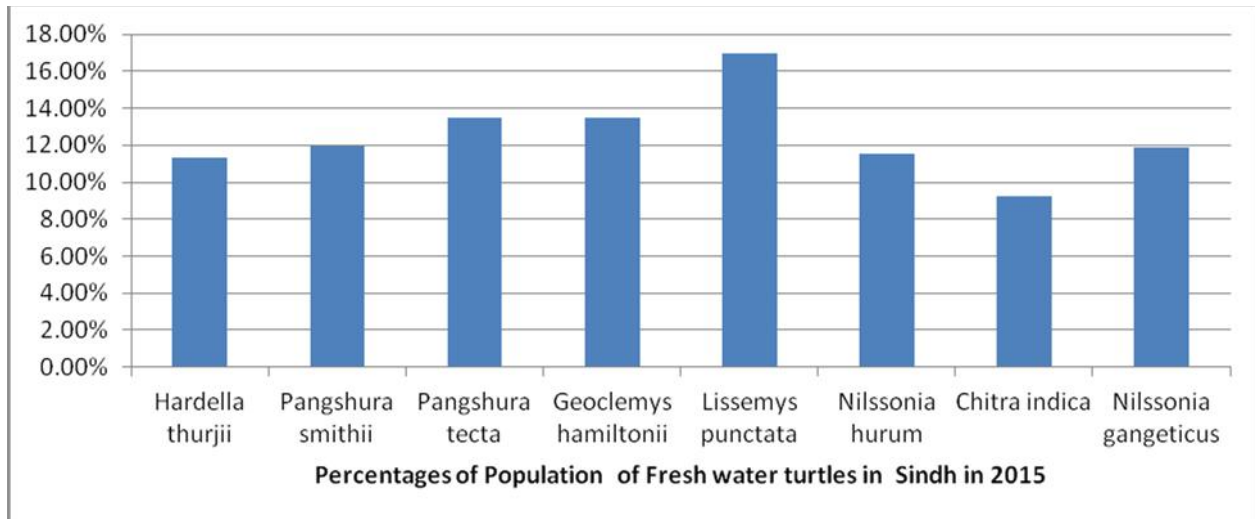


Fig. 2. Percentages of Population of Freshwater turtles in Sindh in 2015.

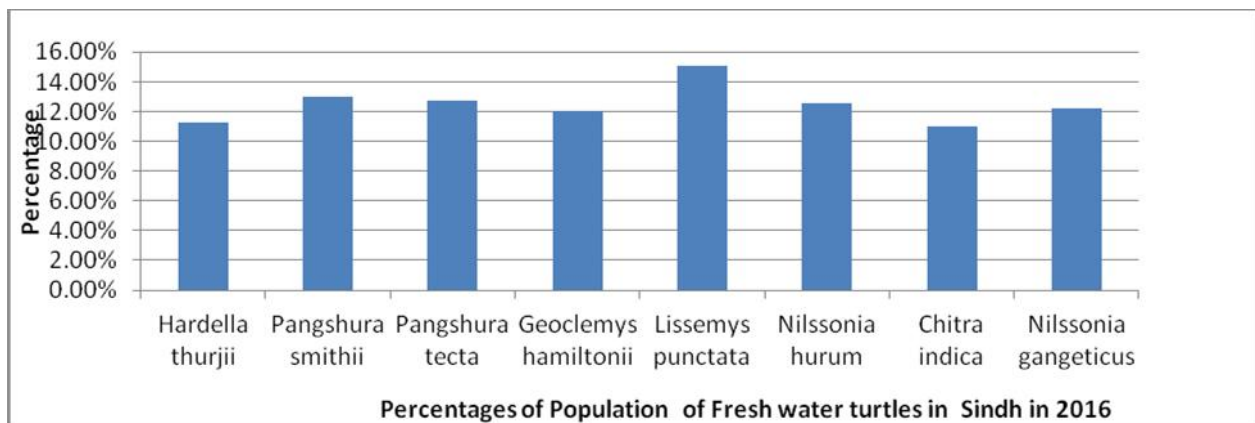


Fig. 3. Percentages of Population of Freshwater turtles in Sindh in 2016.

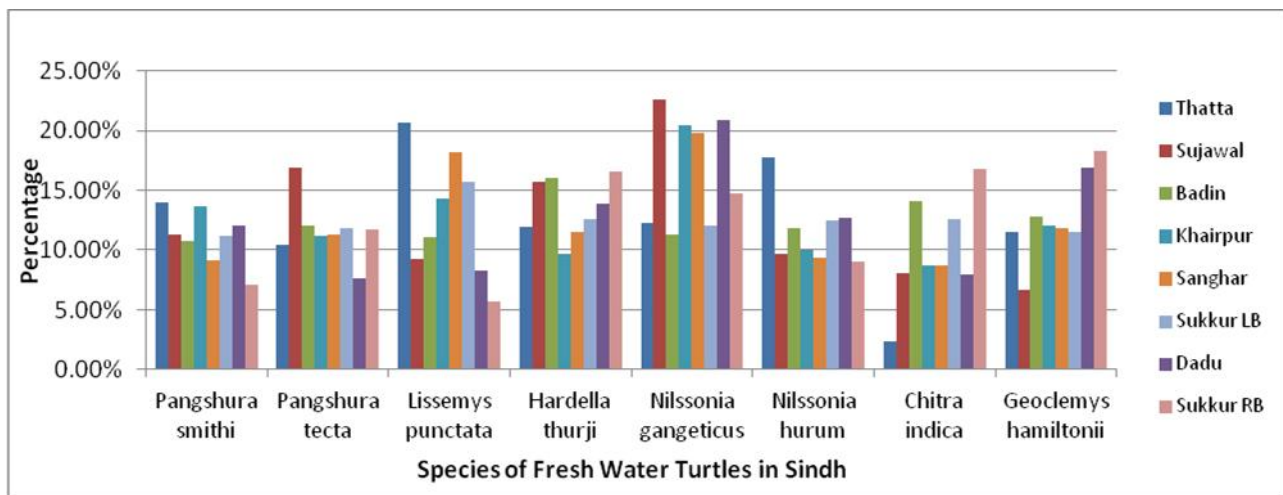


Fig. 4. Percentage of Population Distribution of Freshwater Turtles in year 2015.

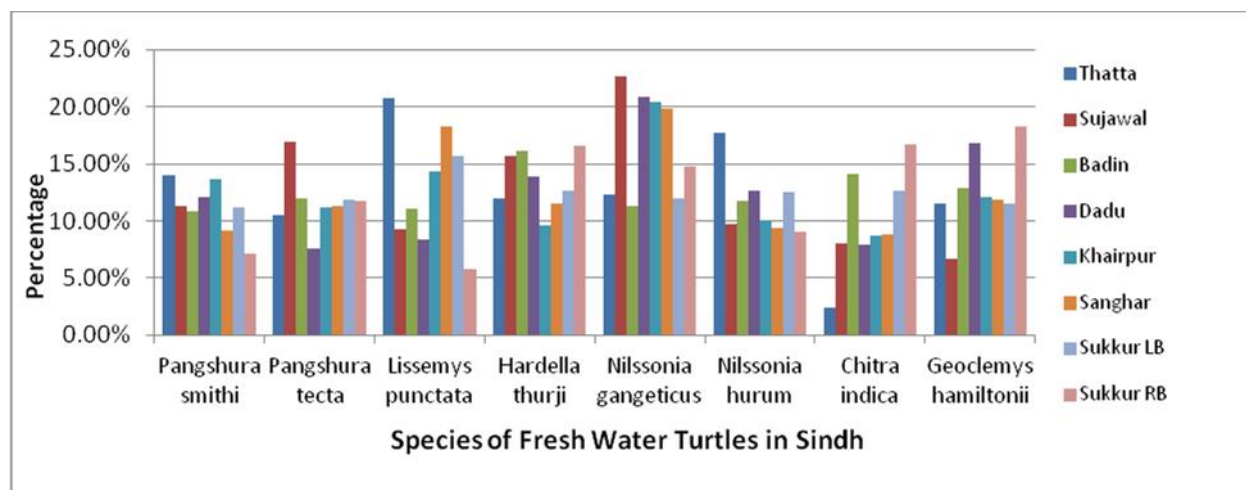


Fig. 5. Percentage of Population Distribution of Freshwater Turtles in year 2016.

In Badin district and Sukkur district, high species diversity (Shannon-Wiener diversity index) has been recorded i.e. 2.071 and 2.070 respectively. Badin and Sukkur districts also showed a slight even distribution in the number of freshwater turtle distribution i.e. Evenness index = 0.406, 0.390, respectively.

Statistical data revealed that Thatta district has shown large number of species ratio of *Pangshura tecta* (0.167) and *Nilssonina hurum* (0.165), while in Sujawal district largest number of species ratio of *Lissemys punctata* was (0.22), Badin district showed largest number of species ratio of *Geoclemys hamiltonii* (0.16), while Dadu district showed the largest number of species ratio of *Lissemys punctata* (0.21), Khairpur district showed the largest number of species ratio of *Lissemys punctata* (0.20) while Sanghar district showed the largest number of species ratio of *Lissemys punctata* (0.19) and Sukkur district showed the largest number of species ratio of *Lissemys punctata* (0.15). Over all largest species ratio of *Lissemys punctata* was recorded from all districts of Sindh.

DISCUSSION

Sindh is the third largest province of Pakistan having a diversified range of aquatic habitats including the expanded network of Indus river system, which comprises of several major canals, lakes, irrigation networks, reservoirs, meadows, swamps, marshes and shallow ponds.

Freshwater turtles are spread out all through the branches of river Indus. Presently freshwater turtles in Sindh are struggling for their existence against several threatening factors and severe ecological modifications that have been made by continuing anthropogenic activities.

From some recent years the trade and business activities of freshwater turtles has escalated in Sindh due

to high demands for turtles, their body parts and meat in South Asian countries like China, Vietnam and Hong Kong. Their skin, flesh and fats are used for many purposes like food industry, cosmetics industry, pharmaceutical industry and pet industry. Their fats, carapaces, and plastrons are used for preparation of Traditional Chinese medicines and turtle jelly known as Gulingao jelly. Their meat is enjoyed as a luxurious dish in restaurants of China, Hong Kong, Philippines, and Vietnam. Due to these entire reasons, turtle's survival crisis increased up to high risk in past few years. Van Dijk *et al.* (2014) noticed the worldwide decline in turtle's population, while 47% species are classified as Vulnerable, Endangered and Critically Endangered by IUCN SSC. Some of the factors which were observed during this research are as follows.

Indus river water flowing in down hills of Sindh making its way to Arabian Sea not only contains water and soil but also restrain many pollutants and contaminants from several industrial units, agricultural lands, domestic wastages and effluents. All these impurities including pesticides, heavy metals, radioactive waste, fertilizers and all other toxic waste lead the population of turtles to decline.

Most of the people in Sindh are dependent of fishing practices for their livelihood and turtles are captured as by catch which results in increased mortality of turtles. Raby *et al.* (2016) studied the effects of freshwater by catch on ecological communities in freshwater ecosystem.

Several developmental projects in Sindh are under progress. Natural habitat of freshwater turtles is deteriorated and fragmented due to unsustainable developmental activities. These anthropogenic activities includes damming, channeling of rivers, highways constructions, wind power projects, coal projects and establishment of thermal grid stations resulted in habitat loss and decline in freshwater turtle populations. Several

developmental projects are under progress like Wind Mill projects Jhimpir (Thatta), Thar Coal project (Tharparkar), Double carriageway project (Thatta to Karachi), Solar power project (Khairpur) and Thermal power projects in Sindh. Stokeld *et al.* (2014) studied the effects of deterioration of natural habitat on freshwater turtle's populations and found that habitat loss, degradation of aquatic ecology and modification in embankment areas due to developmental projects adversely affects the distribution and population of freshwater turtles.

Induced and invasive species also harm the native populations of turtles. Invasive species can modify habitat ecology and resident vegetation species which unfavorably affects the native species (Cavia *et al.*, 2009).

Parasites and infectious agents also effects on the turtle populations. Most of the turtles are affected by shell lesions (Lovich *et al.*, 1996). *Mycoplasma* spp. is also responsible for respiratory problems in turtles. Clinical symptoms included eyelid swelling, nasal discharge, and nasal edema (Jacobson and Berry, 2012). During present studies, same symptoms were observed in many sampled species.

Various climatic extremities are also affecting turtle populations in Sindh. The major causes are high temperatures due to global warming, drought conditions in Sindh. Variable rainfall rate and regular flooding in some districts of Sindh are also causes of their decline.

Illegal Trade: Other threatening factors for freshwater turtles are illegal hunting and poaching. They are captured, killed and slaughtered for trade and export to different South Asian countries. Pakistan being a Muslim country, does not use turtles for edible purposes but due to extensive trade activities, the illegal capture of freshwater turtles has also increased up to a risk.

The porous border between Pakistan and China also facilitates the traders of freshwater turtles to smuggle them to China. Several consignments have been seized by law enforcement agencies of Pakistan in past few years. Pakistan is a sourcing country while China, Thailand and Hong Kong are the receivers in international markets (Noureen *et al.*, 2012).

The quantitative data of trade in Pakistan is mostly unavailable because of non recorded trade transactions and wrong identification of species by custom officials.

Karachi is the main hub for export of freshwater turtles and their body parts. The hotspots for turtle's capture are Punj and Sulimanki, Trimmu, Sindhnai, Qadirabad, Khanki, Rasul, Baloki, Sukkur, Kashmor, Sanghar, Naushero Feroze, Dadu, Badin, Hyderabad and Thatta (Noureen *et al.*, 2012).

Conservation of Freshwater Turtles in Pakistan: Sindh Wildlife Department, Zoological Survey Department, IUCN Pakistan, Department of Zoology,

University of Karachi and Scientific and Cultural Society of Pakistan are playing an important role in monitoring and conservation efforts for freshwater turtles in Sindh.

In Pakistan, many researchers worked on distribution and conservation of freshwater turtle. They includes Akbar *et al.* (2006), Noureen (2007), Noureen (2009), Arshad and Noureen (2010), Khan *et al.* (2012), Noureen *et al.* (2012), Malik *et al.* (2013), Safi and Khan (2014), Khan (2015), Khan *et al.* (2015), Khan *et al.* (2016 a,b).

Legislation: Sindh Wildlife Protection Ordinance 1972 is functional in Sindh. The amendment to this ordinance was made in Wildlife Protection Act 2008 and declared freshwater turtles as "Protected".

Under the "Sindh Turtle and Tortoise Protection, Conservation and Compensation Rules 2014" The poaching, catching, trapping, netting of turtles and tortoises, and using them as whole, parts, products or derivatives thereof for any purpose is declared as prohibited.

The trading, transportation, petting, caging and export of turtles and tortoises as live or dead, as a whole, part, products and derivatives thereof is strictly prohibited.

As per notification No. FW2WL (SOII) turtles/2013, dated 19. 09. 2014, the turtles and land tortoises of order Chelonia are in the Second Schedule (Protected Animals) of Sindh Wildlife Ordinance, 1972.

Seizures Details in Pakistan: Following are some seizures details regarding illegal trade of fresh water turtles. In April 2016, 170 Black pond turtles were rescued from Super High Way Karachi which were left in Polythene bags. In April 2016, 64 turtles were seized from Shantinagar, Karachi, they were packed in boxes and due to suffocation 50 of them died. In March 2016, FIA and Custom seized 45 Black spotted turtles at Faisalabad International Airport which were to be smuggled to Malaysia. In February 2016, Sindh Wildlife Department and WWF Pakistan seized 200 Black Pond Turtles (*Geoclemys hamiltonii*) from Karachi and released them near Indus Dolphin Conservation Center at Lab-e-Mehran, Sukkur. In January 2016, consignments were seized at Illama Iqbal International Airport containing 144 Black spotted pond turtles which were tried to be smuggle to Colombo. In November 2015, 42 vulnerable turtles and tortoises rescued by WWF and SWD near Clifton Beach which were sealed packed into cartons. Further, they were released at Hub Dam, Khar center in Khirthar National Park. In October 2015, 62 Black Pond Turtles rescued from EBM Causeway in Korangi Industrial area which were left there because of the fear of strict vigilance by Sindh Wildlife Department. In September 2015, Pakistan customs seized 190 metric ton dried meat of Fresh water Turtles worth 616.564 millions. In April 2015, confiscated consignments of

dried body parts of fresh water turtles have been collected through dealers operating in Sindh and Punjab. In March 2015, Karachi customs seized from Karachi harbor containing 2000kg of turtle meat which was obtained from killing of 4000 turtles. It was tried to be smuggled to Hong Kong. This consignment was labeled as Fish meat. This meat worth US \$ 60,000.00 in International market. In March 2015, Hong Kong officials ask Pakistan to receive 751 smuggled turtles back to Pakistan. In year 2015, Pakistan Customs captured 1426 turtles from smugglers in Punjab, 320 from Islamabad, 218 from Sindh. In October 2014, 218 fresh water turtles tried to be smuggled to Thailand, confiscated from Karachi Airport were handed over to Sindh Wildlife Department under Custom Act 1969. In September 2014, China returned Turtles to Pakistan which were smuggled and confiscated in China. They were returned in a ceremony at Khunjerab Pass on Pakistan –China border. Further they were released into River Indus in Kalar lake in Rohri forest, near Sukkur. According to data figures from Pakistan customs, China uncovered 114 smuggling cases of wild animals in 2014. In November 2013, Sindh High Court called a report on proceedings initiated by customs authorities against the alleged traffickers of 218 rare black spotted turtles. In September 2013. The Wildlife Department seized body parts of turtles weighting 300 kg in AmanGar area of Nowshera district. In October 2012, a consignment of 34 live turtles was confiscated from Pakistan's northern most Sust border between Pakistan and China by Gilgit Baltistan Forest, Wildlife and Parks Department. These turtles were released into Korang river, Islamabad.

According to the report published by TRAFFIC international on seizures of tortoise and freshwater turtles in 2008 to 2013, the most traded species of chelonians in Pakistan are *Geochelone elegans* (Star Tortoise) and *Geoclemys hamiltonii* (Black Pond Turtle).

Conclusion: Our study provides important baseline data on turtle populations within seven districts of Sindh. More detailed research as well as continuous monitoring is needed for better conservation and management. There is a need to increase public awareness to enhance public participation in conservation activities particularly directed towards freshwater turtles and their habitats through community based NGO's, IUCN Commission on Ecosystem Management, West & Central Asia, Zoological Survey Department, WWFP, Scientific and Cultural Society of Pakistan and Academia. The status, population distribution, and negative impacts of wild turtle trade are discussed and possible suggestions for effective management and conservation are presented in this research.

Action Plan: Conservation plans and turtle conservation models can only be prepared when there is complete information and detailed inventory available about the

species, population density, status, distribution, habitat, breeding biology and threats.

A detailed monitoring and complete survey is required for recognition of weak areas with respect to turtle trouble. It is also necessary to keep an eye on Illegal trade and on local traders to discourage their activities.

Government and other authorities need to protect important sections of river as well as key nesting and foraging sites from commercial developmental and commercial activities.

Law enforcement personnel need training to identify threatened species of turtles for their better protection.

The national and international markets should be periodically investigated to discover species of conservation.

The use of advanced technologies like GIS mapping, spatial data sets, ground validation and radio telemetry should be encouraged which are very helpful gears for getting information about turtles movement, modifications in river embankments and ecological alteration in habitat.

Rules and regulations for conservation should be implemented.

Training workshops for species identification are recommended for wildlife officials, law enforcement officials and local communities.

Turtle conservation awareness should be created through different platforms like electronic, print and social media.

Local public awareness should be initiated by brochures and pamphlets in their local languages.

The use of species identification software applications in cell phones should be encouraged for custom officials.

Regular population surveys should be conducted.

Farming and captive breeding should be encouraged.

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