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Volume XVI

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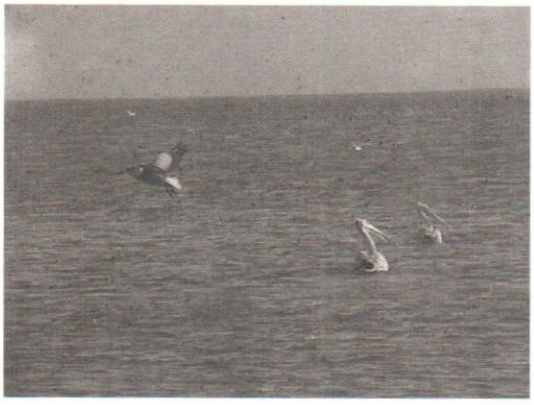

Cover: Pelicans near Jiwani "A paper by Abrarul Hasan and Saadat Ali Khan entitled "Some Observations on the Vertebrate Fauna of Jiwani Wetland Complex" is included in this issue.

RECORDS ZOOLOGICAL SURVEY OF PAKISTAN

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Some observations on the population of Suleiman markhor (*Capra falconeri jerdoni* Hume, 1875) in Takatu, Balochistan Province, Pakistan

Hamid Iqbal Javed and Mirza Muhammad Azam
Zoological Survey Department, Government of Pakistan, Islamabad

Abstract

Population of Suleiman markhor (*Capra falconeri jerdoni*) was studied in October 2003, which suggested that a total of 45 markhors exist in Sikhar Gut, Praang, Mazghae and Naagha within Takatu Conservation Area. The population in the study area consisted of 11 males, 18 females and 16 young. Considering that markhor is a polygamous animal and a single male can mate with a herd of females, therefore, it is proposed that one or two old males may be allowed for trophy hunting, which will enable local conservation group to effectively manage the population of markhor in the Takatu Conservation Area.

Keywords: Suleiman markhor, *Capra falconeri jerdoni,* Takatu, Balochistan

Introduction

Takatu Conservation Area is located in Quetta and Pishin Districts. It spreads to the northern end of Quetta valley in northeast and southwest direction as an outlying spur. The twin peaks, which form its highest peak with elevations of 11,390 feet and 11,340 feet, are situated in the center (Fig. 1). The main conservation area in Takatu is Bostan Daraa, Zawar Kaan, Praang, Tumbale, Shin Mozghae, Nagha, Marachagh and Mari Chak (Takatu Wildlife Conservation Plan for Suleiman Markhor, 2003). This area is known to be inhabited by a sizeable population of Suleman markhor *Capra falconeri jerdoni* Hume, 1875, however, information of actual population inhabiting the Takatu Conservation Area was not documented.

It is generally believed that wildlife law enforcement in Pakistan usually fails unless local population is involved. Balochistan province is the pioneer to develop a mechanism by involving local people to protect the wildlife of an important area known as Torghar where this mechanism has successfully been practiced since 1985, through trophy hunting programme. Trophy hunting provides an incentive to local community to conserve both species and their habitat. The local communities are being persuaded to stop hunting in there own interest. In exchange, they receive some income from limited and carefully controlled trophy hunting. These hunts are based on annual surveys, which allow the scientists and villagers to assess the status of species. This programme has paved the way for sustainable use of wildlife in some areas of Pakistan.

The success of community-based trophy hunting programme in Torghar has changed the attitude of other communities as well. Few years back people of Takatu followed the same lines and started their effort to organize the communities inhabiting the surroundings of the Takatu.

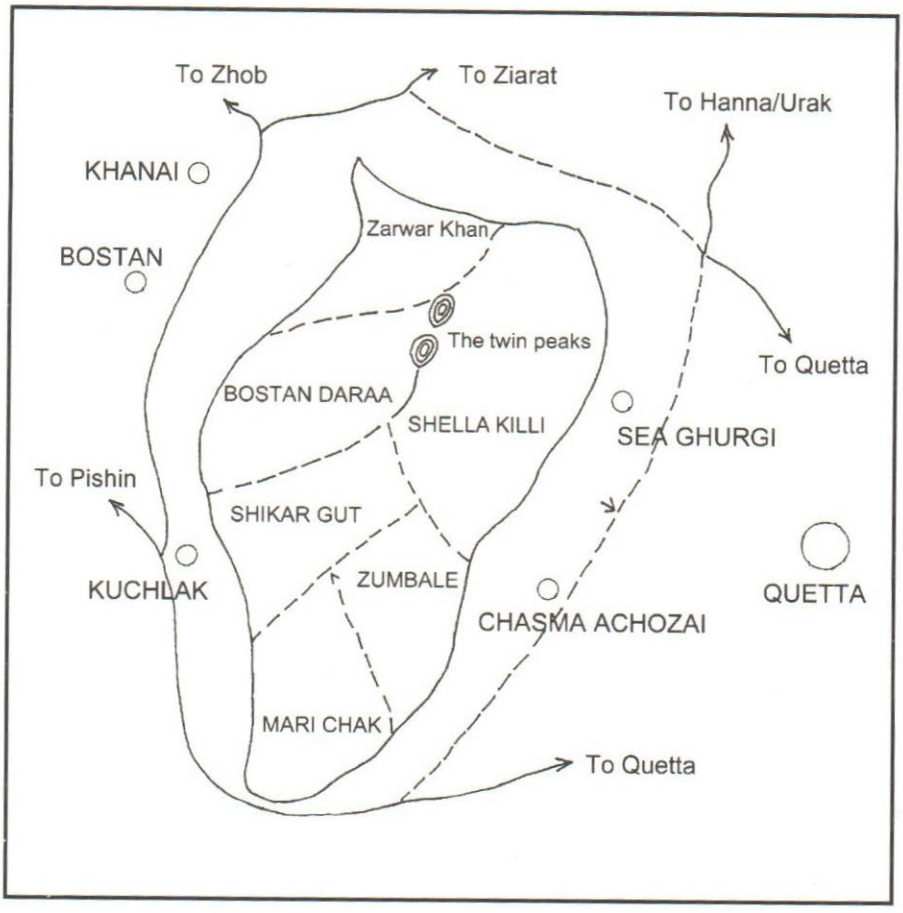

Figure 1. Map of Takatu Conservation Area.

In the past markhor species was declining with rapid pace due to excessive and indiscriminate hunting by locals and visitors from outside. In 1999 at the time of inception of idea for sustainable use of resources, the population of Markhor and Urial were recorded 32 and 6 respectively (Muhammad Yousuf Kakar, personal communication). Therefore, the present study was carried out to assess the present status of markhor population in Takatu Conservation Area.

Materials and Methods

Population survey of markhor was conducted from 23 to 26 October 2003 in four sites i.e. Sikhar Gut, Praang, Mazghae and Naagha within Takatu Conservation Area. During these surveys, three teams were dispatched to mountains to locate the animal using binocular and data was recorded about sex and age of the animals.

Results and Discussion

The study site (Takatu Conservation Area) has an area of approximately 50,000 acres. The area surveyed is about 15% of the total area, which consists of high ridges separated from one another by deep and narrow gorges. The hilltops are almost rounded whereas lower slopes are steep to moderately steep (Fig. 2-3). The climate is cold during winter snowfall from December to March and frost is frequent. (Takatu Wildlife Conservation Plan 2003). Annual rainfall is about 5 to 13 inches, most of which precipitates, in the form of snow during winter.

This habitat is alpine dry steppe and vegetation of Takatu is of steppe forest in southern latitude (Roberts, 1997). The dominant plants in the area are *Juniperus excelsa, Polycarpon sp., Pistacia khinjuk* and *Fraxinus xanthoxyloides* whereas among the bushes and grasses *Caragana ulcina, Caragana ambigua, Cotoniaster nummularia, Prunus eburnea, Artemisia maritima, Cousinia onopordioides, Ephedra nebrodensis, Sophora griffithii, Berberis balochistanica, Pennisetum orientale, Stipa pennata, Dichanthium annulatum, Melica persica Chrysopogon montanus* and *Eulaliopsis binata* are worth mentioning (Fig. 2-3).

Figure 2. Vegetation of Mazghae (Takatu) at about 10,000 feet.

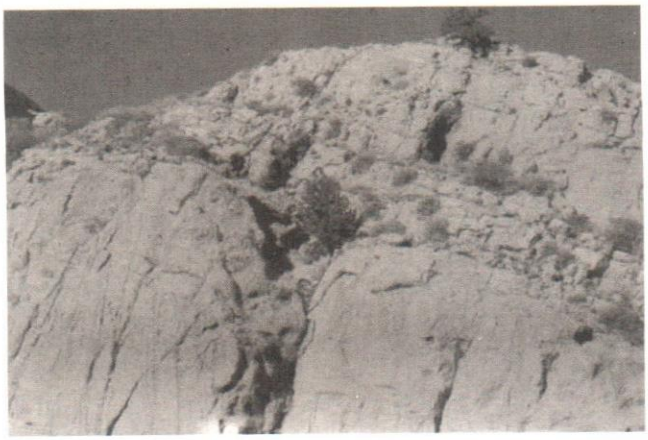

Figure 3. Vegetation of Takatu Mountain.

During the four-day survey, 45 Markhor were counted (Table-I). Out of total estimated area of 50,000 acres, only about 10,000 acres may have surveyed. The results of the present census were limited to only four areas, however, results seems to be encouraging because previously it was reported that population of markhor was declining. It may be mentioned that the present survey was not done in rutting season (November), during which markhors gather in large herds

Table- I. Population of markhor observed in Takatu Conservation Area

S. No.	Date	Area	Male	Female	Young	Total	Remarks
1	23-10-03	Shikar Gut	2	3	4	9	One male of trophy size.
2	24-10-03	Praang	5	8	6	19	Two male of trophy size.
3	25-10-03	Sheen Mazghae	4	7	6	17	Two male of trophy size.
4	26-10-03	Naagha	---	---	---	---	---
		Total:	**11**	**18**	**16**	**45**	

The survey results suggest that the population is large enough to sustain even if the trophy harvest programme is induced, in which 1 or 2 males of trophy size (7-8 year old) may be permitted to hunt which possibly will have no negative impact on the population size. Markhors are polygamous animals and a single male can mate with a herd of several females so the overall reproductive rate would not be affected by the loss of a few older males (Schallar, 1977).

Markhor population in the area is usually monitored involving local communities supported by a conservation organization (Takatu Warorgalvi Tanzeem) and Balochistan Forests and Wildlife Department. Recent observations showed that the population of markhor is gradually increasing. Continuous surveillance through the community and wildlife watchers for the past few years has a successful check on uncontrolled hunting in the area, which may be one of the reasons for reported increase in markhor population.

Viewing that the population in the study area is large enough to sustain and proliferation of the species, it may be considered trophy hunting a small, strictly controlled number of markhor by inviting foreign hunters. The generated revenue can be defrayed in local community for the sake of species protection. However, regular and continuous monitoring should ensure the stability of the population of the Suleiman markhor in Takatu and other areas of its distribution.

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On the status of Jhabo Wetland, Badin, Sindh.

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Abstract

Jhabo wetland, which is located in Badin, was known for well-diversified bird and fish fauna dominated by species inhabiting freshwater wetland. Due to change in water regime especially because of sea intrusion during cyclone in 1999, the wetland has either dried up or dominated by seawater. A noticeable change in the bird and fish fauna in this wetland was observed indicating prevalence of marine and dry land species of birds. Similar changes in fish fauna were also noticed.

Keywords: Jhabo Wetland, Badin, sea intrusion, fishes, birds, mammals, reptiles

Introduction

Jhabo wetland, which is located in Badin, is almost completely dry, at present. Water which fed this wetland, used to flow from Karo-Ghangro. However, Karo-Ghangro Outfall Drain discharges into tidal part from southern side of Karo-Ghangro Check Point. The Wetland has been dried because its channel was deepened and it has no more drain into this weland. Additionally there is very little flow of water in the drain and after the cyclone of 1999; the outlets of the channel into Jhabo Wetland area were choked due to sedimentation, which caused total stoppage of water in the Jhabo Wetland. Due to seawater intrusion into the area, the salinity of the area has increased and was recorded as 28 o/oo in the end of December.

This wetland used to have brackish water and vast mudflats and had a well-diversified fish and bird fauna. Freshwater, brackish and marine fish and penaeid shrimps used to be harvested in commercial quantities from this wetland. In 1977, a 548 m long portion of the weir got damaged resulting in collapse of the fresh water separation process through the controlled system. This also affected the water storing capacity of system. The other factors like drought, reduction in flow of freshwater and cyclone of 1999 further deteriorated the situation.

Because of change in the water regime of the area, the Jhabo Wetland has lost its importance with respect to fisheries and refuge for wintering fauna. The economy of the area was totally dependent on the fisheries and marginal agriculture, which has now been seriously affected under, altered conditions of

the wetland. It was reported that Goth Ismail Chalko used to be main agriculture center of the area but because of stoppage in flow of freshwater no agriculture activity is done in the area except in the Goth Achar where small scale cropping is done. Similarly livestock rising was an important activity, which like agriculture was reduced to bare minimum.

Most of the areas are dry and only in the area where Karo-Ghangro outfall drains discharges, some fishes of mostly marine origin are found. Severe drought during 2001 and 2004 has further deteriorated the conditions of the wetland. Fishing used to be the main economic activity of Goth Ismail, Goth Chalko and Goth Bachoo, however, due to drying up the wetland; fishing activity has been practically wiped out. Species like Rohu or Dumbra (*Labeo rohita*), Black Rohu (*Labeo calbasu*), Morakhi (*Cirrihinus mrigala*), Seenghara (*Aorichthys aor*), Dangri (*Lates calcarifer*), and Catla (*Catla catla*) used to be commonly caught in the area especially in area around Goth Bachoo but these freshwater species are not found in the area.

During the present study a survey of Jhabo Wetland was carried out to determine the species composition of mammals, reptiles, birds and fishes found in the area.

Materials and Methods

Field visits were made to different locations in the Jhabo Wetland and survey of various animals found in the area was done using standard techniques (Javed and Hasan, 2004). A list of species observed during various surveys conducted in 1990's is also given in the paper. For the identification of bird Perrins and Attenborough (1987), Hasan (1994, 1996), Heninzel *et al* (1987), Roberts (1991, 1992) and Ali *et al.* (1983) were used whereas for fishes Bianchi (1985) and Munro (1955) were mainly referred to.

Results and Discussions

The survey revealed that only light reed vegetation (*Typha spp.*) exists in the areas of the wetland whereas the surrounding areas have sparse growth of *Prosopis juliflora, Salvadora spp.* and *Suaeda fruiticosa.*

At present, most of the area of Jhabo is totally dried up, therefore, it harbours only birds that are inhabitant of arid and dry zone (Table-I). However, some birds usually inhabitant of freshwater bodies were recoded from Karo-Ghangro Channel (Table-I). Dense concentration of birds was observed in the area where Karo-Ghangro Outfall Drain falls into sea (Table-I). A comparison with the bird fauna observed during surveys made in 1990 has been given in Table-I, which indicates that number of species occurring in the area has been considerably decreased. The population of species like pelican (*Pelecanus*

onocrotalus) and greater flamingo (*Phoenicopterus rubber*) has decreased considerably. No individual of lesser flamingo (*Phoeniconaias minor*) was observed during the present study. Species of ducks like common shelduck (*Tadorna tadorna*), wigeon (*Anas Penelope*), gadwall (*Anas crecca*), mallard (*Anas platyrhonchos*), northern pintail (*Anas acuta*), garganey (*Anas querquedula*), northern shoveler (*Anas clypeata*), common pochard (*Aythya ferina*), tufted duck (*Anas fuligula*) and common coot (*Fulica atra*) were not observed during the present study whereas these species seems to be common during 1990's surveys.

Table-I. Bird fauna of Jhabo wetland

THE DRY PORTION OF JHABO	ALONG THE KARO-KHANGRO OUTFALL DRAIN	THE SEA CONNECTED SIDE OF JHABO.	FAUNA RECORDED DURING SURVEYS IN 1990's.
Yellow Wagtail (*Motacilla flava*)	Large Cormorant (*Phalacrocorax carbo*)	Large Cormorant (*Phalacrocorax carbo*)	Great white Pelican (*Pelecanus onocrotalus*)
Pied Wagtail (*Motacilla alba*)	Little Egret (*Egretta garzetta*)	Grey Heron (*Ardea cinerea*)	Dalmatian Pelican (*Pelecanus crispus*)
White Cheeked Bulbul (*Pycnonotus leucogenys*)	Pariah Kite (*Milvus migrans*)	Little Egret (*Egretta garzetta*)	Reef Heron (*Egretta gularis*)
Common Babbler (*Turdoides caudatus*)	Brahminy Kite (*Haliastur indus*)	Indian Reef Heron (*Egretta gularis*)	Grey Heron (*Ardea cinerea*)
Chiff-Chaff (*Phylloscopus collybitus*)	Lesser Black-backed Gull (*Larus fuscus*)	Flamingo (*Phoenicopterus rubber*)	White Spoonbill (*Platalea leucorodia*)
Common Myna (*Acridotheres tristis*)	Blackheaded Gull (*Larus ridibundus*)	Pariah Kite (*Milvus migrans*)	Greater Flamingo (*Phoenicopterus ruber*)
Bank Myna (*Acridotheres ginginianus*)	Indian Whiskered Tern (*Chlidonais hybrida*)	Brahminy Kite (*Haliastur indus*)	Ruddy Shelduck (*Tadorna ferruginea*)
Black Drongo (*Dicrurus macrocercus*)	Caspian Tern (*Hydroprogne caspia*)	Curlew (*Numenius arquata*)	Common Shelduck (*Tadorna tadorna*)
House Crow (*Corvus splendens*)	Little Tern (*Sterna albifrons*)	Redshank (*Tringa totanus*)	Wigeon (*Anas Penelope*)
Pariah Kite (*Milvus migrans*)		Green Shank (*Tringa nebularia*)	Gadwall (*Anas strepera*)
Brahminy Kite (*Haliastur indus*)		Herring Gull (*Larus argentus*)	Common Teal (*Anas crecca*)
Tawny Eagle (*Aquila rapax*)		Blackbacked Gull (*Larus fuscus*)	Mallard (*Anas platyrhynchos*)
Indian Collared Dove (*Streptopelia decaocta*)		Blackheaded Gull (*Larus ridibundus*)	Northern Pintail (*Anas acuta*)
		Indian Whiskered Tern (*Chlidonais hybrida*)	Northern Shoveler (*Anas clypeata*)

Pied Kingfisher (*Ceryle rudis*) Common Blue Kingfisher (*Alcedo attis*) White breasted Kingfisher (*Halcyon smyrnensis*) Little Green Bee-eater (*Merops orientalis*) Hoopoe (*Upupa epops*)		Caspian Tern (*Hydroprogne caspia*) Little Tern (*Sterna albifrons*) Pied Kingfisher (*Ceryle rudis*) Common Blue Kingfisher (*Alcedo attis*) White breasted Kingfisher (*Halcyon smyrnensis*) Little Green Bee-eater (*Meriops orientalis*)	Common crane (*Grus grus*) Common Coot (*Fulica atra*) Avocet (*Recurvirostra avosetta*) Black-tailed Godwit (*Limosa limosa*) Eurasian Curlew (*Numenius arquata*) Redshank (*Tringa totanus*) Little Stint (*Calidris minuta*) Ruff (*Philomachus pugnax*) Herring Gull (*Larus argentatus*) Great Black-headed Gull (*Larus fuscus*) Black-headed Gull (*Larus ridibundus*) Whiskered Tern (*Chlidonias hybrida*) Caspian Tern (*Hydroprogne caspia*)

During present study, marine fishes were collected from the seaside of Jhabo wetland whereas freshwater fishes were collected from the channel of Karo-Ghangro (Table-II). Major fish fauna in the wetland, thus, consists mainly of marine species and freshwater species are only found in drains leading to this wetland. Similar changes in the faunal composition were noticed in Nurrari (Javed and Hasan, 2004).

In the area adjacent to Jhabo wetland, porcupine (*Hystrix indica*), Asiatic jackal (*Canis aureus*), and red fox (*Vulpes vulpes pusilla*) were observed. Among small rodents, Indian gerbil (*Tatera indica*), Balochistan gerbil (*Gerbillus nanus*), house mouse (*Mus musculus*) and five striped palm squirrel (*Funambulus pennanti*) were recorded. Two species of reptiles i.e checkered keelback snake (*Xenochrophis piscator*) and Indian flatshell turtle (*Lissemys punctata punctata*) were collected from the Jhabo Wetland during the present study.

Table-II. Fish fauna of Jhabo wetland

SEASIDE OF JHABO WETLAND	KARO-GHANGRO DRAIN
Bloch's gizzard-shad (*Nematalosa nasus*)	*Labeo boga*
Indian Oil-sardine (*Sardinella longiceps*)	*Mystus gulio*
Sindh sardine (*Sardinella sindensis*)	*Glossogobius giuris*
Spot-tail needlefish (*Strongylura strongylura*)	*Channa punctata*
Crocodile flathead (*Cociella crocodila*)	*Oreochromis mossambica*
Jarbua terapon (*Terapon jarbua*)	
Silver sillago (*Sillago sihama*)	
Splendid ponyfish (*Leiognathus splendens*)	
Smallspotted grunter (*Pomadasys commersonni*)	
Saddle grunt (*Pomadasys maculates*)	
Yellowfin seabrean (*Acanthopagrus latus*)	
Greenback mullet (*Liza subviridis*)	
Square-tail mullet (*Liza vaigiensis*)	

Considering that the Jhabo Wetland has been considerably altered due to stoppage of flow of freshwater and intrusion of sea water especially on account of cyclone of 1999, there is a need to take necessary steps to ensure flow of adequate freshwater in the wetland and also to ensure that intrusion of seawater is minimized. This wetland, which used to inhabit a well-diversified fauna especially, birds and fishes can thus be restored.

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Some observations on the vertebrate fauna of Jiwani Wetland Complex

Abrarul Hasan and Saadat Ali Khan
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Abstract

Jiwani wetland complex is located on the extreme southwestern part of Pakistan. Vertebrate fauna of this complex was studied. A total of 5 species of mammals, 3 species of amphibians, 4 species of reptiles, 7 species of birds, and 6 species of fishes were collected from this complex. A well-diversified vertebrate fauna exists in this habitat.

Keywords: Jiwani wetland complex, fishes, birds, mammals, reptiles, amphibians

Introduction

Jiwani is a small town located on the extreme southwest part of Pakistan and is known for a variety of habitats including ocean, backwaters, desert, open scrub forest, mangrove, agriculture fields and human settlements. These habitats are known to have a well-diversified vertebrate fauna. It was declared as a wetland complex. Present study deals with the vertebrate fauna of this complex.

Materials and Methods

A nine-day survey of Jiwani Wetland Complex was conducted during December 28, 2001 to January 5, 2002 and another 10 days survey was conducted in June 5, 2002 to June 15, 2002. Identification of bird species were done with the help of binoculars and spotting scopes. For counting of birds direct count method was applied. For mammals, surveys were conducted at night and identification of cetaceans was made in daylight. The reptiles such small lizards were collected by hand while snake trapper was used to collect snakes. Direct observations with binoculars were also made particularly for green turtles and crocodiles. Fishes were collected from the commercial landings.

For the identification of vertebrates Ali *et al* (1983), Bianchi (1985), Heinzel *et al* (1987), Minton (1966), Munro (1955), Perrins and Attenborugh (1987), Roberts (1991, 1992, 1997) were considered.

Results and Discussion

The study revealed that the Jiwani Wetland Complex has a well-diversified vertebrate fauna. A total of 125 species of birds, 11 species of

mammals, 11 species of reptiles, a single species of amphibians and 23 species of fishes were reported during the present study (Table-I).

Table-I. Species of birds, reptiles, mammals, amphibian and fishes from Jiwani Wetland Complex.

SCIENTIFIC AND COMMON NAME	STATUS
Birds	
Tachybaptus ruficollis (Little grebe or dabchick)	Common/winter visitor
Podiceps cristatus (Great crested grebe)	Scarce/winter visitor
Podiceps nigricollis (Black necked or eared grebe)	Scarce/winter visitor
Phalacrocorax carbo sinensis (Eurasian great cormorant)	Common/winter visitor
Pelecanus crispus (Dalmatian or grey pelican)	Rare/winter visitor
Ardeola grayii (Indian pond heron or paddy bird)	Common/resident
Egretta gularis (Indian reef heron)	Common/resident
Egretta garzetta (Little white egret)	Common/resident
Egretta alba (Great white egret)	Common/winter visitor
Ardea cinerea Grey or common heron)	Common/winter visitor
Plegadis falcinellus (Glossy ibis)	Scarce/irregular year round visitor
Platalea leucorodia (Eurasian white spoonbill)	Frequent/winter visitor

Phoenicopterus rubber (Greater flamingo)	Common/irregular year round visitor
Tadorna tadorna (Common shelduck)	Scarce/winter visitor
Anas pelelope (Eurasian wigeon)	Common/winter visitor
Anas strepera (Gadwall)	Common/winter visitor
Anas crecca (Common teal)	Common/winter visitor
Anas platyrhynchos (Mallard)	Scarce/winter visitor
Anas acuta (Northern pintail)	Common/winter visitor
Anas clypeata (Northern shoveler)	Common/winter visitor
Marmaronetta angustirostris (Marbled teal)	Rare/winter visitor
Netta rufinia (Red crested pochard)	Rare/winter visitor
Aythya ferina (Common pochard)	Common/winter visitor
Aythya nyroca (White-eyed pochard)	Rare/winter visitor
Aythya fuligula (Tufted duck)	Frequent/winter visitor
Mergus serrator (Red-breasted merganser)	Rare/winter visitor
Mergus merganser (Common merganser)	Scarce/winter visitor
Haliaeetus leucoryphus (Pallas's Ring-tailed Fish Eagle)	Scarce/winter visitor

Circus aeruginosus (Marsh Harrier)	Frequent/winter visitor
Circus macrourus (Pallid Harrier)	Scarce/winter visitor
Accipiter nisus melasehistos (Eurasian Sparrow Hawak)	Frequent/winter visitor
Buteo buteo japonicus (Common Buzzard)	Frequent/winter visitor
Buteo rufinus (Long-legged Buzzard)	Common/winter visitor
Aquila clanga (Greater Spotted Eagle)	Frequent/winter visitor
Aquila rapax (Tawny Eagle)	Frequent/winter visitor
Aquila nipalensis (Steppe Eagle)	Frequent/winter visitor
Aquila heliaca (Imperial Eagle)	Scarce/winter visitor
Pandion haliaetus (Osprey)	Common/winter visitor
Falco tinnunculus (Common Eurasian Kstred)	Common/winter visitor
Falco concolor (Sooty Falcon)	Rare/resident
Falco pelegrinoides babylonicus (Red-naped Shaheen)	Rare/winter visitor
Ammoperdix griseogularis (See-See Partridge)	Rare/resident
Francolinus pondicerianus (Indian Grey Partridge)	Rare/resident
Gallinula chloropus (Common Moorhen or Waterhen)	Common/winter visitor
Fulica atra (Black or Eurasian Coot)	Common/winter visitor

Haematopus ostralegus (Eurasian Oystercatcher)	Common/winter visitor
Himantopus himantopus (Black-winged Stilt)	Common/winter visitor
Esacus recurvirostris (Greater Stone curlew)	Scarce/resident
Cursorius cursor (Cream coloured courser)	Scarce/winter visitor
Charadrius dubius (Little-ringed Plover)	Common/winter visitor
Charadrius alexandrinus ((Kentish or Snowy plover)	Common/resident
Charadrius mongolus (Lesser or Mongolian Sand plover)	Common/winter visitor
Charadrius leschenaultii (Large or Geoffroy's Sand plover)	Common/winter visitor
Hoplopterus indicus (Red wattled Lapwing)	Common/resident
Chettusia lencura (White-Tailed lapwing Plover)	Common/resident
Calidris alba (Sanderling)	Scarce/winter visitor
Calidris minuta (Little Stint)	Common/winter visitor
Calidris ferruginea (Curlew Sandpiper)	Common/winter visitor
Calidris alpina (Dunlin)	Common/winter visitor
Gallinago gallinago (Common or Fantail Snipe)	Common/winter visitor
Limosa limosa (Black tailed Godwit)	Scarce/winter visitor

Limosa lapponia (Bartailed Godwit)	Scarce/winter visitor
Numenius phaeopus (Whimbrel)	Frequent/winter visitor
Numenius arquata (Eurasian curlew)	Common/winter visitor
Tringa totanus (Red snank)	Common/winter visitor
Tringa ochropus (Green sandpiper)	Frequent/winter visitor
Tringa nebularia (Green sandpiper)	Frequent/winter visitor
Xenus cinerus (Terek sandpiper)	Common/winter visitor
Actitis hypoleucos (Common sandpiper)	Common/winter visitor
Larus hemprichii (Sooty gull)	Scarce/Summer breeding
Larus ichthyaetus (Great black-headed gull)	Common/winter visitor
Larus ridibundus (Black-headed gull)	Common/winter visitor
Larus genei (Slender billed gull)	Common/resident
Larus argentatus (Herring gull)	Common/winter visitor
Larus fuscus heuglini (Lesser black headed gull)	Common/winter visitor
Galochelidon nilotica (Gull-billed tern)	Common/winter visitor
Sterna caspia (Caspian tern)	Common/irregular year round visitor

Sterna bergii (Large crested tern)	Common/irregular year round visitor
Sterna sandvicensis (Sandwich tern)	Common/irregular year round visitor
Pterocles orientalis (Imperial or black bellied sand grouse)	Scarce/winter visitor
Columba livia intermedia (Blue rock pigeon or rock dove)	Common/resident
Streptopelia decaocto (Indian collared or ring dove	Frequent/Summer breeding occasional wintering
Streptopelia senegaensisl (Little brown dove)	Frequent/resident
Eudynamys scolopacea (Asian koel)	Frequent/winter visitor
Apus pallidus (Pallied or pale brown swift)	Scarce/winter visitor
Halcyon smyrnensis (White breasted kingfisher)	Frequent/winter visitor
Alcedo atthis (Common or small blue kingfisher)	Frequent/winter visitor
Merops orientalis (Little green bee-eater)	Frequent/winter visitor
Coracias benghalensis (Indian roller or blue jay)	Common/summer breeding
Ammomanes cincturus (Bar or black tailed desert lark)	Common/resident
Ammomanes deserti (Desert finch lark).	Frequent/winter visitor
Alaeomon alaudipes (Hoopoe lark)	Scarce/resident
Calandrella acutirostris (Hume's short toed lark	Scarce/summer breeding
Galerida cristata (Crested lark)	Common/resident

Alauda gulgula (Small Indian or oriental skylark	Common/winter visitor
Riparia paludicola (Plain sand martin)	Common/winter visitor
Ptyonoprogne fuligula (Pale crag or African rock martin)	Common/resident (breeding)
Hirundo rustica (Common or barn swallow)	Common/winter visitor
Anthus campestris (Tawny pipit)	Common/winter visitor
Anthus similis (Long bellied or Persian rock pipit)	Common/winter visitor
Moticilla alba (Pied or white wagtail)	Frequent/winter visitor.
Pycnonotus leucogenys (White cheeked bulbul)	Frequent/resident (breeding)
Luscinia svecica (Blue throat)	Frequent/winter visitor.
Phoenicurus ochruros (Black redstart)	Frequent/winter visitor.
Saxicola caprata (Pied bushchat)	Frequent/winter visitor.
Oenanthe deserti (Desert wheatear)	Common/winter visitor
Oenanthe xanthoprymna (Red-tailed wheatear)	Scarce/winter visitor
Oenanthe picata (Eastern pied or variable wheatear)	Common/winter visitor
Oenanthe monacha (Hooded wheatear)	Rare/resident
Cettia cetti (Cetti's warbler or eastern bush warbler)	Scarce/winter visitor (occasional)

Prinia gracilis (Graceful or stripe backed prinia)	Common/winter visitor
Prinia buchanani (Rufous-fronted prinia/wren warbler)	Common/winter visitor
Acrocephalus dumetorum (Blyth's reed warbler)	Frequent/winter visitor
Sylvia nana (Desert warbler)	Frequent/winter visitor
Sylvia curruca (Lesser white throat)	Common/winter visitor
Phylloscopus collybita (Chiffchaff)	Common/winter visitor
Turdoides caudatus (Common babbler)	Common/resident
Nectarinia asiatica (Purple sunbird)	Common/resident
Lanius vittatus (Bay backed shrike)	Common/resident
Lanius excubitor (Great grey shrike)	Common/Summer breeding occasional wintering
Corvus splendens (Indian house crow)	Common/Summer breeding occasional wintering
Corvus ruficollis (Brown necked or desert raven)	Common/resident (breeding)
Acridotheres tristis (Common or Indian myna)	Common/resident (breeding)
Passer domesticus indicus (Indian house sparrow)	Common/resident (breeding)
Bucanetes githagineus (Trumpeter Finch)	Scarce/resident (breeding)
Butastur teesa (White eyed buzzard)	Common/resident
Streptopelia turtur (Turtle dove)	Common/resident

Mammals

Sousa plumbea (Indian humpback dolphin)	Locally common/resident or locally migration
Neophocaena phocaenoides (Black finless porpoise)	Locally common/resident or locally migration
Canis aureus aureus (Asiatic jackal)	Frequent/resident
Vulpes vulpes pusillus (White footed desert fox)	Scarce/resident
Felis chaus prateri (Jungle cat)	Scarce/resident
Felis silvestris ornata (Indian desert or Asiatic steppe wild cat)	Rare/resident
Herpestes javanicus (Small Indian mongoose)	Scarce/resident
Rattus rattus (Roof Rat or House Rat)	Common/resident
Mus musculus (House mouse)	Common/resident
Funambulus pennantii (Five striped palm squirrel)	Common/resident
Pipistrellus kuhlii (Kuhl's pipistrelle bat)	Common/resident

Reptiles

Chelonia mydas (Indian ocean green turtle)	Rare/resident local migration
Eretomochelys imbricata squamata (Pacific hawks-bill turtle)	Rare/occasional visitor
Crocodylus palustris palustris (Marsh or swamp crocodile)	Rare/resident

Agama nupta fusca (Yellow headed agama)	Common/resident
Agama agilis (Brilliant agama)	Frequent/resident
Eremias guttulata watsonana (Long-tailed desert lacerta)	Common/resident
Acanthodactylus cantoris blanfordi (Mekran fringed toed sand lizard	Rare/resident
Ophisops jerdoni (Punjab snake eyed lacerta)	Rare/resident
Hemidactylus turcicus turcicus (Mediterranean house gecko)	Common/resident
Coluber rhodorachis *(Cliff racer snake)*	Common/resident
Hydrophis cyanocinctus (Annulated or chittul seasnake	Common/resident

Amphibians

Rana cyanophlyctis (Skittering frog)	Common

Fishes

Acanthopagrus bifaciatus (Two bar seabream)	The fishes were caught with cast net
Acanthopagrus latus (Yellowfin seabream)	"
Liza vaigiensis (Square tail mullet)	"
Leiognathus equulus (Common panyfish)	"

Pseudotricanthus striligrlifer (Longspined tripod fish)	"
Arthron leapardus (Banded leopard blowfish)	"
Sillago sihama (Silver sillago)	The fishes were caught with a small sized gillnet.
Valamugil seheli (Grey mullet)	"
Diodon maculifer (Blotched porcupine Fish)	The fish was found dead from muddy habitat.
Scolidon laticaudus (Spadenose shark)	The fishes were collected by the fishermen 20-25 km. off Jiwani coast.
Galeocerda cuvieri (Tiger shark)	"
Pomadasys argyreus (Blue-cheek silver grunt)	The fish was collected by small sized gillnet from sandy side of Jiwani coast.
Sparidentex hasta (Sobaity sea-bream)	"
Leiognathus spiendens (Splendid ponyfish)	"
Pellona ditchela (Indian pelons)	"
Nibea soldado (Soldier croaker)	"
Chemerius rufer (Santer seabream)	"
Gerrus filamentosus (Whipfin silver-biddy)	Fishermen from off Jiwani coast collected the fishes.
Rhinobatos granulatus (Granulated shovelnose ray)	"
Nibea maculata (Bloched croaker)	"

Dendrophyusa russeli
(Goatee croaker)

Jhonius belangeri "
(Belanger's croaker)

Protonibea diacanthus "
(Spotted croaker)

A sizeable population of Dalmatian pelican (*Pelecanus crispus*) was observed during this study. Among ducks, common shelduck (*Tadorna tadorna*), Eurasian wigeon (*Anas penelope*), gadwall (*Anas strepera*), common teal (*Anas crecca*), mallard (*Anas plathrhynchos*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata), marbled teal* (M*armaronetta angustirostris*), red crested pochard (*Netta rufini*a), common pochard (*Aythya ferina*), white eyed pochard (*Aythya nyroca*), tufted duck (*Aythya fuligula*), red breasted merganser (*Mergus serrator*) and common merganser (*Mergus merganser* were observed in Sajji Dam (located about 35 km from Jiwani) which makes this wetland complex of great importance. The rare ducks like marbled teal (*Marmaronetta angustirostris*), red crested pochard (*Netta rufina*), white-eyed pochard (*Aythya nyroca*) and red-breasted merganser (*Mergus merganser*) were also found in Jiwani Wetland Complex.

In Gwater Bay, Jiwani 27 specimens of Indian humpback dolphins (*Sousa plumbea*) with two juveniles were observed. In addition, 3 black finless porpoises (*Neophocaena phocaenoides*) were observed at the beach of Jiwani. A mature marsh crocodile (*Crocodylus palustris palustris*) was observed at one of the impoundments in the River Dasht, whereas footprints of three others were also observed in the same area.

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Birdlife in Nagarparkar, district Tharparkar, Sindh

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Abstract

The paper describes the bird fauna of the Nagarparkar located on the southeastern part of Pakistan. A well-diversified bird fauna was observed in the area consisting of 91 species belonging to 60 genera. Long-billed vulture (*Gyps indicus*), sarus crane (*Grus antiona*) and dusky crag martin (*Ptyonoprogne concolor*) are noteworthy species. Breeding pair of sarus crane (*Grus antiona*) was also observed in the area.

Keyword: Avian biodiversity, Nagarparkar, Tharparkar, sarus crane

Introduction

Nagarparkar is tehsil/taluka of district Tharparkar and is located at southeast part of Sindh. Its climate is extremely hot in summer with temperature soaring upto 50°C in May/June and cold dry in winter when temperature ranging down to 5°C. Nagarparkar and its adjacent areas are regarded as one of the most important wildlife area of Pakistan. Diverse reptile, bird and mammal fauna is known to occur in the area. Wild Ass (*Equus hemionus*), a threatened mammalian species, which used to inhabit both in Sindh and Balochistan, now occurs in small numbers only in Nagarparkar area. Blue bull (*Bosalaphus tragocamlles*) and Indian gazelle (*Gazella bennetti*) are also found in reasonable numbers in the area.

A number of workers have contributed in the studies of birds of Sindh. Some of these include Humes (1989), Ticehurst, (1922-24) Khanum and Ahmad (1986), Roberts (1991-1992) and Ghalib and Hasnain (1994, 1997). Present paper deals with the avian biodiversity of the Nagarparkar and adjacent areas.

Results and Discussion

Adjacent areas of Nagarparkar have different important habitat types. These include desert, Karunjhar hill range, wetlands, agriculture fields and Rann of Kutch.

Desert Area: This area has both sand dunes and plain sandy area. Adjacent area of Nagarparkar town has dominant vegetation of *Prosopis juliflora* while major species found in the area include *Prosopis spicigera, Capparis decidua, Ziziphus nummularia, Calotropis procera, Acacia nilotica* etc.

Ponds: There are a number of ponds constructed for drinking of local people and livestock. These ponds got importance since these provide drinking water to wildlife. The ponds have reed vegetation on the banks and trees of *Acacia nilotica*, and *Tamaix aphylla* in surroundings. Occurrence and breeding of a small number of sarus crane has increases significance of these ponds.

Karunjhar: Karunjhar range consists of low altitude hills in the adjacent areas of Nagarparkar. There is sparse vegetation of *Prosopis spicigera, Capparis decidua, Ziziphus nummularia, Salvadora oleoides* etc.

Agriculture fields: There are some patches of agriculture fields in plain desert areas, which are mostly fed by monsoon showers. Kasbo and adjacent area have agriculture land irrigated by wells. Vegetable and wheat is grown in the irrigated fields while in the rain dependent fields sorghum is cultivated. The irrigated fields known to inhabit peafowl and a variety of passerine birds while fields dependent on rainfall have abundant dove and sparrow population.

Rann of Kutch: Rann of Kutch is mainly a salty bare plain with patchy vegetation of *Sueda fruiticosa* and *Salsola sp.* Wild Ass occurs in the areas of Rann of Kutch. Major part of the Rann of Kutch is located in India.

Materials and Methods

The study area was periodically visited in different seasons during November 1994 to July 1998. The birds were identified in the field by using spotting scope and binocular.

The study produced 91 species belonging to 60 genera 33 families and 15 orders in the study area (Table-I).

Table-I. Bird fauna of Nagarparkar area

ORDER:	**PODICIPEDIFORMES**	
FAMILY:	**PODICIPEDIDAE**	
	Tachybaptus ruficollis	Little Grebe
ORDER:	**PELECANIFORMES**	
FAMILY:	**PHALACROCORACIDAE**	
	Phalacrocorax niger	Little Cormorant
FAMILY:	**PELECANIDAE**	
	Pelecanus onocrotalus	White or Rosy Pelican
ORDER:	**CICONIIFORMES**	
FAMILY:	**ARDEIDAE**	
	Ardeola grayii	Pond Heron

	Bubulcus ibis	Cattle Egret
	Egretta garzetta	Little Egret
ORDER:	**PHOENICOPTERIFORMES**	
FAMILY:		
	Phoenicopterus rubber	Greater Flamingo
ORDER:	**ANSERIFORMES**	
FAMILY:	**ANATIDAE**	
	Anas penelope	Eurasian Wigeon
	Anas crecca	Common Teal
	Anas strepera	Gadwal
	Anas acuta	Pintail
	Anas poecilorhyncha	Spotbilled Duck
	Anas clypeata	Shoveler
ORDER:	**ACCIPITIFORMES**	
FAMILY:	**ACCIPITRIDAE**	
	Elanus caeruleus	Black-winged Kite
	Milvus migrans	Brahminy Kite
	Neophron percnopterus	Egyptian Vulture
	Gyps bengalensis	White-backed Vulture
	Gyps indicus	Long-billed Vulture
	Gyps fulvus	Eurasian Griffon Vulture
	Aegypus monachus	Cinereous Vulture
	Circaetus gallicus	Short-toed Eagle
	Circus macrourus	Pallid Harrier
	Butaster teesa	White-eyed Buzzard
	Buteo rufinus	Long-legged Buzzard
	Aquila rapax	Tawny Eagle
	Aquila haliaca	Imperial Eagle
	Aquila clanga	Spotted Eagle
	Hieraaetus fasciatus	Bonnelli's Eagle
FAMILY:	**FALCONIDAE**	
	Falco tinnunculus	Common Kestrel
	Falco naumanni	Lesser Kestrel
	Falco jugger	Larger Falcon
ORDER:	**GALLIFORMES**	
FAMILY:	**PHASIANIDAE**	
	Pavo cristatus	Indian Peafowl
ORDER:	**GRUIFORMES**	
FAMILY:	**RALLIDAE**	
	Gallinula chloropus	Common Moorhen
	Fulica atra	Eurasian Coot
FAMILY:	**GRUIDAE**	
	Grus antigone	Sarus Crane
	Anthropoides virgo	Demoiselle Crane

FAMILY:	**OTIDIDAE**	
	Chlamydotis undulata	Houbara Bustard
ORDER:	**CHARADRIIFORMES**	
FAMILY:	**RECURVIROSTRIDAE**	
	Himantopus himantopus	Black-winged Stilt
FAMILY:	**CHARADRIIDAE**	
	Charadrius dubius	Little Ringed Plover
	Hoplopterus indicus	Red-wattled Lapwing
FAMILY:	**SCOLOPACIDAE**	
	Calidris minuta	Little Stint
	Tringa totanus	Redshank
	Tringa nebularia	Green Shank
	Tringa ochropus	Green Sandpiper
	Tringa glareola	Wood Sandpiper
ORDER:	**PTEROCLIDIFORMES**	
FAMILY:	**PTEROCLIDIDAE**	
	Pterocles exustus	Chestnut-bellied Sandgrouse
ORDER:	**COLUMBIFORMES**	
FAMILY:	**COLUMBIDAE**	
	Streptopelia decaocto	Indian Ring Dove
	Streptopelia senegalensis	Little Brown Dove
ORDER:	**PSITTACIFORMES**	
FAMILY:	**PSITTACIDAE**	
	Psittacula krameri	Rose-ringed Parakeet
ORDER:	**STRIGIFORMES**	
FAMILY:	**STRIGIDAE**	
	Athene brama	Spotted Owlet
ORDER:	**CUCULIFORMES**	
FAMILY:	**CUCULIDAE**	
	Clamator jacobinus	Pied-crested Cuckoo
ORDER:	**CAPRIMULGIFORMES**	
FAMILY:	**CAPRIMULGIDAE**	
	Caprimulgus mahrattensis	Sand Night Jar
	Caprimulgus asiaticus	Little Night Jar
ORDER:	**PASSERIFORMES**	
FAMILY:	**ALAUDIDAE**	
	Alaemon alaudipes	Persian Desert Lark

	Galerida cristata	Crested Lark
	Alauda gulgula	Small Skylark
FAMILY:	**HIRUNDINIDAE**	
	Riparia riparia	Collard Sand Martin
	Ptyonoprogne concolar	Dusky Crag Martin
	Hirundo rustica	Common Swallow
FAMILY:	**MOTACILLIDAE**	
	Anthus compestris	Tawny Pipit
	Motacilla alba.	White Wagtail
FAMILY:	**CAMPEPHAGIDAE**	
	Tephrodornis pondicerianus	Lesser Wood Shrike
	Pericrocotus cinnamoneous	Small or Wandering Minivet
FAMILY:	**PYONONOTIDAE**	
	Pycnonotus leucogenys	White-checked Bulbul
	Pycnonotus cafer	Red-vented Bulbul
FAMILY:	**TURDIDAE**	
	Saxicola torquata	Stonechat
	Saxicola caprata	Indian Bush Chat
	Oenanthe isabellina	Isabelline Wheatear
	Oenenthe deserti	Desert Wheatear
	Oenanthe xanthoprymna	Red-tailed Wheatear
	Saxicoloides fulicata	Indian Robin
FAMILY:	**SYLVIDAE**	
	Prinia buchanani	Rufous-fronted Wren Warbler
	Sylvia nana	Desert Warbler
	Sylvia hortensis	Orphean Warbler
	Sylvia curraca	Lesser White Throat
	Phylloscopus neglectus	Plain Willow Warbler
FAMILY:	**NECTARINIDAE**	
	Nectarinia asiatica	Purple Sunbird
FAMILY:	**LANIIDAE**	
	Lanius excubitor	Great Grey Shrike
FAMILY:	**CORVIDAE**	
	Corvus corax	Punjab Raven
FAMILY:	**STURDINAE**	
	Sturnus pagodarum	Black-headed Myna
	Sturnus roseus	Rosy Starling
	Acridotheres tristis	Indian Myna
	A. ginginianus	Bank Myna

FAMILY:	**PASSERIDAE**	
	Passer domesticus	House Sparrow
	Passer hispaniolensis	Spanish Sparrow
	Euodice malabarica	White-throated Munia
	Emberiza melanocephala	Black-headed Bunting

The study revealed the presence of well-diversified bird fauna in the Nagarparkar area. Cream coloured courser and Indian courser were seen both in winter and summer with small number in the area. In the area of Rann of Kutch about 15 km. east of Nagarparkar a number of rare waterfowl species were seen in December 1994. These include rosy pelican, demoiselle crane and flamingo. A pair of spot-billed duck was observed at Bhartala in July 1998.

Peafowl was found with considerable population in the adjacent areas of Nagaraparkar mostly in the southern and southwestern sides. Long-billed vulture was seen in the Karunjhar. Other important raptor species include laggar falcon, Imperial eagle, tawny eagle and spotted eagle. Houbara bustard was found in winter both in the areas of desert and Rann of Kutch.

Roberts (1991) mentioned sarus crane, which was once resident and breeding bird, has become extinct in the country. According to him, two pairs were seen in Larkana district on Drigh Lake in 1929. In 1939, a breeding pair was found in Larkana on one of the larger lakes (Robert, 1991). This was last record of breeding of the species in Pakistan. During the present study a pair with two young were observed at Bhansar Lake near Nagarparkar district Tharparkar in December 1994. According to the local people the pair has been breeding at the site for many years. In July 1997, a nest with a single egg was also seen.

Demoiselle crane (*Anthropoides virgo*) is passage migrant through Pakistan. Its occurrence has not been referred from Tharparkar except areas of Thar Desert adjacent to Sanghar (Robert, 1991). During the present study four birds were seen on 1994 in Rann of Kutch near Nagarparkar. Long-billed vulture and dusky crag martin were found only in the Karunjhar range near Nagarparkar (Roberts, 1991). These species were not recorded by Ticehurst (1923) from any other part of Sindh. During present studies both species were recorded. Long-billed vulture was seen in the cliffs while dusky crag martin was observed both in the hills and adjacent plain areas.

Black-headed myna is distributed in West Pakistan roughly east of Indus valley (Ali and Ripley, 1968) whereas according to Roberts (1992) this species more or less continuously distributed as summer breeding visitor in the outer Himalayan foothills areas and broadest valleys from Chitral in the west to the foothills of Jhelum and Sialkot district and in some areas of Kashmir. During survey a single bird was recorded a few kilometers in the east of Nagarparkar.

According to Roberts (1992) lesser-wood shrike is widespread in Sindh and Punjab and it penetrates into the fringes of the Thar Desert in *Prosopis spicigera* scrub around Khipro (Sanghar) district and Chor (Tharparkar district). During the present study it was seen with small numbers between Islamkot and Nagarparkar.

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Fish and birds in Keti Bundar, Shah Bundar and other parts of the Indus delta

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Abstract

Bird and fish fauna of the Indus delta was studied. In all 51 species of birds and 22 species of fishes were recorded from various parts of Indus delta especially from keti Bundar and Shah Bundar area. Preponderance of coastal species of bird and fishes were observed during the study.

Keyword: Keti Bundar, Shah Bundar, Fish, Bird, Indus Delta, Ecology

Introduction

The coastline of Sindh province is about 320 km long extending from Hub River in the west to the Sir creek in the east and cover the entire delta of Indus River. Total area of the Sindh coastal zone is estimated to be about 35,880 sq.km. Indus delta consists of fifth largest mangrove forest of the world and consists of swamps, tidal mudflats, a network of creek channels and a large number of small to large islands extending from Korangi-Gharo-Phitti creeks near Karachi upto Sir creek at its south eastern end. Thee diversified habitats harbour rich fauna and flora. Despite its importance, very little work has been done of the faunal diversity of the area (Hasan and Ahmad, 2000). Present paper form a series, which will describe the fauna of the Indus delta and it deals with the fish and bird fauna of Keti Bundar and Shah Bundar which are two important population centers in the Indus delta.

Materials and Methods

For the identification of bird Perrins and Attenborough (1987), Hasan (1994, 1996), Heninzel *et al* (1987), Roberts (1991, 1992) and Ali *et al.* (1983) were used whereas for fishes Bianchi (1985) and Munro (1955) were mainly referred to. The paper enlists the species, which were collected, and indicates their relative abundance. Fishes were collected from commercial landings as well as sampling was done using cast and gillnets. Observations on birds were made using binocular and spotting scope.

Results and Discussions

During the study 51 species of bird and 22 species of fishes were observed. The bird and fish species according to their systematic arrangements

are given in Table-I and Table-II respectively. Typical coastal species of birds and fishes were observed in the Indus delta area. Similar assemblages were observed in Nurruri wetland (Javed and Hasan, 2004).

Table-I. Bird species observed at Keti Bundar and Shah Bundar area in the Indus Delta.

S. No.	Scientific Name/ Common Name	Status	Place of observation
1	*Tachybaptus ruficollis* (Little grebe)	Common/Winter visitor	A small wetland near Ghado
2	*Phalacrocorax carbo sinensis* (Large cormorant)	Common/Winter visitor	Keti Bundar/Kharochan/ Near Hasan Goth.
3	*Phalacrocorax niger* (Little cormorant)	Common/Resident	Keti Bundar/Yousuf Goth
4	*Ardea cinerea* (Grey heron)	Common/Winter visitor	Keti Bundar village/ Raeesan Wari
5	*Ardeola grayii grayii* (Indian pond heron)	Common/Resident	Keti Bundar Hasan Goth/Kun Sharif Shah Bundar
6	*Bubulcus ibis* (Cattle egret)	Common/Resident	Ghado
7	*Egretta garzetta* (Little egret)	Common/Irregular year round visitor	Keti Bundar Kharochan/ Kun Sharif Shah Bundar/ Raeesan Wari
8	*Egretta gularis* (Indian reef heron)	Common/Resident	Kharochan Keti Bundar village/Kun Sharif Shah Bundar.
9	*Phoenicopterus rubber* (Greater flamingo)	Common/Irregular year round visitor	Hasan Goth/Makar Dhand
10	*Milvus migrans govinda* (Pariah kite)	Common/Resident	Throughout the area
11	*Accipiter gentilis* (Goshawk)	Common Resident/ Winter visitor	On the way Juwa to Ghado
12	*Circus aeruginosus* (Marsh harrier)	Common/Winter visitor	Hasan Goth

13	*Francolinus francolinus* (Black partridge)	Common/Winter visitor	On the way Juwa to Ghado/ Makar Dhand
14	*Haematopus ostralegus* (Oystercatcher)	Common/Winter visitor	On the way to Keti to Kharochan Keti Bundar
15	*Himantopus himantopus* (Black winged stilt)	Common/Winter visitor	Keti Bundar Kun Sharif Shah Bundar/Makar Dhand
16	*Vanellus indicus* (Red-wattled lapwing)	Common/Resident	Keti Bundar Kun Sharif Shah Bundar
17	*Charadrius dubius* (Indian little ringed plover)	Common/Winter visitor	Keti Bundar
18	*Charadrius alexandrinus* (Kentish plover)	Common/Resident	Keti Bundar Kun Sharif Shah Bundar/Raeesan Wari.
19	*Numenius arquata arquata* (Curlew)	Common/Winter visitor	Keti Bundar Kun Sharif Shah Bundar/Raeesan Wari.
20	*Numenius arquata orientalis* (Eastern curlew)	Common/Winter visitor	Keti Bundar Kun Sharif Shah Bundar/Raeesan Wari.
21	*Xenus cinereus* (Terek sandpiper)	Common/Winter visitor	Keti Bundar
22	*Actitis hypoleucos* (Common sandpiper)	Common/Winter visitor	Keti Bundar
23	*Calidris minuta* (Little stint)	Common/Winter visitor	Keti Bundar
24	*Larus ridibundus* (Black-headed gull)	Common/Winter visitor	Kharochan/Yousuf Goth/ Makar Dhand
25	*Chlidonias hybridus* (Indian whiskered tern)	Common/Winter visitor	Keti Bundar/Kharochan/Kun Sharif Shah Bundar/Makar Dhand
26	*Sterna caspia* (Caspian tern)	Common/Year-round visitor	Keti Bundar/Kharochan/Makar Dhand
27	*Streptopelia tranquebarica* (Red turtle dove)	Common/Resident	On the way Keti Bundar to Kharochan/Yousuf Goth
28	*Streptopelia decaocto* (Collared dove)	Common/Resident	On the way Keti Bundar to Kharochan/Kun Sharif Shah Bundar
29	*Streptopelia senegalensis* (Little brown dove)	Common/Resident	Yousuf Goth

30	*Eudynamys scolopacea* (Indian koel)	Common/Resident	On the way Keti Bundar to Kharochan/Kun Sharif Shah Bundar/Yousuf Goth
31	*Ceryle rudis* (Pied kingfisher)	Common/Resident	Near Gharo village/Kun Sharif Shah Bundar
32	*Alcedo atthis bengalensis* (Indian common blue kingfisher)	Common/Resident	Near Gharo village/Kun Sharif Shah Bundar
33	*Halcyon smyrnensis smyrnensis* (White-breasted kingfisher)	Common/Resident	Near Gharo village/Kun Sharif Shah Bundar
34	*Merops orientalis beludschicus* (Sindh little green bee-eater)	Common/Resident	On the way Gharo to Ghado/Yousuf Goth
35	*Upupa epops* (Hoopoe)	Common/Resident	Near Ghado
36	*Galerida cristata* (Balochistan crested lark)	Common/Resident	Near Ghado/Yousuf Goth
37	*Hirundo rustica rustica* (Barn swallow)	Common/Winter visitor	Near Ghado
38	*Pycnonotus leucogenys* (White-cheeked bulbul)	Common/Resident	On the way Gharo to Ghado/un Shrif Shah Bundar.
39	*Pycnonotus cafer* (Red vented bulbul)	Common/Resident	On the Gharo to Ghado/Kun Sharif Shah Bundar
40	*Lanius excubitor* (Great grey shrike	Common/Resident	Ghado/Kun Sharif Shah Bundar
41	*Sexicoloides fulicata* (Indian robin)	Common/Resident	On the Gharo to Ghado/Kun Sharif Shah Bundar
42	*Saxicola caprata* (Pied bush chat	Common/Resident	Gharo/Kun Sharif Shah Bundar
43	*Turdoides caudatus* (Indian common babbler)	Common/Resident	On the Gharo to Ghado/Kun Sharif Shah Bundar
44	*Prinia gracilis* (Greaceful prinia)	Common/Winter-visitor	Yousuf Goth.
45	*Passer domesticus indicus* (Indian house sparrow)	Abundant/Resident	Throughout the Keti Budar and Shah Bundar.
46	*Acridotheres tristis* (Indian common myna)	Common/Resident	Throughout the Keti Budar and Shah Bundar.

47	*Acridotheres ginginanus* (Bank myna)	Common/Resident	Throughout the Keti Budar and Shah Bundar.
48	*Dicrurus macrocercus* (Black drongo)	Common/Resident	On the Gharo to Ghado/Kun Sharif Shah Bundar
49	*Dendrocitta vagabunda* (Indian tree-pie)	Less common/Resident	Ghado/Yousuf Goth
50	*Corvus splendens* (House crow)	Abundant/Resident	Throughout the area
51	*Ploceus philippinus* (Indian baya)	Common/Resident	Yousuf Goth

Table-II. Fish species observed at Keti Bundar and Shah Bundar area in the Indus Delta.

S.No.	Scientific Name/English Name	Place of observation/collection
1	*Sardinella longiceps* (Indian oil sardinella)	Keti Bundar/Rehri
2	*Escualosa thoracata* (White sardine)	Keti Bundar/Rehri
3	*Thryssa hamiltonii* (Hamilton's thryssa)	Keti Bundar
4	*Thryssa malabarica* (Malabar thryssa)	Shah Bundar
5	*Thryssa mystax* (Moustached thryssa)	Keti Bundar
6	*Arius maculatus* (Spotted catfish)	Rehri
7	*Arius tenuispinis* (Thinspine catfish)	Keti Bundar/Rehri
8	*Platycephalus indicus* (Bartail flathead)	Keti Bundar
9	*Terapon jarbua* (Jarbua terapon)	Rehri
10	*Sillago sihama* (Silver sillago)	Rehri/Keti Bundar

11	*Parastromateus niger* (Black pomfret)	Rehri
12	*Scomberoides tol* (Needlescaled queenfish)	Rehri
13	*Lutjanus fluviflamma* (Black spot snapper)	Keti Bundar/ Shah Bundar
14	*Lutjanus malabaricus* (Malabar snapper)	Keti Bundar
15	*Secutor insidiator* (Pugnosa ponyfish)	Shah Bundar
16	*Pomadasys maculatum* (Saddle grunt)	Rehri/Shah Bundar/ Keti Bundar
17	*Acanthopagrus latus* (Yellowfin seabream)	Rehri
18	*Acanthopagrus bifasciatus* (Twobar seabream)	Rehri/ Keti Bundar
19	*Liza vaigiensis* (Square tailed mullet	Keti Bundar/Rehri
20	*Lepturacanthus savala* (Savalii hairtail)	Keti Bundar/Rehri
21	*Pumpus argentus* (Silver pomfret)	Rehri/ Keti Bundar
22	*Salea elongata* (Elongate sole)	Rehri/ Keti Bundar/Shah Bundar

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On the status of marsh crocodile in Balochistan

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Abstract

The paper describes population of marsh crocodile (*Crocodylus palustris*) in Balochistan, an area known for its extreme aridity. Marsh crocodile was observed in four major rivers i.e. Dasht, Hingol, Nari and Hub of which Hub possibly has the largest population among the four rivers. The paper also describes some of the major threats being faced by the marsh crocodiles in Balochistan.

Key Words: Marsh crocodile, status, Balochistan, *Crocodylus palustris*,

Introduction

Out of three species of crocodilian known from Indian sub-continent, only one species i.e. mugger or marsh crocodile (*Crocodylus palustris*) is known to occur in Pakistan (Ahmad, 1986; Ghalib *et al*, 1981; Javed *et al,* 2004; Khan and Mirza 1976). Marsh crocodiles are widely distributed in their former wide range from Dasht in the extreme west of Pakistan to Assam in north eastern India and also, in Sri Lanka. Mugger is distributed in Balochistan including Hub and Dasht Rivers (Minton, 1966).

The species is regarded as endangered, exterminated in most of its range, rare in Iran and near extinction in Pakistan (Whitaker and Daniel, 1978). It is listed in IUCN Red Data Book and is included in Appendix 1 of CITES. Present paper describes the distribution of mugger in Balochistan.

Material and Methods

For the estimation of the marsh crocodile population direct and indirect methods were used during the present study (Javed *et al*, 2004). The survey was conducted in four areas of Balochistan i.e. Dasht, Hingol, Hub and Nari Rivers.

Results and Discussion

The population of marsh crocodile was observed in four rivers of Balochistan is presented in Table-I. The data indicates a comparatively thin population of marsh crocodile in Balochistan.

Dasht River: It is one of the largest river of Balochistan which starts from northern Balochistan and culminates in the Gwater Bay (Fig. 1). This river was surveyed in December 2001.This river only flows after rains thereafter water remains in a number of impoundments along its course. Rains are scanty in the area (>2 inches/year). Marsh crocodile was observed near Mitting village 95 km north of Jiwani. The vegetation of the area consists of *Tamarix spp., Indigofera oblongifolia, Sesbania sesban, Saccharum spp., Typha spp., Cynodon dactylon* and *Acacia senegal* etc.

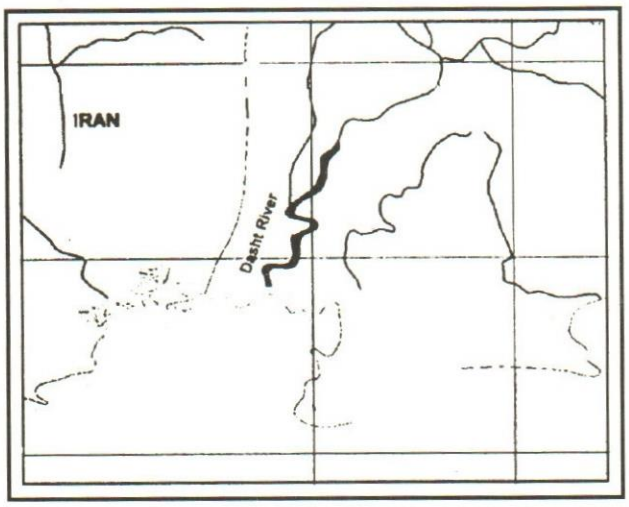

Fig. 1. Dasht River

Hingol River: This river which flows in the middle Balochistan is also seasonal except perennial at its lower reaches (Fig. 2). The high mountain along major part of the river course surrounds one side of the river. From mountain range wild goat (*Capra hircus*) come down for drinking water and seem that sometimes attacked by crocodiles because during this survey skeleton of a juvenile was found near bed of the river. There were many signs of paws, foot, claws and tracks of heavy tail near bed of the River. *Tamarix spp., Acacia spp., Prosopis spp.* and *Typha spp.* were found at the base of the river which provides good shelter or hiding place for crocodile. Nearly 15 km area of Hingol River from Agor camp upstream was surveyed.

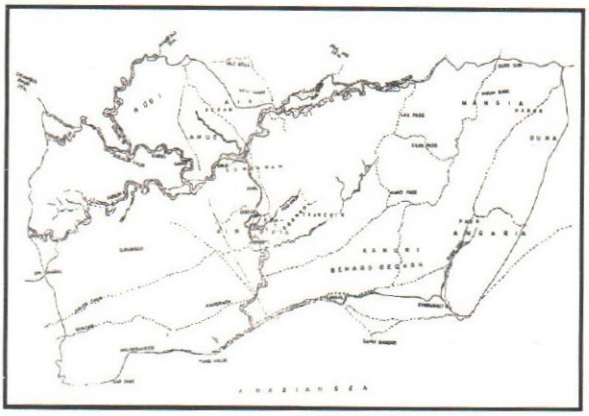

Fig. 2 Hingol River

Nari River: Nari River traverses district Sibi. The area was surveyed in March 2003. This river flows along the railway tract, which leads toward Nari. An area of 10 km upstream from Nari Railway Station was surveyed. The river is surrounded by mountain on both sides. The river basin is sandy cum muddy with vegetation *Tamarix spp.* and *Saccharum spp.* where as soil near road and railway tract is hard and stony. The river is narrow towards upstream from Nari station toward Harnai. There are four to five points where river basin is wide including Dewarwala Bridge, Sarsoonwala Nara, and Bux Ali Nara where crocodile group consisting of 4-5 crocodile each were reported.

Hub River: (Fig. 3) Hub River is an important perennial river of Balochistan. It was surveyed in January 2004. This river receives many tributaries at different points. At Arypir Shrine a tributary of Hub River has a reasonable population of marsh crocodile. The Hub River crosses Hub Duriji Road near Hanidam and from that point 10-12 km upstream there is place called 'Sore' which is another area inhabited by marsh crocodile. Population of marsh crocodiles at 'Sore' is confined at two places i.e. 'Gut' and 'Guhar'. Hanidam to Hub dam is about 45 km. The vegetation of the area consists of *Tamarix sp.*, *Acacia spp.*, *Salvadora spp.*, *Prosopos spp.*, *Zcziphus spp.*, *Saccharum spp.*, and *Typha spp.* The soil near water channel and riverbed is sandy and muddy whereas it is mainly hard and stony.

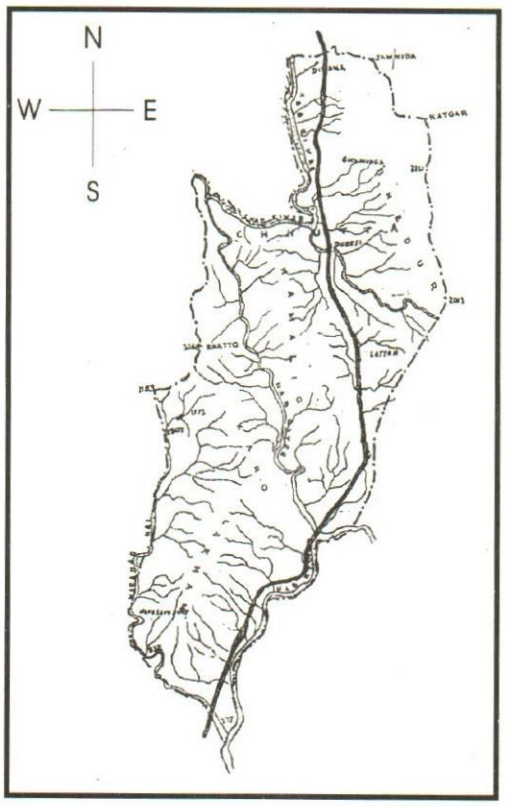

Fig. 3. Hub River

Table-I. Data of Marsh Crocodile in Balochistan

S.No.	Date	Name of the Rivers	Approximate Crocodile population	Crocodile population seen.	Remarks
Dasht River (District Gwadar)					
1.	20-12-01 to 01-01-02	Dasht River	4	1	Survey team observed footprints of three crocodiles
Hingol River (District Awaran and Lasbella)					
2.	20-08-02 to 27-08-02	Hingol River 18 km up stream Agor Camp	18+	18	Actually counted
Nari River (District Sibi)					
3.	16-03-03 to 18-03-03	Nari River 10 km upstream from Nari Railway station.	20-25	1	Local guide Khuda Dad Luni confirmed the presence of four groups of crocodile comprising 4-5

					crocodile each. This was reconfirmed by Payrai Khan of Pakistan Railway who was checking the railway tract.
Hub River (District Lasbella)					
4	03-01-04 to 06-01-04	Hub River Aripir to Hub dam	40-45	4	The staff of Duriji Game Reserve area confirmed the presence of 10 crocodiles at Sore and 4 in between Sore and Hub Durji Road (about six km from Sore area). Sindh Wildlife Watcher at Khar Breeding Centre confirmed the presence of a group about 20 crocodile near Hub Dam a few km from Khar Centre
	TOTAL		82	24	

Province of Balochistan is mostly arid and most of the rivers of the area are small and seasonal still these rivers support population of mugger. Some of the impoundments in these rivers have substantial large population of crocodile, which is now facing serious threat of both natural and man made factors. It has been reported that a number of impoundments have been dried up during the long drought of four to five years between 1999 and 2004 which is believed to a major decline in the population of muggers in these rivers.

Despite rarity, mugger are considered by general public to be threat for human and livestock, therefore, a substantial population of mugger is killed. There were reports of killing of muggers for their hides but during the survey this impression was dispelled as no one reported any such activity in Balochistan.

Marsh crocodile population is threatened mainly because of habitat alteration and human intervention. Construction of coastal highway has made access to those remote areas of Balochistan which previously was inaccessible especially population at Hingol River and to a lesser extent at Dasht Rivers. Construction of dam at Mirani on Dasht River will affect the population of marsh crocodile because some of the impoundments are known as crocodile abode, will be submerged. Similarly population existing downstream the Mirani Dam will be affected due to stoppage of flow of water. There is a plan in offing, though

shelved at present to construct a dam on Hingol River, which, if constructed, will also affect the population of crocodiles in the area.

Considering vulnerability of the marsh crocodile in Balochistan, there is a need to develop a management plan for the protection of the species. There is also a need to regular monitor the population of marsh crocodile in rivers of Balochistan. With effective management, the population of muggers, which is very small considering large area of Balochistan, can be protected.

Acknowledgements

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Some observations on the distribution and abundance of freshwater turtles in the river Indus

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Abstract

A survey on distribution and status of freshwater turtles was conducted in River Indus adjacent to Sukktir Barrage, Guddu Barrage, Jamaldin Wali and Pond areas adjacent to Kandhkot during March and April 2003. A total of 6 species of turtles i.e. *Kachuga smithi, Kachuga tecta, Hardella thurgi, Chitra indica, Aspederates gangeticus and Lissemys punctata* were recorded from the study area.. *Chitra indica* and *Kachuga smithi* were observed to be abundant in various parts of the study area.

Keywords: Freshwater turtle, Chelonia, River Indus, *Kachuga, Hardella, Chitra Aspederates, Lissemys.*

Introduction

Eight species of freshwater turtles are known from Pakistan. These include *Chitra indica, Aspederates gangeticus, Kachuga smithi, Kachuga tecta, Aspederates hurrum, Hardella thurgi, Lissemys punctata* and *Geoclemys hamiltonii.* Some species of freshwater turtles are in high demands for food and also for pet trade in Southeast Asia. Mass exploitation of wild caught turtles for these purposes has developed a concern among conservationists and environmentalists.

Soft shell turtle is extensively farmed in mainland China and Taiwan. At present farms produce an estimated quantity of 5,000 to 10,000 metric tons per year exceeding the quantity caught from wild. In the pet trade, Indian star tortoise, Australian snake-necked turtle and pig nosed turtle are preferred. Main centers of turtle pet trades are Jakarta, Singapore and Bangkok. In Pakistan, at present, there is a ban on export of all the reptiles including turtles under various legislations.

Five species of the turtles found in Pakistan are included in the CITES list. These include *Kachuga tecta, Lissemys punctata, Geoclemys hamiltonii, Aspederates hurrum* and *Aspederates gangaticus.* Of these, 4 species i.e. *Lissemys punctata, Chitra indica, Kachuga smithi* and *Hardella thurgi* have been listed in the Red list of IUCN. Despite their importance, little and fragmented information is available on the distribution and status of fresh water turtles in

Pakistan. Minton (1966) described known distribution of reptiles in Pakistan. Khan and Mirza (1976) presented a key and checklist of reptiles-Chelonia including distribution of turtles in Pakistan. Ghalib *et al* (1981) published checklist of reptiles of Pakistan including known distribution. No detailed study on distribution and abundance of freshwater turtle in Pakistan is known. Keeping in view the importance and lack or scantiness of the information on freshwater turtle, present study on their distribution in some parts of Indus River was conducted.

Study Area

A survey was conducted on Sukkur Barrage, Guddu Barrage and adjacent areas, riverine stretch near Jamal Din Wali and lakes and ponds near Kandkot during March 20, 2003 and April 7, 2005.

Sukkur Barrage

Both upstream (5km) and downstream (4 km) area of the barrage was studied. Three canals emerge from right bank at Sukkur Barrage. These are Dadu canal, Rice canal and Kirthar canal. In addition to upstream and downstream of Sukker Barrage, population of freshwater turtles was estimated in first 10 km of Kirthar and Dadu canals (Table-I)

Upstream: The area consists of a water reservoir behind the barrage. It has slow moving deep-water body but at the margins it is shallow. There are small inlets on northern margin of the river. This area was observed to have high concentration of *Chitra indica.*

Downstream: Downstream of the Sukkur Barrage has relatively fast moving water in the middle and slow moving water at the margin. The water has depth upto 20 feet.

Kirthar canal: It has slow moving water with approx. depth 4 to 5 feet in depression

Dadu canal: This canal also has slow moving shallow water having depth upto 4 feet.

Guddu Barrage:

Guddu Barrage is situated in thesil Kashmore district Jacobabad of Sindh. Upstream of the Barrage, the downstream and three canals originating from the barrage was surveyed for estimation of fresh water turtles Table-II).

Upstream: There is a water reservoir behind the barrage. The reservoir is approximately 1 km wide and 4-5 km long. Water is slow moving and depth is about 30 feet. The water is almost without aquatic vegetation. About 4 km stretch of this water body was surveyed.

Downstream: The water is relatively fast moving in center and slow moving at margins. It has approximate depth of 20 feet but at the banks it is shallow. About 4 km stretch of the river was surveyed. Drag net was used for trapping and counting of turtles in area. Basking and floating turtles were also enumerated.

Guddu canal and Pat feeder: Guddu and Pat Feeder canals originate from right bank of the River Indus at Guddu Barrage. The canals were flowing at full with water having high speed with an average depth of 10 feet. About 8 km stretch of the canal was surveyed by walking along the bank of the canals from its origin.

Ghotki canal: Ghotki canal emerges from left bank of Guddu Barrage. It passes towards southeast and irrigates the areas of Ghotki district. Two segments of the canal were surveyed. These include first 8 km of the main canal from its origin and its branches ends near Mirpur Mathelo and Obaro. At the time of survey the canal was almost close. The part of the canal near the barrage has shallow slow moving water. It has bare sandy banks and inlets, which provides ideal site for basking of turtles. Parts of the canal near Obaro and Mirpur Mathelo were almost dry but having some water in depressions.

Basti Sadu Khan (Indus River Stretch)

The area is near Jamaldin Wali, thesil Sadiqabad, district Rahimyar Khan in the province of Punjab. The study site is an outlet of River Indus having slow moving and less turbid water. It has a length of about 10 km, width of 100 to 300 meters and depth ranging from 1 to 20 feet. Water is almost without aquatic vegetation except at margins, which has very light reed vegetation.

Lakes/Ponds and Farms

Some lakes and ponds in adjacent areas of Kandkot district Jacobabad were also surveyed.

Alghazi Farm: It is basically a waterlogged area being used as fish farm located south of Kandkot city, thesil Kandkot, district Jacobabad. It has an area of about 100 acres. It is fed from seepage of Guddu Canal, rainwater and sewage of Kandkot city. Water depth ranges upto 7 feet. The farm has light aquatic vegetation having weeds and reeds including species *Potamogeton sp.*, *Hydrilla verticillata*, *Phragmites karka*, *Saccharum spp.* etc and *Tamarix* scrub. The farm is used for culture of three species of fish i.e. *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla*. Alghazi farm has rectangular shape.

Al-Shahbaz and Al-Noor Farms: Both these farms are located on the southern side of Indus highway, near Kandkot. These farms have an area of 100 and 450 acres respectively, logged and fed through seepage of Guddu Canal, and rainwater etc. The farms have approximate depth of 6-7 feet with light aquatic vegetation. These farms have fish species including *Labeo rohita, Cirrhinus mrigala, Labeo calbasu, Catla catla, Wallago attu* and *Mystus seenghala* etc.

Materials and Methods

The study was based mainly on direct observation; enumerations depended on basking and floating turtles, and calculated by.

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

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

In the shallow standing or slow moving water cast nets were also used to sample turtle in randomly selected sample areas. Numbers of each species in the captured turtles were counted and population of similar habitat was estimated.

Results

A total of 6 species of turtles i.e. *Kachuga smithi, Kachuga tecta, Hardella thurgi, Chitra indica, Aspederates gangeticus and Lissemys punctata* were recorded from the study area.

Table-I. Distribution of freshwater turtles in Sukkur Barrage area

Date/ Time/ Species	Sukkur Barrage (Upstream)	Sukkur Barrage (Downstream)	Kirthar Canal	Dadu Canal
	April 7, 2003	April 30, 2003	April 31, 2003	April 6, 2003
	7:00 to 10:00 AM	1:00 to 6:00 PM	7:00 to 10:30 AM	4:00 to 6:00 PM
Chitra indica	350	120	110	124
Aspederates gangaticus	50	28	22	40
Kachuga smithi	180	260	260	180
Kachuga tecta	20	24	30	30
Hardella thurgi	0	8	20	15

Table-II. Distribution of freshwater turtles in Guddu Barrage area

Date/ Time/ Species	Guddu Barrage (Upstream)	Guddu Barrage (Downstream)	GudduCanal	Pat Feeder	Ghotki Canal
	April 1, 2003	April 1, 2003	April 6, 2003	April 2, 2003	April 1, 2003
	8:30 – 10:00 AM	10:00 AM to 01:00 PM	04:00 to 06:00 PM	01:00 – 05:00 PM	2:00 to 5:00 PM
Chitra indica	112	80	64	50	96
Aspederates gangaticus	12	10	16	10	18
Kachuga smithi	94	320	80	80	200
Kachuga tecta	16	60	10	12	16
Hardella thurgi	4	25	10	6	12

Table-III. Distribution of freshwater turtles in Basti Sadu Khan area and various Farms

Date/ Time/ Species	Basti Sadu Khan	Al-Ghazi Farms	Al-Shahbaz Farms	Al-Noor Farms
	April 2, 2003	April 4, 2003	April 4, 2003	April 4, 2003
	9:00 Am to 5:00 PM	1:30-4.0 PM	09:00 AM-1:00 PM	09:00 AM-1:00 PM
Chitra indica	160	66	60	180
Aspederates gangaticus	30	15	12	36
Kachuga smithi	180	96	90	300
Kachuga tecta	25	18	12	24
Hardella thurgi	20	15	12	36
Lissemys punctata		20	8	20

Discussion

Two of the six species of the freshwater turtle, *Chitra indica* and *Kachuga smithi* were found abundant in the study area while other four were relatively occuring with smaller numbers. *Chitra indica* was found with most dense population at the upstream of the Sukkur Barrage whereas its density was relatively lower in downstream. The species was also found with good numbers in Dadu canal and low in Kirthar canal. At Guddu Barrage, its concentration was observed at riverine stretch at upstream. *Kachuga smithi* was found most abundant at downstream of Guddu Barrage. In Ghotki Canal *Chitra indica* was observed abundant at first few kilometers while its population decreased further downstream.

Minton (1966) and Ghalib etal (1976) cited that *Chitra indica* and *Kachuga tecta* were distributed in limited area of Sindh. During the present study it was observed that both the species are common in Indus river and extending their distribution to the district, Raheem Yaar Khan, Punjab.

Spotted Pond Turtle (*Geoclamys hamiltonii*) was not seen during the present survey. This does not mean that the species is not present in the area but it shows its rarity. It has been recorded in the adjascent areas.

During the study, it was noticed that population of freshwater turtles in the study area is under threat due to a number of factors.

Resource as food: Some non-muslim communities were reported to harvest turtles on small scale for their food requirements. Although the extent of annual harvest is not known, however, it is not significant.

Killing by fish farmers: Since turtles especially *Chitra indica* is known to be a fish predator, therefore, fish farmers consider it a pest of their economic valued species. It was reported that if the fishermen capture any turtle in netting it is killed. The extent of damage is not known therefore, it needs to be estimated.

Closure of canals: Canals are periodically closed which are a cause of drying up of the channels, which is reported to affect turtle population at a large scale.

Drought: It was informed by the fishermen that drying up of some of the wetlands and water bodies due to persistent drought result in major mortality of freshwater turtles in some of its inhabitant areas.

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A review of family Triacanthidae (Pisces) occurring in Pakistan

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Abstract

A total of two species of family Triacanthidae i.e. *Pseudotriacanthus strigilifer* (Cantor, 1849) and *Triacanthus biaculeatus* (Bloch, 1786) were previously known from Pakistan. Present paper also reports another species i.e. *Triacanthus nieuhofii* Bleeker, 1852 from Pakistan is also given in the paper. A key to known species has been provided.

Keywords: Family Triacanthidae, *Pseudotriacanthus strigilifer, Triacanthus biaculeatus, T. nieuhofii*

Introduction

Member of Family Triacanthidae (tripodfishes, triplespines) are known to inhabit shallow coastal waters of the Indo-Pacific areas. Seven species of the family i.e. *Pseudotriacanthus strigilifer, Triacanthus biaculeatus, T. nieuhofii Trixiphichthys ripodichthys angustifrons weberi Tripodichthys blochii Tripodichthys oxycephalus* are known so far (Froese and Pauly, 2005). Of the known species, only two *Pseudotriacanthus strigilifer* (Cantor, 1849) and *Triacanthus biaculeatus* (Bloch, 1786) were previously known from Pakistan.

Members of family Triacanthidae are commonly caught in the trawl and beach seine fisheries operations along Pakistan coast. These species of this family are not utilized for human consumption but dried alongwith other species and converted into fishmeal. These fishes are known as 'Kookh' in Sindh, 'Pokki' or ' Khar' in Balochistan and 'Tidda' in Katchi language. Present paper gives information about species of the Family Triacanthidae including a new record *Triacanthus* nieuhofii from Pakistan.

Materials and Methods

In addition to review of literature, samples of fishes were collected from landing centers, photographed and preserved in 5 % neutralized formalin for later examination.

Results and Discussions

Two species of Family Tricanthidae belonging to two genera *Pseudotriacanthus strigilifer* and *Triacanthus biaculeatus* are previously reported from Pakistan. Specimens of a third species i.e. *Triacanthus* nieuhofii were collected during the present study.

Pseudotriacanthus strigilifer (Cantor, 1849)
Long-spined tripodfish
(Fig. 1)

This species was originally described as *Triacanthus strigilifer* from Sea of Penang, Malaysia by Cantor (1849). Its holotype is not known (Eschmeyer, 1998). Bianchi (1985), Froese and Pauly (2005), Hoda (1985, 1988), Hussain (2003), Jalil and Khalil (1972, 1981) reported this species from Pakistan without specifying any location. This species was reported from Sindh coast by Anonymous (1955), Hutchins (1984). From Sindh, it was also reported from Jhangi Sir by Ahmed *et al* (1999), from Karachi by Ahmad *et al* (1973) and Anonymous (1955) and from Paradise Point by Moazzam and Rizvi (1980). It was reported from Balochistan coast by **Ahmad** *et al* (1973), Anonymous (1955), Hutchins (1984) and Zugmayer (1913). Elsewhere, this species is known from Persian Gulf, Gulf of Oman to Indonesia, the Philippines, Papua New Guinea, Taiwan and Australia.

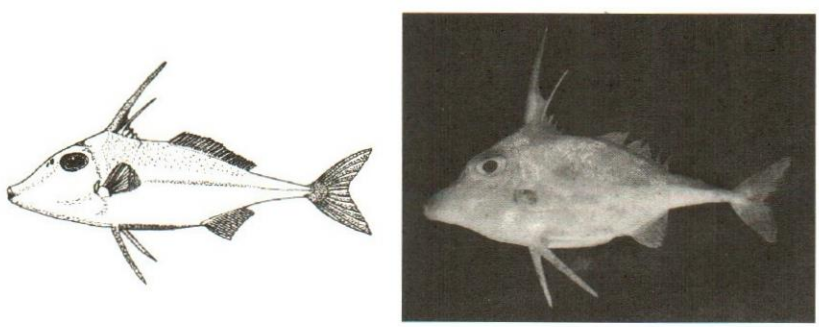

Fig. 1 *Pseudotriacanthus strigilifer* (after Day,1878)

Triacanthus biaculeatus (Bloch, 1786)
Short-spined tripodfish
Fig. 2

This species was originally described as *Balistes biaculeatus* from Indian Ocean by Bloch (1786). No holotype of this species is known, however, lectotype (ZMB 4148) is housed in Zoologisches Museum, Humboldt Universitat, Berlin, Germany (Eschmeyer, 1998). *Triacanthus indicus* described

by Regan (1903) from Port Blair, Andaman Islands, India is considered to be a synonym of this species. No holotype of this synonym is known, however, lectotype (BMNH 1889.2.1.4096) is housed in British Museum of Natural History, London, U. K. (Eschmeyer, 1998). Another species *Triacanthus brevirostris* was described by Temminck and Schlegel (1850) from Japan which is considered to synonym of this species. Holotype (RMNH 4123) of the latter is housed in Rijksmuseum van Natuulijke Histoire, Leiden, Netherlands (Eschmeyer, 1998).

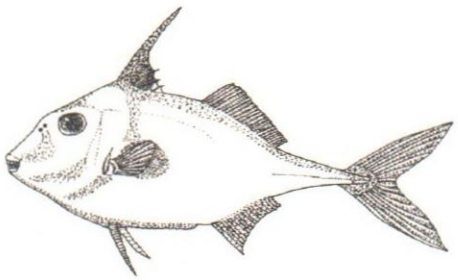

Fig. 2. ***Triacanthus biaculeatus*** (after Day,1878)

Bianchi (1985), Froese and Pauly (2005), Hoda (1985, 1988), Hussain (2003) and Jalil and Khalil (1972, 1981) reported this species from Pakistan without specifying any location. This species was reported from Sindh coast by Hutchins (1984), Murray (1880), Punwani (1934), Sorley (1932) whereas it was reported from Karachi by Ahmad *et al* (1973) and Anonymous (1955, 1999) and from Tidal Link Canal, Badin District by Jafri *et al* (2000). It was reported from Balochistan by Ahmad *et al* (1973); Anonymous (1955), Day (1878), Hutchins (1984), Qureshi (1952) and Zugmayer (1913). Elsewhere this species is known from Persian Gulf eastward through Bay of Bengal to eastern Australia, northward to southern Japan and China and southward to Mauritius.

Triacanthus nieuhofii Bleeker, 1852
Silver tripodfish
(Fig. 3)

This species was originally described from Sibogha, western Sumatra, Indonesia by Bleeker (1852). Its holotype (RMNH 25402) is housed in Rijksmuseum van Natuulijke Histoire, Leiden, Netherlands (Eschmeyer, 1998). This species can be distinguished from other species in having spiny dorsal-fin membrane very dark between first and second spines, slightly to much less darker between second and third spines, and pale between third and fifth spines. Outline of head between base of first dorsal-fin spine and eyes somewhat convex in front of spine and then straight or slightly concave over eye. Scale-covered

ventral surface of pelvis almost as wide anteriorly as posteriorly, not distinctly tapered to a point.

This species is mainly reported from Indonesia, Vietnam, Taiwan, to northwestern Australia. It is also reported from Indian coast in the Bay of Bengal (Froese and Pauly, 2005). It is reported for the first time from Pakistan and is first record from Arabian Sea. Two specimens of this species were collected from commercial catches in Karachi Fish Harbour in August 2005.

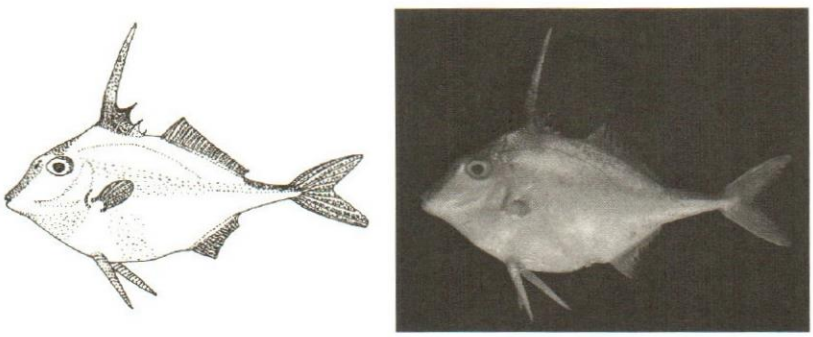

Fig.3. *Triacanthus nieuhofii*

Key to the species of Family Triacanthidae occurring in Pakistan (based on Matsuura, 2001) has been prepared.

1. Scale-covered ventral surface of pelvis much wider anteriorly than posteriorly, distinctly tapered to a point ..... *Pseudotriacanthus strigilifer*

   Scale-covered ventral surface of pelvis almost as wide anteriorly as posteriorly, not distinctly tapered to a point..... 2

2. Spiny dorsal-fin membrane very dark between first and third spines, and usually equally dark between third and fifth spines; outline of head from base of first dorsal-fin spine to above eye an even slightly convex curve or almost a straight line..... *Triacanthus biaculeatus*

   Spiny dorsal-fin membrane very dark between first and second spines, slightly to much less darker between second and third spines, and pale between third and fifth spines; outline of head between base of first dorsal-fin spine and eyes somewhat convex in front of spine and then straight or slightly concave over eye..... *Triacanthus nieuhofii*

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Indian Mackerel (*Rastrelliger kanagurta*) from Pakistan-I. Some aspects of biology and fisheries

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Abstract

Indian mackerel (*Rastrelliger kanagurta*) is an inhabitant of shallow water, which is commonly harvested throughout the coast of Pakistan. It is estimated that about 30,000 m. tons of Indian mackerel is now exported annually. Present paper described various aspects of Indian mackerel fisheries including fishing ground, seasons, harvesting methods, handling and processing practices etc. The paper also discusses biology of this species including food and feeding, length-weight relationship, sex ratio and spawning.

Keywords: Indian mackerel, *Rastrelliger kanagurta,* fishery, biology, landings

Introduction

Major part of the activities of the artisenal fisheries of Pakistan is restricted to shallow coastal waters; however, most of these activities are not aimed for a particular species. Indian mackerel, being a schooling fish, is, however, targeted by those fishermen who are engaged in use of gillnets or encircling net (locally known as 'katra'). Its landings prior to 2002 remained insignificant and not reflected in the official fisheries statistics of Pakistan. However, landings thereafter increased and it is estimated that about more than 34,000 of Indian mackerel is now caught annually, bulk of which is exported. Although this species is commercially exploited since long in Pakistan, however, an aimed Indian mackerel fisheries was started in 1992 when its export to Saudi Arabia and later on to Malaysia was started in 1992. Since 2002, the export of Indian mackerel multiplied achieving a level of about 30,000 m. tons.

Indian mackerel is known from Pakistani waters since long. Day (1876) and Murray (1880) have reported this species from Sindh as *Scomber microlepidotus* and *Scomber kanagurta* respectively whereas Zugmeyer (1932) reported this species from Mekran coast as *Scomber microlepidotus*. However, little or no information is available about the biological aspects of this fish. In the present paper which is first of the series of publications on the Indian mackerel, an attempt is made to look into various aspects of fisheries of this species including fishing ground, seasonality, commercial landings, fishing gears,

processing and export etc. The paper also describes various aspects of biology of Indian mackerel from Pakistan.

Materials and Methods

Information regarding fisheries aspects was collected from data archives of various agencies such as Fishermen's Co-operative Society and Marine Fisheries Department. Information about fishing methods, seasonality, fishing grounds and other aspects of fisheries was collected from interviews of the fishermen and through field observations. Sampling of Indian mackerel was started in April 2002 from Karachi Fish Harbour and data pertaining to length frequency distribution, length-weight relationship, sex ratio, seasonal gonadal changes etc. were recorded. Although attempts were made to collect such data on daily basis, however, in most cases data were recorded at least three times in a week.

Results and Discussion

Taxonomy:

This species was originally described as *Scomber kanagurta* from Vishakhapatnam (now called Vizagapatam), India by Cuvier (1816), however, no type is known (Eschmeyer, 1998). Considering the species to be highly variable a number of species have been described which are now considered as synonym of this species.

Scomber kanagurta Cuvier (1816),
Rastrelliger kanagurta (Cuvier, 1816),
Rastrelliger loo (Lesson, 1829)
Scomber loo Lesson, 1829)
Scomber canagurta Cuvier, 1829
Scomber delphinalis Cuvier, 1832
Scomber chrysozonus Rüppell, 1836
Scomber microlepidotus Rüppell, 1836
Scomber moluccensis Bleeker, 1856
Scomber uam Montrouzier, 1857
Scomber reani Day, 1871
Scomber lepturus Agassiz, 1874
Rastrelliger serventyi Whitley, 1944

Description:

D1, IX-XI; D2, 11-13+5 finlets; A, 11-12+5 finlets; P, 19-22; V, I+5. Head longer than body depth. Maxilla partly concealed, covered by lacrimal bone

but extending to about hind margin of eye. Gillrakers very long, visible when mouth is opened, 30 to 46 on lower limb of first arch; a moderate number of bristles on longest gillraker, 105-119. Interpelvic process small and single. Swimbladder present.

Colour: narrow dark longitudinal bands on upper part of body (golden in fresh specimens) and a black spot on body near lower margin of pectoral fin; dorsal fins yellowish with black tips, caudal and pectoral fins yellowish; other fins dusky.

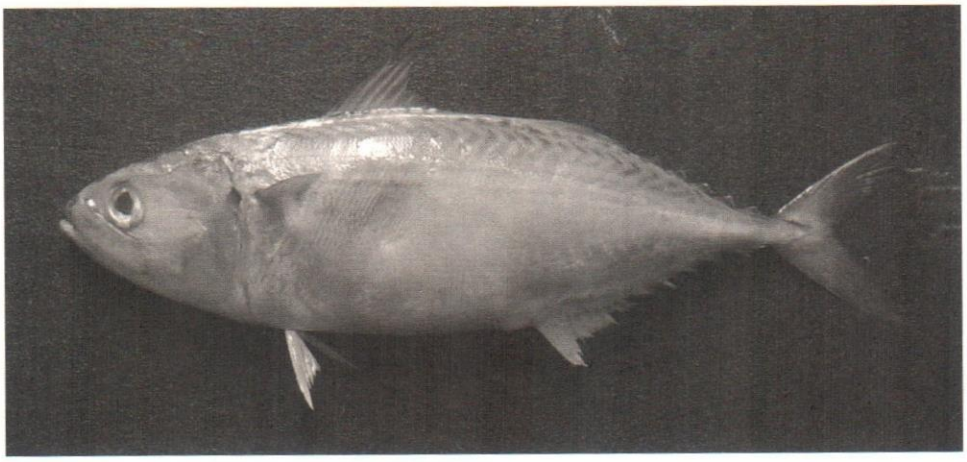

Fig. 1 Rastrelliger kanagurta

There are two other species of genus *Rastrelliger* i.e. short mackerel *R. brachysoma* (Bleeker, 1851) and island mackerel *R. Faughni*. From *R. brachysoma*, Indian mackerel can be distinguished is not having a deep body and presence of dusky stripes running along sides of body. From *R. Faughni* it can be distinguished in having more than 30 gill rakes (*R. Faughni* has 22-25).

Variation in colour and pattern on the body of Indian mackerel was noticed during the present study (Fig. 2). Jayasankar *et al* (2004) observed morphometric and genetic variation in Indian mackerel from India. A similar variation may occur in Pakistan for which further study is needed.

Distribution:

Indian mackerel is widely distributed in the Indo-West Pacific extending from Red Sea and East Africa to Indonesia, north to the Ryukyu Islands and China, south to Australia, Melanesia and Samoa (Froese and Pauly, 2005). This species is reported to have entered the eastern Mediterranean Sea through the Suez Canal (Collete, 1970).

It is widely distributed along the coast of Pakistan. Ahmad (1988), Ahmad and Niazi (1988), Bianchi (1985), Froese and Pauly (2005), Hoda (1985, 1988), Jalil and Khalil (1972, 1981), Khan (1994), Majid *et al* (1992), Qureshi (1969), Rashid (1966); Qureshi (1960) and Siddiqi (1956) reported this species from Pakistan without specifying any location. This species was reported from Sindh coast by Anonymous (1955), Collette (1984), Collette and Nauen (1983), Day (1876), Misra (1962), and Sorley (1932). It was also reported from Sindh coast by Murray (1880) as *Scomber kanagurta* whereas Hussain (2003) reported this species from Sindh as *Rastrelliger chrysozonus*. It was reported from Indus Delta by Mahmood, *et al* (1999), from Karachi by Anonymous (1955) and from Korangi Creek by Ahmed and Abbas (1999b, 2000). From the Balochistan coast it was reported by Anonymous (1953), Collette (1984) and Collette and Nauen (1983). It was also reported from Balochistan coast by Zugmayer (1913) as *Scomber microlepidotus*. It was reported from Makran by Anonymous (1955) and Qureshi (1952) and from Miani Hor by Ahmed and Abbas (1999a, 2000).

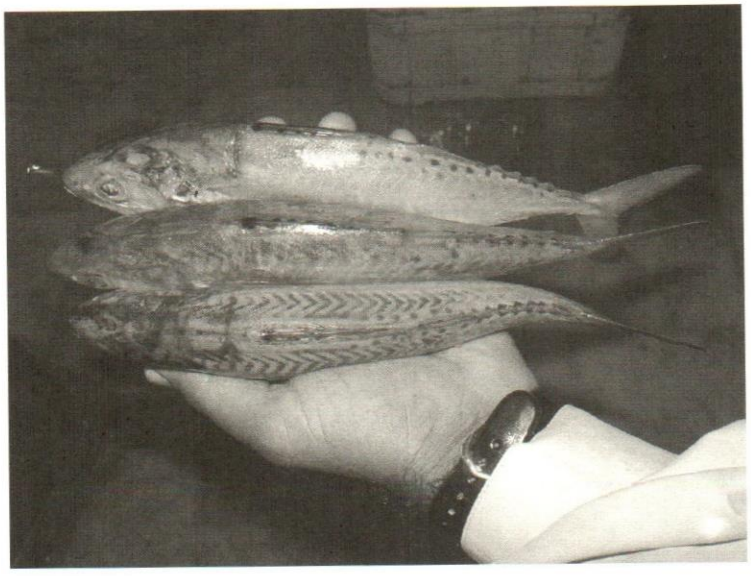

Fig. 2. Variation in pattern of Indian mackerel collected from Gwader.

Ecology

Indian mackerel is schooling pelagic fish, which inhabits shallow coastal waters especially in bays along the coastline. It enters in creeks and estuaries, however, it is dominantly found in comparatively open waters known to rich is planktons. Ganz, Phushukan, Gwader (west Bay), Gwader (East Bay), Sur, Karwat, Kappar, Bidok, Rumbra, Basul, Ormara (West Bay), Kund Malir, Gaddani, Churan Island, Ras Mauri, Paradise Point, Buleji, Sandspit, off Manora, off Clifton, off Bundal Island and mouth of major creeks are major concentrations areas along the coast of Pakistan.

Food and Feeding Habit

It is planktivrous fish mainly feeding on phytoplankton and zooplankton. Analysis of the stomach contents reveals that phytoplankton (dominated by diatoms and dinoflagellates), copepods, hypriid amphipods dominate in most cases. In the month of March shrimp post larvae were dominating. In two cases octopus larvae were also observed in the stomach content. Similar observations on the stomach content of Indian mackerel were noted Bhimachar and George (1952), Doiphode (1974), Devanesan and John (1940), George and Annigeri (1960) and John and Menon (1942).

Fig. 3. Fish school of Indian mackerel in Gwader (Pedi Zur) Picture by A Rahim

Length weight Relationship

The length-weight relationship of Indian mackerel from Pakistan coast based on 3,594 specimens ranging from 7.0 cm and 31.0 cm in total length and between 2.5 g and 500 g in weight was studied. For the determination of length weight relationship sexes were combined. The scatter diagram between length and weight showed a parabolic relationship (Fig. 4a). A scatter diagram of the log-length and log-weight was plotted (Fig. 4b) which indicated a linear relationship. The regression equation is:

$$\text{Log } L = -2.264 + 3.207 \text{ Log } W$$

$$L = 0.00544\ L^{3.207}$$

Where L is total length (in cm) and W is weight (in g) of fish. The coefficient of correlation was found to be 0.931, which indicated a high degree of positive correlation between the two parameters. A comparison with the length-weight relationship determined from various parts of the world is given in Table-I (based maily on Froese and Pauly, 2005), which indicates that length-weight relationship determined during the present study is similar to studies made by other workers.

Table-I. Length-weight relationship of *Rastrelliger kanagurta* from different parts of world.

Country/Locality	a	b	R	Reference
India (Andaman Islands)	0.000002164	3.2874	-	Luther (1973)
India (Andaman Islands)	0.000029	3.3087	-	Jones and Silas (1964)
Thailand	0.0163	2.7550	-	Yanagawa (1994)
Bangladesh	0.0158	2.8950	-	Mustafa (1999)
Australia (Northern Territory)	0.0160	2.9950	0.969	Willing and Pender (1989)
Yemen	0.0170	3.010	-	Edwards and Shaher (1991)
Malaysia	0.0067	3.090	-	Tampubolon (1988)
South Africa	0.0064	3.170	-	Torres (1991)
Indonesia (Western Region)	0.0061	3.174	0.995	Pauly *et al* (1996)
Indonesia (Java Sea)	0.0039	3.19	-	Tampubolon (1988)
Egypt (Red Sea)	0.0043	3.2650	-	Rafail (1972)
Mozambique	0.0041	3.040	-	Sousa and Gislason (1985)
Saudi Arabia	0.0040	3.33	-	Sanders and Morgan (1989)
Pakistan	0.00544	3.207	0.931	Present study

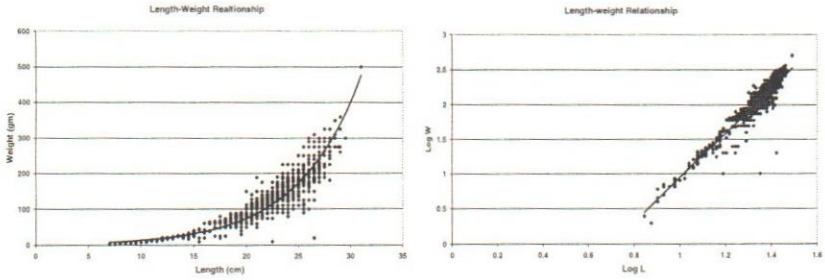

Fig. 4. Length-weight relationship in Indian mackerel.

Sex ratio

Table-II presents data of sex ratio observed during the present study which revealed that for five months (June to October) male dominate in the catch whereas female dominate in the landings during remaining part of the year. In November, all specimens were observed to be in very stage of development, therefore, their sex could not be determined. It is worth mentioning that the cumulative sex ratio (1:1.1)is near the universal sex ratio (1:1).

Table-II Sex ratio of Indian mackerel

Month	Female	Male	Total	Sex Ratio
May	240	198	438	0.8
June	224	260	484	1.2
July	156	229	385	1.5
August	188	320	508	1.7
September	292	350	642	1.2
October	74	94	168	1.3
November	No data	No data	No data	No data
December	14	7	21	0.5
January	40	15	55	0.4
February	50	15	65	0.3
March	97	68	165	0.7
April	46	36	82	0.8
Total	1,421	1,592	3,013	1.1

Spawning

During the present study, reproductive bodies of female and males were ranked in accordance with maturity stages. Male and female reproductive were ranked in five categories based on the stage of development with fish with unripe being ranked as Stage-I and running/ spent as Stage-V. The study indicates that in Indian mackerel spawning takes place in during summer months i.e. between June and October with peak in September–October (Table-III; Fig. 5). All the specimens in the month of November were observed to be early stages of development, therefore, sex could not be determined.

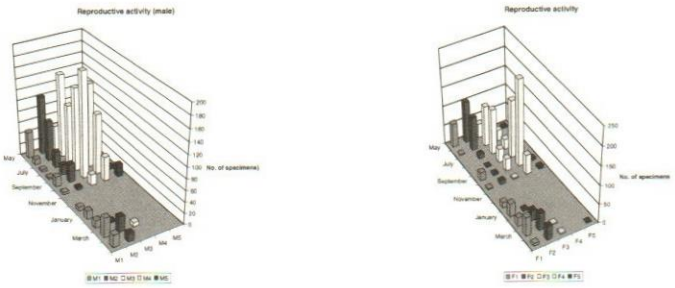

Fig. 5. Reproductive activity in female and male

This also indicates that by the month of October all the fishes spawn. Early stage of maturity was found during the winter months. The study thus revealed that Indian mackerel is a summer breeder in Pakistani waters. Along west coast of India, *Rastrelliger kanagurta* is reported to breed in summer monsoon months (Nair and Rao, 1970; Venkataraman, 1970). Luther (1973) found that Indian mackerel in Andaman Islands spawn during the winter months (October to April).

Tab le-III. Maturity stage distribution in *Rastrelliger kanagurta* from Pakistan

MONTH	FEMALE						MALE					
	Maturity Stages (%)						Maturity Stages (%)					
	No.	I	II	III	IV	V	No.	I	II	III	IV	V
May	24	25.8	44.6	15.4	12.5	1.7	198	23.7	53.1	22.2	1.0	0
June	224	0.9	39.3	46.9	12.9	0	260	3.8	27.3	57.7	10.8	0.4
July	156	0	7.1	75.6	16.7	0.6	229	1.7	12.2	45.9	37.1	3.1
August	188	0	0.5	18.6	80.9	0	320	0.9	5.6	46.3	46.6	0.6
September	292	7.5	1.7	11.0	78.1	1.7	350	5.2	9.4	53.7	30.3	1.4
October	74	4.1	12.2	4.1	70.1	9.5	94	4.3	4.3	21.3	46.8	23.3
November	0	0	0	0	0	0	0	0	0	0	00	0
December	14	100	0	0	0	0	7	100	0	0	0	0
January	40	90	10	0	0	0	15	100	0	0	0	0
February	50	46	54	0	0	0	15	86.7	13.3	0	0	0
March	97	51.5	46.4	2.1	0	0	68	50.0	39.7	10.3	0	0
April	47	12.8	76.6	8.5	0	2.1	35	60	40	0	0	0

Fisheries

Indian mackerel is commercially harvested from coastal areas of Pakistan almost throughout the year with peak landing during February and March. It is mainly caught with surface gillnets with a mesh size of 5 cm (stretched). Large schools of Indian mackerel are also caught with 'katra' net (surrounding net). Fishing boats mainly used for catching Indian mackerels are called 'hora' in Sindh and 'rachin' in Balochistan (Fig.6). These boats have a size

range between 35 to 40 feet (LOA). Small quanities of Indian mackerel is also caught in shrimp trawl nets.

Upon locating a fish school (Fig. 3), the net is laid down around the fish school and fish is driven towards the net so that they may get entangle in the net. Gillnet laden with fish is heaved and if the catch is substantial return journey to the landing centre is started. Fish is removed from the net and kept on board without ice or any other treatment. Fish is offloaded in the landing centers and transported to processing facilities after sale or auction. In other parts of the world, Indian mackerel is caught with purse seines, encircling gillnet, high-opening bottom trawl, lift nets, and bamboo stake traps.

Fig. 6. Wooden boat ('Rachin') and gillnet with Indian mackerel in Gwader

Major fishing grounds along the coast of Balochistan are Ganz, Phushukan, Gwader (west Bay), Gwader (East Bay), Sur, Karwat, Kappar, Bidok, Rumbra, Basul, Ormara (West Bay), Kund Malir and Gaddani whereas along the Sindh coast it is caught at Churan Island, Ras Mauri, Paradise Point, Buleji, Sandspit, off Manora, off Clifton, off Bundal Island and near the mouth of major creeks. Major landing centers are Gwader (West Bay), Ormara, Kund Malir, Sonara, Sandspit, Karachi Fish Harbour and Ibrahim Hyderi.

Landings

Although Indian mackerel are caught on commercial scales since long, however, organized fishery for Indian mackerel started in 1993 when its export to Saudi Arabia was started. Since then, landings of Indian mackerel started to

increase, however, no separate statistics for this species was available before 2001 (Table-IV). The data indicates overall increasing trend in landings except that landings of Indian mackerel dropped in Sindh in 2004.

Table-IV. Landings of Indian mackerel along the coast of Pakistan

Year	Sindh	Balochistan	Total
2001	5,131	Not reported	5,131
2002	18,721	9,117	27,838
2003	19,100	12,026	31,126
2004	16,987	17,565	34,552

Source: Marine Fisheries Department, Government of Pakistan

Monthly landings of *inter alia* Indian mackerel were monitored since January 2000 at Karachi Fish Harbour, which is presented in Fig. 7. It is evident that landings of Indian mackerel starts in September-October and ends in June. Due to southwest monsoon catching of Indian mackerel reduces because of rough seas. It is also evident that there are year-to-year variations in the landings of this species. In year 2001, high landings of Indian mackerel were observed during January to May. In 2003, such high landings were observed during January and March. In December 2000 and 2003 high landings were also observed.

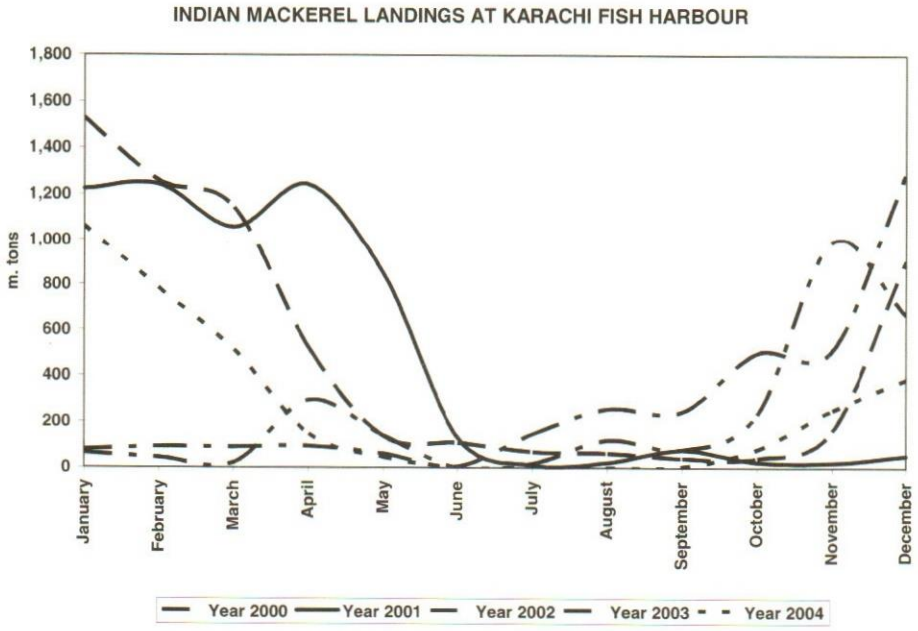

Fig. 7. Monthly landings of Indian mackerel at Karachi Fish Harbour.

Indian mackerel is one of the important species in many parts of its distribution range. Its landing fluctuated in the last 25 years between about 96,000 m. tons in 1975 and 351,193 m. tons in 1994. Major landings of Indian mackerel was reported from the Western Indian Ocean (about 185,000 m. tons in 1995), the Eastern Indian Ocean (about 267,000 m. tons and the Western Central Pacific 130,000 m. tons. Major producer of Indian mackerel are India (146,367 m. tons) and the Philippines (53,606 m. tons).

Association

Indian mackerel is a schooling fish (Fig. 3), however, different size groups move in separate shoals. During the present study, data on species of fish and shellfish caught along with the Indian mackerels were also recorded which revealed that since encircling gillnet is an aimed gear and laid around the Indian mackerel school, therefore, 97.246 % of the catch consists of single species i.e. Indian mackerel (Table-V), followed by sardinellas (0.509 %). In trawl catches (analysis of only those catches were done which contained Indian mackerel) during the same period, Indian mackerel contributed only 1.717 % whereas dominating species included hairtails (26.173), Japanese threadfin bream (8.614 %). Since Indian mackerel is pelagic and schooling fishing, therefore, its preponderance in the pelagic gillnets seems to be justified. It is, however, interesting the specimens caught in the bottom trawl seems to be of larger size category (between 20 and 30 cm) whereas majority of the specimens in gillnet catch were observed to be on small size categories (10 to 23 cm).

Processing and Export

Indian mackerel is mainly exported to Malaysia in frozen form. Usually fish is frozen at -45°C in blast tunnel in individually quick frozen (IQF) form in blast freezers and packed in 20 kg blocks (Fig. 8-9). A few processing plants have started freezing Indian mackerel on belt freezer.

Fig. 8. Preparation for freezing in blast freezer

Table-V. Species composition of gillnet and trawl catches (average data for 2003-2004)

SPECIES	PERCENTAGE
GILLNET CATCH	
Rastrelliger kanagurta	97.246
Selar crumenophthalmus	0.015
Decapterus.russelli	0.076
Sardinella spp.	0.509
Ilisha spp.	0.156
Pomadasys stridens	0.145
Pomadasys maculatum	0.073
Gazza minuta	0.126
Liza spp.	0.113
Nematalosa nasus	0.109
Alepes djedaba	0.109
Terapon puta	0.109
Thryssa vitrirostris	0.019
Stolephorus sp.	0.073
Anodontostoma chacunda	0.018
Sciaenidae	0.007
Others	1.09
Loligo duvauceli	0.007
TOTAL	100.000
TRAWL CATCH	
Rastrelliger kanagurta	1.717
Lepturacanthus savala	26.173
Nemipterus.japonicus	8.641
Selar crumenophthalmus	7.195
Saurida.tumbil	6.154
Grammoplites suppositus	4.091
Nemipterus.spp.	3.386
Upensus taeniopterus	2.970
Pseudorhombus spp.	2.028
Sphyraena.putnamiae	2.010
Epinephelus diacanthus	1.781
Decapterus.russelli	1.502
Pseudorhombus elevetus	1.517
Lepidotrigla.spiloptera	1.058
Sepia.pharaonis	10.140
Sepia latimanus	5.273
Others	14.364
TOTAL	100.000

(a) (b)

Fig. 9 Indian mackerel packed for (a) Saudi Arabian market in polybags and (b) in 10 kg master carton for Malaysian market.

Indian mackerel is packed in 1 kg polybags (about 6 pieces) and 10 kg master carton for Saudi Arabian market whereas for Malasian market IQF Indian mackerel of range between 6 to 12 pieces per kg is packed in 10 kg master carton. The product is exported in reefer carriers. Small quantities of Indian mackerel are also exported to other countries including Singapore, Vietnam and Thailand. Indian mackerel caught by 'katra' net, in case not landed quickly, get deteriorated and then usually dried for pulverization into fishmeal.

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Effects of different citrus varieties on the developmental behaviour of Citrus Butterfly *Papilio demoleus* in lower Sindh, Pakistan.

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Abstract

The consumption of ten different varieties of citrus plantation by butterfly *Papilio demoleus* and its effects on its larval and postlarval development were studied at Tando Mohammad Khan, Lower Sindh. Different type of food showed significant effects on growth rate, food utilization and reproductive potential of this pest. It was revealed that the growth index value was highest being 13.84 in *Citrus aurantifolia* (kaghzi lime) while the lowest value was reported to be 4.0 in *Citrus sinensis* (orange Washington). On the basis of ovipostion preference of adult, larval survival, percentage of pupation and emergence and survival of adults, the sequence of difference citrus varieties was determined.

Key Words: *Papilio demoleus*, Citrus varieties, developmental behaviour.

Introduction

Papilio demoleus is a serious pest of citrus plantation in Pakistan, India, Saudi Arabia, Iran, China and Africa (Badawi, 1981; F.A.O., 1970, 1972; Talbot, 1939; Mushtaque, 1964). The pest is active almost through out the year and the larvae are vigorous foliage feeders. In case of sever infestation, citrus trees are seriously affected and the young seedlings become completely defoliated (Ayyar, 1940). It is imperative to know that the food preference of this pest is based on the rate of food intake, indigestibility and efficacy of conversion of ingested food into body biomass. These parameters give an idea about the utilization efficiency of pest species with a view to know the preferential food habits. Yunus and Munir (1972), while studying the host plants and host preference of lemon butterfly (*P. demoleus*) reported that the larvae consumed all the 19 citrus varieties they tested. Pipatwantankul (1979), Gangwar and Singh (1989) studied different development stage of *P. demoleus* on different varieties of citrus from Thailand and India. Matsumoto and Noerdjito (1996) reported immature stages of *P. demoleus* from Java and Indonesia on different citrus varieties including *Citrus hystrix*, *Citrus aurantifolia* and *Citrus ambiyocarpa.* Roberts (2001) reported *P. demoleus* larvae feed on citrus plants species, of which lime and pomelos being preferred but they also feed on Zizyphus and other members of

family Rutaceae such as *Ruta gravealus* and *Glyeosims pentaphylla.* The life history of *P. demoleus* was worked out by Atwal (1976) and Khan (1940). Lakhanpal (1987) discussed certain aspects of host preference and effect of different host plant on the post larval development of *P. demoleus*. Present paper describes the effects on biology and developmental behaviour of citrus butterfly (*Papilio demoleus*), which were fed different citrus varieties available in the lower Sindh.

Material and Methods

The rearing of citrus butterfly (P*apilio demoleus*) was conducted in wooden cages of size 10' x 15' x 10' at Tando Mohammad Khan, Lower Sindh. Ten varieties of citrus i.e. *Citrus aurantifolia* (kaghzi lime), *Citrus limonia* (common jamberi), *Citrus reticulata* (citrus willow leaf), Citrus *aurantifolia* (sweet lime), *Citrus reticulata* (sangtra coorg), C*itrus reticulata* (kinnow sangtra), *Citrus aurantium* (khatta root stock), *Citrus limon* (eureka lemon), *Citrus medica* (citron) and *Citrus sinensis* (orange Washington) were planted in pots. Five plants of 1-meter height belonging to each variety were selected for the experiment. The plants were placed randomly in a free choice environment for the subject species. Observation was taken daily by counting the numbers of egg laid by ten pair of butterflies on each variety for the observation of development behaviour. Ten first instar larvae were collected from the respected varieties and transferred to the plastic jars of size 15 x 12 x 6 cm. Larvae were provided the respective host plant leaves twice a day *ad libitum*. Various aspects of the host preference i.e. larval period, larvae pupated, growth index value, pupal period, adult emergence, adult sex ratio, adult longevity were observed on ten varieties of citrus plants.

Results and Discussion

Selected plants with more number of newly leaves of favourite selected host plants preferred by *Papilio demoleus* has usually higher number of eggs, larvae and pupae. The data presented in Table 1 shows number of eggs laid, mean larval duration, number of larvae pupated, growth index value, pupal period, number of pupa emerged, sex ratio, longevity in days in relation to different host plants. Results suggested that in *Citrus aurantifolia* (kaghzi lime) highest growth index value was recorded as 13.84 followed by *Citrus limon*i (common jamberi) being 12.30 and lowest in *Citrus medica* (citron), *Citrus sinensis* (orange Washington) being 4. The above observations indicate that shorter the larval period greater is the number of larvae pupated and higher the growth index value. Further, it is also seen that the number of pupae emerged was highest in kaghzi lime and lowest in orange Washington. Yunus and Munir (1972) reported that the extent of damage was found 21 to 54% on freshly sprouted rough lemon hedge plant, 8-9 % in kinnow nursery plants and 3-19 % on branches of kinnow tree.

Table-1. Growth index values of the developmental stages of *Papilio.demoleus* to different citrus varieties.

Species	Total no of eggs	Total no of larvae	Mean larval period (days)	No. of larvae% pupated	Growth index value	Pupal Period (days)	No. of pupa showing emergence	Adult sex ratio		Survival %
								M	F	
Citrus aurantifolia Kaghizi lime	20.6	10	6.5	90	13.84		9	3	6	90
Citrus reticulate Citrus willow leaf	19.8	10	6.3	80	12.30	6	8	3	5	80
Citrus limonia Common jamberi	14.4	10	6.5	80	12.30	7	8	2	6	80
Citrus aurantifolia Sweet lime	13.4	10	7.0	70	10.0	6	7	3	4	70
Citrus aurantium Khatta root stock	17.6	10	7.0	70	10.0	6	7	3	4	70
Citrus reticulata Kinnow Sangtra	11.8	10	7.5	60	8.0	8	5	2	3	50
Citrus limon Eureka lemon	11.6	10	5.0	50	7.14	9	4	2	2	40
Citrus reticulate Sangtra coorg	11.6	10	5.0	50	7.14	7	4	2	2	40
Citrus sinensis Orange washington	10.8	10	10	40	4.00	8	3	1	2	30
Citrus medica Citron	11.4	10	10.0	40	4.00	7	3	1	2	30

During present study, it was clearly observed that *P.demoleus* lays eggs on all varieties of citrus but their numbers are different and duration of life cycle is different Pipatwatanakul (1979) indicated that *P. demoleus* could complete its life cycle on lime trees, few citrus varieties, i.e. (*Citrus aurantifolia*), pumelo

(*Citrus grandus*), lecch lime (*Citrus hystrix*) and tangerine (*Citrus reticulata*), however, it fails to complete its lifecycle on bael (*Aegle marmelos*) and jasmine (*Murraya panlculta*). Presently, *P. demoleus* showed short life cycle on *Citrus aurantifolia* and *Citrus sinensis*, majority of larvae do not survive, if their duration is longer. Rafi and Khan (1999) observed the host preference of lemon butterfly in barani area of Pakistan laying the large number of egg on *Citrus aurantium* in comparison to *Citrus sinensis*. Similarly, during present study, large number of eggs laying were found on *Citrus aurantifolia* with comparatively less on *Citrus aurantium*. It is also seen that the healthy larvae ratio was highest in kaghzi lime and orange Washington.

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Range extension of the land crab *Cardisoma carnifex* (Herbst, 1796) to further north on the Pakistan coast (Arabian Sea)

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Zoological Survey Department, Government of Pakistan, Karachi (SP)

Abstract

Land crab (*Cardisoma carnifex*) was reported for the first time from the Korangi Creek. A description of the species with note on its distribution is given in the paper. The species was previously known from a number of places Indian and Pacific Oceans. Present paper extends the distribution of this species into northern Arabian Sea, along the coast of Pakistan.

Keywords: *Cardisoma carnifex,* land crab, Pakistan, Arabian Sea

Introduction

The land crabs (*Cardisoma*) inhabit, during non-breeding season, in such areas as bush and grass near the seashore. Sometimes it lives a few kilometers inland from the sea. In the non-breeding season it is primarily nocturnal. The land crabs are considered to be pests of rice fields. With the discontinuation of cultivation of red variety of rice as a result of desertification in the deltaic flood plains (Ahmed, 1994) the species of land crabs may now considered threatened. *Cardisoma* are consumed in the Seychelles (Haig, 1984) and in West Africa (Bruce-Chwatt and Fitz-John, 1951).

The Indo-west-Pacific land crabs of the family Gecarcinucidae MacLeay 1838 are currently represented by four genera (*Cardisoma, Discoplax, Gecarcoidea* and *Epigrapsus*) (Ng and Guinot, 2001). The Pakistani material belongs to the genus *Cardisoma* Latreille, 1828, and out of its four species worldwide, the Pakistani species are identified as *Cardisoma carnifex* (Herbst, 1796). The present record is the first report of the species from Pakistan.

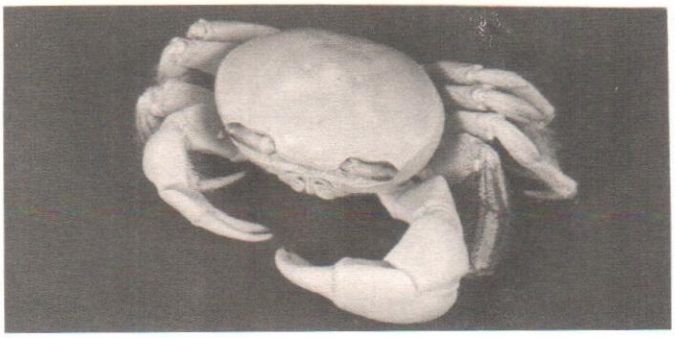
Taxonomic Enumeration

Family Gecarcinidae
Subfaimily Gecarcinucinae
Cardisoma carnifex (Herbst, 1796)
(Fig. 1-2)

Synonymy

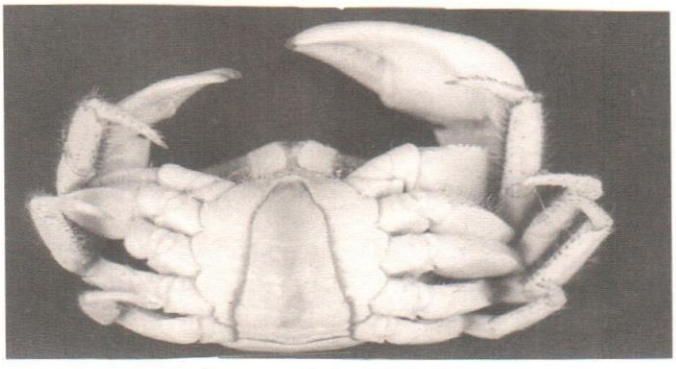
Cardisoma obesum Dana, 1851: 252.

Cancer urvillei H. Milne Edwards, 1853: 204.
Cardisoma carnifex Herbst 1796, pl. xli; Henderson, 1893: 380; Alcock, 1900: 445; Rathbun, 1907:26; Kemp, 1915: 241; Tesch, 1918: 137 (key and distribution); Barnard, 1950: 110; Haig, 1984: 128 (see for synonyms); Ng and Guinot, 2001: 333 (list and figs.) 1B, 3B only.



Cardisoma carnifex (dorsal view)

Cardisoma carnifex (frontal view)



Cardisoma carnifex (ventral view)

Fig. 1. *Cardisoma carnifex* Male, 57 by 52 mm; A. Dorsal view; B. Front; C. Ventral view.

Material: Korangi Creek collected 7-6-1975, Zoological Survey of Pakistan Cat. No.C-417, 2 males, CL 42-50mm; CB 51-56mm; 4 females (all spent), CL 42-52mm; CB 50-59mm.

Description: The specimens closely resemble the descriptions given by Alcock (1900), Barnard (1950) and photographs by Ng and Guinot (2001). The species can be easily diagnosed in having the carapace strongly convex (Pl. 1) with the regions indistinct, the lateral margin of the carapace strongly and abruptly bulging behind the epibranchial tooth, which is present immediately behind outer orbital angles, the meri of legs having stiff setae only at the distal end.

The first gonopod (Fig. 1A) is almost straight, very stout, densely lined with long stiff setae, particularly in the subdistal region, so that the pectinated tip is not covered by setae, the subdistal part of sternal surface has a well developed subovate fleshly setose flap which is apprised tightly to the main structure; the inner surface has a deep median longitudinal depression; the pectinated tip abruptly bends, the extreme tip is nosle-like, tapering to a spout- like structure. The second gonopod (Fig. 1B) has about half the length of the first gonopod, abruptly tapering apically, the apex is pointed, the basal part is setose and the distal part is pectinate.

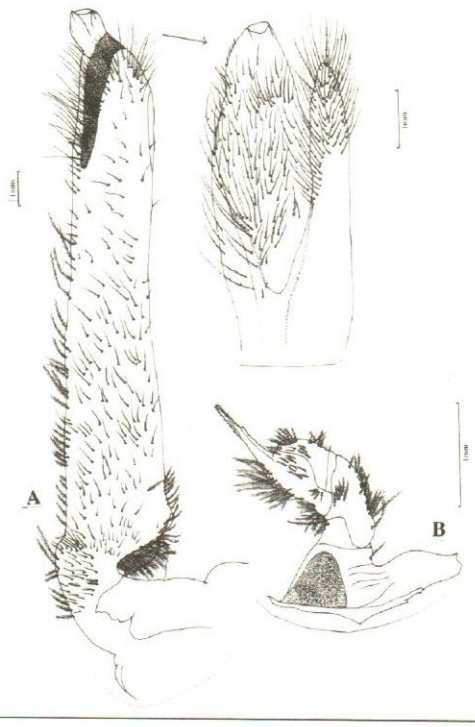


Fig. 2. *Cardisoma carnifex* Male, 57 by 52mm. A. Left first gonopod, dorsal view. A.All setae denuded. B. Left second gonopod, dorsal view.

Habits and Habitat: This species, like other gecarcinids, is primarily nocturnal, omnivorous and gregarious, always found in the vicinity of fresh saline water or wet mud and sand like on tidal mudflats. In soft soils it digs well-defined burrows. The species occupies the landward fringe of the mangroves and are well adapted to terrestrial habitat (Jones, 1984). Only ovigerous females of *Cardisoma* migrate to the seashore to release zoeae within a few nights of highest high water during the breeding season (Okamoto, 1975). Mating occurs during daytime (Ameyaw-Akumfi, 1987).

Colour in life: According to Kemp (1915) the colour in life is striking. The dorsal surface of the carapace is purple with a close and fine reticulation of yellowish-green, which gradually disappears towards the sides and is densest in the central part of the cardiac region. The hepatic regions and the sides of the carapace are lilac. The ventral sternite is cream-coloured, the epistome tinged with purple. The chelipeds are cream-coloured, deepening to yellow on the palm and fixed finger and suffused on the dorsal surface of the merus and carpus with purple. The extreme tips of the fingers are brown. The basal joints of the walking legs are yellowish; the merus, carpus and propodus are deeply tinged with purple and bear dark brown hairs; the dactylus is orange yellow.

Distribution: The species has been reported from several places in the Indian and Pacific Oceans, but not in the northern Arabian Sea. This is the first report from coastal areas of the northern Arabian Sea

Acknowledgement

We are grateful to Prof. Dr. L.B. Holthuis of National Museum of Natural History, Leiden for improving the text.

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Marine gastropods of Karachi in the collection of Zoological Survey Department

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Abstract

The paper enlists species of marine gastropods collected from Karachi and housed in the Zoological survey of Pakistan. In all 62 species belonging to 31 families were recorded from Karachi coast.

Keywords: Mollusca, Gastropoda, Karachi

Introduction

Gastropoda forms an important and sizable part of molluscan diversity among the coastal invertebrates. Information about mollucsan collection is limited to only a few publications (list available in Tirmizi and Zehra, 1984). Present paper enlists marine gastropods species collected from various parts of Karachi coast and housed in the collection of Zoological Survey Department, Karachi. The classification adopted in the present work is based mainly upon Subba Rao (2003) and Tirmizi and Zehra (1984).

Class	:	Gastropoda
Subclass	:	Prosobranchia
Order	:	Archaeogastropoda
Family	:	Fissurelidae

1. *Diodora funiculata* (Reeve, 1850) (Fig. 1) Manora, Buleji, Paradise Point, Cape Monze

Family : Patellidae

2. *Cellana radiata* (Born, 1778) (Fig. 2) Manora, Buleji, Paradise Point, Cape Monze

Family : Trochidae

3. *Trochus (Belangeria) scabrosus* Philipi 1850 (Fig. 3) Manora, Buleji, Cape Monze
4. *Trochus (Belangeria) depictus* Deshayes 1883 (Fig. 4) Manora, Buleji, Pacha, Cape Monze
5. *Monodonta australis* (Lamarck 1822) (Fig. 5) Buleji, Paradise Point, Cape Monze
6. *Euchelus asperus* (Gmelin 1791) (Fig. 6) Buleji, Paradise Point, Cape Monze
7. *Umbonium vestiarium* (Linnaeus, 1758) (Fig. 7) Manora, Pacha

Family : Stomatellidae

8. *Stomatella elegans* Gray, 1847 (Fig. 8) Manora, Buleji, Cape Monze

Family : Turbinidae

9. *Turbo (Lunella) coronatus* Gmelin, 1790 (Fig. 9) Manora, Buleji, Paradise Point, Cape Monze
10. *Turbo (Marmarostoma) intercostalis* Menke, 847 (Fig. 0), Paradise Point, Cape Monze
11. *Astraea semicostata* (Kiener, 1850) (Fig. 11) Manora, Buleji, Paradise Point

Family : Neritidae

12. *Nerita (Nerita) undata* Linnaeus, 1758 (Fig. 12) Manora, Buleji, Cape Monze
13. *Nerita (Theliostyla) albicella* Linnaeus, 1758 (Fig. 13)Buleji, Paradise Point, Charna
14. *Nerita (Theliostyla) textilis* Gmelin, 1791 (Fig. 14)Manora, Buleji, Paradise Point
15. *Nerita (Ritena) costata* Gmelin, 1791 (Fig. 15) Manora, Charna Lighthouse

Order : Mesogastropoda
Family : Littorinidae

16. *Nodilittorina (Nodilittorina), trochoides* (Gray 1839) (Fig. 16) Buleji

Family : Cerithiidae

17. *Rhinoclavis (Rhinoclavis) sinensis* (Gmelin 1791) (Fig. 17) Buleji, Pacha beach.
18. *Clypeomorus vaiegatum* (Quoy & Gaimard 1834) (Fig. 18) Manora, Buleji, Cape Monze
19. *Clypeomorus caeruleum* (Sowerby, 1855) (Fig. 19) Manora, Buleji, Cape Monze

Family : Potamididae

20. *Telescopium telescopium* (Linnaeus, 1758) (Fig. 20) Sandspit backwaters
21. *Cerithidea (Cerithideopsilla) cingulata* (Gmelin, 1791) (Fig. 21) Sandspit, Cape Monze,

Family : Strombidae

22. *Tibia insulachorab curta* (Sowerby, 1842) (Fig. 22) West Wharf, Manora, Cape Monze.

Family : Epitonidae

23. *Epitonium pyramidale* (Sowerby, 1844) (Fig. 23) Buleji

Family : Xenophoridae

24. *Xenophora (stellaria) solaris* (Linnaeus, 1764) (Fig. 24) Manora, Kaemari

Family : Cypraeidae

25. *Cypraea (Mauritia) arabica* (Linnaeus, 1758) (Fig. 25) Buleji, Manora
26. *Cypraea (Mauritia) ocellata* (Linnaeus, 1758) (Fig. 26) Buleji, Pacha beach
27. *Cypraea (Mauritia) moneta* (Linnaeus, 1758) (Fig. 27) Buleji, Pacha beach
28. *Cypraea (Cypraea) tigris* (Linnaeus, 1758) (Fig. 28) Buleji
29. *Cypraea turdus* (Lamarck 1810) (Fig. 29) Manora, Buleji, Pacha beach, Cape Monze

Family : Naticidae

30. *Natica tigrina* (Roeding, 1798) (Fig. 30) Clifton, Cape Monze
31. *Natica (Neverita) didyma* (Roeding, 1798) (Fig. 31) Clifton, Cape Monze
32. *Natica lineata* (Lemarck 1810) (Fig. 32) Clifton, Cape Monze

Family : Tonnidae

33. *Tonna (Dolium) maculata* (Lamark, 1822) (Fig. 33) Clifton, Cape Monze

Family : Ficidae

34. *Ficus gracilis* (Sowerby, 1825) (Fig. 34) Clifton

Family : Bursidae

35. *Bursa echinata* (Lamarck, 1816) (Fig. 35) Manora, Cape Monze

Family : Cymatidae

36. *Cymatriton nicobaricum* (Roeding, 1798) Manora
37. *Cymatriton pileare* (Linnaeus, 1758) (Fig. 36) Manora
38. *Gyrinium natator* (Roeding, 1798) (Fig. 37) Manora, Buleji, Cape Monze

Order : Neogastropoda
Family : Muricidae

39. *Murex ternispina* Lamarck, 1822(Fig. 38) Manora, Kaemari, Cape Monze

Family : Buccinidae

40. *Babylonia spirata* (Linnaeus, 1758) (Fig. 39) Manora, Kaemari, Buleji, Cape Monze
41. *Canthurus spiralis* (Gray, 1839) (Fig. 40) Manora, Kaemari, Buleji, Cape Monze
42. *Canthurus undosus* (Linnaeus, 1758) (Fig. 41???) Manora, Kaemari, Buleji, Cape Monze

Family : Columbellidae

43. *Pyrene flowa* (Bruguiere, 1789) (Fig. 42) Manora, Kaemari, Buleji, Sandspit
44. *Mitrella blanda* (Sowerby, 1844) (Fig. 43) Cape Monze

Family : Melonginiidae

45. *Melongena bucephala* (Lamark, 1822) (Fig. 44) Manora

Family : Nassaridae

46. *Nassarius obockiensis* (Jourseaume, 1888) (Fig. 45) Manora, Buleji
47. *Alectrion sufflatus* (Gould, 1860) (Fig. 46) Manora, Buleji

Family : Olividae

48. *Oliva bulbosa* (Roeding,????) (Fig. 47) Cape Monze
49. *Oliva gibbosa* (Roeding,) (Fig. 48) Manora, Cape Monze

Family : Thaididae

50. *Thais lacera* (Born, 1778) (Fig. 49) Buleji, Manora, Paradise point, Sandspit, Cape Monze
51. *Thais rudolphi* (Chemnliz, 1778) (Fig. 50) Buleji, Manora, Paradise Point
52. *Thais hippocostonium* (Linnacus, 1758) (Fig. 51) Manora, Buleji
53. *Morula granulata* (Duclos, 1832) (Fig. 52) Manora, Buleji
54. *Morula (Cronia) amygdala* (Kiener, 1835) (Fig. 53) Manora, Buleji
55. *Rapana bulbosa* (Slander, 1786) (Fig. 54) Clifton, Manoro, Kaemari

Family : Conidae

56. *Conus (Pinoconus) magus* Linnaeus, 1758 (Fig. 55) Buleji, Manora

Family : Turridae

57. *Turricula javana* Linnaeus, 1767 (Fig. 56) Buleji, Cape Monze

Sub class : Heterobranchia
Order : Allogastropoda
Family : Architectonidae

58. *Architectonica perspectiva* Linnaeus, 1758 (Fig. 57) Buleji, Manora

Sub class : Opisthobranchia
Order : Cephalaspidea
Family : Bullidae

59. *Bulla ampula* Linnaeus, 1758 (Fig. 58) Keamari, Manora

Family : Hydatinidae

60. *Hydatina physis* Linnaeus, 1758 (Fig. 59) Buleji, Manora
61. *Hydatina velum* Gmelin 1791 (Fig. 60) Bhit Island, Manora, Buleji

Family : Hamineidae

62. *Haminea elegans* A. Adams, 1850 (Fig. 61) Manora, Cape Monze

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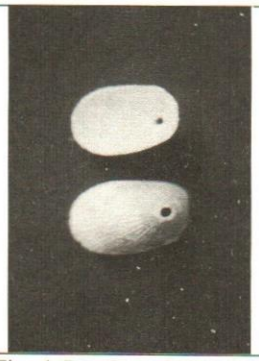


Fig. 1 *Diodora funiculata*

Fig. 2 *Cellana radiata*

Fig. 3 *Trochus (Belangeria) scabrosus*

Fig. 4 *Trochus (Belangeria) depictus*

Fig. 5 *Monodonta australis*

Fig. 6 *Euchelus asperus*

Fig. 7 *Umbonium vestiarium*

Fig. 8 *Stomatella elegans*

Fig. 9 *Turbo (Lunella) coronatus*

Fig. 10 *Turbo (Marmarostoma) intercostalis*

Fig. 11 *Astraea semicostata*

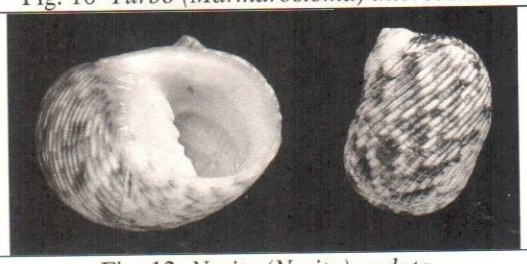


Fig. 12 *Nerita (Nerita) undata*

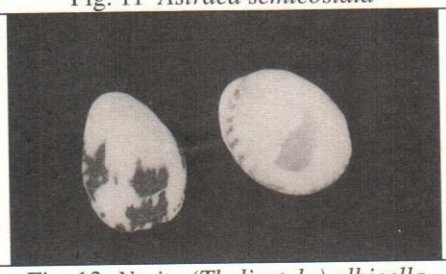


Fig. 13 *Nerita (Theliostyla) albicella*

Fig. 14 *Nerita (Theliostyla) textilis*

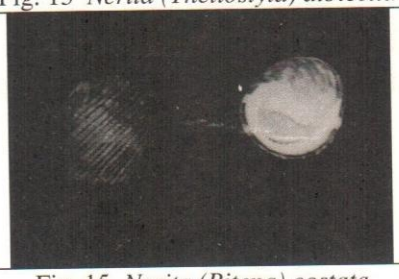


Fig. 15 *Nerita (Ritena) costata*

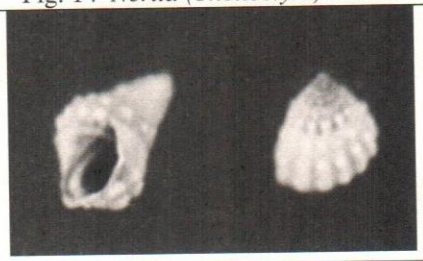


Fig. 16 *Nodilittorina (Nodilittorina), trochoides*

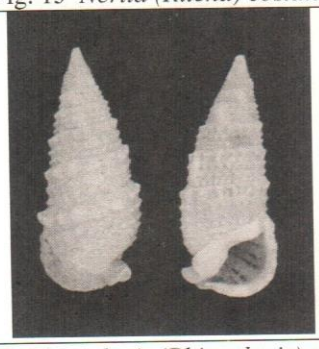


Fig. 17 *Rhinoclavis (Rhinoclavis) sinensis*

Fig. 18 *Clypeomorus vaiegatum*

Fig. 19. *Clypeomorus caeruleum*

Fig. 20 *Telescopium telescopium*

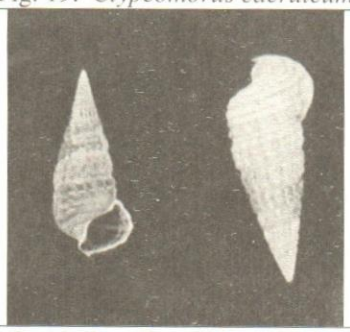


Fig. 21 *Cerithidea (Cerithideopsilla) cingulata*

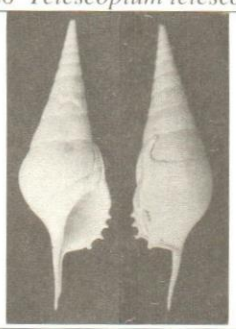


Fig. 22 *Tibia insulachorab curta*

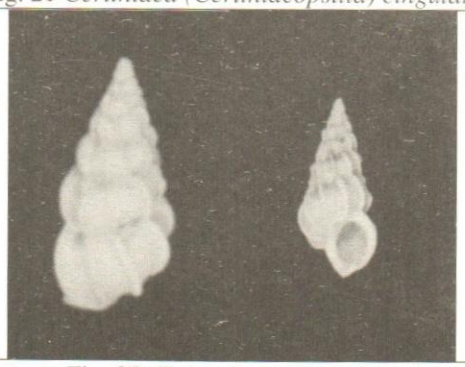


Fig. 23 *Epitonium pyramidale*

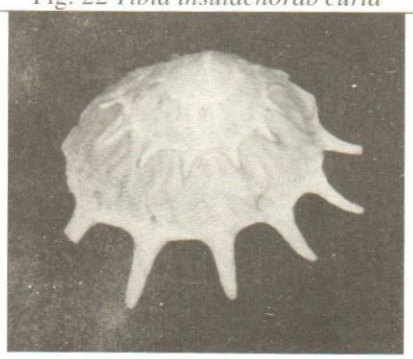


Fig. 24 *Xenophora (stellaria) solaris*

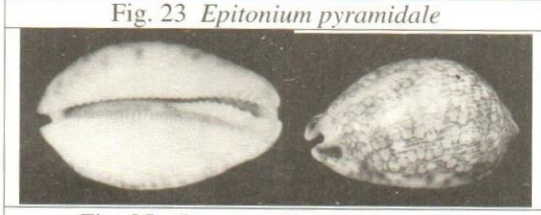


Fig. 25 *Cypraea (Mauritia) arabica*

Fig. 26 *Cypraea (Mauritia) ocellata*

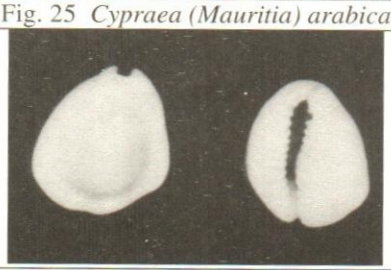


Fig. 27 *Cypraea (Mauritia) moneta*

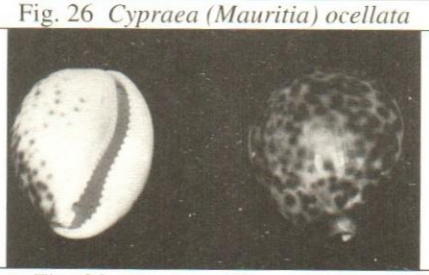


Fig. 28 *Cypraea (Cypraea) tigris*

Fig. 29 *Cypraea turdus*

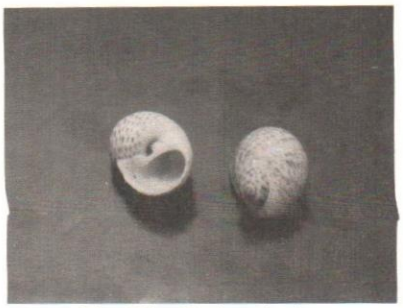


Fig. 30 *Natica tigrina*

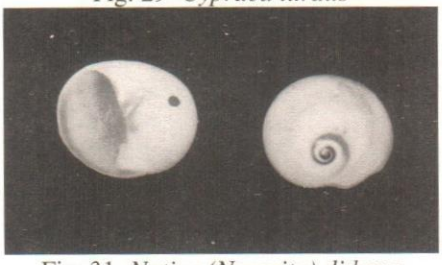


Fig. 31 *Natica (Neverita) didyma*

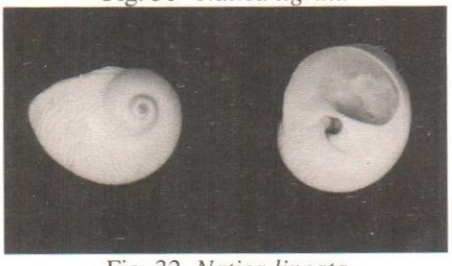


Fig. 32 *Natica lineata*

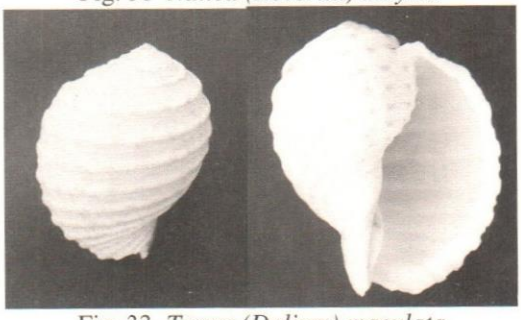


Fig. 33 *Tonna (Dolium) maculata*

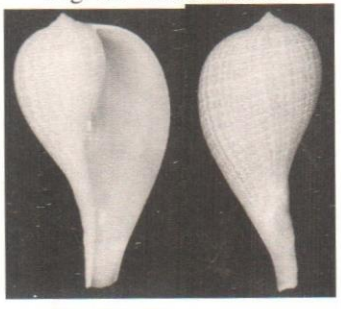


Fig. 34 *Ficus gracilis*

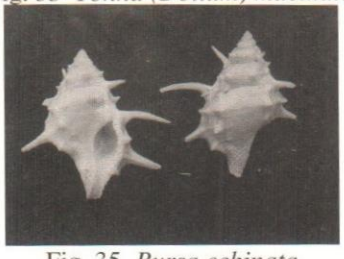


Fig. 35 *Bursa echinata*

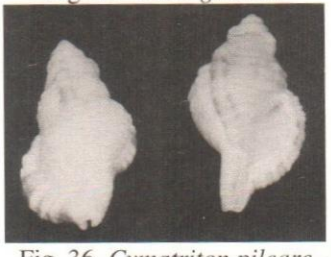


Fig. 36 *Cymatriton pileare*

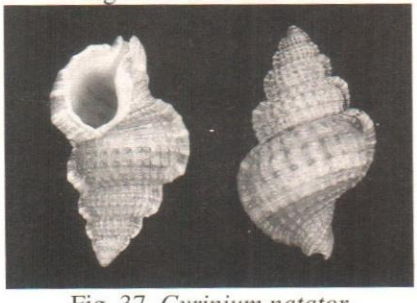
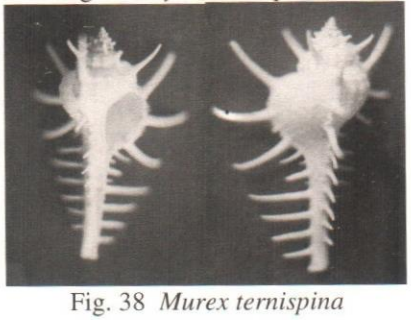


Fig. 37 *Gyrinium natator*



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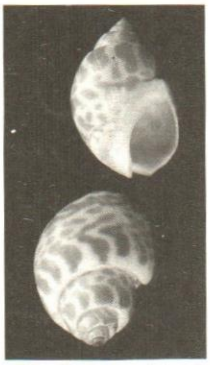

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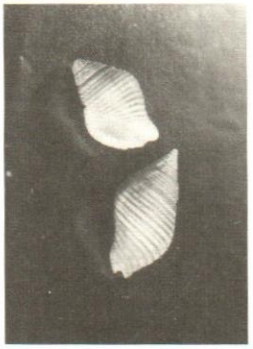

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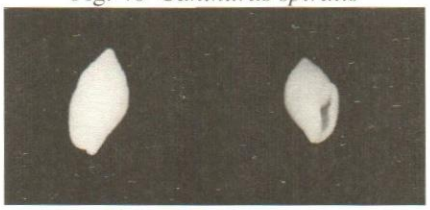

Fig. 41 *Canthurus undosus*

Fig. 42 *Pyrene flowa*

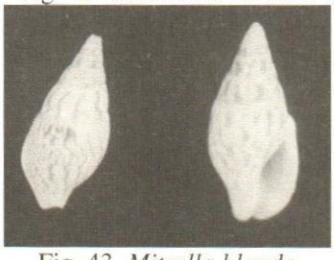

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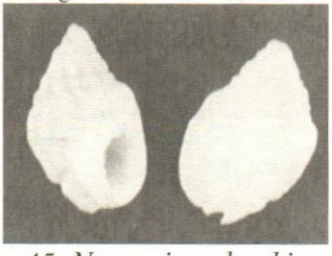
Fig. 44 *Melongena bucephala*



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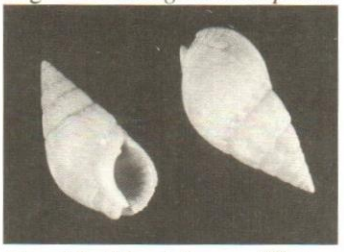

Fig. 46 *Alectrion sufflatus*

Fig. 47 *Oliva bulbosa*

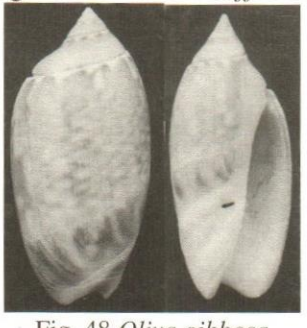

Fig. 48 *Oliva gibbosa*

Fig. 49 *Thais lacera*

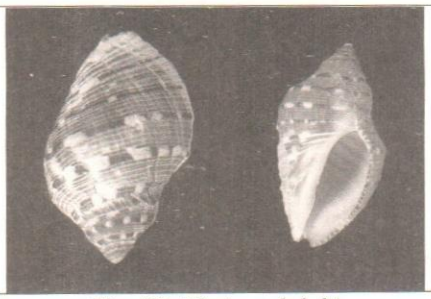

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Fig. 51 *Thais hippocostonium*

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Fig. 53 *Morula (Cronia) amygdala*

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Fig. 55 *Conus (Pinoconus) magus*

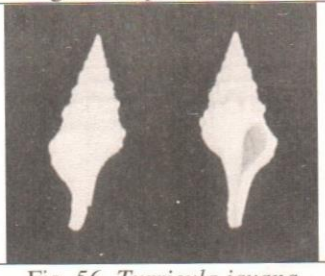
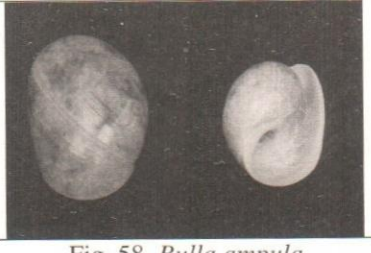


Fig. 56 *Turricula javana*

Fig. 57 *Architectonica perspectiva*



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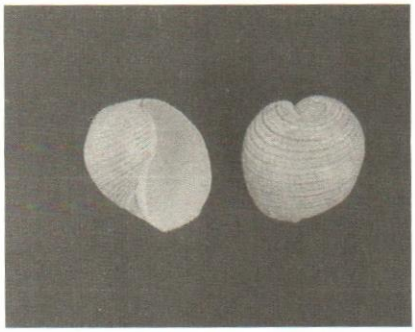

Fig. 59 *Hydatina physis*

Fig. 60 *Hydatina velum*

Fig. 61 *Haminea elegans*

RECORDS ZOOLOGICAL SURVEY OF PAKISTAN

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