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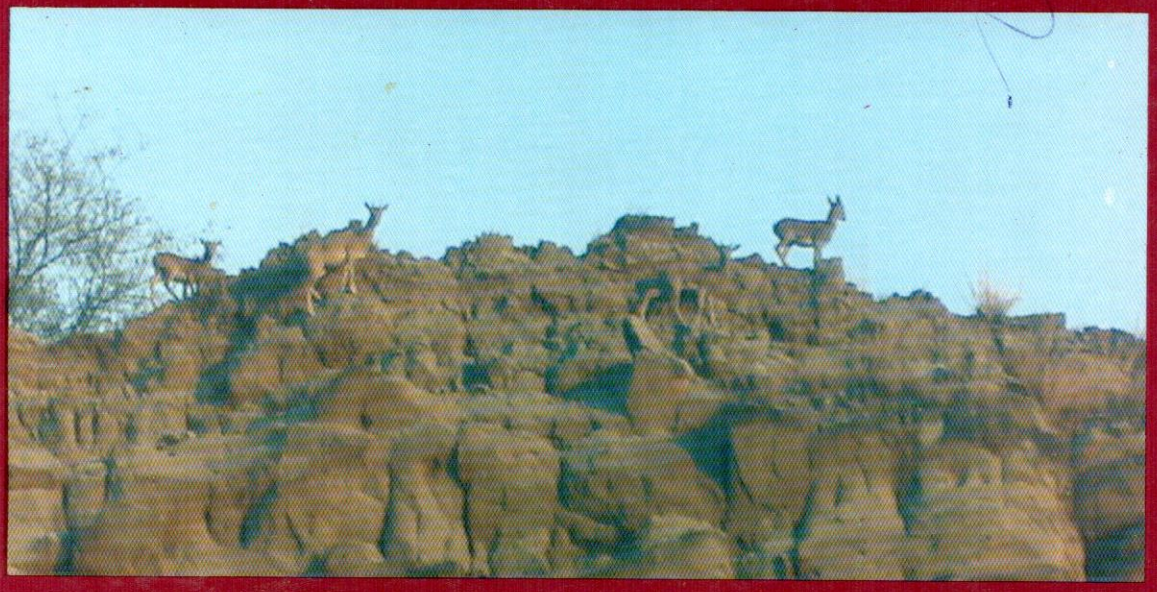
Volume XVII



Zoological Survey Department
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Islamabad, Pakistan
2006

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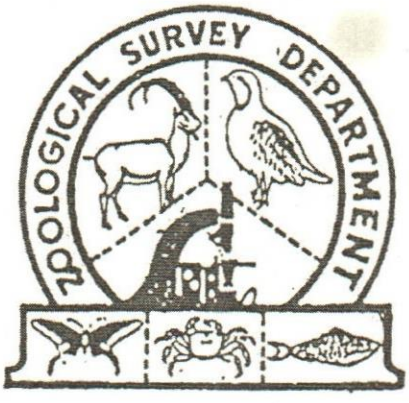

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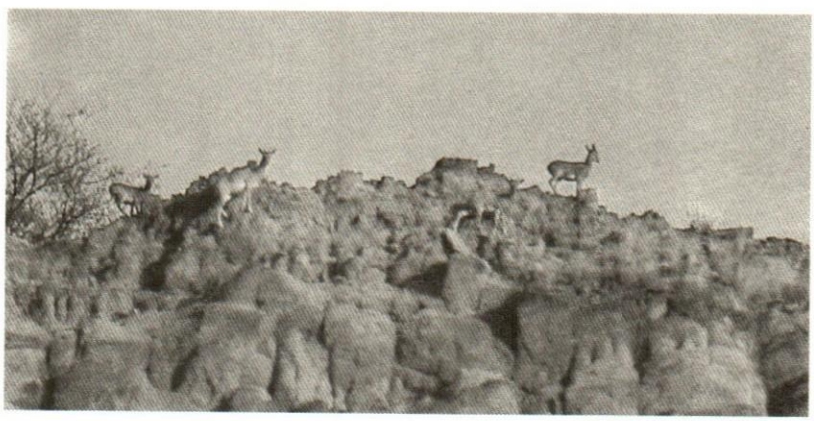

Cover: Punjab Urial in Jalalpur Wildlife Sanctuary a paper entitled "Studies on Population Status of Punjab Urial (*Ovis vignei punjabienses*) in Jalalpur, District Jhelum" is included in the current issue of Records of Zoological Survey.

RECORDS ZOOLOGICAL SURVEY OF PAKISTAN

Table of Contents

Volume 17 **2006**

Studies on Population Status of Punjab Urial (*Ovis vignei punjabienses*) in Jalalpur, District Jhelum

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Abstract

Jalalpur Wildlife Sanctuary and adjacent areas of Salt Range in district Jhelum, Punjab, were surveyed for study of population status of Punjab urial *(Ovis vignei punjabienses)*. The population in the sanctuary was estimated to be 130. The average density was 4.89 animals per sq km. Of the 51 animals actually seen, 19 were females, 17 young, 13 males below 6.5 years age and two males above 6.5 year age. In the area adjacent to the sanctuary, 44 sq km was surveyed and an estimated population of 80 urials with the average density of 1.8 animals per sq km. Of the 19 animals actually seen, 8 were females, 5 young, 5 males below 6.5 year age and two males above 6.5 year.

Keywords: Jalalpur Wildlife Sanctuary, Punjab Urial, population, Status.

Introduction

Pakistan has versatile habitat types and ecological zones, from deep sea to high mountains including coasts, rivers, lakes, forest, deserts and mountains. Due to this versatile ecology the country is rich in diversity of its fauna and flora. Ungulates are the most important of the game animals, which are now under an extremely high hunting pressure. In addition, they are also facing habitat degradation with increasing human settlements. Some of the species of ungulates, such as, swamp deer and black buck have became extinct in the county while some others have been exterminated from a numbers of their original distribution ranges and are now restricted to some pockets where they still face high hunting pressure and habitat degradation.

For the protection and conservation of the ungulates various government and NGOs have been working since long with a little success. This has led to a recent trend of involvement of local communities in the programme aiming at protection and conservation of ungulates. This has resulted in the development of many community based conservation programme throughout the world, including community-based trophy hunting programmes. The trophy hunting programmes have met success in NWFP province and Torghar in Balochistan. The programme has now been expanded in all the four provinces and Northern Areas of the country. Punjab urial *(Ovis vignei punjabienses)* is though seriously threatened in the country yet unabated hunting is continuing. Starting a trophy hunting programme the present study aims at knowing the present status of the urial in one of such proposed site i.e. Jalalpur (District Jhelum, Punjab, Pakistan).

A number of workers have conducted studies on distribution, status, biology and ecology of urials in Pakistan. Schaller (1974, 1977) studied feeding and breeding habits of urial whereas Stocky (1922), Nowak (1991) conducted studies on its breeding biology. Ahmad and Ghalib (1975) described the distribution of urial in Pakistan. Roberts (1997)

described distribution, status, ecology and biology. Mirza *et al* (1979) and Aleem (1977) studied population status of urials.

Material and Methods

The Jalalpur Wildlife Sanctuary (Fig. 1) is situated a few miles in the northeast of Jalalpur Town in Tehsil Pind Dadan Khan, District Jhelum. It has an area of 22.6 sq km. The sanctuary area comprises of an almost parallel series of hills with a torrent between them. The altitude ranges from 700 feet to about 2,000 feet. The sanctuary is bounded in the north by Rakh Noorpur and private land of Nakka Kalan, in the south by Jalalpur Sharif, in the east by Rakh Kandal and in the west private land of Wagh. The sanctuary has typical steppe vegetation of the area dominated by *Acacia modesta* with seattered bushes of *Ziziphlus nemmularia*, *Acacia nilotica, Prosopis spp. Salvadora oleoids* and *Capparis decidua.*

A part of the area of a Salt Rang adjacent of Jalalpur was also studied which includes 20 sq km areas adjacent to Behr Faqirian, and 24 sq km area adjacent to Pind Sawikka This area was also observed to have typical habitat and vegetation of the Salt Range.

Fig. 1. A general view of Jalalpur Wildlife Sanctuary:

The study was undertaken between December 17 and 24, 2005 adopting belt transect samping method. Handheld GPS was used for the determination of the observation points. Observation teams consisting of 3 to 4 experienced observers were constituted to survey different parts of the areas simultaneously to minimize the chance of double count. Location and altitude of site and observation of urial was recorded. Density and population were calculated by dividing the numbers of animals by the size of survey area. The age of the rams was determined by the horn rings method. Females

were difficult to be aged with this technique; therefore, they were classified according to the size of their body and color. The data was categorized as young, adult females, adult males class 1 (upto 6.5 years) and adult males class II (above the 6.5 years).

Results and Discussion

During present survey observation and sightings of animals revealed that a sizeable population of urial was present in the Jalalpur Wildlife Sanctuary, while in the adjacent area density of urial is much low.

Jalalpur Wildlife Sanctuary

The study suggested a population of 130 urial in the Jalalpur Wildlife Sanctuary. This distribution was found to be not uniform as some areas have higher density while it was relatively lower in other areas (Table-I). Major concentration was noticed in the northeastern part of the Sanctuary, while in the southwestern part density was relatively low. The average density was calculated to be 4.89 animals per sq km. During survey 51 animals were actually seen. These include 19 females, 17 young, 13 males below the age of 6.5 years and 2 males above 6.5 years. The largest herd comprised of 10 animals while average herd size was found 5.1.

Area Adjacent of Jalalpur

The estimated number of animals in this area was 80 (Table-II). As the survey area was approximated 44 sq. km, therefore, there was an average population of 1.8 urial per sq. km. Of the 19 animals actually seen, 8 were females, 5 young, 5 males below 6.5 years age and 2 were males above 6.5 years age. The largest herd has 6 animals while average number of animal in the herd was 3.8.

Table-I. Distribution of Punjab urial in various sites in the Jalalpur Wildlife Sanctuary

Location	Total	Female	Young's	Male - I	Male - II
Kalwacha	5	2	2	1	-
Sarjali	10	3	5	1	1
Kharappa	2	-	1	1	-
Kharapha	8	2	4	2	-
Kharapha	4	2	-	2	-
Kharapha	3	2	-	1	-
Kharapha	4	2	-	2	-
Shappes Nalls	8	2	4	1	1
Shappes Nalls	5	3	1	1	-
Kharappa	2	1	-	1	-
Total	**51**	**19**	**17**	**13**	**2**

Only two trophy size males, having the age of 6.5 years, were seen out of a total of 19 animals. It is calculated that number of males exceeding 6.5 years age (which may be categorized as trophy hunting size) may up to 8 in total open area surveyed under present study.

Table-II. Distribution of Punjab Urial in various sites in the area adjacent to Jalalpur

Location	Total	Female	Younger	Male – I	Male - II
Sharabbi	6	3	2	1	-
Pind Sawihha	4	1	2	1	-
Lamma Mera	2	1	-	-	1
Sai Shoukat Kas	3	1	1	1	-
Sai Shoukat Kas	4	2	-	1	1
Total :-	**19**	**8**	**5**	**4**	**2**

Very few and fragmented studies have been conducted on urials, especially in Salt Range. Roberts (1997) observed that in the Salt Range urials have been totally exterminated from the Koho-i-Murat hills and only a few were reported to be surviving around Traki Morth of Jhelum, around Bhoun and west of Chokri. Main concentration of urials is reported to be in the Kala Chitta hills, northwest at Masan valley and Kalabagh. Mirza *et al* (1976), who surveyed the hill in the Salt Range in 1976, estimated 1,288 urials for the Kalabagh Reserve (District Mianwali), 213 in Kala Chitta Hills (Chack Jabbi area) and a total of 588 animals in Jhelum District with sizeable population in the Domeli Hills, Barali Hills, Tilla Hills, Kandal Rakh and Parera Hills.

Fig. 2 Punjab urial *(Ovis vignei punjabienses)* in Jalalpur Wildlife Sanctuary

Based on the data, the area can be categorized as high density and low-density areas. Jalalpur Wildlife Sanctuary may be regarded as high density area, while areas adjacent to sanctuary may be treated as low-density areas. Wildlife sanctuary can again be classified into high quality habitat and low quality habitat. It may be pointed out that high density and low density area of Wildlife Sanctuary are not based on the vegetation and habitat qualities but rated according to disturbance level. The areas of Wildlife Sanctuary relatively closer to Jalalpur Town are the areas of relatively high disturbance, caused by domestic grazers, while those of relatively far away are relatively less disturbed.

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Survey of Small Mammals of Hingol National Park Balochistan.

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Abstract

Survey of small mammals of the Hingol National Park was carried out which revealed preponderance of rodents. One carnivore and one lagomorph species were also observed. Palm squirrel (*Funnambulus pennantii*) and Balochistan gerbil (*Gerbillus nanus*) seems to be dominating species found in the National Park.

Keywords: Hingol National Park, Balochistan, mammals, gerbil, mouse, jird, porcupine, mongoose, hare, squirrel

Introduction

Hingol National Park is situated 250 km northwest of Karachi in Balochistan Province. It spreads over 6,000 km and falls in three administrative districts i.e. Lasbella, Gwadar and Awaran. The park is stretched between the coastline on its southern boundary t hilly with valleys and few agricultural fields in the north. In the southern parts of the park there is a desert between coastline and mud hills.

Hingol National Park has diversified habitat such as coastline, river, estuarine area, riverine flood plain, rocky and muddy hills, valleys, desert with sand dunes and mud volcanoes. The dominant plants species of the area are *Acacia senegal, Acacia nilotica, Prosopis cineraria, Salvadora sp., Ziziphus jujuba, Euphorbia, Tamarix* spp. Owing to its versatile habitat types the Hingol National park has rich biota. Information on the animals inhabiting in the area is limited. Robert (1997) in his book on Mammals of Pakistan indicated presence of mammals in the National Park area. Azam (2004) studies the avifauna of the Park whereas Javed *et al* (2005) studied population of marsh crocodile inhabiting the National Park.

Material and Methods

Small mammals were studied from May 31 to June 5, 2006 in the southern parts of the National Park. Areas adjacent to Agor, Nani Mundar, Kund Malir. Nala Jakee (Buzi Pass) and Kashee Goth were surveyed. Trapping was carried out on five nights in different habitats including desert, agricultural land, hills and riverbed using Sherman traps. These traps were baited with peanut butter, and honey. All the trapped animals were identified and released. Each plot was sampled only once in the present study. Captured mammals were identified using Robert (1997, 2005a, 2005b).

Results and Discussion

In the present survey a total of 11 species of small mammals were idenfified from the National Park (Table 1). Out of 9 species of rodents, Balochistan gerbil, (*Gerbilus nanus)* seems to be most abundant and most widely distributed in sandy cultivated lands. Palm squirrel (*Funnambulus pennantii*) was found to be most abundant at one particular place as in the Nani Mandhir area where 15 specimens were observed. This was followed by Cairo spiny mouse (*Acomys cahirinus)* which was found to be the most common in hilly tracts and crevices. Some other rodents like Indian desert jird (*Meriones hurriane*) were also sighted but could not be trapped in present survey.

Table- I. Small mammals at Hingol National Park

Location	**Kund Malir (25° 20'N 65° 26' E)**	**Nani Bent (25° 31'N 65° 31'E)**	**Nani Maudhir (25° 30'N 65° 32'E)**	**Nala Jakee (Buzi Pass) (25° 28'N 65° 14' E)**	**Kashee Goth (25° 28'N 65° 35' E)**	**Agor (25° 27'N 65° 33'E)**
	Sandy and rocky stony hill	Agricultural land	Rocky stony hill	Mountain and sandy area and slope	Agricultural land, Sandy area, rocky stony area.	Rocky and stony hill area and sandy area
Balochistan Gerbil *Gerbillus nanus*	4	4		4	2	4
Cairo Spiny Mouse *Acomys cahirinus*	2			1	1	
House Mouse *Mus musculus*	1					
Persian Jird *Meriones persicus*				1		
Palm Squirrel *Funnambulus pennantii*		2	15			
Indian Gerbil *Tetra indica*					1	1
Porcupine *Hystrix cristatus*		Foot prints/ spines		Foot prints/ Spines	Foot prints/ spines	Foot prints/ Spines
Mongoose *Herpestes javanicus*			2			
Cape Hare *Lepus capensis*	Droppings	Droppings	Droppings	Foot prints/ Droppings	Foot prints/ Droppings	Droppings
Indian Desert Jird *Meriones*			Sighted but could not be caught			

hurricane						
Hedgehog *Hemiechinus auritus megalotis*					Reported by villagers	

Spines and foot prints of porcupine *(Hystrix cristatus)* were noted but no direct sighting could be made . Hedgehog (*Hemiechinus auritus megalotis)* was also reported by local villagers of Kashee Goth. Droppings of Cape hare were sighted at many places through out the survey area, while no direct sightings occurred during the present survey.

In addition to small mammals, large mammals including Sindh ibex (*Capra aegagrus blythi*), urial (*Ovis vignei blanfordi*) Asiatic jackal (*Canis aurius)* and desert fox (*Vulpesruppelli*) were also observed. Among birds, seesee partridge (*Ammoprdix grasio gularis*), grey partridge (*Francolinus pondicerianus*), small blue kingfisher (*Alcido atthis*), collared dove (*Streptopelia deccota*), little brown dove (*Strepto pelia senegalensis*) and blue rock pigeon (*Columbia livia*) were observed. Marsh crocodile (*Crocodylus plaustris*) were observed at in Hingol River at Agor area. During present survey it was observed that the area of Hinglaj particularly Nani Mandhir is well protected where Sindh ibex roams freely.

Present study reveals that Hingol National Park is rich in small mammal diversity, however, further studies will be required to catalogue all mammals and other fauna found in this important habitat. Balochistan Forest and Wildlife department has already started a programmeme to study the biodiversity of the Hingol National Park.

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Status of Urial, Ibex and Chinkara at Durreji, Balochistan

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Abstract

A sizeable and stable population of three ungulates, i.e., urial (*Ovis vignei blanfordil),* ibex (*Capra aegagrus blythi*), chinkara (*Gazella gazella benettii*), has been observed in Durreji Game Management Area. Large population of ibex was observed at Obain and Hum mountains, whereas a large population of chinkara was observed at Sorr. Urial was observed to inhabit all mountainous area in the Durrji Game Management Area.

Keywords: Urial, *Ovis vignei blanfordi,* Ibex *Capra aegagrus blythi*, Chinkara *Gazella gazella benettii*, Durreji

Introduction

Durreji Game Management Area is located in Lasbella District of the Balochistan bordering the Kirthar National Park of Sindh Province in the southeast. The area is both rocky mountainous and sandy plain. The Hub River, one of the largest rivers of the Balochistan, passes through the Durreji Game Reserve. Because of the variation between various habitats the area is known for its rich biodiversity. Despites its importance, almost no documented record on wildlife of Durreji is available. Present paper is first attempt to describe the wildlife of the area and describes the status of three ungulates, i.e. urial, ibex and chinkara, in this Game Management Area.

With the exception of Frisina *et al* (2003), no study on the population of urial and ibex has been undertaken in the Durreji Game Management Area. Roberts (1977) and Schaller (1977) indicated the preence of these three ungulates in the areas, yet no work seems to have been done on their populations in the Durreji, Balochistan. This paper presents the report of the survey conducted on the population of ungulates of the Durraji Game Management Area during 2006.

Materials and Methods

Survey for the population of urial, ibex and chinkara was conducted during 7-11 March, 2006 at seven sites, i.e., Hamali, Obain, Hum, Lakkan, Karo, Kato, and Sorr, of the Durreji Game Management Area. Population survey of ungulates is considered to be very difficult, because of the high mobility and cryptic colouration of these human shy ungulates. For the survey two teams scanned the area along the transect line to locate the animals by using binoculars. The relevant data on location, species, group composition, age,sex, time of sighting, date, weather condition and vegetation was recorded. Night surveys were conducted for chinkara in the cultivated tracks within the Game Managment Area by using jeep and search-lights.

Results and Discussion

Surveys of the Durreji Game Management Area revealed that Sindh ibex (*Capra aegagrus blythi*), urial (*Ovis vignei blanfordi*) and chinkara (*Gazella gazella benettii*) are present in different locations as detailed below.

Hamali Mountain: This Mountain is located about 40 km north of Durreji town. The mountain is rugged with slopes and rocky in nature. The dominant plant species observed at this site were *Accacia spp.* (Kanor in Sindhi), *Ziziphus jujuba* (Pissi in Sindhi and Brahvi), dwarf palm (Peesh in Brahvi and Sindhi), *Tamarix indica* and grasses (*Saccharum spp. Barleria acanthoides* and *Capris spinosa*). This site is observed to be an important habitat of urial (*Ovis vignei blanfordi*) with a population of about 150. A pair of chinkara (*Gazella gazella benethi*) was also sighted.

Obain Mountain: This Mountain is located at a distance of 45 km in the northeast of Durreji town. The mountain is steep with high slopes and plain at the top. The dominant plant species of this site are *Acacia senegal, Acacia* spp. *Salvadora, Euphorbia, Prosopsis cineraria* and *Ziziphus* spp. *along with some* grasses (*Asparagus damosus, Lasiaurus, Audrachna aspera*) with an estimated population of some 250.The urial population in this mountain was estimated at about 100.

Hum Mountain: This Mountain is also located in the northeast of Durreji town, adjacent to Obain Mountain. This mountain is steep with high slopes and stony. The grasses were totally absent. The dominant vegetation includes *Salvadora oleoides*, *Ziziphus* ssp. *Acacia* spp. and *Prosopis cineraria*. This mountain is also habitat of Sindh ibex, whose population at this mountain was estimated to range between100 to 120. Because of bad light due to rain and chilly weather, this site could not be adequately surveyed, therefore, it is safe to believe that the actual population of ibexes is more than that estimate under present study. Few urials were also observed at the lower slopes of the mountain.

Lakkan Mountain: This Mountain is located at a distance of 110 km in the southwest of Durreji town. The mountain is stony with lower slopes. The dominant plant species found on this mountain are *Acacia* spp., *Salvadora oleoides* (Jarr in Sindhi) *Ziziphus jujuba*, and dwarf palm This mountain is also an important habitat of urial with a thick population of about 200.

Katto Mountain: This Mountain is located at a distance of 110 km from Durreji town in the west. The Hub River is located at the east of this mountain. This mountain is stony with low ridges. The main vegetation cover of the site are *Acacia* spp., *Ziziphus jujuba* and *Prosipus cinerari,*etc. This site has a population of approximately 60 urials.

Karo Mountain: This Mountain is located adjacent to Katto Mountain in the southeast. This site is an important habitat of urial with about 80 individuals. This Mountain could not be adequately surveyed owing to limited time. Only 60 urials were actually counted during the survey.

Sorr: This is a sandy and rocky plain area located west of Hub river and northwest of Karo and Katto mountain. At this location 18 chinkaras were sighted during the survey.

During the survey Asiatic jackal (*Canis aurius*), fox (*Vulpes vulpes*), striped hyaena (*Hyaena hyaena*) and crested porcupine (*Hystrix indica*) were observed. The locals of the area mentioned that Indian wolf and caracal are also frequently observed in the Game Management Area. Among birds, seesee partridge (*Ammoperdix grasiogularis*), grey partridge (*Francolinus pondicerianus*) black partridge (*Francolinus francolinus*), sandgrouse (*Pterocles sp.*), spotted dove, blue rock pigeon and sunbirds were sighted. Marsh Crocodile (*Crocodylus palustris*) was seen in Hub River at Arypir, Gut and Guhar.

Table-I. Population of different ungulate species in Durreji Game Management Area.

Area	Urial	Chinkara	Ibex
Hamali	150	2	-
Obain	100	-	250
Hum	-	-	100
Lakkan	200	-	-
Katto	60	-	-
Karo	80	-	-
Sorr	-	18	-
Total			

The survey revealed that Durreji Game Management Area harbours a stable population of the ungulates, i.e. urial, ibex and chinkara. It was observed that the population of these animals is well protected. The population seems to be stable, yet drought (2000 to 2005) in the area is reported to have severely affected the population. During the survey, a few carcasses of urial and Sindh ibex were also observed, mainly of old males, possibly surviving in harsh drought conditions.

A survey conducted in the Durreji Game Management Area in April 2001 and the population of urial was estimated of 858 whereas during the present study a total of 590 urials were observed. If it is extrapolated for the entire Durreji Game Management Area, the population would be much larger than that observed in 2001. Similarly 403 ibexes were reported from the Durreji Game Management Area in 2001, whereas during the present survey the population of ibexes in Obain and Hum Mountains was around 350. If this estimate is extrapolated for entire Game Management Area the population of ibexes in Durreji will be much larger than those observed in 2001. However, it would require further studies to verify the population of these two ungulates. If there is a substantial increase in the population then it can be attributed to strict management measures taken by the local Sardar and Wildlife Department.

Considering frequent drought, it will be advisable to construct water pools at some important sites in the Game Management Area. In the Chiltan Hazar Ganji National Park and Kirthar National Park, construction of such water pools has reported to bring stability in population of ungulates. It is worth mentioning that in the Durreji Game Management Area hold a sizeable population of Chinkara (*Gazella gazella benettii*), which is heavily hunted in the other areas of the country.

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Some Observations on Birds and Marine Mammals of Karachi Coast

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Abstract

The population of bird and marine mammals was studied through beach and boat surveys, conducted along Karachi coast, extending from Khuddi Creek to Cape Monz. A total of 55 species of birds and 2 species of cetaceans were observed. The population status, occurrence and distribution were also studied.

Key Words: Birds, Marine mammals, Karachi Coast

Introduction

Karachi coast is known for high diversity of bird and marine mammals. A total of 62 species of birds were reported by Hasan (1994) from the coast of Sindh including Karachi. Hasan (1996) considered Korangi/Phitti Creek System, along Karachi, to have more diversified bird fauna as compared to Shah Bundar (located on the eastern side of the river Indus). The mangrove thickets at Korangi/ Phitti creek system provide an ideal habitat for various species of birds. Siddiqui *et al* (2001) have given a comprehensive account of coastal areas Sindh, including Cape Monze, Korangi/ Phitti creek, Rehri, Shah Bundar, Sando Bundar and Keti Bunder. Ghalib and Hasnain (1994, 1997) and Ahmed *et al* (1988), Hasan and Ahmed (2000), Javed and Hasan (2004 a,b) have also studies bird fauna of the coastal areas of Pakistan.

Humpback dolphin (*Sousa plumbea*) is a common dolphin and is found throughout East Africa and Indo-Malayan seas (Roberts, 1997). There were several records of its direct sightings from coastal areas of Karachi. Most of the direct sightings of the species were recorded in the months of November to January throughout coastal areas of Pakistan. Maximum number of this species was observed from Gwater Bay near Jiwani, Balochistan coast, where 27 animals were sighted in area of 2-3 km^2. Bottle-nosed dolphin (*Tursiops truncatus)* is another common species in waters of Arabian sea, Indian Ocean, Indonesia and Australia (Roberts, 1997). This species is also commonly found in coastal waters of Pakistan. There are several records of direct sightings of humpback dolphin (*Sousa plumbea),* bottlenose dolphin (*Tursiops truncates*) and black finless porpoise (*Neophocaena phocaenoides*) in Indus delta (ZSD, unpublished records) while Roberts (1977) has recorded the presence of 5 species of dolphins, i.e., long-beaked dolphin (*Delphinus tropicalus*), rough- toothed dolphin (*Steno bredanensis*), Indian humback dolphin (*Sousa plumbea*), bottlenose dolphin (*Tursiops truncatus*) and Electra dolphin (*Peponocephala electra*), and one species of porpoise i.e. black finless porpoise) (*Neophocaena phocaenoides*) from coastal waters of Pakistan (Roberts 1997).

Keeping in view the importance of birds and marine mammals in the coastal ecosystem especially to protect the population of cetacean, present baseline study was cunducted.

Material and Methods

For the estimation of population of birds, line transect method was used, in which direct counting was made with the help of binocular and spotting scope. The area comprises of different habitats, including small to large channels of creeks and bird populations are not evenly distributed. The areas near the water channels usually support high bird population densities, which make the data biased if compared with open coastal areas. To avoid biased estimation bird population density along the water channels were calculated instead of estimating the population of the whole area by modifying the techniques mentioned in Ahmed (1988). On islands, where line transect method was not possible, the birds populations were estimated by counting a portion of bird population of a single species with spotting scope and multiplying it with the number of similar portions on a island. Birds in flying condition were directly counted. To avoid the biased estimation the birds which were not uniformly distributed were also directly counted.

For marine mammal, main water channels along western side of Bandal Island, eastern side of Bandal Island, Phitti Creek main channel, channels towards Khuddi Creek was surveyed on boat. Keeping the speed of the boat constant, sightings obtained from boat transects were used to estimate the density of dolphins within the area on one or both sides of boats tracts. The per unit area was then extrapolated to the total area of the region to an estimate of the total population (Evans, 1987).

Results and Discussions

Bird belonging to 17 families, 32 genera and 55 species were observed along the Karachi coast between Cape Monze and Khudi Creek (Table I) of which 36 species were common while 12 species were regarded as less common and 7 as rare. According to Hasan (1994), 62 species of bird were recorded from Sindh coast, while during present study, 55 species of birds were reported. Hasan (1996) noted that area of Shah Bundar has greater avifauna diversity than Korangi/Phitti creek. These studies and observations made during the present study revealed that there is not much difference in the species diversity in the three areas.

During study, only one species of dolphin, i.e. bottlenose dolphin (*Turiops truncatus*), was sighted at two different locations. Both the sighting were made from east coast of Karachi. One was observed at Phitti Creek while the other was observed in Khuddi Creek. The direction of the movement of the dolphins in both the cases was from east to west. In addition, one carcass of black finless porpoise (*Neophocaena phocaenoides*) was observed on the west coast of Karachi.

Table I. Species of birds, their status, occurrence and population estimation from Karachi coast (Khuddi Creek to Cape Monze).

Species	Population size (Density / Km²)	Occurrence	Status	Distribution
Little Grebe (*Tachybaptus ruficollis*)	50	R	C	WC
White Pelican(*Pelicanis oncrotalus*)	8	Wv	Lc	EC, WC
Great Cormorant (*Phalacrocorax carbo*)	462	Wv	C	EC, C, WC
Indian Shag (*Phalacrocorax fuscicallis*)	6	Wv	Lc	WC
Little Cormorant (*Phalacrocorax niger*)	(20) 15	R	Lc	EC, C, WC
Pond Heron (*Ardeola grayii*)	(200) 30	R	C	EC, WC
Reef Heron (*Egretta gularis*)	(250) 145	R	C	EC,C, WC
Little Egret (*Egretta garzetta*)	(250)162	R	C	EC, C, WC
Median Egret (*Egretta intermedia*)	22	R	Lc	EC, WC
Large Egret (*Egretta alba*)	4	R	R	EC
Grey Heron (*Ardea cinerea*)	13	Wv	Lc	EC,C,WC
Spoonbill (*Platalea leucorodia*)	25	Wv		WC
Flamingo (*Phoenicopterus ruber*)	(100) 1500	R	C	EC,C,WC
Common Shoveller (*Anas clypeata*)	84	Wv	C	C
Pariah Kite (*Milvus migrans govinda*)	(200)	R	C	EC,C,WC
Brahminy Kite (*Haliastur indus indus*)	(40) 26	R	C	EC,C,WC
Osprey (*Pandion haliaetus haliaetus*)	12	Wv	C	EC,WC
Common Coot (*Fulica atra*)	42	R	C	C
Painted Snipe (*Rostratula bengalensis*)	2	R	R	Wc
Oystercatcher (*Haematopus ostralegus*)	200	Wv	C	EC,WC
Black winged Stilt (*Himantopus himantopus*)	(20)	R	C	EC,WC

Little Ringed Plover (*Charadrius dubius*)	500	Wv	C	EC,WC
Ringed Plover (*Charadrius hiaticula*)	25	Wv	Lc	EC,WC
Kentish Plover (*Charadrius alexandrinus*)	3500	R	C	EC, WC
Mongolian Plover (*Charadrius mongolus*)	25	Wv	C	EC,WC
Greater Sand Plover (*Charadrius eschenaultii*)	2	Wv	R	WC
Grey Plover (*Pluvialis squatarola*)	27	Wv	C	EC
Red-wattled Lapwing (*Vanellus indicus*)	7	R	R	EC,C
Sanderling (*Calidris alba*)	5500	Wv	C	EC,WC
Little Stint (*Calidris minuta*)	7000	Wv	C	EC,C,WC
Curlew Sandpiper (*Calidris ferruginea*)	25	Wv	Lc	EC,WC
Dunlin (*Calidris alpina*)	7200	Wv	C	WC
Ruff (*Philomachus pugnax*)	12	Wv	Lc	EC
Black-tailed Godwit (*Limosa limosa*)	10	Wv	Lc	EC,WC
Bartailed Godwit (*Limosa lapponica*)	2	Wv	R	EC,WC
Whimbrel (*Numenius phaeopus*)	1	Wv	R	EC
Curlew (*Numenius arquata*)	72	Wv	C	EC,WC
Red Shank (*Tringa totanus*)	(600) 375	Wv	C	EC,C,WC
Marsh Sandpiper (*Tringa stagnatilis*)	3	Wv	Lc	EC,WC
Green shank (*Tringa nebularia*)	10	Wc	Lc	C
Green Sandpiper (*Tringa ochropus*)	4	Wv	R	C
Terek Sandpiper (*Tringa terek*)	5	Wv	Lc	EC, WC
Common Sandpiper (*Actitis hypoleucos*)	(500)1050	Wv	C	EC,WC
Great Blackheaded Gull (*Larus ichthyaetus*)	5	Wv	LC	EC
Blackheaded Gull (*Larus ridibundus*)	6600	Wv	C	EC,C,WC

Brown-headed Gull (*Larus brunnicephalus*)	1	Wv	R	EC
Slenderbilled Gull (*Larus genei*)	25	Wv	LC	EC,WC
Herring Gull (*Larus argentatus*)	508	Wv	C	EC,C,WC
Lesser Blackbacked Gull (*Larus fuscus fuscus*)	812	Wv	C	EC,WC
Gull-billed Tern (*Gelochelidon nilotica*)	179	Wv	C	EC,C,WC
Caspian Tern (*Hydroprogeni caspia*)	382	Wv	C	EC,C,WC
Sandwitch Tern (*Thalassens sandcenses*)	300	Wv	C	EC,WC
Common Tern (*Sterna hirundo*)	200	Wv	C	EC,WC
Little Tern (*Sterna albifrons*)	26	Wv	C	EC,WC
House Crow (*Corvus splendens*)	Many	R	C	EC,C,WC

Occurrence: R –Residence, Wv- Winter visitor
Status : C- Common, Lc –Less Common, R- Rare
Distribution: EC- East Coast, WC- West Coast, C- Clifton

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Ecology of Birds of Kuppi Plantation, Faisalabad, Pakistan I. Phyto-sociology

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Abstract

The study deals with the phyto-sociology of the Kuppi Plantation located in district Faisalabad. A total of 94 plant species belonging to 35 families were recorded from 13 compartments, which were studied during the investigation. The study revealed that the present condition of Kuppi plantation is a representative of degraded forest habitat but supports several species of natural flora of the region.

Keywords: Kuppi Plantation, birds, phyto-sociology,

Introduction

The development of canal irrigation system in the Punjab, also increase the possibility of growing human population, under intensive silviculture operations to provide wood-based products. These irrigated forest plantations were initially established to provide fuel wood and coal requirement for railway engines. With the passage of time and replacement of coal engines with mineral oil/gasoline engines and the growing demand of timber based products, the objective of raising and maintaining irrigated forest plantation was shifted towards production of timber and wood. These plantations provided a refuge to large varieties of birds. Present paper is first of the series of studies conducted on the avifauna of such plantation and deals with the phyto-sociology of Kuppi Plantation, located in district Faisalabad, Punjab.

At present, Kuppi plantation is in short of water supply. The canal water supply is not perennial and even when available it is extremely inadequate to meet the need of plantation. Sufficient funds are also not available to run tube-wells in the plantation.

Boundaries of the Kuppi plantation are not clearly demarcated, which has lead to encroachment at some places. Local human population is dependent on the plantation for firewood and grazing livestock. For whole the day herds of cattle and goat roam freely in the plantation. Silvicultural activities like felling, thinning and regeneration also are not practiced. All these factors are detrimental for the plantation and its related fauna as well. About two decades back this plantation was in good condition and supported important species of birds and mammals. In its present state it may be regarded as a degraded ecosystem.

The Kuppi plantation falls in the arid and semi arid sub tropical continental lowlands climatic region (Ahmed, 1951). These areas are characterized by great annual and diurnal variations in the temperatures. The summer from April to September and winter from November to January are the hottest and the coldest months respectively.

Maximum rainfall is received in monsoon season (July to September), and constitutes 70 to 80% of annual rainfall.

The major plantation of Kuppi Forest Plantation (Fig. 1) is *Dalbergia sissoo* (Sissoo tree, locally called as Sheesham or Tahli). *Acacia nilotica* (Babul or Kiker) and *Eucalyptus camaldulensis* (Red river-gum or Safeda) are the other planted species. Therteen compartment were randomly selected for vegetation studies, through stratified sampling based on the type of plantation, vegetation structure, soil type and surrounding area, to sample the total variability as detaild in Table I.

There is a very little literature available on vegetation studies of irrigated forest plantations in the Punjab. Ahmad *et al.* (2002) conducted studies on medicinal plants in the Salt Range. *Olea ferruginea, Acacia modesta, Reptonia buxifolia* and *Salvadora oleoides* represented the apparent arboreal landscape of the terrain. More than 92 medicinal plants are not only used for curing ailments ranging from mild infections to the chronic ulcers but are also contributing a lot to the rural economy of the area.

Hameed *et al.* (2002) conducted phyto-sociological studies of Lal Suhanra National Park, Bahawalpur. Old irrigated plantations consisted of mixed species plantations, mostly of *Dalbergia sissoo*, *Acacia nilotica* and *Eucalyptus camaldulensis*. Forest plantations had specific type of flora, consisting of *Prosopis glandulosa, Saccharum bengalense* and *Imperata cylindrica*. New irrigated plantation possessed mixed type plantations but monocultures of *Dalbergia sissoo* and sometimes *Eucalyptus camaldulensis* are practiced in few blocks. The ground flora comprised of agriculture weed like *Conyza ambigua, Desmostachya bipinnata, Imperata cylindrica* and tall grasses like *Saccharum bengalense* and *Saccharum spontaneum* with few native trees/large shrubs like *Tamarix aphylla* and *Prosopis cineraria*. Dense plantations almost totally eliminated the ground flora, perhaps due to poor light intensity and non-decomposed plant material of deciduous trees.

Akbar *et al.* (2003) carried out studies to investigate the floristic composition of roadside vegetation in Sahiwal district, Pakistan. Among 60 recorded species, the main grass species include *Cynodon dactylon, Desmostachya bipinnata, Panicum turgidum, Cyperus rotundus* and *Cenchrus biflorus*. The dominant species exhibited little variation between different zones of verges. Other species however, showed preferences for certain zones of the verges indicating differences in microhabitat conditions in the verges.

Sultan and Nasir (2003) surveyed gram fields of district Chakwal in two growing seasons (December and March) in order to study the variations in weed species assemblages within different weed communities. On the basis of importance value; eight weed communities, viz., *Lathyrus-Asphodelus-Vicia*, *Asphodelus-Lathyrus-Vicia*, *Trifolium-Rhynchosia-Medicago*, *Anagallis-Carthamus-Medicago*, *Asphodelus-Carthamus-Medicago*, *Asphodelus-Medicago-Convolvulus*, *Asphodelus-Carthamus-Convolvulus* and *Asphodelus-Carthamus-Calendula* were recognized at eight different localities during December. In March, the weed communities at these sites were *Asphodelus-Vicia-Lathyrus*, *Asphodelus-Sorghum-Medicago*, *Asphodelus-Fumaria-*

Euphorbia-Vicia, *Asphodelus-Carthamus-Convolvulus*, *Asphodelus-Convolvulus-Vicia*, *Asphodelus-Convolvulus-Carthamus*, *Asphodelus-Calendula-Convolvulus*.

Ali *et al* (2004) carried out vegetation analysis and evaluation of stand structure to establish plant communities in control area and in the sites contaminated with industrial effluents. Two major distinct groups were identified, comprising of *Cynodon dactylon* group, the dominating species of the control area and *Desmostachya bipinnata,* the dominating species of the contaminated sites. Mahmood *et al* (2004) carried out the studies to assess, record and report the ethnobotanical potential of the Kala Chitta Hills of District Attock. They report 40 species (21 families) of important medicinal plant from the area.

Elsewhere, El-Keblawy and Ksiksi (2005) evaluated the role of artificial forests in the UAE to protect floral diversity through the determination of the effect of forest trees on species diversity and abundance of perennial plants in six forests. Nosignificant variation in species richness and species diversity index was recorded among the six studied forests. Ishida *et al* (2005) studied the effects of forest management on the composition and richness of vascular plant species in lucidophyllous (evergreen broad-leaved) forests, secondary lucidophyllous forest stands regenerating after clear-cutting. The previously clear-cut logged tracts were compared with primary lucidophyllous forest stands in two altitudinal zones on Tsushima Island, Japan.

Materials and Methods

Kuppi Irrigated Plantation (Fig. 1) is an un-classed forest and is situated at a distance of 1.6 Km from RD 10521 of Nurange distributory, which takes off from Burale Branch. It falls in two Chak (363 and 367 G.B) in Jaranwala forest sub-division, district Faisalabad. It comprises 41 compartments divided into two beats. The area of this plantation is 364.94 ha, almost flat with mild undulations at some places. Half of the area comprises of moderately well drained deep fine silty and clay soil. The other half has a silty saline-alkaline soil. The soils on the sloping edges are dense, while in other parts these are porous in nature. Generally the soil is well suited for growing tree species.

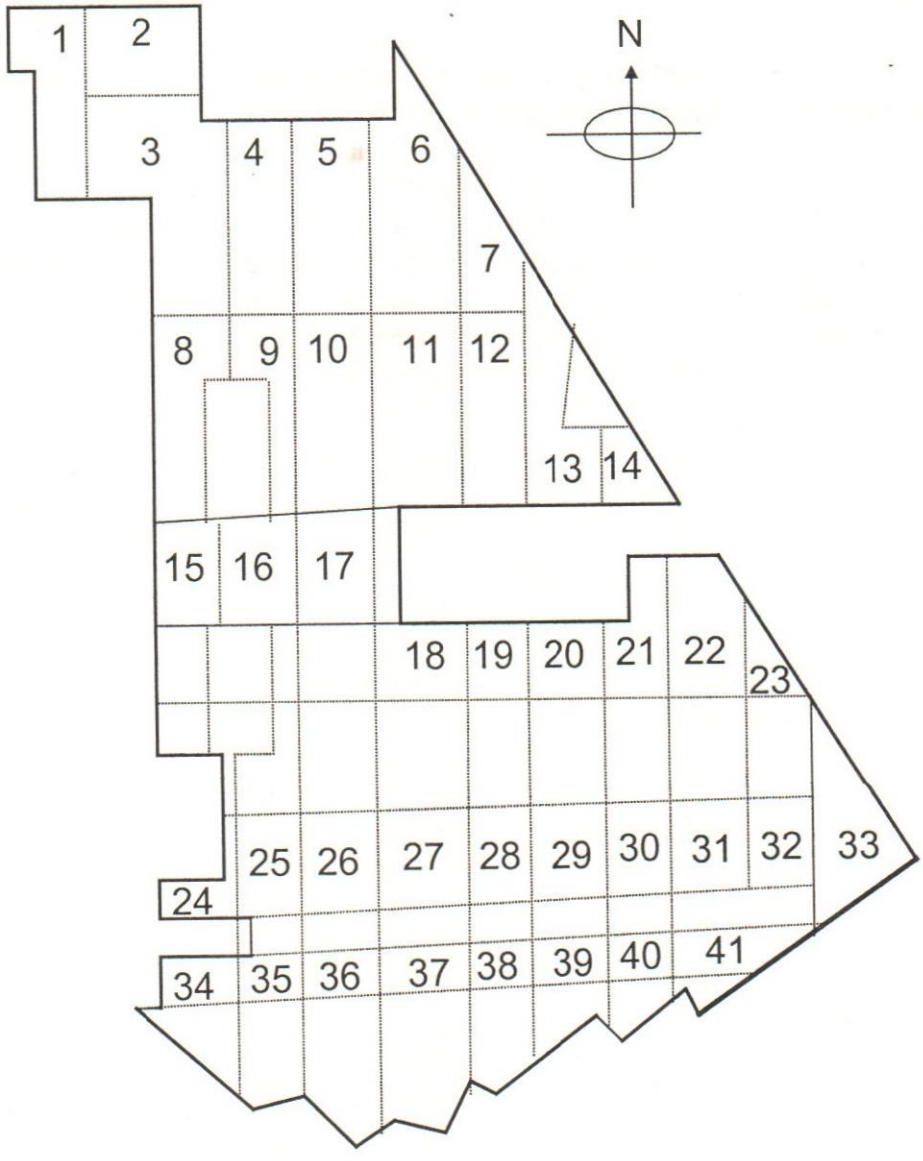

Fig.1. Map of Kuppi plantation showing compartments of forest plantation.

Vegetation was studied during winter 1999 and spring 2000. Independent quadrats were laid during both surveys. Vegetation was samples using quadrate method along a 100 m straight line in the center of the compartment and five 10 x 10 m square quadrats were taken at 20 m intervals to record data on tree species and large shrubs. For the sampling of small shrubs and ground vegetation, including herbs, grasses and sedges, 5 x 5m quadrats were used. The data were analyzed for density, frequency, percent cover, relative density, relative frequency, relative cover and importance value.

Results and Discussions

During the survey, 94 plant species were recorded from 13 compartments, belonging to 35 families (Table II). The richest family in terms of number of species was Poaceae (represented by 21 species), followed by Asteraceae (8 species). Chenopodiaceae, Papilionaceae and Mimosaceae were represented by 5 species each.

Table I. General description of compartments in Kupi Forest Plantation sampled for phyto-ecological studies.

Cpt.No.	Area (Km^2)	Plantation type	Habitat description
2a	0.122	*Dalbergia sissoo*	Almost completely surrounded by agricultural lands, first plantation in 1955
2b		*Dalbergia sissoo* *Bombax cieba*	Nursery raised in 1993-94
3	0.118	*Dalbergia sissoo* *Acacia nilotica*	Planted in 1955, felled in 1978-79. Regeneration in 1978-79. Cultivated lands on north and west sides
6	0.115	*Dalbergia sissoo* *Acacia nilotica*	Planted in 1955, kikar plantation in 1979-80. Cultivated lands on north
8	0.103	*Acacia nilotica* *Dalbergia sissoo*	Planted in 1955, regeneration in 1978-79 of kikar
10	0.096	*Acacia nilotica*	Planted in 1967-68.Replanted by kikar in 1976-77. Surrounded by other forest compartments
15	0.136	*Acacia nilotica*	Planted in 1965-66.Replanted in 1976-77. Surrounded by other forest compartments

24	0.107	*Acacia nilotica* *Dalbergia sissoo* *Eucalyptus camaldulensis*	Planted in 1978-79 and 1979-80. Cultivated land on west side
26	0.093	*Acacia nilotica* *Dalbergia sissoo*	Planted in 1979-80, 1980-81 and 1981-82. Surrounded b forest compartments
30	0.119	*Acacia nilotica* *Dalbergia sissoo*	Planted in 1979-80, 1980-81, surrounded by forest compartments
33	0.055	*Acacia nilotica*	Planted in 1979-80. Cultivated lands on north, east and south

Table II. List of species recorded from Kuppi Forest plantation

Family	Species
Aizoaceae	*Trianthema portulacastrum, Trianthema triquetra*
Amaranthaceae	*Achyranthes aspera, Alternanthera sessilis, Digera muricata*
Asclepiadaceae	*Calotropis procera, Pentatropis spiralis, Periploca hydaspica*
Bombacaceae	*Bombax cieba*
Boraginaceae	*Cordia oblique*
Caesalpiniaceae	*Parkensonia aculeate*
Capparidaceae	*Capparis decidua, Cleome brachycarpa, Crataeva religiosa*
Chenopodiaceae	*Amaranthus viridis, Chenopodium album, Chenopodium murale, Salsola baryosma, Suaeda fruticosa*
Compositae (Asteraceae)	*Carthamus oxyacantha, Cichorium intybus, Cnicus arvensis, Conyza ambigua, Coronopus didymus, Eclipta alba, Launaea nudicaulis, Sonchus oleraceous, Xanthium strumarium*
Convolvulaceae	*Convolvulus arvensis, Convolvulus pluricaulis*
Cucurbitaceae	*Mukia scrabrella*
Cyperaceae	*Cyperus rotundus, Scirpus maritimus, Scirpus mucronatus*
Euphorbiaceae	*Euphorbia hirta, Euphorbia prostrata, Euphorbia royleana*
Fumariaceae	*Fumaria indica*
Liliaceae	*Asphodelus tenuifolius*
Malvaceae	*Abutilon fruticosum, Malva parviflora, Malvastrum coromandelianum*
Meliaceae	*Melia azedirach*
Mimosaceae	*Acacia modesta, Acacia nilotica, Leuceana leucocephala, Prosopis cineraria, Prosopis glandulosa*
Moraceae	*Ficus bengalense, Morus alba*
Myrtaceae	*Eucalyptus camaldulensis, Syzygium cumini*
Nyctaginaceae	*Boerhavia diffusa*

Oxalidaceae	*Oxalis corniculata*
Papilionaceae	*Alhagi maurorum, Dalbergia sissoo, Lathyrus aphaca, Medicago polymorpha, Vicia sativa*
Poaceae	*Aeluropus lagopoides, Bambusa bambos, Brachiaria ramosa, Brachiaria reptans, Cenchrus pennisetiformis, Cenchrus setigerus, Cynodon dactylon, Dactyloctenium aegyptium, Desmostachya bipinnata, Dichanthium annulatum, Digitaria adscendens, Echinochloa colona, Eragrostis poaeoides, Ochthochloa compressa, Panicum antidotale, Paspalidium flavidum, Saccharum bengalense, Saccharum spontaneum, Setaria glauca, Sorghum halepense, Sporobolus diander*
Polygonaceae	*Rumex dentatus*
Primulaceae	*Anagallis arvensis*
Rhamnaceae	*Ziziphus mauritiana*
Salicaceae	*Populus euro-americana*
Salvadoraceae	*Salvadora oleoides*
Scrophulariaceae	*Verbascum thapsus*
Solanaceae	*Solanum surratense, Withania somnifera*
Tamaricaceae	*Tamarix aphylla*
Tiliaceae	*Grewia tenax*
Verbenaceae	*Clerodendron inerme, Phyla nodiflora*
Zygophyllaceae	*Fagonia indica, Peganum harmala*

Compartment No. 2, consisting of old forest plantation produced from a nursery raised during 1993-94 was dominated by *Dalbergia sissoo* during both seasons, having importance value 77.94 during winter and 85.72 during spring. Two other species, *Bombax cieba* and *Eucalyptus camaldulensis* were much frequently recorded. Among grasses *Cynodon dactylon* was the only dominant species with importance value of 75.67 during winter and 134.51 during spring. Among herbs *Xanthium strumarium, Malvastrum coromandelianum, Conyza ambigua* and *Oxalis corniculata* were the dominant plant species (Table III).

Table III. Phytosociological character of the plant species in two sub-compartments of compartment No 2 during diftered seasons.

Compartment 2a	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Achyranthes aspera	6.13	12.50	1.83	20.46	2.06	15.00	1.52	18.58
Aeluropus lagopoides					0.74	5.00	0.14	5.88
Bombax cieba	24.51	18.75	62.93	106.19	25.37	25.00	61.98	112.35
Cynodon dactylon	58.82	18.75	27.46	105.03	69.32	25.00	30.30	124.62
Dalbergia sissoo	1.96	12.50	2.75	17.21	1.62	20.00	3.86	25.48
Morus alba	1.72	12.50	1.60	15.82	0.00	0.00	0.00	0.00
Saccharum bengalense	0.49	6.25	1.14	7.88	0.59	5.00	2.07	7.66
Xanthium strumarium	6.37	18.75	2.29	27.41	0.29	5.00	0.14	5.43
Compartment 2b								
Achyranthes aspera	7.67	7.69	3.54	18.90	0.33	5.26	0.18	5.77
Bombax cieba	0.77	3.85	2.95	7.56				
Cynodon dactylon	43.48	11.54	20.65	75.67	67.66	26.32	40.54	134.51
Dalbergia sissoo	13.30	11.54	53.10	77.94	14.36	26.32	45.05	85.72
Saccharum bengalense	0.26	3.85	0.29	4.40	0.99	15.79	1.62	18.40
Xanthium strumarium	15.35	7.69	11.80	34.84	13.20	15.79	9.91	38.90
Boerhavia diffusa	0.26	3.85	0.15	4.25				
Digitaria adscendens	2.05	3.85	1.18	7.07				
Cenchrus setigerus	1.79	7.69	0.44	9.93				
Conyza ambigua	3.84	3.85	0.59	8.27				
Cyperus rotundus	2.05	3.85	0.59	6.48				
Eucalyptus camaldulensis	0.26	3.85	1.47	5.58	0.17	5.26	1.80	7.23
Euphorbia hirta	1.53	7.69	0.74	9.96				
Malvastrum coromandelianum	1.79	7.69	0.59	10.07	3.30	5.26	0.90	9.46
Oxalis corniculata	4.35	7.69	1.62	13.66				
Verbascum thapsus	1.28	3.85	0.29	5.42				

In Compartment No. 3, *Desmostachya bipinnata* dominated the habitat with the importance value of 149.28 during spring. *Dalbergia sissoo* and *Acacia nilotica* were the two planted species, *Dalbergia sissoo* having a higher frequency. Overall the vegetation status was not good. Large shrubs or trees, like, *Prosopis cineraria* and *Prosopis glandulosa,* were recorded at scattered places (Table IV).

Table IV. Phytosociological character of the plant species in compartment No 3 during diftered seasons.

Compartment 3	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	1.20	15.00	10.15	26.35	1.13	14.29	11.85	27.27
Cynodon dactylon	18.36	15.00	6.19	39.56	6.77	7.14	1.08	14.99
Dalbergia sissoo	3.59	25.00	32.49	61.08	1.13	21.43	11.85	34.41
Desmostachya bipinnata	75.85	25.00	48.73	149.58	90.29	35.71	73.28	199.28
Prosopis cineraria	0.20	5.00	1.02	6.21				
Prosopis glandulosa	0.60	10.00	1.22	11.82	0.23	7.14	0.43	7.80
Saccharum bengalense	0.20	5.00	0.20	5.40	0.45	14.29	1.51	16.25

Compartment 6 was planted with *Acacia nilotica* and *Dalbergia sissoo* trees. *Cynodon dactylon* dominated the area among grasses but *Desmostachya bipinnata* was recorded in patches only. Not grass species can strictly be regarded as dominant, but *Phyla nodiflora* was recorded more frequent. Status of plantation was not good as illegal operations like grazing of live stock and wood cutting was common (Table V).

Table V. Phytosociological character of the plant species in compartment No 6 during diftered seasons.

Compartment 6	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	0.80	21.74	9.91	32.46	0.19	25.00	11.54	36.73
Cynodon dactylon	91.31	21.74	68.64	181.68	99.56	62.50	85.90	247.96
Dalbergia sissoo	0.95	21.74	13.73	36.42				
Desmostachya bipinnata	4.16	13.04	6.29	23.50	0.24	12.50	2.56	15.31
Euphorbia prostrata	0.15	4.35	0.10	4.59				
Launaea nudicaulis	0.15	4.35	0.10	4.59				
Phyla nodiflora	2.48	13.04	1.24	16.77				

Acacia nilotca dominated in Compartment No. 8, with 32.11 importance value during winter and 48.16 during spring. *Desmostachya bipinnata, Cynodon dactylon* and *Sporobolus diander* were the three dominant grasses species, each appeaing separate area. Large shrubs, like, *prosopis cineraria* and *Capparis deciduas,* were recorded at scattered places (Table VI).

Table VI. Phytosociological character of the plant species in compartment No 8 during diftered seasons.

Compartment 8	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	1.01	12.00	19.10	32.11	3.64	20.00	24.53	48.16
Calotropis procera	5.78	4.00	3.47	13.25				
Capparis deciduas	0.72	12.00	4.86	17.58	7.88	20.00	24.91	52.78
Cynodon dactylon	42.63	16.00	39.93	98.56				
Dalbergia sissoo	0.43	8.00	8.68	17.11	0.61	5.00	3.77	9.38
Desmostachya bipinnata	43.35	16.00	11.46	70.81	18.18	10.00	7.55	35.73
Ochthochloa compressa	4.34	4.00	1.74	10.07				
Peganum harmala					2.42	5.00	0.38	7.80
Prosopis cineraria	0.58	8.00	3.47	12.05				
Prosopis glandulosa	0.58	8.00	3.47	12.05	4.85	20.00	17.74	42.58
Salsola baryosma	0.29	4.00	0.35	4.64				
Salvadora oleoides	0.14	4.00	1.74	5.88				
Sporobolus diander					60.61	10.00	13.21	83.81
Suaeda fruticosa					1.21	5.00	0.38	6.59
Tamarix aphylla	0.14	4.00	1.74	5.88	0.61	5.00	7.55	13.15

Grasses, *like, Cynodon dactylon*, *Desmostachya bipinnata* and *Sporobolus diander,* completely dominated the area in compartment No. 10. Only planted forest species was *Acacia nilotica,* showing importance value of 50.25 during winter and 52.96 during spring. Perennial grass (*Saccharum bengalense)* was recorded in patches only (Table VII).

Compartment No. 15 has only single planted species (*Acacia nilotica)*. Many invaded species were recorded from the area were significant *Tamarix aphylla, Prosopis glandulosa, Capparis decidua* and *Suaeda fruticosa were sigmpeant* S. *fruticosa* is a good indicator of saline soil. *Cynodon dactylon, Desmostachya bipinnata and Sporobolus diander* were the dominant species (Table VIII).

Table VII. Phytosociological character of the plant species in compartment No 10 during diftered seasons.

Compartment 10	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	0.70	31.25	18.29	50.25	1.25	25.00	26.71	52.96
Chenopodium album					4.17	8.33	0.67	13.17
Cynodon dactylon	79.89	31.25	64.02	175.17				
Desmostachya bipinnata	14.05	18.75	13.21	46.01				
Phyla nodiflora					0.21	8.33	0.17	8.71
Prosopis glandulosa	0.09	6.25	0.41	6.74	0.42	16.67	5.01	22.09
Saccharum bengalense					0.21	8.33	0.67	9.21
Sporobolus diander	5.27	12.50	4.07	21.83	93.75	33.33	66.78	193.86

Table VIII. Phytosociological character of the plant species in compartment No 15 during diftered seasons.

Compartment 15	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	4.53	20.00	28.15	52.67				
Capparis deciduas	3.29	12.00	8.28	23.57				
Cynodon dactylon					35.81	23.53	18.52	77.86
Desmostachya bipinnata					0.55	5.88	0.41	6.84
Eucalyptus camaldulensis					1.65	23.53	18.52	43.70
Prosopis glandulosa	11.11	20.00	34.77	65.88	1.38	17.65	24.69	43.72
Sporobolus diander	45.27	12.00	11.59	68.86	60.61	29.41	37.86	127.88
Suaeda fruticosa	28.40	20.00	6.95	55.35				
Tamarix aphylla	1.23	12.00	9.93	23.17				
Trianthema triquetra	6.17	4.00	0.33	10.50				

Acacia nilotica was the single planted species, where the importance value was 37.41 during winter and 57.09 during spring in compartment No.18. *Cynodon dactylon* and *Desmostachya bipinnata* dominated the ground vegetation completely. While *Sporobolus diander, Capparis decidua* and *Prosopis glandulosa* were the large species recorded occasionally (Table IX).

In compartment No.19, *Acacia nilotica* was the only planted species having the reasonable cover. Ground vegetation was completely dominated by grasses, like, *Ochthochloa compressa, Sporobolus diander*, *Cynodon dactylon* and *Desmostachya bipinnata*, with *Brachiaria ramosa* appearing isolated places. Other species were rarely recorded (TableX).

Table IX. Phytosociological character of the plant species in compartment No 18 during diftered seasons.

Compartment 18	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	1.44	17.39	18.58	37.41	1.52	25.00	30.58	57.09
Capparis decidua	0.43	4.35	2.19	6.97	0.17	6.25	1.08	7.50
Cynodon dactylon	2.88	4.35	1.09	8.32	80.94	31.25	48.56	160.76
Desmostachya bipinnata	50.36	17.39	45.90	113.65	3.37	6.25	3.60	13.22
Launaea nudicaulis	0.29	4.35	0.11	4.74				
Ochthochloa compressa	11.51	8.70	6.56	26.76	5.06	6.25	3.60	14.91
Prosopis glandulosa	0.86	13.04	4.37	18.28	0.51	18.75	8.99	28.25
Saccharum bengalense	0.29	4.35	0.22	4.85				
Sporobolus diander	31.65	21.74	20.77	74.16	8.43	6.25	3.60	18.28
Suaeda fruticosa	0.29	4.35	0.22	4.85				

Table X. Phytosociological character of the plant species in compartment No 19 during diftered seasons.

Compartment 19	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	3.58	26.67	46.08	76.33	2.58	26.67	36.05	65.30
Brachiaria ramosa	0.30	6.67	0.23	7.20				
Capparis decidua					0.29	6.67	0.63	7.58
Cynodon dactylon					40.11	20.00	17.24	77.36
Desmostachya bipinnata					54.44	20.00	37.62	112.06
Launaea nudicaulis	0.60	6.67	0.23	7.49				
Ochthochloa compressa	83.58	26.67	36.87	147.12				
Prosopis glandulosa	1.49	20.00	11.52	33.01	1.15	20.00	7.84	28.98
Sporobolus diander	10.45	13.33	5.07	28.85	1.43	6.67	0.63	8.73

In Compartment No. 24, *Eucalyptus camaldulensis* was the dominant planted species, where *Acacia nilotica* was also planted but was less frequent. Ground vegetation was dominated by *Sporobolus diander*, *Ochthochloa compressa* and *Desmostachya bipinnata*, while *Dactyloctenium aegyptium* was recorded at isolated places. *Suaeda fruticosa* and *Peganum harmala* were the dominant species among herbs or under shrubs, while solitary large shrub, *Capparis decidua* was recorded occasionally (Table XI).

Table XI. Phytosociological character of the plant species in compartment No 24 during diftered seasons.

Compartment 24	Winter/autumn 1999				Spring/summer 2000			
	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	0.25	3.70	0.47	4.42	1.64	7.69	6.38	15.72
Capparis decidua					0.15	3.85	1.06	5.06
Cynodon dactylon	18.61	11.11	13.99	43.71	10.46	11.54	4.26	26.26
Dactyloctenium aegyptium	0.62	3.70	0.23	4.56	0.00	0.00	0.00	0.00
Desmostachya bipinnata	4.96	7.41	4.66	17.03				
Eucalyptus camaldulensis	6.20	18.52	27.97	52.69	5.68	19.23	35.11	60.02
Ochthochloa compressa	22.33	18.52	13.99	54.84	32.88	19.23	14.89	67.01
Peganum harmala					1.64	7.69	3.19	12.53
Prosopis glandulosa	0.25	3.70	2.33	6.28	0.30	3.85	1.06	5.21
Sporobolus diander	40.94	18.52	29.14	88.60	44.84	19.23	28.72	92.80
Suaeda fruticosa	5.83	14.81	7.23	27.87	2.39	7.69	5.32	15.40

The Compartment 26 was planted with *Dalbergia sissoo* and *Acacia nilotica* in almost 1:1 ratio. Quite a few shrubs and under shrubs, i.e., *Prosopis glandulosa, Capparis decidua, Suaeda fruticosa* and *Acacia nilotica,* were frequently recorded. Ground vegetation was dominated by grasses, like, *Desmostachya bipinnata, Ochthochloa compressa and Sporobolus diander* (Table XII).

Table XII. Phytosociological character of the plant species in compartment No 26 during diftered seasons

Compartment 26	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia modesta	0.19	3.57	1.02	4.79				
Acacia nilotica	3.12	17.86	27.61	48.58	3.08	25.00	27.59	55.66
Capparis decidua	0.58	7.14	2.04	9.77	1.23	18.75	8.62	28.60
Dalbergia sissoo	1.95	10.71	17.38	30.05	0.00	0.00	0.00	0.00
Desmostachya bipinnata	29.82	10.71	14.31	54.85	12.31	6.25	6.90	25.45
Ochthochloa compressa	37.04	10.71	9.20	56.95	80.00	25.00	27.59	132.59
Prosopis glandulosa	2.92	17.86	17.38	38.16	3.38	25.00	29.31	57.69
Sporobolus diander	23.39	14.29	10.63	48.31				
Suaeda fruticosa	0.97	7.14	0.41	8.53				

Dalbergia sissoo and *Acacia nilotica* were the planted species, having a moderate status in Compartment 30. *Desmostachya bipinnata, Ochthochloa compressa* and *Sporobolus diander* were recorded in abundance among grasses, *while Cynodon dactylon* was the rare species. Other important species were *Prosopis glandulosa, Capparis decidua Tamarix aphylla* (Table XIII).

Table XIII. Phytosociological character of the plant species in compartment No 30 during diftered seasons.

Compartment 30	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	0.56	12.00	11.45	24.01	3.35	21.74	22.66	47.74
Capparis decidua	3.60	20.00	18.32	41.92	4.83	8.70	18.13	31.66
Cynodon dactylon					3.72	4.35	0.60	8.67
Dalbergia sissoo	1.58	20.00	27.48	49.06	0.74	8.70	4.53	13.97
Desmostachya bipinnata	33.22	20.00	2.80	56.02				
Launaea nudicaulis					1.49	4.35	0.30	6.14
Ochthochloa compressa	60.81	20.00	38.17	118.98	55.76	17.39	14.50	87.65
Prosopis glandulosa	0.23	8.00	1.78	10.01	3.72	21.74	27.19	52.65
Sporobolus diander					26.02	8.70	7.55	42.27
Tamarix aphylla					0.37	4.35	4.53	9.25

The cultivated species of the Compartment 33 were *Acacia nilotica* and *Dalbergia sissoo*. The compartment was completely dominated by grasses like *Ochthochloa compressa, Sporobolus diander, Cynodon dactylon and Desmostachya bipinnata. Prosopis glandulosa* was the only shrub (Table XIV).

Dalbergia sissoo and Acacia nilotica were the cultivated species of the compartment 39. Three grasses (*Sporobolus diander, Ochthochloa compressa, Desmostachya bipinnata)* dominated the ground vegetation, but patches of *Cynodon dactylon* were also recorded. *Prosopis glandulosa* was the only shrub recorded in the area (Table XV).

Table 14. Phytosociological character of the plant species in compartment No 33 during diftered seasons.

Compartment 33	Winter/autumn 1999				Spring/summer 2000			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	2.13	25.00	37.16	64.30	3.11	21.43	34.21	58.74
Cynodon dactylon	70.12	31.25	40.54	141.91				

Dalbergia sissoo	0.30	6.25	3.38	9.93	1.45	21.43	13.16	36.04
Desmostachya bipinnata	6.10	6.25	3.38	15.73	72.46	35.71	43.42	151.60
Ochthochloa compressa					22.77	14.29	7.89	44.95
Prosopis glandulosa					0.21	7.14	1.32	8.67
Sporobolus diander	21.34	31.25	15.54	68.13				

Table 15. Phytosociological character of the plant species in compartment No 39 during diftered seasons.

Compartment 39	**Winter/autumn 1999**				**Spring/summer 2000**			
Plant species	Relative Density	Relative Frequency	Relative Cover	Importance Value	Relative Density	Relative Frequency	Relative Cover	Importance Value
Acacia nilotica	0.10	5.26	3.32	8.69	1.12	22.22	21.28	44.62
Capparis decidua	0.41	10.53	1.55	12.49	2.46	22.22	13.62	38.30
Cynodon dactylon					3.36	5.56	2.13	11.04
Dalbergia sissoo	0.31	10.53	7.74	18.58				
Desmostachya bipinnata	47.67	26.32	45.35	119.34	0.89	5.56	2.13	8.58
Ochthochloa compressa	34.20	15.79	22.12	72.11	26.85	11.11	17.02	54.98
Prosopis glandulosa	0.21	5.26	3.32	8.79	0.45	11.11	11.91	23.47
Sporobolus diander	17.10	26.32	16.59	60.01	64.88	22.22	31.91	119.01

Kuppi plantation was planted for commonly grown valuable timber species, i.e., *Acacia nilotica* and *Dalbergia sissoo,* though *Eucalyptus camaldulensis* is of no or very little timber value, but has been planted in some compartments. In recent practices, *Eucalyptus camaldulensis* has been discouraged due to its high water requirement and transpiration rate. For Irrigated plantations like Kuppi, where there is a limitation of water resources, plantation of *Eucalyptus camaldulensis* should not be allowed as it may result in a serious loss of habitat.

Plant species other than cultivated forest species were generally a representation of arid or semi-arid habitat in the Punjab (Hameed *et al*, 2002; Akbar *et al*, 2003). Grass species, like, *Desmostachya bipinnata, Panicum antidotale. Sporobolus diander, Cenchrus pennisetiformis* and *Ochthochloa compressa* are known to be well adapted to low moisture or desert climates (Arshad *et al.,* 2002) and can be regarded as indicator species in Kuppi plantation. Other drought tolerant species were *Peganum harmala, Capparis decidua and Alhagi maurorum.* Salt affected area in the plantation was represented by mainly *Aeluropus lagopoides* and *Suaeda fruticosa* which were adapted species to high salinities (Ashraf and Yasmeen, 1997).

As per present conditions, Kuppi plantation represents degraded forest habitat which supports several species of natural flora of the region. Immediate action should be required to conserve the status of the plantation. This can be done by increasing the supply of irrigation water to the plantation and by planting some other native species of the region, like, *Bombax cieba, Morus alba* and *Prosopis cineraria* along with some

Ficus spp. These species not only increase economy of the plantation but also attract many wildlife species including birds by providing food and shelter.

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On the Lizards of Karachi Coast

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Abstract

Surveys along the coastal stretch, from Sandspit to Cape Monze, were undertaken during March 2003 to March 2006, to study the species of lizards. A total of 11 species of lizards belonging to 6 genera were reported from the area.

Keywords: Karachi Coast, *Hemidactylus, Acanthodactylus, Mesalina, Agamura, Crossobamon, Varanus.*

Introduction

Karachi coast provides different habitats known for diverse faunal assemblages. Hawks Bay, Buleji, Paradise Point and Cape Monze are among the important sites along the coast of Karachi which are considered to have diverse terrestrial fauna including lizards.

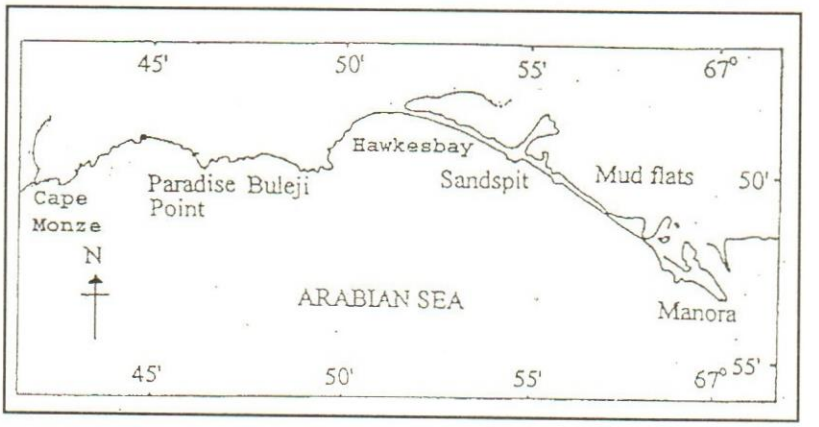

Fig. 1. Coast of Karachi showing surveyed area.

Lizards of Pakistan are known through the works of Auffenberg *et al* (1989, 1990), Boulenger (1890), Ghalib *et al* (1981), Iffat and Auffenberg (1988), Khan (1972, 2003), Khan and Mirza (1977), Khan and Nazia (2003), Khan *et al* (2005), Mertens (1969), Minton (1966), Rahman *et al* (2002) and Rahman and Papenfuss (2005). However, none of these studies covered coastal areas of Karachi except Khan *et al* (2005), who reported 4 species from the area. The present paper deals with the lizards of the coastal areas of Karachi, however, it does not cover mangroves and associate habitats.

Materials and Methods

The study was carried out along sandy/rocky belt of the Karachi coast, starting from Sandspit to Hawks Bay to Cape Monze (Fig. 1). The area consists of two prominent habitats for lizards i.e. buildings/huts/boulders along sea front, and sandy stretch and sandy/muddy/rocky areas above high water mark with patches of shrubs and other vegetations.

A number of field tours were conducted between March 2003 to March 2006, to observe the lizard species in the two habitats. Forceps and magnifying glass were used to study the morphological features. Identification of lizard was made using Minton (1966).

Results and Discussion

No lizards were observed from sandy/rocky area of sea front including inter-tidal zone. No marine lizard is known from the other regional countries as well. Buildings and other man made structures and natural boulders above the high water mark provide suitable abode for a number of *Hemidactylus* species. Following lizard species belonging to this genus are predominantly inhabiting buildings, wooden fixtures and boulders.

Hemidactylus brooki Gray	Spotted Indian gecko
Hemidactylus flaviviridis Ruppell	Yellow bellied house gecko
Hemidactylus persicus Anderson	*Persian gecko*
Hemidactylus turcicus (Linnaeus)	Mediterranean gecko
Hemidactylus triedrus (Daudin)	Blotched gecko

In the sandy/muddy/rocky areas above high water mark common plant species are *Acacia senegal, Euphorbia caducifolia, Prosopis spicigera, Ziziphus nummularia, Salvadora persica, Grewia tenax* and *Blepharis syndic* (Beg, 1966). Along the backwaters of Sandspit, there are mudflats with sparse mangroves. This area was observed to be inhabited by following lizards.

Acanthodactylus cantoris Gunther	Indian fringe toed lizard
Calotes versicolor (Daudin)	Indian garden lizard
Mesalina watsonana Stoliczka	Long tailed desert lacerta
Agamura persica (Dumeril)	Blunt tailed spider gecko
Crossobamon orientalis (Blanford)	Sindh sand gecko
Varanus bengalensis (Daudin)	Indian monitor

A total of 11 species of lizards inhabit the coastal areas along Karachi coast. There is a need to conduct similar studies in the other areas along the coast of Pakistan, which will be helpful in understanding the biodiversity and interaction of various species inhabiting the coastal regions of Pakistan.

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Review of Family Haemulidae Occurring in Pakistan

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Abstract

A total of 25 species of family Haemulidae belonging to 3 genera are reported from Pakistan. *Plectorhinchus gaterinus*, *Plectorhinchus playfairi*, *Plectorhinchus sordidus* and *Pomadasys aheneus* are reported for the first time from Pakistan

Keywords: Haemulidae, *Diagramma, Plectorhinchus gaterinus*, *P. playfairi*, *P. sordidus* and *Pomadasys aheneus*

Members of family Haemulidae, which include grunts and sweetlips, are considering as important food fishes. Grunts fetch very high price in local markets owing to their similarity and resemblance with popular Indian carps. Annual landings of members of this family are estimated to be about 5,000 m. tons (Fig. 1). However, its landings started showing a declining trend. These fishes are caught mainly with gillnets and by trawling in coastal waters upto a depth of 100 m, however, handlines are also used for their catching. Main fishing seasons is from August to March. The catch is mostly stored with adequate quantity of ice and locally consumed. Small quantities are, however, exported to Kuwait, Bahrain and U. A. E.

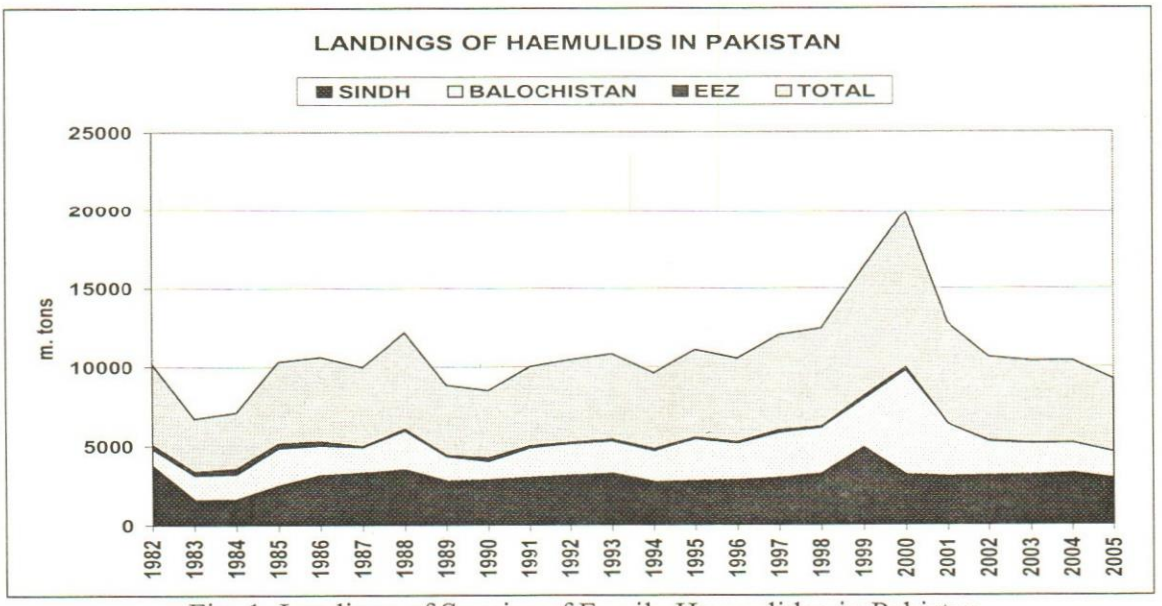


Fig. 1. Landings of Species of Family Haemulidae in Pakistan

With the exception of listing or providing description of a few common species in fish faunal studies, family Haemulidae is not well studied from Pakistan (Anonymous,

1955; Jalil and Khaliluddin, 1972, 1981; Froese and Pauly, 2006; Hoda, 1985b, 1988; Hussain, 2003, Majid *et al*, 1990). Amtyaz and Khan (2003), Hussain and Abbas (1995) and Safi and Khan (2005) studied food and feeding of *Pomadasys maculatum, P. kaakan* and *P. stridens,* respectively. Iqbal (1991) studied the population dynamics of some species of *Pomadasys,* occurring in northern Arabian Sea. Hussain and Ahmed (1992), Hussain and Khatoon (2002), Iqbal (1989) and Majid and Imad (1991) studied various aspects of age and growth in *Pomadasys kaakan* whereas Karim and Habib-ul-Hasan (1994) studied age and growth of *Pomadasys argyreus.* Iqbal (1992) studied stocks of various haemulids from the coast of Pakistan. Present paper reviews the species of family Haemulidae occurring in 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 Discussion

Twenty nine species belonging to three genera of Family Haemulidae have been reported from Pakistan. Four species, i.e. *Plectorhinchus gaterinus*, *Plectorhinchus playfairi*, *Plectorhinchus sordidus* and *Pomadasys aheneus* have been reported for the first time from Pakistan. The genera and species are arranged in alphabeticall order. Species of genera *Diagramma* and *Plectorhinchus* are locally known as Chipran, Moi or Chapar moi in Sindh and Chippil or Lunti in Balochistan whereas species of *Pomadasys* are known as Dhotar in Sindh and Kumpo in Balochistan. Erroneous and doubtful species are not included in the list of members of family Haemulidae of Pakistan.

1. *Anisotremus virginicus* (Linnaeus, 1758)
(Painted sweetlips)

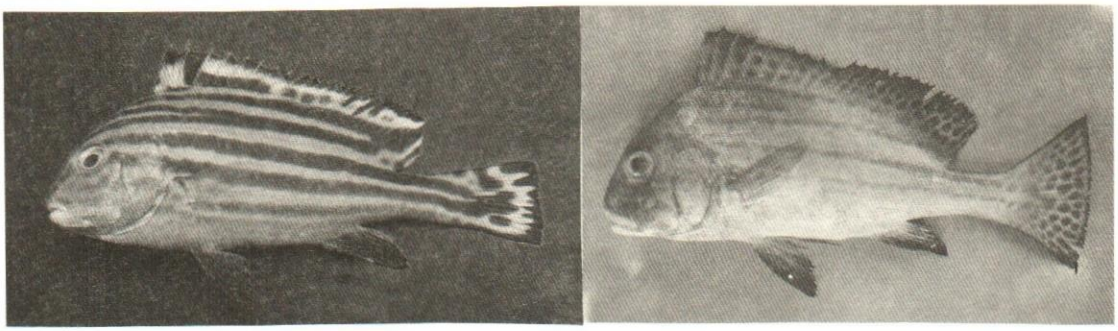
Ahmed (1996), Ahmed and Wazarat (1993) mentioned occurrence of this species from Rehri village and Buleji near Karachi and a photograph was provided. It seems that photograph was taken from some foreign publications because it is highly improbable that this species, which is known from western Atlantic, may occur in Pakistan. Considering the record of this species to be erroneous, it is not included in the key for the species.

2. *Diagramma affine* Gunther, 1859

This species was reported by Murray (1880) from Sindh. Originally it was described from Indo-west Pacific by Gunther (1859). No holotype is known, however syntypes collected from Ambon Island is housed in British Museum of Natural History, London, U. K. (Eschmeyer, 1998). Murray (1880) reported the species from Sindh, however, it is not included in Froese and Pauly (2006). Status of the species is not certain, therefore, it is not included in the key for the species.

3. *Diagramma pictum* (Thunberg, 1792)
(Painted sweetlips) Fig. 2

Bianchi (1985), Froese and Pauly (2006), and Majid *et al* (1992) reported this species from Pakistan without mentioning any specific location, whereas Hoda (1985b, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981) also reported this species from Pakistan as *Spilotichthys pictus*. McKay (1984) and Murray (1880) reported this species from Sindh whereas McKay (1984) has shown its distribution along Balochistan coast as well. This species was originally described as *Perca picta* from Japan by Thunberg (1792), however, no type is known (Eschmeyer, 1998).



(a) (b)
Fig. 2. *Diagramma pictum.* (a) juvenile, (b) subadult.

4. *Diagramma punctatum* Cuvier, 1830
(Spotted sweetlips)

This species is reported from waters of Sindh by Sorley (1932). It was originally described from Red Sea by Cuvier (1830). No holotype is known, however, syntypes are housed in Zoologisches Museum, Humboldt Universitat, Berlin, Museum National d'Historie Naturelle, Paris, France and Rijksmuseum van Natuulijke Histoire, Leiden (Eschmeyer, 1998). According to Froese and Pauly (2006) these specimens of this species were collected/known from South Africa, Tanzania, Oman, India, China, Japan, Indonesia, along the north and east of New Guinea, New Caledonia and other parts of the western Pacific.

5. *Plectorhinchus cinctus* (Temminck and Schlegel, 1843)
(Crescent sweetlips)

This species was reported from Pakistani waters without specifying any location by Hoda (1985b, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Qureshi (1960, 1965) and Siddiqi (1956). It was reported from waters of Sindh by Ahmad *et al* (1973), Aitken (1907), Anonymous (1955), Day (1875, 1889) and Murray (1880) and waters of Balochistan by Anonymous, (1953) and Zygmayer (1913). It wes also reported from Karachi (Ahmad *et al*,1973; Anonymous, 1955 and Jenkins, 1910) and Makran (Ahmad *et al*, 1973; Anonymous, 1955 and Qureshi, 1952). This species was originally described as *Diagramma cinctum* from Japan by Temminck and Schlegel (1843). No holotype is known, however, lectotype (RMNH D311) is housed in Rijksmuseum van Natuulijke Histoire, Leiden (Eschmeyer, 1998).

6. *Plectorhinchus gaterinus* (Forsskal, 1775)
(Blackspotted rubberlips) Fig. 3

This species is reported for the first time from coast of Pakistan. Two specimens were collected from commercial landings in Karachi Fish Harbour in January 2003. This species was not reported by McKay (1984) from Pakistan coast but reported from Red Sea south to Natal, South Africa, Mauritius, Madagascar and Comoro Islands and Oman by Froese and Pauly (2006) and Randall (1995).

This species was originally described as *Sciaena gaterina* from Jeddah, Saudi Arabia, Red Sea by Forsskal (1775). No holotype is known, however, lectotype (MNUC P48212) is housed in Zoological Museum, University of Copenhagen, Denmark (Eschmeyer, 1998).

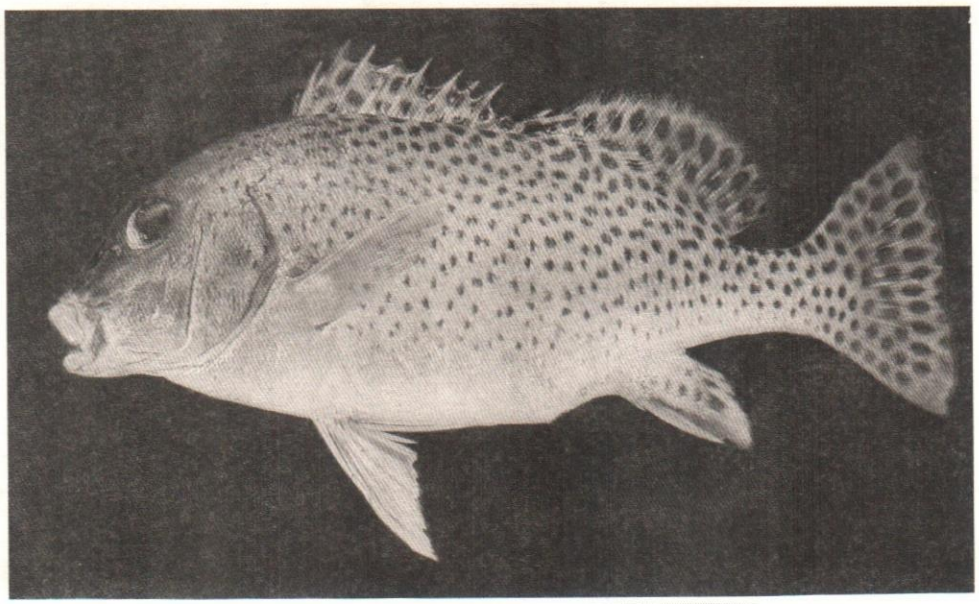


Fig. 3. *Plectorhinchus gaterinus* (juvenile)

7. *Plectorhinchus gibbosus* (Hombron and Jacquinot, 1853)
(Harry hotlips) Fig. 4

This species was reported from Pakistani waters by Bianchi (1985), Froese and Pauly (2006) and Hussain (2003) without specifying any specific location. It was reported from Sindh and Balochistan coast. It was reported from Leth Nullah by Ahmad *et al* (1984) and Niazi and Moazzam (1999). The species was originally described as *Diagramma gibbosus* from Samoa by Hombron and Jacquinot (1853), however, no information about types is available (Eschmeyer, 1998).

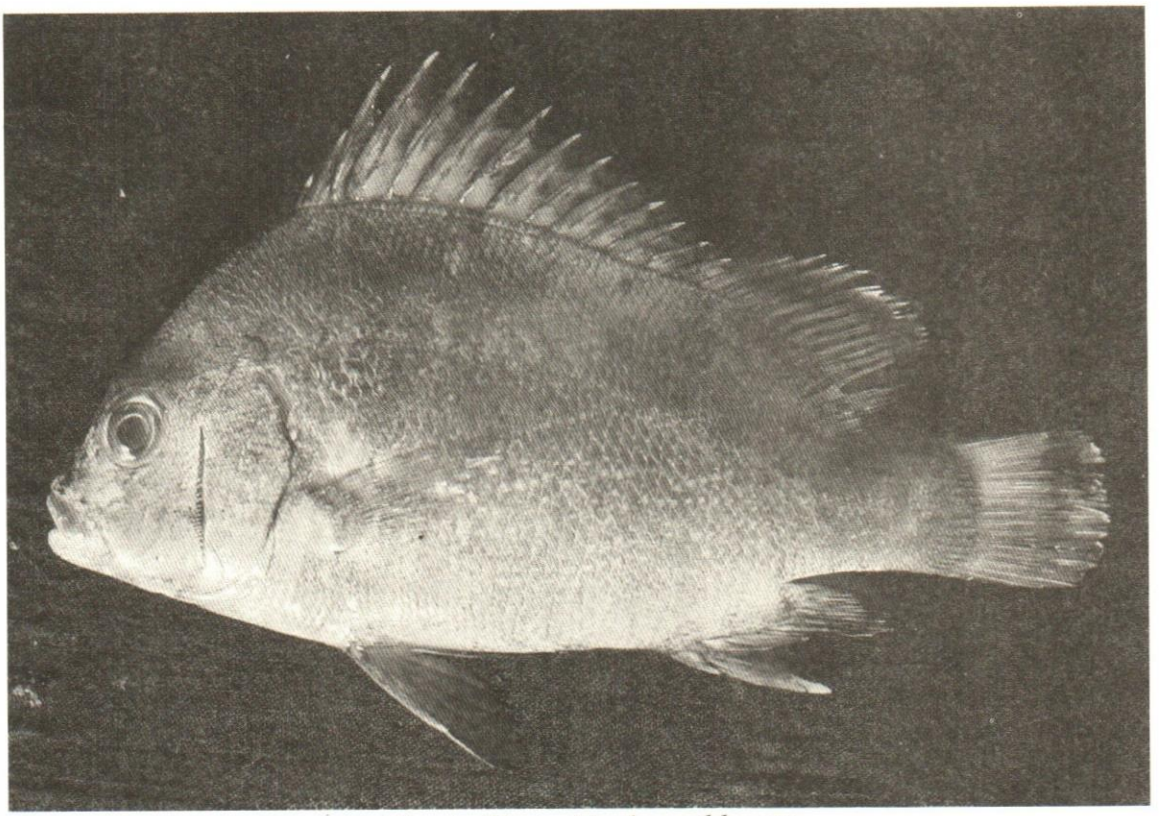


Fig. 4. *Plectorhinchus gibbosus.*

8. *Plectorhinchus lineatus* (Linnaeus, 1758)
(Yellow-banded sweetlips)

This species was reported from Pakistani waters by Hoda (1985b, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981 without specifying any specific location. Originally this species was described as *Perca lineata* by Linnaeus (1758). No type locality is known, however, holotype (NRM 8) is housed in Naturhistoriska Riksmuseet, Stockholm, Sweden (Eschmeyer, 1998).

9. *Plectorhinchus nigrus* (Cuvier, 1830)
(Black sweetlips)

This species was reported fro Pakistani waters by Hoda (1985b, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981 without specifying any specific location. It is also reported from waters of Sindh by Aitken (1907), Misra (1952) and Sorley (1932, as *Diagramma crassipinnis*). This species was originally described as *Pristipoma nigrum* from Manila, Philippines by Cuvier (1830), however, no type is known (Eschmeyer, 1998). Another species *Diagramma crassispinum* described by Ruppell (1838) from Jeddah, Saudi Arabia, Red Sea is considered to be a synonym of this species. No holotype is known, however, syntypes are housed in Forshungs Institut und Natur Museum Senckenberg, Frankfurt, Germany (Eschmeyer, 1998).

10. *Plectorhinchus orientalis* (Bloch, 1793)
(Oriental sweetlips)

This species was recorded from Pakistan coast by Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hussain (2003) and Jalil and Khaliluddin (1972, 1981) without specifying any specific location. McKay (1984) reported this species from Sindh and Balochistan coast. This species was originally described as *Anthias orientalis* from Japan by Bloch (1793). No holotype is known, however, syntype is housed in Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998).

11. *Plectorhinchus pictus* (Tortonese, 1936)
(Trout sweetlips) Fig. 6

This species was recorded from Pakistan coast by Ahmad (1988), Bianchi (1985), Froese and Pauly (2006), Hoda (1988), Hussain (2003) and Misra (1952) without specifying any specific location. McKay (1984) reported this species from Sindh and Balochistan coast whereas Ahmad *et al* (1984) and Niazi and Moazzam (1999) described it from Leth Nullah. This species was originally described as *Hapalogenys pictus* from Bunder Abbas, Strait of Hormuz, Iran by Tortonese (1936). Holotype (MZUT 2722) is housed in Universita di Torino, Museo Zoologico, Torino, Italy (Eschmeyer, 1998).

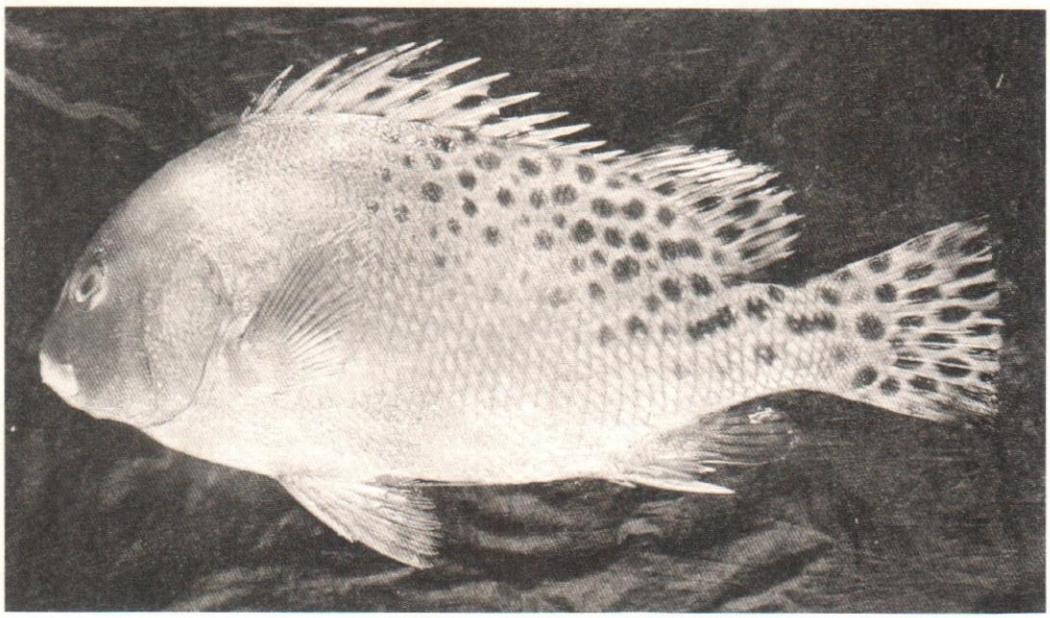


Fig. 6. *Plectorhinchus pictus*

12. *Plectorhinchus playfairi* (Pellegrin, 1914)
(Whitebarred rubberlips)

This species is reported for the first time from coast of Pakistan. A single specimen was collected by an angler using shrimp as bait and photographed at Sandspit in December, 1984. This species was not reported by McKay (1984) from Pakistan coast but it is known from Western Indian Ocean south to Port St. Johns, South Africa and

18. *Pomadasys argyreus* (Valenciennes, 1833)
(Bluecheek silver grunt)

Another commercially important species which is reported by Ahmad (1988), Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hussain (2003), Iqbal (1992), Jalil and Khaliluddin (1972, 1981) and Talwar and Jhingran (1991) from Pakist however, no specific location was identified. It was reported from Sindh and Balochistan coast by McKay (1984). In commercial catches landed at Karachi Fish harbour it was reported by Karim and Habib-ul-Hasan, 1994). It was also reported from Paradise Point, Karachi and from Miani Hor by Ajazuddin and Ahmed (2002).

This species was originally reported as *Pristipoma argyreum* from Coromandel coast (India), Mauritius and Jakarta, Java and Sumatra (Indonesia). by Valenciennes (1833), however, no type is known (Eschmeyer, 1998).

19. *Pomadasys commersonnii* (Lacepede, 1802)
(Small-spotted grunt) Fig. 10

This species is locally known as Holara and Holari dhotar in Sindh and Ulo-la in Balochistan., Ali (2002), Bianchi (1985), Froese and Pauly (2006), Hussain (2003), Iqbal, 1992) and Majid *et al* (1992) reported this species from Pakistan without specifying any specific location. McKay (1984) reported this species from Sindh and Balochistan coast. From Leth Nullah it was reported by Ahmad *et al* (1984) and Niazi and Moazzam (1999). Originally this species was described as *Labrus commersonnii* from "Great Ocean" (Indo-Pacific) by Lacepede (1801), however, no type is known (Eschmeyer, 1998).

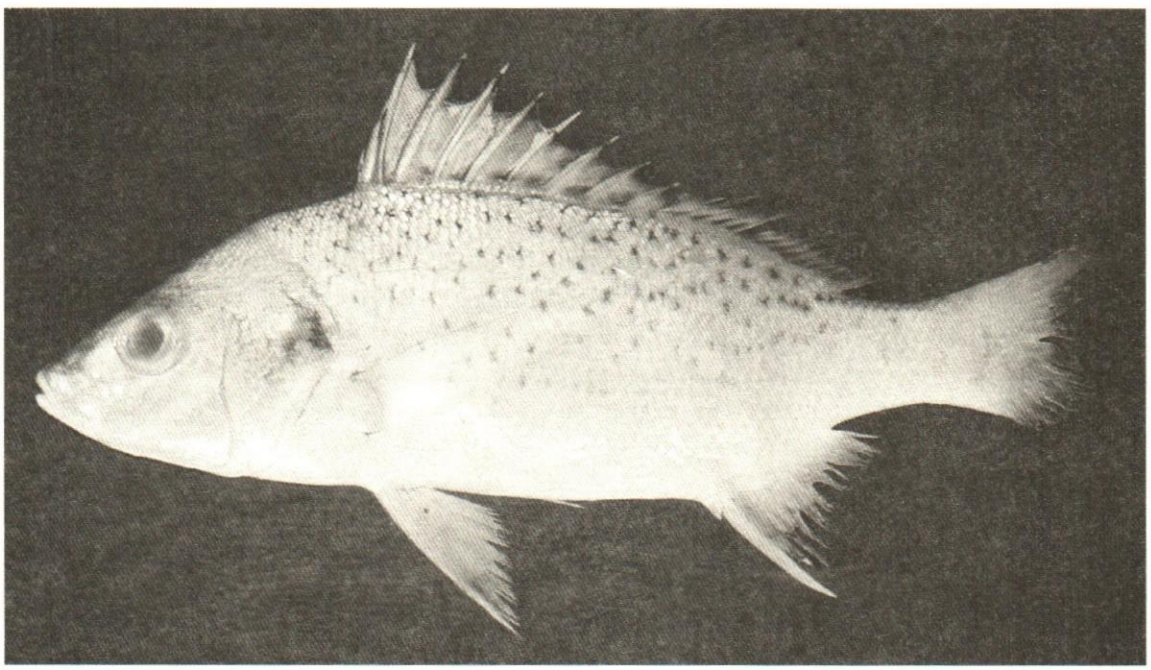


Fig. 10. *Pomadasys commersonnii.*

(Eschmeyer, 1998). This species is relished locally as well as used as live bait for catching requiem sharks.

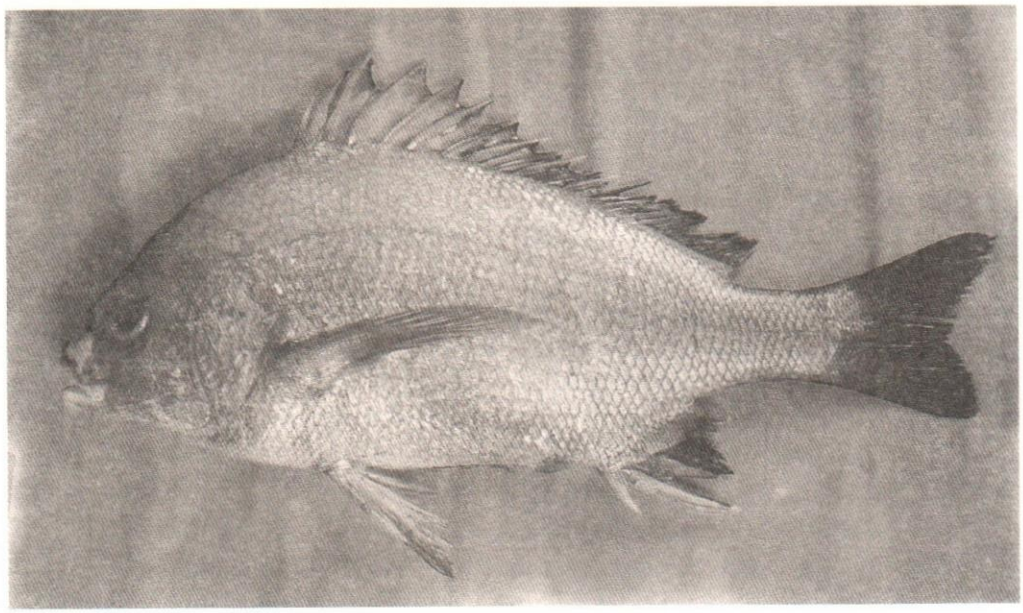


Fig. 9. *Pomadasys aheneus.*

16. *Pomadasys andamanensis* McKay and Satapoomin, 1994
(Andaman grunt)

This species is reported from Karachi by Anonymous (1999). It was originally described from Kata Bay, Phuket, Thailand by McKay and Satapoomin (1994). Holotype (PMBC10068) is housed in Phuket Marine Biological Centre, Phuket, Thailand (Eschmeyer, 1998).

17. *Pomadasys argenteus* (Forsskal, 1775)
(Silver grunt)

This commercially important species was described from Pakistan coast by Ahmad (1988), Bianchi (1985), Froese and Pauly (2006), Hoda (1988), Hussain (2003), Iqbal (1992), Jalil and Khaliluddin (1972, 1981) and Majid *et al* (1992), without specifying any specific location. It was reported from Karachi, Mekran and Balochistan by Anonymous (1955). It was reported from Sindh coast by McKay (1984) and Murray (1880) and from Balochistan coast by Qureshi (1952). It was also reported from Indus Delta (Mahmood *et al*, 1999).

This species was originally described as *Sciaena argentea* from Jeddah, Saudi Arabia, Red Sea by Forsskal (1775). Holotype (ZMUC P48218) is housed in Zoological Museum, University of Copenhagen, Denmark (Eschmeyer, 1998).

14. *Plectorhinchus sordidus* (Kluninger, 1870)
(Sordid rubberlip) Fig. 8

This species is reported for the first time from the coast of Pakistan. A single specimen was colected and photographed at Karachi Fish Harbour in December 2004 which was caught by a shrimp trawler operating in Malan area. This species was not reported by McKay (1984) from Pakistan coast but it is known from Red Sea to South Africa, Seychelles, Mauritius, Behrain and Oman (Froese and Pauly, 2006; Randall, 1995). Originally described as *Diagramma sordidum* from Al-Quseir, Egypt, Red Sea by Kluzinger (1870). No holotype of this species is known, however, syntypes are housed in British Museum of Natural History, London, U. K., MNS, Zoological Institute, Academy of Sciences, St. Petersburg, Russia and Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998).

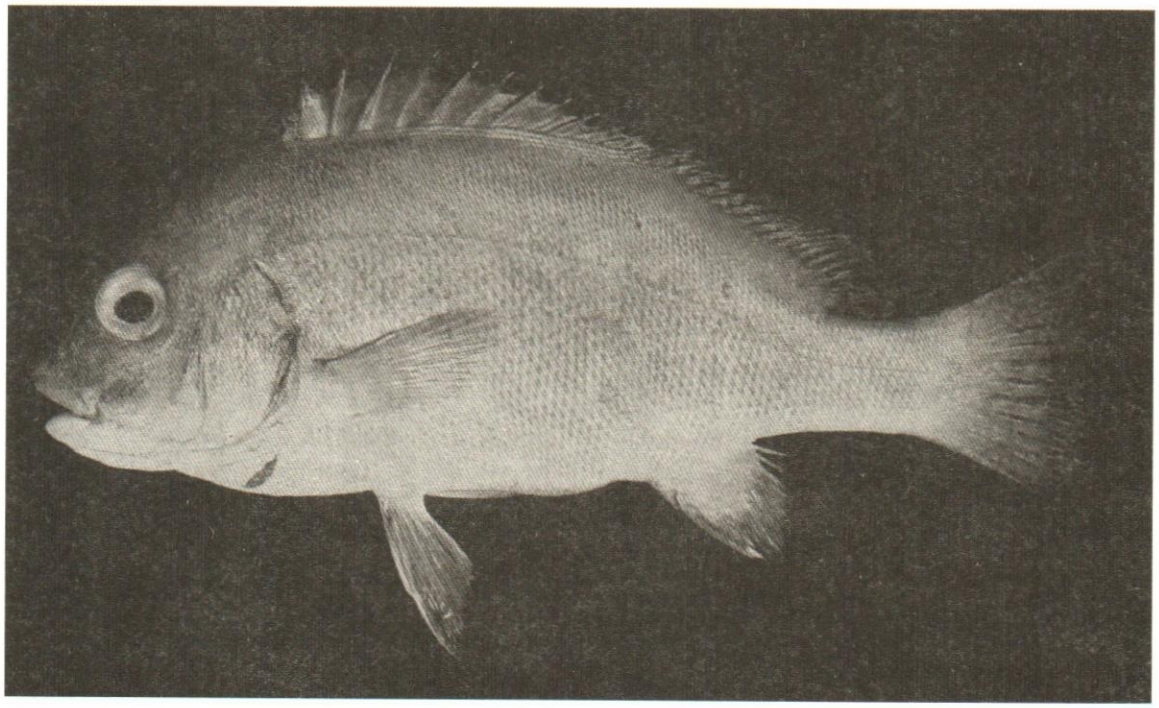


Fig. 8. *Plectorhinchus sordidus.*

15. *Pomadasys aheneus* McKay and Randall, 1995
(Yellowback grunt) Fig. 9

This species is also reported for the first time from coast of Pakistan. It is a commercially important species and commonly found along Pakistan coast. Local fishermen identify this fish by a separate name i.e. Kala Dandia in Sindh and Paalari in Balochistan. This species was described from Raysut Rock, Salalah, off Salalah Harbor (16°56'01"N, 54°00'08"E), Oman, Arabian Sea by McKay and Randall (1995). Holotype (BPBM 35931) is housed in Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.

Oman (Froese and Pauly (2006) and Randall (1995). This species was originally described as *Diagramma (Griseum) playfairi* from Mahambo, Madagascar by Pellegrin (1914). Holotype (MNHN 1914-0012) is housed in Museum National d'Historie Naturelle, Paris, France known (Eschmeyer, 1998).

13. *Plectorhinchus schotaf* (Forsskal, 1775)
(Minstrel sweetlips) Fig. 7

This is commonest of all the sweetlips in Pakistani waters. It was reported by Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Majid *et al* (1992) and Qureshi (1960, 1965) without specifying any specific location. It is reported from Sindh coast by Anonymous (1955, 1999), Day (1875, 1889), Misra (1962) and McKay (1984), Karachi by Anonymous (1955, 1999), Misra (1962) and Niazi (2001) and from Balochistan coast by Anonymous (1955), Day (1875, 1889), McKay (1984), Misra (1962) and Zugmayer (1913, as *Diagramma (Plecrorhynchus) griseum*). Anonymous (1999), Cuvier (1830), Day (1875, 1889) referred this species as *Diagramma griseum.* Originally this species was described as *Sciaena schotaf* from Red Sea by Forsskal (1775). Holotype (ZMUC P48214) is housed in Zoological Museum, University of Copenhagen, Denmark (Eschmeyer, 1998). *Diagramma griesium* decribed by Cuvier (1830) from Malabar, India is considered to be a synonym of this species. No holotype of the latter is known, however, syntypes are housed in Museum National d'Historie Naturelle, Paris, France (Eschmeyer, 1998).

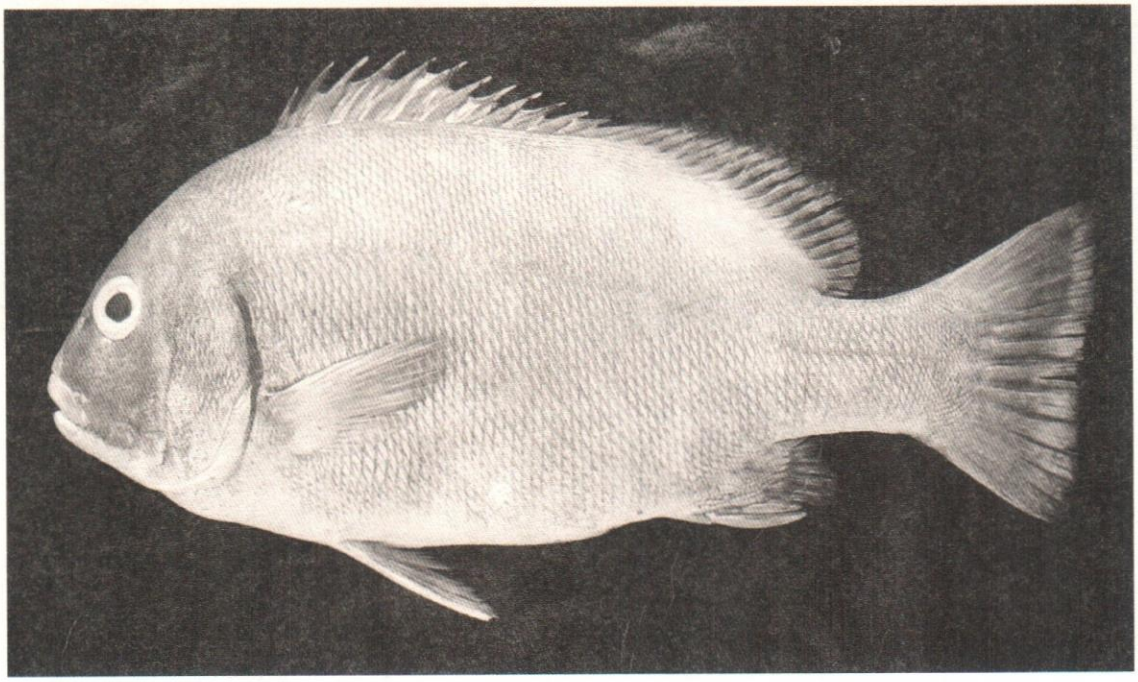


Fig. 7. *Plectorhinchus scha.f.*

Pomadasys opercularis is sometimes considers as synonym of this species (McKay, 1984). Therefore, there is a possibility of overlap in the distribution of two species. There seems to be confusion between status of these two species and needs to be sorted out. Froese and Pauly (2006) have maintained these as two separate species.

20. *Pomadasys guoraca* (Cuvier, 1829)
(Guoraka grunt)

This species was reported from Sindh as *Pristipoma guoraka* and *Primstopoma dussumieri* by Murray (1880) whereas from Balochistan as *Primstopoma (Pomadasys) dussumieri* by Zugmayer (1913). Elsewhere this species is known from East Africa to the Philippines (Froese and Pauly, 2006).

Originally this species was described as *Pristipoma guoraca* from Vishakhapatnam, India and Red Sea by Cuvier (1829). No holotype is known, however, some nontypes are housed in Museum National d'Historie Naturelle, Paris, France (Eschmeyer, 1998). *Pristipoma dussumieri* described by Cuvier (1830) from Malabar, India, is considered to be a syonym of this species. Holotype of the latter (MNHN 7693) is housed in Museum National d'Historie Naturelle, Paris, France (Eschmeyer, 1998).

21. *Pomadasys furcatum* (Bloch and Schneider, 1801)
(Banded grunt) Fig. 11

Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hussain (2003) and Iqbal (1992) reported this species from Pakistan without specifying any specific location. McKay (1984) reported it from Sindh and Balochistan coast, whereas Sorley (1932) reported this species from Sindh. Originally this species was described as *Grammistes furcatus* from East India by Bloch and Schneider (1801). Holotype (ZMB 960) is housed in Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998).

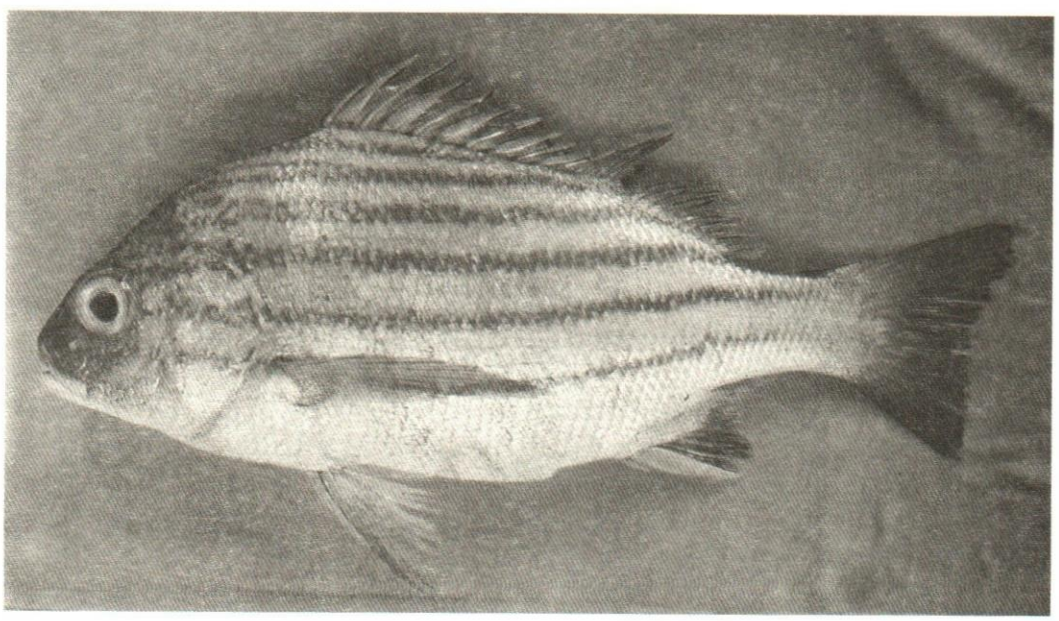


Fig. 11. *Pomadasys furcatum*

21. *Pomadasys hasta* (Bloch, 1790)

This species is reported from Pakistan without specifying any specific location by Froese and Pauly (2006), Hoda (1985b, 1987, 1988), Hussain (2003) and Jalil and Khaliluddin (1972, 1981). Aitken (1907) and Murray (1880) reported this species from Sindh and Anonymous (1953), Day (1875), and Zugmayer (1913) from Balochistan, from Karachi (Anonymous, 1999; Jenkins, 1910), Khobar Creek, Hajamro Creek, Sisa Creek (Mirza and Baquer, 1994), Paradise Point Off Malan (Anonymous, 2001); Gwader (Abildgaard *et al*, 1994), Makran and Sonmiani Bay (Brandhorst, 1994)

Originally this species was described as *Liutjanus hasta* from Japan by Bloch (1793). No holotype is known, however, lectotype (ZMB 8713) is housed in Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998). This species is usually confused with other species of *Pomadasys* especially with *P. kaakan.* Hoda (1988) considers *Pomadasys hasta* as a synonym of *Pomadasys argenteus.*

23. *Pomadasys jubelini* (Cuvier, 1830)
(Sompat grunt)

Hoda (1985a, 1985b, 1988) have reported this species from Pakistan but according to Froese and Pauly (2006), it is known from eastern Atlantic only. Considering the record of this species to be erroneous, it is not included in the key for the species.

24. *Pomadasys kaakan* (Cuvier, 1830)
(Javelin grunt) Fig. 12

This is one of the most common and popular species of this family which is relished locally. Often this species is referred to as *Pomadasys hasta* and is reported from Pakistan without specifying any specific location by Ahmad (1988), Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hussain (2003), Hussain and Ahmed (1992), Iqbal (1992), Iqbal *et al* (1999) and Majid *et al* (1992). McKay (1984) and Misra (1952) reported this species from Sindh and Day (1876), McKay (1984) and Zugmayer (1913) from Balochistan. Additionally it was reported from Bhambhore (Ahmed and Abbas (1999a, 2000); Indus Delta (Mahmood *et al*, 1999); Karachi (Jenkins, 1910; Misra, 1952; Niazi, 2001); Korangi Creek (Ahmed and Abbas, 1999c, 2000; RETA, 2003); Pasha Bunder (Hussain and Khatoon, 2000); Tidal Link Canal, Badin District (Jafri, 2004; Jafri *et al*, 2000); Makran (Misra, 1952) and Miani Hor (Ahmed and Abbas, 1999b, 2000; Ajazuddin and Ahmed, 2002),

Originally this species was described as *Pristipoma kaakan* from Arian River, Coupang, Timor, Pondicherry and Mahé, India by Cuvier (1830). No holotype is known, however, syntypes are housed in Museum National d'Historie Naturelle, Paris, France and Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998). *Pristipoma nageb* described by Ruppell (1838) from Jeddah, Saudi Arabia, Red Sea is considered to be a synonym of this species. No holotype of the latter is known, however, lectotype

(SMF 1756) is housed in Forshungs Institut und Natur Museum Senckenberg, Frankfurt, Germany (Eschmeyer, 1998).

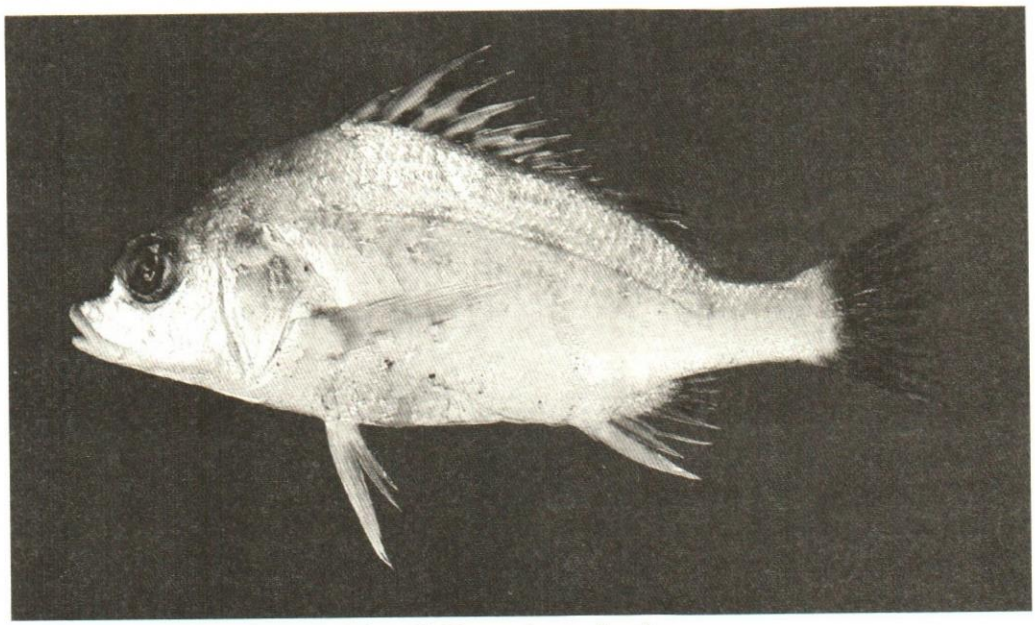


Fig. 12 *Pomadasys kaakan*

25. *Pomadasys maculatum* (Bloch, 1793)
(Saddle grunt)

This is also a commonly occurring species which is known as Gaingara and Gogaro and Sindh and Taan-tar in Balochistan. In addition to the local consumption, this species is also used as live bait for catching large requiem sharks. Ahmad (1988), Ali (2006), Anonymous (1999, 2001), Bianchi (1985), Froese and Pauly (2002), Hoda (1985b, 1988), Hussain (2003), Iqbal (1992), Iqbal *et al* (1999), Jalil and Khaliluddin (1972, 1981), and Majid *et al* (1992) reported this species from Pakistan without specifying any specific location. This species is also reported from Sindh by Anonymous (1955, 1999), McKay (1984), Misra (1952) and Sorley (1932), Dabbo Creek (Mirza and Baquer, 1994); Karachi (Amtyaz and Khan, 2003; Anonymous, 1955; 1999; Niazi, 2001); Korangi Creek (Ahmed and Abbas (1999c, 2000); Leth Nullah (Ahmad *et al*, 1984; Niazi and Moazzam, 1999); Paradise Point, Karachi Gwader (Abildgaard *et al*, 1994); Makran (Anonymous, 1955; Qureshi, 1952); Miani Hor (Ahmed and Abbas, 1999b, 2000; Ajazuddin and Ahmed, 2002); off Malan and off Sonmiani (Anonymous, 2001) and Ormara (Anonymous, 1999);

Originally this species is described as *Anthias maculatus* from East Indies by Bloch (1793). No holotype is known, however, lectotype (ZMB 8703) is housed in Zoologisches Museum, Humboldt Universitat, Berlin (Eschmeyer, 1998).

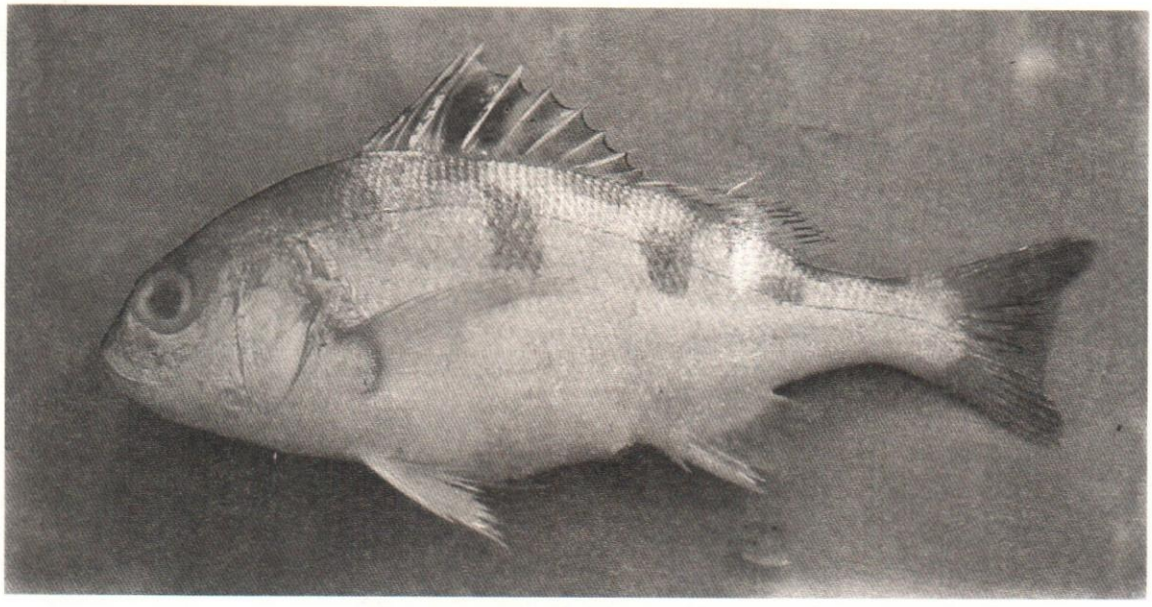


Fig. 13. *Pomadasys maculatum.*

26. *Pomadasys multimaculatum* (Playfair, 1867)
(Cock grunt)

Bianchi (1985), Hoda (1985b, 1988), Hussain (2003), Iqbal (1992), Majid *et al* (1992) and McKay (1984) have reported this species from Pakistan coast without specifying any specific location. This species was originally described as *Pristipoma multimaculatum* from Bagamoia, East Africa and Durban, South Africa by Playfair (1867). No holotype is known, however, syntype is housed in British Museum of Natural History, London, U. K. (Eschmeyer, 1998). Randall (1995) reports to this species from Persian Gulf and Gulf of Oman, is based on misidentification of *Pomadasys argenteus.* Smith and McKay (1986) reported the distribution of this species to be restricted to Zanzibar to Algoa Bay, South Africa. Pending further confirmation, this species is not include in the list of species of family Haemulidae occurring in Pakistan.

27. *Pomadasys olivaceus* (Day, 1875)
(Olive grunt)

Ahmad (1988), Ali (2002), Bianchi (1985), Froese and Pauly (2002), Hoda (1985b, 1988), Hussain (2003), Iqbal (1992), Jalil and Khaliluddin (1972, 1981), Mujib (1985) and Siddiqi (1956) reported this species from Pakistan without specifying any location. It is also reported from Sindh by Anonymous (1955, 1999), Bauchot *et al* (1983), Day (1875, 1889), Hureau (1991), McKay (1984) and Whitehead and Talwar (1976) and from Balochistan by Bauchot *et al* (1983), Day (1875, 1889), McKay (1984) and Whitehead and Talwar (1976). Additionally it is reported from Karachi (Anonymous, 1955; Niazi, 2001) and Makran (Anonymous, 1955; Qureshi, 1952).

This species was originally described as *Pristipoma olivaceum* from coasts of Balochistan, Pakistan (or Iran?) and Sindh, Pakistan by Day (1875). No holotype is known, however, syntypes/or Days' specimens are housed in AMS, British Museum of

Natural History, London, U. K. , Museum National d'Historie Naturelle, Paris, France, Naturhistorisches Museum, Wien (Vienna), Austria and Zoological Survey of India, Kolkata (Eschmeyer, 1998).

28. *Pomadasys opercularis* (Playfair and Günther, 1867)
(Smallspotted grunt ??)

This species which is locally known as Holara in Sindh and Ulola in Balochistan is reported from Pakistan by Hoda (1985b, 1988), Jalil and Khaliluddin (1972, 1981) and Majid *et al* (1992) without specifying any location. It was reported from Sindh by Anonymous (1955), Day (1875), Murray (1880) and Sorley (1932) and from Balochistan by Zugmayer (1913). Additionally it is reported from Karachi (Ahmad *et al*, 1973; Anonymous, 1955) and Makran (Ahmad *et al*, 1973; Anonymous, 1955). Sometime considered as synonym of *Pomadasys commersonnii* (McKay, 1984), therefore, there is a possibility of overlap in the distribution of two species.

Originally this species was described as *Pristipoma operculare* from Aden and Durban, South Africa by Playfair (1867). No holotype is known, however, syntypes are housed in British Museum of Natural History, London, U. K. (Eschmeyer, 1998).

29. *Pomadasys stridens* (Forsskal, 1775)
(Striped piggy)

This species is locally known as Gogra and Bukra in Sindh and Palari in Balochistan. Bianchi (1985), Froese and Pauly (2006), Hoda (1985b, 1988), Hureau (1991), Hussain (2003), Iqbal (1992), Jalil and Khaliluddin (1972, 1981), Majid *et al* (1992) and Safi and Khan (2005) reported this species from Pakistan without specifying any location. It was reported from Sindh by Anonymous (1955, 1999) and Murray (1880) and from Balochistan by Zugmayer (1913). Additionally this species is reported from Karachi (Anonymous, 1955, 1999; Day, 1875, 1889; Hureau, 1991; Niazi, 2001), Makran (Anonymous, 1955; Day, 1875); Gwader (Abildgaard *et al*, 1994); Miani Hor (Ajazuddin and Ahmed, 2002) and Ormara and Pasni (Anonymous, 1999)

Originally this species was described as *Sciaena stridens* from Massawa, Eritrea, Red Sea by Forsskal (1775). No holotype is known; however, neotype (HUJ F6708) is housed in Hebrew University, Department of Zoology, Jerusalem, Israel (Eschmeyer, 1998).

This species is inhabitant of shallow waters and creek areas along the coast of Pakistan. In addition to human consumption, this species is also used as live bait for catching large sharks. This species is caught in almost all fishing gears especially by handlines, cast net, estuarine set bag net, bottom set gillnet alnd trawl net.

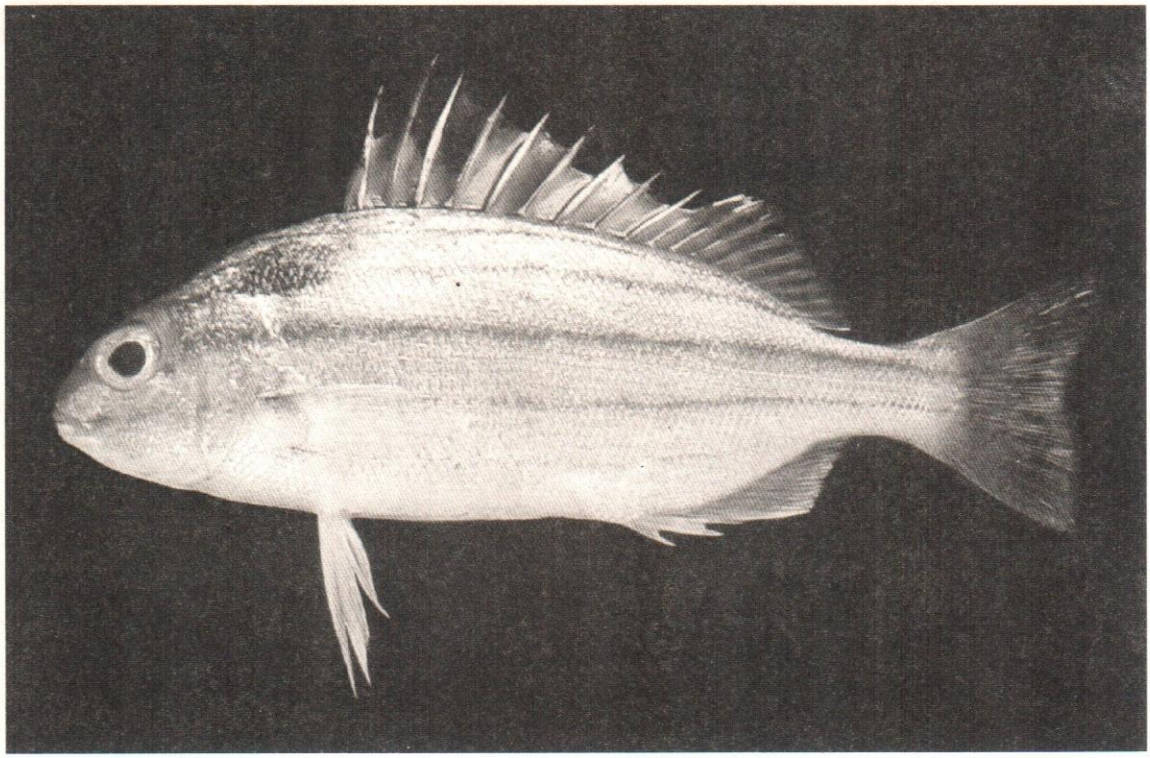


Fig. 14. *Pomadasys stridens.*

Review of the literature and inclusion of some new records reveals that 25 species of fishes belonging to family Haemulidae are known from Pakistan. There are three genera, *Pomadasys* with 13 species is most diversified followed by *Plectorhinchus* with 10 species and *Diagramma* with 2 species (Table-I).

Most of the species of the family Haemulidae are of common occurrence in Pakistan including some members of genus *Pomadasys* which are harvested on commercial scale. The identification of some species of this genus are still not resolved. There is a general confusion in identification of *Pomadasys hasta* and *P. kaakan*. Similarly the identification of *P. commersonii* and *P. opercular* is still not resolved, at least among local ichthyologist. Among grunts *Pomadasys kaakan* is most common species whereas most common sweetlips is *Plectorhinchus pictus.*

Members of genus *Pomadasys* are found to be mostly inhabitants of soft bottom along the coast of Pakistan whereas sweetlips of genus *Diagramma* and *Plectorhinchus* are mostly associated with rocky bottom and other submerged structures, therefore, latter are found to be more common in line gears whereas grunts are caught by trawl nets and gillnets.

Although in the present paper an attempt has been made to review species of family Haemulidae, there is still possibility of occurrence of some additional species in Pakistan, especially occurrence of *Pomadasys punctulatus* (Ruppell, 1838) and *P. taeniatus* McKay and Randall, 1995, which have been ere reported from Oman, cannot overruled.

Table-I. List of Species of Family Haemulidae known from Pakistan

Species Known from Pakistan
1. *Diagramma pictum* (Thunberg, 1792)
2. *Diagramma punctatum* Curvier, 1830
3. *Plectorhinchus cinctus* (Temminck and Schlegel, 1843)
4. *Plectorhinchus gaterinus* (Forsskal, 1775)
5. *Plectorhinchus gibbosus* (Hombron and Jacquinot, 1853)
6. *Plectorhinchus lineatus* (Linnaeus, 1758)
7. *Plectorhinchus nigrus* (Cuvier, 1830)
8. *Plectorhinchus orientalis* (Bloch, 1793)
9. *Plectorhinchus pictus* (Tortonese, 1936)
10. *Plectorhinchus playfairi* (Pellegrin, 1914)
11. *Plectorhinchus schotaf* (Forsskal, 1775)
12. *Plectorhinchus sordidus* (Kluninger, 1870)
13. *Pomadasys aheneus* McKay and Randall, 1995
14. *Pomadasys andamanensis* McKay and Satapoomin, 1994
15. *Pomadasys argenteus* (Forsskal, 1775)
16. *Pomadasys argyreus* (Valenciennes, 1833)
17. *Pomadasys commersonnii* (Lacepede, 1802)
18. *Pomadasys guoraca* (Cuvier, 1829)
19. *Pomadasys furcatum* (Bloch and Schneider, 1801)
20. *Pomadasys hasta* (Bloch, 1790)
21. *Pomadasys kaakan* (Cuvier, 1830)
22. *Pomadasys maculatum* (Bloch, 1793)
23. *Pomadasys olivaceus* (Day, 1875)
24. *Pomadasys opercularis* (Playfair and Günther, 1867)
25. *Pomadasys stridens* (Forsskal, 1775)

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History of Carcinology of the Lower Indus Basin

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Abstract

The paper enlists publications made on taxonomy of crustaceans found in the Lower Indus basin and provides information on the published scientific work done on various groups of crustaceans.

Keywords: Carcinology, Lower Indus basin, bibliography,

Introduction

History of carcinological studies for the lower Sindh dates back to work of Henderson (1893). In this way the history can be divided into two phases: Pre-partition (first from 1893 to 1947) and post partition (1947 todate). During first phase, in the then British India mostly the British naturalists like Henderson (1893), Alcock (1895. 1896, 1898, 1899, 1900, 1910), Alcock and Mcardle (1902), Kemp (1917) and Kohli (1822) and some locals got interested in the Crustaceans of this region. Some research surveys like "John Murray Expedition", and Indian Marine Surveyer "Investigator" touched Karachi and collected specimens. Then, in the second phase, starting from the inception of Pakistan, crustaceans attracted attention of the Pakistani scientists, in all probability due to their importance in the local fisheries. Several post-partition national and international expeditions surveyed Karachi and Indus Delta fan. The geographical analysis of the region provided by Pithawala (1936) and animal biodiversity by Mirza (1998).

The importance of the work done on the Pakistani coast has been emphasized by the top most carcinologists in the field and many non-Pakistani carcinologists also surveyed the area and contributed to the faunal list (Bruce, 1986; Keenan et al., 1998; Manning, 1988; Markham, 1980; Schotte, 1995; Trimizi and Manning, 1968; Wagele, 1984). A symposium on River Indus was held in 1994 under the auspices of the Linnean Society of London (Meadows and Meadows, 1999).

The second phase of carcinological studies in Pakistan commenced with the establishment of the Zoological Survey Department of Government of Pakistan in 1949. From modest start serious studies on decapod and stomatopod Crustacea did not begin until after 1958, first at the Department of Zoology, University of Karachi, and then at the Invertebrate Reference Museum, later renamed and reorganized as the Marine Invertebrate Reference Collection and established as a part of the Zoology Department then independently as Marine Reference Collection & Resource Centre (MRC). In the beginning the work at the centre was very slow, but it has gained momentum with better facilities and now contains a good representative crustacean collection from the Karachi

Sindh coast and a few random samples from the Balochistan coast. The collections are preserved both wet (in alcohol) and dry. MRC has now grown into a nucleus of taxonomic research activities with several monographs, books and illustrated keys, imparting research leading to M.Sc., M.Phil. and Ph.D.

Other institutes who joined in these studies include the Centre of Excellence in Marine Biology, Marine Fisheries Department, National Institute of Oceanography, Institute of Marine Sciences, Zoology Department (University of Karachi), Pakistan Agricultural Research Council, Pakistan Council for Scientific and Industrial Research and Freshwater Biology and Fisheries (University of Sindh, Jamshoro).

The carcinological studies in Pakistan are mainly taxonomic. The taxonomic information on Pakistani Crustacea is scattered in different publications, and not all are easily available. This citation is an attempt to put together the published information on the subject and region.

A review of literature shows that some works on morphology, anatomy, larval development, breeding and fecundity, zoogeography, parasitism, associations, ecology, bionomics, distribution, food, fisheries, biochemistry, nutritive value, bioassay, biotechnology and pollution have also been carried out in Pakistan but only the work done on taxonomy is listed in Table-I. The groups are arranged in a phylogenetical order, following classification synopsis (Martin and Davis, 2001).

Table-I. Review of scientific literature on Crustacea from Pakistan

HABITAT	TAXON	REFERENCE
Riverine and terrestrial	Class Branchiopoda Subclass Sarcostraca Order Anostraca	Qadri and Baqai (1956), Jafri and Mahar (2002)
	Subclass Phyllopoda Order Diplostraca Suborder Spinicaudata	Qadri and Baqai (1956)
	Suborder Cladocera	Ali *et al* (1983), Arora (1935), Biswas (1971), Iqbal and Baqai (1976), Jafri *et al* (1999), Leghari *et al* (1999)
	Class Maxillopoda Subclass Branchiura	Jafri and Ahmed (1991), Kazmi (2003d)
	Subclass Copepoda	Ali *et al* (1983), Baqai and Ishrat (1973), Baqi *et al* (1975), Jafri (1995), Jafri and Mahar (2003a, 2003b), Jafri *et al* (1999), Leghari *et al* (1999).
	Class Ostracoda	†Ahmed and Baryar (1984), Ali *et al* (1983), †Baryar and Ahmed (1984, 1985), Jafri *et al* (1999, 2000), Leghari *et al* (1999)
	Class Malacostraca Order Isopoda	Barnard, 1936, Kazmi (2003b,d, 2004), Kazmi *et al* (2000)

	Order Decapoda	Alcock (1910), Husain (1974), Johnson (1973), Kazmi and Kazmi (2003), Kazmi and Kazmi (2006), Kazmi *et al* (2001, 2005), Kazmi and Perveen (2005), Qadri (1960), Tiwari (1962, 1963), Yaqoob (1986), Zuberi (1990).
Marine	Class Branchiopoda	Kazmi (2003b), Sultana *et al* (1991)
	Class Maxillopoda: Subclass Copepoda:	Ali (1995, 1997), Ali-Khan (1992, 1993a, 1993b, 1995, 1998), Ali-Khan and Ali-Khan (1982, 1984), Bindra (1924), Fleminger and Hulsmann (1973), Ghani and Ali (1996, 2003), Ghani and Seemi (1999), Grice and Hulsmann (1967), Globolov and Grobov (1970), Haq and Rehman (1973), Haq (1973), Kazmi (2001b, 2003, 2004), Kazmi and Muniza (1994, 1997a,b, 1998, 2005), Kazmi and Naushaba (2000), Khan and Kamran (1975), Khan (1976a, 1977a,), Khan *et al* (1975), Masihuzzaman (1975), Muniza and Kazmi (1995), Niazi *et al* (1973, 1975), Rehman (1973, 1974),Siddiqui and Bilqees (1995), Sadiq (1996), Saraladevi (1977), Saraswathi (1973), Sewell (1948), Tirmizi and Sadiq (1995).
	Subclass Cirripedia	Annandale (1909), Javed and Mustaquim (1994), Kazmi (2001, 2004), Kruger (1912), Mustaquim and Javed (1993), Moazzam and Rizvi (1978, 1982), Rizvi and Moazzam (2006), Moazzam and Moazzam (2005), Stubbing (1936)
	Class Ostracoda	Kazmi *et al* (1995), †Hasnain and Khan (1976c), Khan (1989).
	Class Malacostraca Subclass Phyllocarida Order Leptostraca	Kazmi and Tirmizi (1989, 1992)
	Subclass Hoplocarida Order Stomatopoda	Baig (1954), Kazmi (2004), Kazmi and Kazmi (1987), Manning (1988), Moazzam and Moazzam (2006), Tirmizi and Kazmi (1980), Tirmizi and Manning (1968), Tirmizi (1994).
	Subclass Eumalacostraca Order Mysidacea	Kazmi *et al* (1992, 1999), Kazmi and Tirmizi (1995a), Nayeem *et al* (1992), Tattersall (1939),
	Order Cumacea	Khan and Khan (1975), Khan (1976),

	Order Amphipoda	Ahmed (1976), Bano and Kazmi (2004, 2005), Kazmi and Bano (2003, 2005), Javed (1987, 1990), Nayeem *et al* (1993)
	Order Isopoda	Anwarullah (1971), Barkati and Tirmizi (1990), Boyoko and Kazmi (2005), Bruce (1986), Bruce and Javed (1987), Chopra (1923), Ghani (1995, 1996), Ghani and Ali (1998, 2001), Ghani and Shireen (1995, 2000), Ghani and Tirmizi (1993b), Javed (1990a), Javed and Ahmed (1987, 1988a, 1988b), Javed and Yasmeen (1989, 1992, 1995,1999), Javed and Yousuf (1995a, 1995b, 1996, 1997), Karim (1975), Kazmi (2001a, 2003b), Kazmi and Boyko (2005), Kazmi and Bourdon (1997), Kazmi and Markham (1999), Kazmi and Tirmizi (1994), Kazmi and Yousuf (2003, 2006), Kazmi *et al* (2000, 2002), Markahm (1980), Markham and Kazmi (1998), Nooruddin (1960), Qazi (1959), Schotte (1995), Shireen (2000, 2001), Shireen and Ghani (2000), Wagele (1984), Wegoescu (1980), Yasmeen and Javed (2000, 2001), Yousuf and Javed (2002).
	Order Tanaidacea	Kazmi and Siddiqui (1992, 2001)
	Order Euphausiacea	Brinton and Gopala Krishna (1973), Fatima (1983), Kahn (1980), Tattersal (1939), Tirmizi (1995).

	Order Decapoda	Ahmed (1985), Ahmed and Khan (1971), Ahmed and Moazzam (1982), Ahmed *et al* (1973), Ahsanullah (1965), Alcock (1895, 1896, 1898, 1899, 1900), Alcock and Mcardle (1902), Bianchi (1985),Chace (1988), Collins *et al* (1984), Das and Chopra (940), Davies and Ghani (1993), Deb (1987), Dore and Frimboldt (1987), Fatima (1983, 2000), Ghani (1999, 2000, 2002), Ghani and Ali (1996), Ghani and Davies (2000), Ghani and Tirmizi (1991a, 1991b, 1991c, 1992, 1993, 1995a, 1995b), Hashmi (1963, 1964), Henderson (1893), Holthuis (1980, 1991), Hussain (1974), Jafri et al (2000), Karim (1985, 1987), Kazmi (1971a, 1971b, 1974, 1988, 1997, 2001, 2003b,c, 2004), Kazmi and Kazmi (1973, 1979, 1987, 1992, 2004), Kazmi and Manning (2003), Kazmi and Qureshi (1974), Kazmi and Siddiqui (1992, 2001, 2006), Kazmi and Tirmizi (1990, 1995b, 1999), Kazmi and Yousuf (2005), Kazmi *et al* (1973, 1975, 1990, 1991, 2000, 2001), Keenan *et al* (1998), Kemp (1917), Khan (1975a, 1976b, 1977b), Khan and Ahmad (1975), Kholi (1992, 2004), Moazzam and Rizvi (1985), Moazzam et al (2003), Mustaquim (1972), Mustaquim and Rabbani (1976), Niazi and Hoque (1974), Nayeem *et al* (1993), Qadri (1960), Siddiqui and Kazmi (2003), Siddiqui and McLaughlin (2003), Siddiqui et al (2004), †Stoliczka (1871), Tirmizi (1962, 1967, 1968, 1970a, 1970b, 1974, 1976, 1977, 1978, 1980), Tirmizi and Ahsanullah (1966), Tirmizi and Bashir (1973), Tirmizi and Ghani (1978, 1982a, 1982b, 1983, 1986, 1988a, 1988b, 1992a, 1992b, 1994a, 1994b, 1996), Tirmizi and Kazmi (1969, 1979, 1980, 1982, 1983, 1984, 1987, 1988, 1990, 1995, 1996), Tirmizi and Siddiqui (1979, 1982), Tirmizi and Serene (1971), Tirmizi *et al* (1982, 1985, 1986, 1989), †Tiwari (1962), Wagner (1986), Wood-Mason and Alcock (1891), Zuberi (1990)

Fossil record

The table indicates that more work is done in the marine littoral ecozone as compared to riverine tract ecozone. It is also evident that two taxon i.e. Decapoda and Isopoda. are well documented.. The geographical range of marine crustaceans recorded from Pakistan clearly indicate that very few are endemic, some are cosmopolitan species, but they are wide spread throughout the western Indian Ocean, Red Sea and gulfs: Arabian/Persian Gulf and Gulf of Aden and only very few extend to Mediterranean through the Suez canal or to Pacific and Atlantic region.

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Table of Contents

Volume 17 **2006**

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