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THE PRECARIOUS STATUS OF THE INDUS DOLPHIN (*PLATANISTA MINOR*) BETWEEN GUDDU AND SUKKUR BARRAGES IN 1999

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The history of ecological studies on the Indus River Dolphin (*Platanista minor*) is reviewed and constraints on counting the dolphins are critically assessed. In spite of its limitations the downstream transect count technique is the best practical solution at the present time. It is suggested that more reliable objective recording techniques need to be developed in order to assess accurately the size of the population and the use of recording hydrophones (PODS) is suggested. Since the Dolphin Reserve was set up in the early 1970s, the number of dolphins steadily increased. Although since the mid-1990s the number seems to have reached a plateau but this may be due to the variability of the counts.

Key words: *Platanista minor*, Indus dolphin, Ecological study.

Introduction

The total population of the Indus Dolphin *(Platanista minor)* is probably between 700 and 1000 individuals (Reeves 1998; WWF 2001) of which less than 150 may survive within Punjab with above half of the remaining numbers of dolphin inhabiting Sindh Dolphin Game Reserve between the Sukkur and Guddu barrages (Fig. 1) and also the Sukkur barrage to Kotri barrage. In 2000 figures released by World Wide Fund For Nature (WWF) found 965 dolphins from Chashma barrage to Kotri barrage (WWF 2001). In 1968, a team from San Francisco came to Pakistan with a permit to capture 20 live river dolphins. The three young females taken by them from upstream of Sukkur died within four months (Herald 1969; Herald *et al* 1969). Pilleri (1970) subsequently began ecological work on the Indus dolphin (Table 1) and counts of animal numbers have continued in a somewhat uncoordinated way to date. Roberts (1972, 1977) also reported the sighting of dolphins in the Indus River. Pilleri (1970, 1972,1975, 1980) carried-out the study of *Platanistas'* anatomy, physiology and sensory system for the taxonomic status of the dolphin. Pilleri and Zbinden 1974 and Pilleri and Pilleri 1979 worked towards the establishment of the Dolphin Reserve and also for the protection of the species from direct hunting. Indus Dolphins live in groups or schools as observed in this field study (Table 7). Most dolphins were found singly or as the unit of mother and calf. The dolphins were often found near the confluence of old canals or by rivers and down stream of shallow areas (personal observation GSG in 1999; Kasuya and Haque 1972; Pilleri and Zbinden 1974; Hua *et al* 1989; Best and Dasaliva 1989; Smith *et al* 1998; Ahmed 1992; Smith 1993). The animal feeds on fish with a long forceps like jaws. These are said to be longer in the female than the male (Roberts 1977). GSG (1999-2000) dissected three dead dolphins to ascertain the sex based on the jaw length which was a useful feature for counting the animals as they surface for air in the wild. The aim of this study was to assess the Indus river dolphin population between Guddu and Sukkur barrages.

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Materials and Methods

Survey methodology. Partly due to the lack of a better available technique, the usual way to survey the Indus dolphin is by counting them as they surface for air. The method is fraught with problems.

1. The main river may be several kilometers wide and animals may surface beyond the visual range of the observer consequently "transects" rather than whole rivers are generally counted.
2. As the animal often swims in schools and each animal has varying dive times, under and multiple counting of individuals is a potential problem.
3. Rain, high winds, sand or dust storms, sun glare and sever heat can impair sighting efficiency.

However, the general method used in most previous surveys, including the one used by one of the authors (GSG), has been described by Chaudhry *et al* (1999). The river is generally sampled down stream by a slow moving boat in a zig zag manner to cover the maximum area of the river. In some circumstances upstream sampling might also take place. Where

possible separate observers count in front, behind and left and right of the boat. Animals are counted as they surface for air, other observers are made aware of each animal to prevent double counting. Parameters recorded include **:** Animal size and relative beak length where possible. · Dive time (interval between surfacings). Dive distance (distance between surfacings) River depth, width, turbidity. Two parameters can influence counting efficiency namely increasing inter surfacing interval and increasing sighting distance. As direct observation is the only available survey method, such inaccuracy can, in part, be compensated for by using a correction factor (CF) (Reeves and Leatherwood, 1994) based on dive time probabilities divided by sighting probabilities and incorporated into a population estimate.

$$\text{i.e Correction factor (CF)} = \frac{\text{Dive time probabilities}}{\text{Sighting probabilities}}$$

Statistics. To determine population density from the transect methodology described above the following calculation was used to determine the density (D) of animals per km^2 of river.

$$D = ng/(2w) \times L$$

Where n = no of dolphin groups observed

g = mean group size

2w = transect width on either side of observer,

L = length of transect in River (km)

To convert this to the number of animals per section of river the above results is multiplied by A, the area of habitat available in km^2.

The total population = A x D

$$\text{Correction factor (CF)} = \frac{\text{Dive time probabilities}}{\text{Sighting probabilities}}$$

If the 2w sighting distance increases to the point where sighting probability falls then the correction factor (CF) mentioned above can be determined and incorporated into a population estimate such that:

So that D become

$$D = CF \times ng/2n$$

Clearly ng is generally equal to the total number of individual but is retained here to dispel confusion with counts by other observers.

Results and Discussion

The Indus Dolphins assessed in the survey are distributed in the Dolphin Reserve between the Guddu and Sukkur barrages in Sindh (Fig 1). The Dolphin Reserve was surveyed downstream to make it comparable with most previous counts (Table 1). The estimate of the dolphin population is made once a year after the breeding season in low water period. As the main river may be several kilo meters wide, transects rather than the whole river are counted giving comparability with earlier data as it is the general method used in previous survey. Pilleri and Bhatti (1978) counted dolphin between the Sukkur and Kotri barrages, Khan (1989) found 21, but in 1996, no dolphins were found by Mirza and Khurshid (1996). However, GSG (1999) counted 30 dolphins between the Sukkur and Kotri

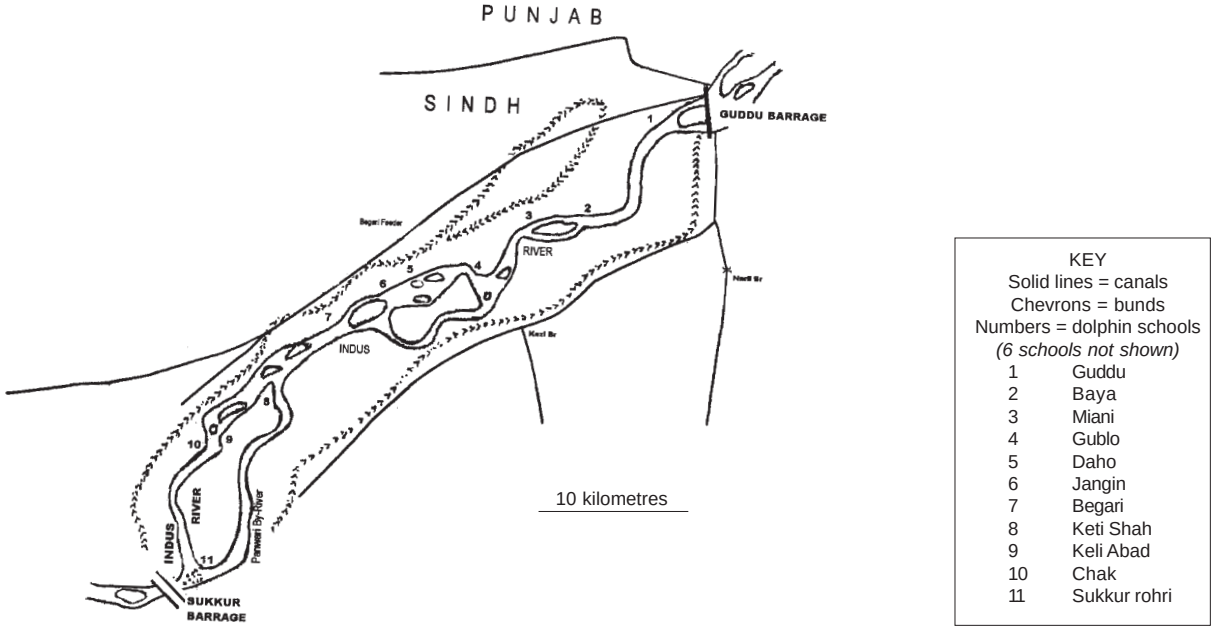

Fig 1. Map of the Indus river from Guddu to Sukkur Barrage showing main Schools of Dolphins in the Dolpin Game Reserve.

barrages and none below the Kotri barrage (Slater and Gachal, 2001). In a 31 days survey, between the Sukkur and Guddu in April/May1996, Mirza and Khurshid (1996) found between 339 and 458 dolphins (i.e.their upstream and down stream counts). Chaudhry *et al* (1999) noted the increase in the Sukkur-Guddu population as counted by various recorders from 150 individuals in 1974 to 241 in 1978, 429 in 1986, 450 in April 1978, 439 in 1992. Monthly counts by one of the present author (GSG) reached a maximum of 367 in August 1999, which is within the 1996 range of Mirza and Khurshid's counts (Table 1, 7). The Indus river within reserve was completely surveyed in August 1999, but in May 1999 and June 1999 river was surveyed in parts to determine the variability of dolphin numbers (Table 1). The only recent data for the proportion of calves in the population are those given by Mirza and Khurshid (1996) and unpublished data from GSG both for Guddu and Sukkur. Although population counts have increased since 1970's, they have either remained stable or even declined slightly since the early 1990's in both Sindh and Punjab (Slater and Gachal 2001) but this may have been because inexperienced surveyors over estimated the population in previous year (Table 1). While the data may not stand rigorous statistical scrutiny, the apparently poor ratio of females to calves in the late 1990's compared with 1980 may

Table 1
Survery data of *Platanista minor* between the Sukkur and Guddu barrages from 1974 to 1999

Year	Dolphins	Sources
January 1974	138	Piller and Zbinden, 1974
December 1974	233	Kasuya and Nishiwaki, 1974
February 1977	171	Pilleri and Bhatti, 1978
April-May 1977	187	Pilleri and Bhatti, 1978
October 1977	168	Pilleri and Bhatti, 1978
Feb-March 1978	191	Pilleri and Bhatti, 1978
May 1978	241	Pilleri and Bhatti, 1978
April 1979	240	Pilleri and Bhatti, 1980
June 1979	292	Pilleri and Bhatti, 1980
September 1979	291	Pilleri and Bhatti, 1980
February 1980	291	Pilleri and Bhatti, 1982
April 1980	346	Pilleri and Bhatti, 1982
March 1986	429	Khan and Niazi, 1986
March 1987	437	Reeves and Chaudhry, 1998
March 1989	370	Reeves and Chaudhry, 1998
November 1992	439	Reeves and Chaudhry, 1998
April-May 1996 (upstream count)	339	Mirza and Khurshid, 1996
April-May 1996 (down stream count)	458	Mirza and Khurshid, 1996
May 1999	104	Gachal(unpublished)
June 1999	220	Gachal(unpublished)
August 1999	367	Gachal(unpublished)

Table 2
Observations on the dive time of dolphins in the main Indus river

S.No.	Dive time (sec)	S. No.	Dive time (sec)
1	40	25	40
2	32	26	25
3	15	27	20
4	62	28	68
5	30	29	26
6	18	30	20
7	65	31	64
8	45	32	25
9	10	33	15
10	42	34	126
11	31	35	10
12	16	36	15
13	64	37	30
14	29	38	26
15	20	39	128
16	70	40	15
17	11	41	09
18	16	42	20
19	63	43	40
20	20	44	30
21	13	45	15
22	122	46	46
23	09	47	121
24	15	48	10

Dive time is the time interval between two surfacings (in seconds) August 1999; Animal observed: Number =1; S. No=surfacing number; Time=0830 hours to 0900 hours; Total time=1800 seconds; Total surfacings=48; Average time between sufacing=37.5 seconds ± 31.5 (S.D)

Table 3
Distribution of dolphin population with distance from observer

S.No.	Range distance (metres)	Number of dolphins sightings	Sighting% probability
1	0-100	10	1.0
2	100-200	06	0.6
3	200-300	02	0.2
	Total	18	

Table 4
Distribution of dive time in dolphin population

S.No	Dive time (seconds)	% count	Cumulative count	Probability
1	0-60	37	37/48x100=77	0.77
2	60-120	07	07/48x100=14.5	0.14
3	120-180	04	04/48x100=8	0.08
	Total	48		

be cause for concern. Chaudhry *et al* (1999) tabulated their own data and that of Kasuya and Nishiwaki (1975); Pilleri and Pilleri (1979), Pilleri and Bhatti (1980), Pelletier and Pelletier (1980); Niazi (1985, 1986), (Table 1). Although the numbers fluctuate, the overall trend seems to have been upward from 1989 to 1996, but dropped in 1977 (Table 1). The regression analysis given of number against years in Table 1, indicate x (year) = -1974.98 + 5.08 y (n); S= 0.0337; R^2 = 17; P = 0.07 and suggest real increase over time does not show a significant trend in the overall data. However, the results of the Study in June and August 1999 from the Sukkur-Guddu barrages are given (Table 1-7). Dolphins 367 were observed in 18 schools or groups ranging from 1-33 dolphins (Table 7) and 16 calves were recorded. The density of the Indus dolphin population observed in August 1999 was 2.11 animals per linear kilo meters and mean group size is 20 (Table 6). The sighting distance and an approximation of the dive distance of dolphins was determined (Table 2). Probabilities were calculated assuming that the dolphin counts between 0 and 100m from observer will be 100% (Table 4). Similarly dive time was recorded for different animals and 48 observations were made (Table 4). From the subsequent calculations, a total of 504 dolphins were estimated between the Sukkur and Guddu barrages, of which, 367 dolphins were actually observed. However, 137 animals which were calculated as missed, were determined using the correction factor (Table 5).

Although it is acknowledged that the counting techniques employed over years by both Sindh and Punjab wildlife Department are far from perfect, they at least have the value of nominal comparatibility. The conservation agencies of Sindh and Punjab have no absolute agreement concerning methods of counting animals. The methodology attributed to Khan and Niazi by Perrin and Brownell (1989) for Sindh survey area has been criticised by Reeves and Chaudhry (1998) as, in parts 'unreliable'. They feel that making two counts, one sailing upstream and one sailing down stream in a 'locally made sail boat' and then taking the mean of the two counts is impracticable in view of the problems of sailing upstream against current. They also doubt that male and female dolphins can 'easily be recognised' during surfacing from relative beak length. Finally, Reeves and Chaudhry (1998) dislike the Sindh counts being reported on the basis of the 17 schools. However, dolphin dissected by present author (1999-2000) showed that male and female can 'easily be recognised' on the basis of short and long beak length and parameter showed significant importance in the methodology to differentiate between male

Table 5
Correction factor

S.No	Sighting probability (SP)	Dive time probability (DVT)	D.T.P./S.P	Correction factor
1	1	0.77	0.77	1.4
2	0.6	0.14	0.23	
3	0.2	0.08	0.4	

Table 6
Summary table

S No	No.of sighting	Sighting distance (m)	Dive time	Sighting proba-bility	Dive time	Corr-ection factor	Mean group	Estimated population
1	10	0-100	60	1	0.77	1.4	360/18=20	504
2	6	100-200	120	0.6	0.14			
3	2	200-300	180	0.2	0.08			

$$\text{Mean group size} = \frac{\text{Total observed}}{\text{Total sighting}}$$

Estimated population = No.of group x Mean group size x Correction factor

18 x 20 x 1.4 = 504
D = ng/ 2 WL
18 x 20/170
D = 2.11
A = 170 km
Total = DxA

Table 7
Dolphin population between the Guddu and Sukkur barrages, August 1999

S.No.	Schools	No.of males	No.of females	No.of calves	Total in groups
1	Guddu upstream	06	05	-	11
2	Guddu downstream	07	05	-	12
3	Mashko	10	06	01	17
4	Gehalpur	07	05	-	12
5	Baya	19	13	01	33
6	Miani	10	08	01	19
7	Gublo	15	11	02	28
8	Daho	11	10	-	21
9	Jangin	12	10	1	23
10	Tori	13	06	-	19
11	Begari	17	11	02	30
12	Tegani	12	09	01	22
13	Mian sahib	10	07	01	18
14	Hizbullah shah	10	06	-	16
15	Chak	14	09	02	25
16	Shah belo	13	08	02	23
17	Keti shah	05	04	01	10
18	Sukkur rohri	13	09	01	23
19	Sukkur down	03	02	-	05
	Total	207	144	16	367

and female (Table 7). The counts of the male are greater to female in August 1999 between Sukkur and Guddu barrages (see Table 7).

The Punjab Wildlife Department uses a motor boat with two or three observers to do the line transect whilst travelling down stream at 5-10km per hour in the low water periods of October-November and March-April, counting and spatially recording animals but not ageing and sexing them. For the future other techniques e.g. Distance might be worth using to help eliminate some spatial counting errors but they would need to be used in tandem with existing technique comparability.

The Indus, unlike the Ganges, carries very few motorised craft and the use of sail boats is likely to cause less disturbance so could contribute to accuracy. The sail boat used by Sindh for dolphin survey is considered most suitable because this technique causes least disturbance to the Indus River. Pilleri and Zbinden (1974), Pilleri and Bhatti (1980-1982) have assumed that direct counts of dolphins are possible, and they appear to have made no adjustment for animals missed or double counted during their survey. Kasuya and Nishiwaki (1975) corrected the numbers observed 'surfacing' to estimate the number of dolphins present and showed a decline in the dolphin population. Chaudhry and Chaudhry (1998) recorded the animals of Punjab in groups and also of Sindh in 'school'. In fact, defining the dolphin groups is a greater problem in wide channels, because of difficulties in recognising the physical features that define a reach, a large size river may encompass a greater area, than can be searched from single location and under these circumstances, a group of dolphins is a 'cluster' of animals, that would have undoubtedly been seen from an initial location and not over a distance which may not exceed more than a few hundred metres. However, assumptions which use a definition of dolphin numbers based on river reach can probably be met when surveying narrow channels but not when surveying wide channels. Moreover, there is a real difference in density between the Sindh and Punjab sections. Though dolphins frequent the counter-current eddies, other sites of interrupted flow and hydraulic refuges, not all the counter current areas are suitable for dolphins (Hua *et al* 1993). Roxburgh (1801) also indicated that animals frequented the confluence of small stream with main river for food (Pilleri 1970). However, little is known of the biology of the animals (Pilleri 1972a) given the inaccuracies endemic in counting an animal undetectable except when it comes up to breath (Mirza and Khurshid data 1996, Table 1). The problem of accurately assessing numbers can be seen by references to table 1. The general change in numbers from the early 1970's is clearly evident, but from more recent counts, variation in numbers is dependent upon the direction of the count (Mirza and Khurshid 1996) and when the count was made (Slater and Gachal 2001). Each year, in flood conditions, dolphins can be swept into canals, from which, they can not return. At best, they are lost to the breeding population, but at worst they die as water level subside (Gachal and Slater 2001).Clearly the numbers counted at different seasons within one year using the essentially the same methodology vary such that no precise estimate of population size can be obtained. The following factors, which the present author (GSG) might add to this variability include:

a. Varying river condition with season.
b. Experience of those counting dolphins.
c. The direction of the count (upstream and down stream).
d. The speed of count.
e. Dolphin behavior under different river conditions.
f. Possible dolphin migration to tributaries in certain seasons.
g. Turbidity of water.
h. Rain, high winds, sand or dust stroms, sun glare and sun heating can contribute to sighting deficeincy.

However, sighting distance and surfacing interval were important parameters in dolphin population estimation. With increase in sighting distance and surfacing interval, the probability of seeing dolphins on the surface of the water decreases and the chances of missing dolphins are increased. Hydrophone techniques could be used for monitoring the dolphin population in order to increase objective numerical data. A system of recording hydrophones has been used to study harbour porpoises (*Phocoena phocoena)* Pierpoint *et al* (1999). The use of hydrophones for monitoring dolphin sonar has been very beneficial to survey the Indus dolphin. These dolphins rarely jump out of water except as juveniles, and are very hard to observe as little of their body is ever seen. Dr Pilleri noted that the Indus dolphins were unusual in comparison with other river dolphins as they do not remain still whilst sleeping, in fact they are always moving near the bottom of the river on their side. In methodology, 30 minutes were allowed to count the animals (Table 2) and the longest dive time of the dolphins observed in the wild is 180 second (Table 4). Therefore, the use of a recording hydrophone could monitor the dolphins when visual observations were impossible. The POD (a type of hydrophone considered for use on the Indus) stores the number clicks per logging interval that meet the specified criteria. Pierpoint *et al* (1999) collected more data in POD field trials than five years visual data recording in a study in Wales. The advantage of using hydrophones of any type in the Indus, unlike the Ganges or Yangtze Rivers, is that there is no motorised boat traffic and therefore a minimum of extraneous sound production to

interfere with recording. Such hydrophones may in future help in evaluating specific conservation sites and may add us to educate fishermen where not to put their nets, in order to minimise accidental dolphin entanglement.

Conclusion

Our general conclusion on dolphin survey techniques is that the Sindh sail boat system seems to work well and has least disadvantages in Indus River, but a more critical analytical technique is necessary but for comparability must initially be used along older technique to determine the dolphin population.

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