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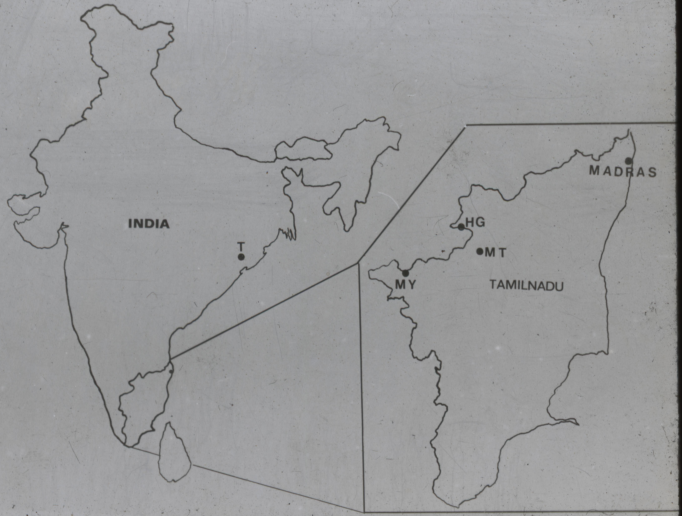
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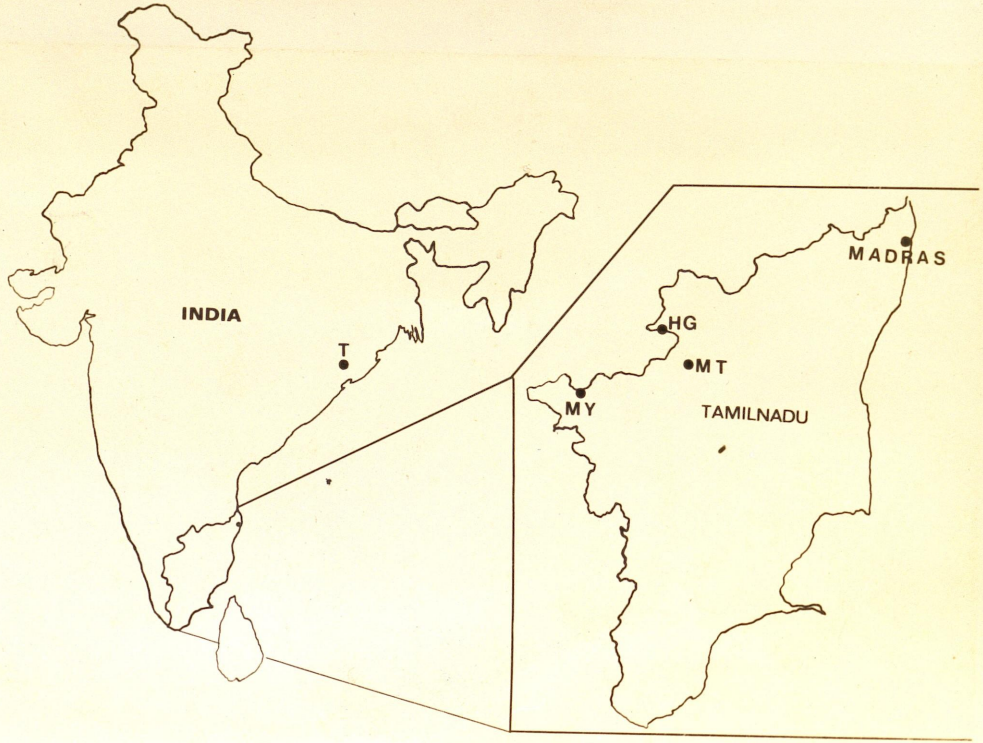
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GROWTH IN THREE POPULATIONS OF INDIAN MUGGER CROCODILES, CROCODYLUS PALUSTRIS LESSON FROM TAMILNADU, SOUTH INDIA

H.R. BUSTARD[1], L.A.K. SINGH[2] & B.C. CHOUDHURY[3]

INTRODUCTION

Scant data exist on growth in crocodilians under natural conditions or under good captive husbandry conditions. Five publications mention growth in C. palustris. Deraniyagala (1941) gave the size and weight of the hatchlings, yearlings and 2 year old mugger as 25.5, 41 and 47.7 cm and 70, 230 and 478 g respectively; Reuben David (1970) stated that early growth for C. palustris was 2.5 cm/months; Malhotra (1975) said that the growth rate was 2.5cm/month during summer; Whitaker (1977) recorded a mean length of 82cm at 1 year and 130cm at 2 years with a mean weight at 2 years of 8 kg. Archaryjo & Mohapatra (1978) recorded the growth of a mugger crocodile, which escaped into a lake when it was 170cm and on recapture after 4 years and 8½ months, measured 220cm. Sex was not recorded.

The present paper records growth of three different populations of the mugger all from the South Indian State of Tamilnadu, reared in the Gharial Research & Conservation Unit at Tikerpada, Orissa. The Unit is situated on the banks of the Mahanadi river where naturally occuring wild mugger are present.

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MATERIALS & METHODS

Five individuals from each of the three mugger populations were used in studying growth in total body length (TBL), snout-vent length (SV), tail length (TL), and body weight (W) in captivity. The three populations were from Hogenakal waterfalls (12° 07'N, 77°80'E) on Cauvery River in Dharmapuri district (HG); Kedarhali stream (11°40'N, 76°45'E) on Moyar River in Nilgiri district (MY) and from captive laid eggs hatched in the Madras Snake Park, of parents collected from Mettur Dam (11°57'N, 77°80'E) in Salem District (MT) (Fig.1)

The hatchlings, were housed in standard hatchling and yearling pools (Bustard,1975) concrete pools of 2m x 2m x 30cm deep with a broad sandy surround richly planted with vegetables to provide cover. The pools contained living Salix sp., and an abundant supply of live fish of the various species naturally-occurring in the adjacent Mahanadi River. Adjacent Pools were separated by vertical wire-mesh partitions 70cm high, replaced later with zinc-sheets of equal height. The enclosure had wire-mesh walls and roof.

The HG Group was estimated to have hatched during the third week of April, 1975, the MY group during the last week of April, and the MT group hatched on 24th May, 1975. The wild hatchlings of HG and MY were collected within one to three weeks after hatching. At the time of collection, the three groups had an average TBL of 300mm (HG), 275mm (MY) and 280mm (MT). Subsequent measurements commenced from August, 1975 and continued every month except August 1976 and March and July 1977 upto August 1977 (Table.1) (Figs.4 & 5) On 9th October 1975 two juveniles, one each from HG and MY escaped into the river. Data for the group thereafter were had on only four individuals.

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A After August 1977, annual data is presented upto five years of age in Tables 2,3 and 4 and shown graphically in Figs. 2 and 3.

Since the different groups comprised animals of varying sizes, although they had hatched around the same period, as per the standard Crocodile rearing technique,(Bustard 1975), young crocodiles were resorted so that similar - sized individuals occupied the same pools. Identification of the members of each group was by tail clippings made prior to the arrival at the Unit. Although individual muggers are recognisable by adopting the tail colour banding method, described by Singh and Bustard (1977) for gharial, data were collected individually for the members of each group as a whole without attempting to identify the crocodiles for this study.

Upto about fifteen months of age, the juveniles of the HG group and one juvenile from the MY group, alongwith other juveniles were fed live fish, an abundant supply of which were maintained in the pool at all times, but later, these juveniles accepted chopped fish and meat of birds (Singh 1979) and terrapins. The majority of the juveniles, however, insisted on live fish upto an age of about twenty five months.

All the juveniles were intitially housed in identical conditions but subsequently when five of them grew very large they were transferred to a larger pool, measuring 4m x 4m x 1m in which all other features like basking area and vegetation remained similar.

Since the Unit maintains a metereological station, it was possible to observe the group in relation to fluctuations in the ambient temperature in different seasons.

R E S U L T S

Growth during the first 28/29 months is summarised in Table 1. At the time of hatching, the juveniles measured HG -30.0 cm, MY-27.5cm and MT-28.0cm. At one one yaar of age, the measurements were: HG-71.1cm, MY-47.3cm and MT-46.5cm, i.e, a respective increase to 2.3 , 1.7 and 1.6 times over length at hatching time. When five years old, the lengths were HG 243cm, MY-171.5cm and MT-199.0cm, i.e, 8.1, 6.2 and 7.1 times over the hatching lengths. Assuming that the weight at hatching for all groups was 100 gms (Choudhury,unpubl.info.), the weight for different groups were HG. at 1 year 1.589 kg (15.89 times), at 5 years 89.7 kg (897 times), MY: at 1 year 1.252 kgs (12 times), at 5 years, 56.7 kgs (567 times) and MT at 1 year 350 gms (3.5 times) at 5 years 43.6 kg (436 times).

Data presented in Tables 2,3 and 4 show an average annual growth of 42.6 cm for HG, 28.8 cm for MY and 34.2 cm for MT. The growth rates are not consistent in each year. For example, for MY, the maximum growth was 43.7 cm during the third year and the minimum growth was 19.8 cm during the first year. Similarly for MT, the maximum (66.0 cm) and minimum (18.5cm) were during the 3rd and 1st year respectively. For HG, the low growth rate recorded for the fourth year is because of the transfer of the two largest individuals and were transferred to a different institution and data on these are not consideration of information on the other two individuals.

HG records the maximum growth, followed by MT. In MY-group, the difference between the smallest and the largest indivudual is much greater than for either HG or MT. For example, when 5 years old, the TBL difference is 52 cm and W difference 34.5 kg for this group. Whereas, these differences are 35.0cm x 21.4 kg for MT-group.

The body weight increased rapidly , in comparison to the group rate for TBL, as the age advanced. For example, for HG, the $\frac{W}{TBL}$ ratio at 1 year and at 5 years of age are respectively 22 gm/1 cm and 344 gm/1 cm. This also shows that males of comparable age are heavier than females. (describe how many of each group male & how many female)

DISCUSSION

In Orissa, the conservation of the muggers, a rapidly depleting species involves active management. The future of the species depends on such management programmes of which cropping may be a key factor in the sustained conservation of the species. Potential growth rates, therefore, assume utmost importance. Most available group information on captive mugger grossly underestimates as a result of poor husbandry conditions. This particularly is the case when the crocodiles are kept in cooler countries outside their normal geographical range. We believe that the present study has overcome these limitations atleast by providing good husbandry conditions and that the growth rates achieved are better than good wild growth rates. (Ahuja et al Mahapatra & Chandra & Bustard) The experiment was conducted withinthe natural geographical range of the species.

Mugger breeding has been a regular feature of the North Indian Zoos of Ahamedabad and Jaipur. David Reuben (1970) states that the early growth rate for C. palustris is 2.5 cm/months. Malhotra (1975) provided data on three individuals reared at Delhi Zoological Park, tow of which died during the experiment. He states that the growth rate was 2.5cm/month during summer. However, two of the three indivuduals were not alive during summer and careful scrutiny of his table indicates that the actual growth rate/months was 8, 6 and 4mm for the three individuals respectively. His weight increase data also appear extremely low, the sole surviving individual at an age of seven months weighing only 128 gms.

The present study shows that the increase in length is slow compared to weight increase. The growth recorded for the Hogenkkal group appears to establish a new record for any crocodilean. The maximum rate recorded is for the Nile Crocodile Crocodylus Niloticus (Cott.1961) ??

These data also exceed the records of Blake and Loveridge (1975) for the Nile Crocodile. The rate is 280mm for an year. In the present Study, however, the growth has been a mean of 426 mm per year for the first five years of the HG group, the highest growing group. For all the three groups, considered together, the average growth is 352 mm per year for the first five years.

The only other comparable data is recorded by Bustard and Singh (1980) for the ~~Grareial~~ Gharial, ~~Ganialis~~ Gavialis gangeticus (Gmelin). For a group of 39 ghareials, (reduced to 6) the average growth during the first four and a half years is 48.8 mm/year.

Growth recorded for MY and MT groups were lower than that for HG. The rates were 28.8 (MY) and 34.2 cm(MT) per year respectively. The rate recorded for the MY group falls between the rates of Blake and Loveridge(1975) and is in close agreement with Cott (1961) data for C.Niloticus.

The juveniles, particularly of the Moyar and the Mettur groups, showed wide variations in growth. Such variability ingrowth rate is well known (Bellairs 1970) in ambhibians and reptiles. Blake (1974) reports that young nile crocodiles, intheir second year could vary in size by 30 cm or even more. In the present observations, the weight variations could reflect fatness, but the variations in length

In crocodile farming, it is important to utilise fast growing genetic stock. This involves selection of rapidly growing populations and the rejection of all but top cohort of growing hatchlings. In the present study, both Hogenakal and the Mettur groups have a fairly homogenous growth, although at markedly two different levels. The Moyar group, however, demonstrated a very wide range of growth. The group included two large individuals (one of which escaped into the river). This heterogenity in growth indicates scope for selective breeding. Even the homogeneous Hogenakal group could be further potentiated by selective breeding.

SUMMARY

Three groups of mugger crocodiles, each in 5 individuals, originating from three different localities, Tikerpada in Orissa and Salem of Tamilnadu, South India, showed three types of growth rates, when reared under identiaal captive conditions, in Orissa, eastern India. The gll male group for Hogenakal showed the highest growth rates (av. 42.6 cm/year). The group for Mayar, consisting equal number of males and females showed highest growth rates for males

at five years of age, as opposed to females

at five years of age and a group average of 28.8 cm/year. The group for Mettur, all female (34.2cm/year) inbetween the other other groups. Growth rates among individuals of any group, irrespective of sex, were not equal. Nearly half of the total length is SV. In later years, the proportional increase in body weight in relation to TBL is high. Males are proportionately heavier than females.

Discussion

1. Difference in growth in River Basins.
2. Difference in growth between sexes.
3. Growth compared to wild Growth
4. Growth Compared to other species.
5. Selective advantages in rearing in commercial farming
6. Seasonal growth variation

FIGURE CAPTIONS

Fig.1 Map of India showing the Origins of the three Mugger strains in Tamilnadu (inset) and Tikerpada, Orrissa, where the group experiment was carried out , HG, Hogenakkal; MT, Mettur and MY, Moyar ; TPA - Tekerpada.

Fig.2 Five-year growth in TBL, in all the three populations, Key to symbols in Fig.1.

Fig.3 Five-year growth curves for W in all the three mugger populations (Key to symbols as in Fig.1) (Heights at hatching time assumed to be 100 gms).

Fig.4 TBL growth curves for first 28/29 months in three populations of the mugger (key to symbols as in Fig.1)

Fig.5 W growth curves for first 28/29 months in the three populations

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Table.1 Mean measurements of snout-vent length (SV), tail length (TL) and total body length (TBL), and mean weight (W) of three mugger populations for Hogenakal (HG), Moyar (MY) and Mettur (MT) size in ~~mm~~ cms and weight in grams.

cms Decimation mm. To be changed.

Month of measurement	HG				MY				MT			
	SV	TL	TBL	W	SV	TL	TBL	W	SV	TL	TBL	W
April/May 75 Hatching	-	-	300	-	-	-	275	-	-	-	280	-
Aug 75	-	-	480	414	-	-	385	184	-	-	386	156
Sep 75	250	253	503	454	205	204	409	253	199	203	402	214
Oct 75	269	270	539	562	222	219	441	314	207	208	415	184
Nov 75	285	279	564*	597	209	199	408*	221**	207	208	415	204
Dec 75	286	280	566	691	209	199	408	236	207	208	415	233
Jan 76	290	286	576	759	211	200	411	273	212	208	420	231
Feb 76	301	287	588	828	212	200	412	295	213	210	423	245
March 76	340	323	663	1259	235	221	456	417	228	227	455	295
April 76	340	323	663	1154	235	221	456	417	228	227	455	292
May 76	372	339	711	1589	243	230	473	488	234	231	465	305
June 76	435	399	834	2589	266	251	517	670	259	258	517	397
July 76	490	471	961	3763	305	289	594	938	259	258	517	386
Aug 76	-	-	-	-	-	-	-	-	-	-	-	-
Sep 76	580	525	1105	5632	305	289	594	1065	293	292	585	533
Oct 76	620	573	1193	7423	305	289	594	1573	293	292	585	693
Nov 76	632	638	1270	9475	309	292	601	1705	301	299	600	689
Dec 76	647	642	1289	11150	318	292	610	1929	312	309	621	945
Jan 77	660	662	1322	12067	336	315	651	2519	317	313	630	979
Feb 77	677	674	1351	12497	336	340	676	2532	322	319	641	938
Mar 77	-	-	-	-	-	-	-	-	-	-	-	-
Apr 77	683	703	1386	14350	345	348	693	2588	324	320	644	929
May 77	756	735	1491	18382	372	355	726	3233	336	338	674	991
~~June 77~~	~~792~~	~~1550~~	~~2082~~	~~401~~	~~368~~	~~764~~	~~3830~~	~~348~~	~~351~~	~~699~~		
June 77	792	758	1550	20582	401	363	764	3830	348	351	699	1118
July 77	-	-	-	-	-	-	-	-	-	-	-	-
Aug 77	842	838	1680	24062	434	407	841	4783	399	403	802	2090

* One juvenile escaped. ~~out~~

** Marked decrease in ~~weight~~ as the larger juvenile escaped

Table.2 Growth of HG-Group mugger during first five years.

measurement in cm, weight (W) in Kg.

~~SV=Snout-Vent, TBL= Total Body Length and TL= Tail Length~~

	Hatching n=5 1975	1 year n=4 1976	2 yrs n=4 1977	3 yrs n=4 1978	4 yrs n=2 1979	5 yrs n=2 1980	Average growth per year
Snout-Vent							
min.	-	33.7	71.2	94.0	106.0	123.0	-
max.	-	38.7	79.5	110.5	113.0	133.5	-
mean	-	37.2	75.6	101.8	109.5	128.2	-
Tail							
min.	-	32.1	69.5	95.0	105.0	116.0	-
max.	-	37.6	77.0	100.0	103.0	113.5	-
mean	-	33.9	73.5	97.0	103.5	114.8	-
Total body length							
min.	-	65.8	140.7	189.0	211.0	239.0	-
max.	-	76.3	156.5	210.5	216.0	247.0	-
mean	30.0	71.1	149.1	198.8	213.0	243.0	42.6
Weight							
~~xxxx~~	~~1x087~~	~~11x680~~	~~31x600~~	~~56x100~~	~~77x800~~		
min. -	-	1.087	14.680	31.600	56.100	77.800	-
max.	-	1.797	20.960	48.000	58.800	89.700	-
mean	160gm	1.589	18.382	40.700	57.400	83.700	-

41.1 78.0 49.7 14.2 30.0

Explain ??

1.589 16.791 22.318 1.6 26.300

TL ~~TBL~~ ~~wt~~ ~~TBL~~ 71.1 (65.8 - 76.3) (1.4 - 1.7) 1.6

S.V 37.2 (33.7 - 38.7) 33.9 (32.1 - 37.6)

143

Boom in one year

14

2

Table. 3 Growth of MY-Group muggers during the first five years.
Measurements in cm. weight (W) in Kg.

~~SV= Snount-vent, TBL=Total Body Length and TL: Tail Length~~

	Hatching n=5	1 year n=4	2 yrs n=4	3 yrs n=4	4 yrs n=4	5 yrs n=4	Average growth per year
SV Snout-vent							
min	–	18.7	22.0	46.0	65.0	75.0	–
max.	–	33.0	59.0	77.0	93.0	108.0	–
mean	–	24.3	37.1	57.7	74.1	89.5	–
TL Tail							
min.	–	–	22.2	50.5	58.0	75.0	–
max.	–	–	57.0	79.0	83.0	94.0	–
mean	–	–	35.5	58.6	66.9	82.0	–
TBL Total body length							
min	–	37.0	44.2	96.5	123.0	150.0	–
max.	–	65.1	116.0	156.0	176.0	202.0	–
mean	27.5	47.3	72.6	116.3	141.0	~~272.5~~ 171.5	28.8
(growth)	19.8	25.3	43.7	24.7	30.5		
Weight							
min.	–	0.132	0.300	3.080	10.800	22.200	–
max.	–	1.252	9.800	24.100	39.800	56.700	–
mean	70g	0.488	3.133	10.200	21.300	36.200	–
Growth		0.388	2.645	7.067	11.100	14.900	

30cm in one year 4 yrs

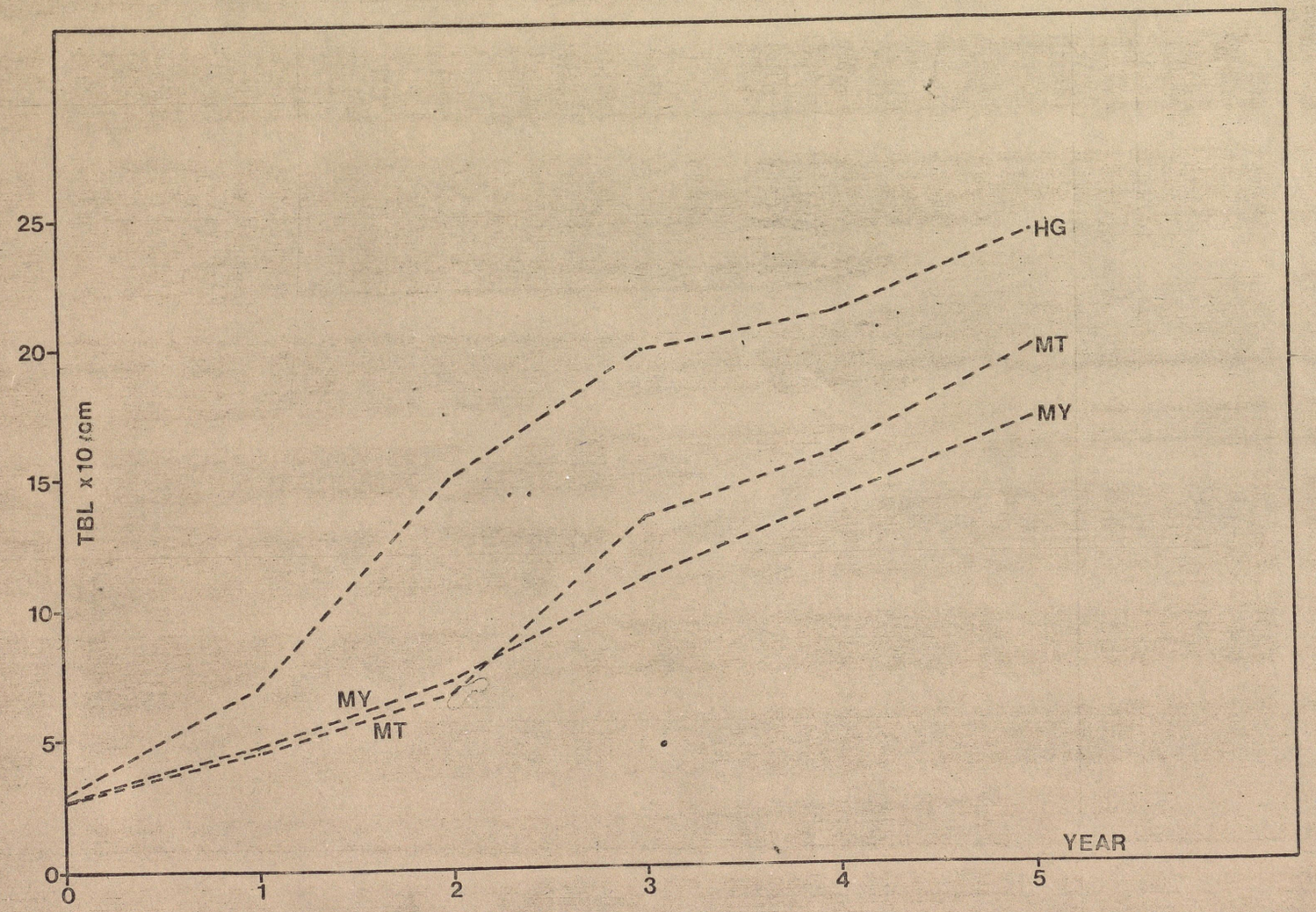
60cm

Table.4 Growth of the MT-group muggers during the first five years.

measurement in cms. and weight (W) in Kg.

~~SV= Snount-Vent, TBL= Total Body Length and TL= Tail Length~~

	Hatching n=5	1 year n=5	2 yrs n=5	3yrs n=5	4 yrs n=1	5 yrs n=4	Average growth per year
Snout-vent							
min.	-	20.9	25.8	50.0	78.0	90.0	-
max.	-	24.8	37.0	75.0	-	109.0	-
mean	-	23.4	33.6	65.0	78.0	101.7	-
Tail							
min.	-	20.0	24.8	52.0	80.0	90.0	-
max.	-	23.4	38.1	81.0	-	106.0	-
mean	-	23.1	33.8	68.4	80.0	97.5	-
Total body length							
min.	-	40.9	50.6	102.0	158.0	180.0	-
max.	-	49.2	75.1	156.0	-	215.0	-
mean	28.0	46.5	67.4	133.4	158.0	199.2	34.2
	18.5	20.9	66.0	24.6	41.2		
Weight							
min.	-	~~0.350~~ 0.172	0.375	3.500	15.700	22.200	-
max.	-	0.350	1.370	14.200	-	~~43.660~~ 43.100	-
mean	8 gm	0.305	0.991	9.400	15.700	35.500	-
Sample	-	0.215	0.686	8.569	6.200	19.800	*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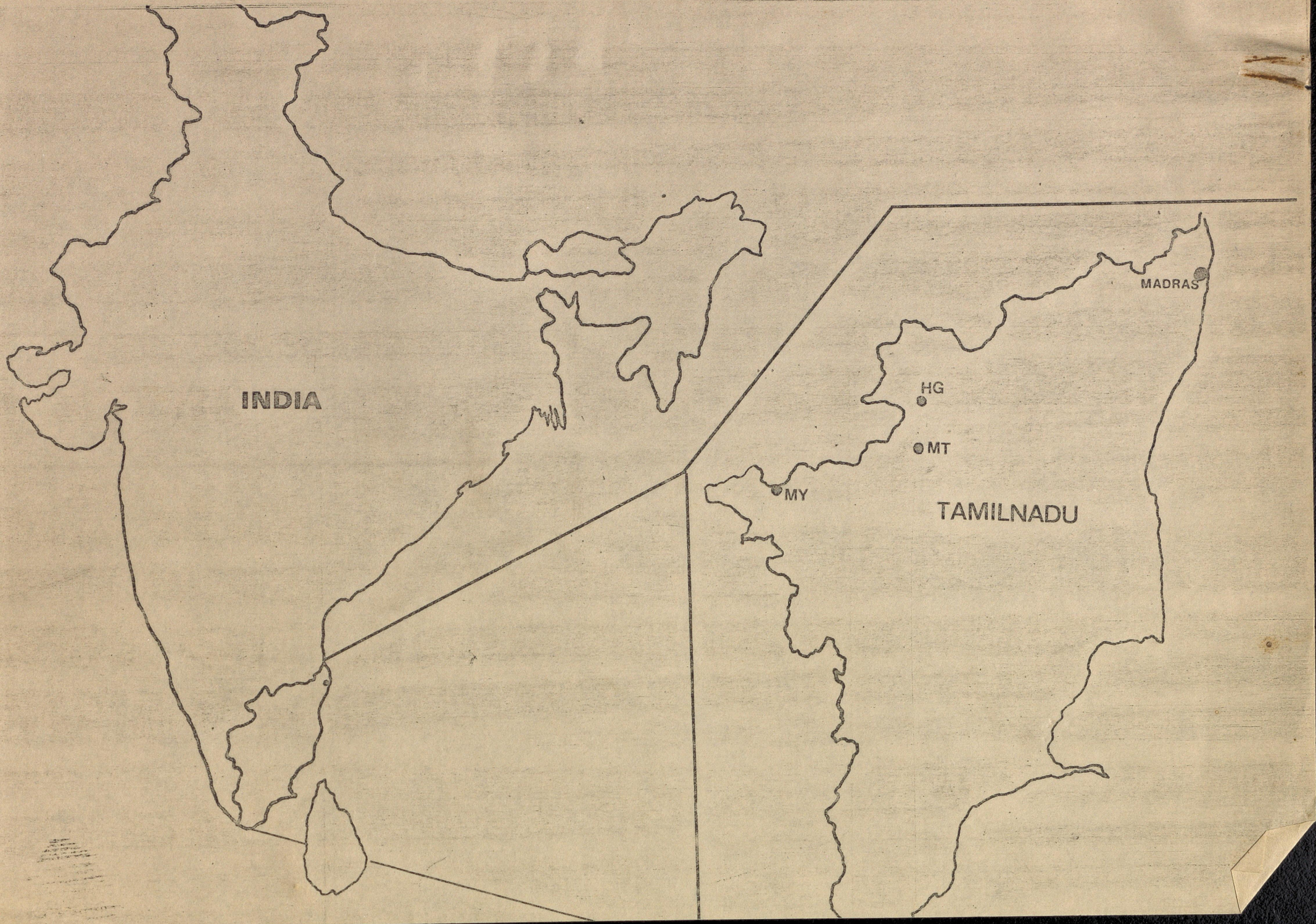
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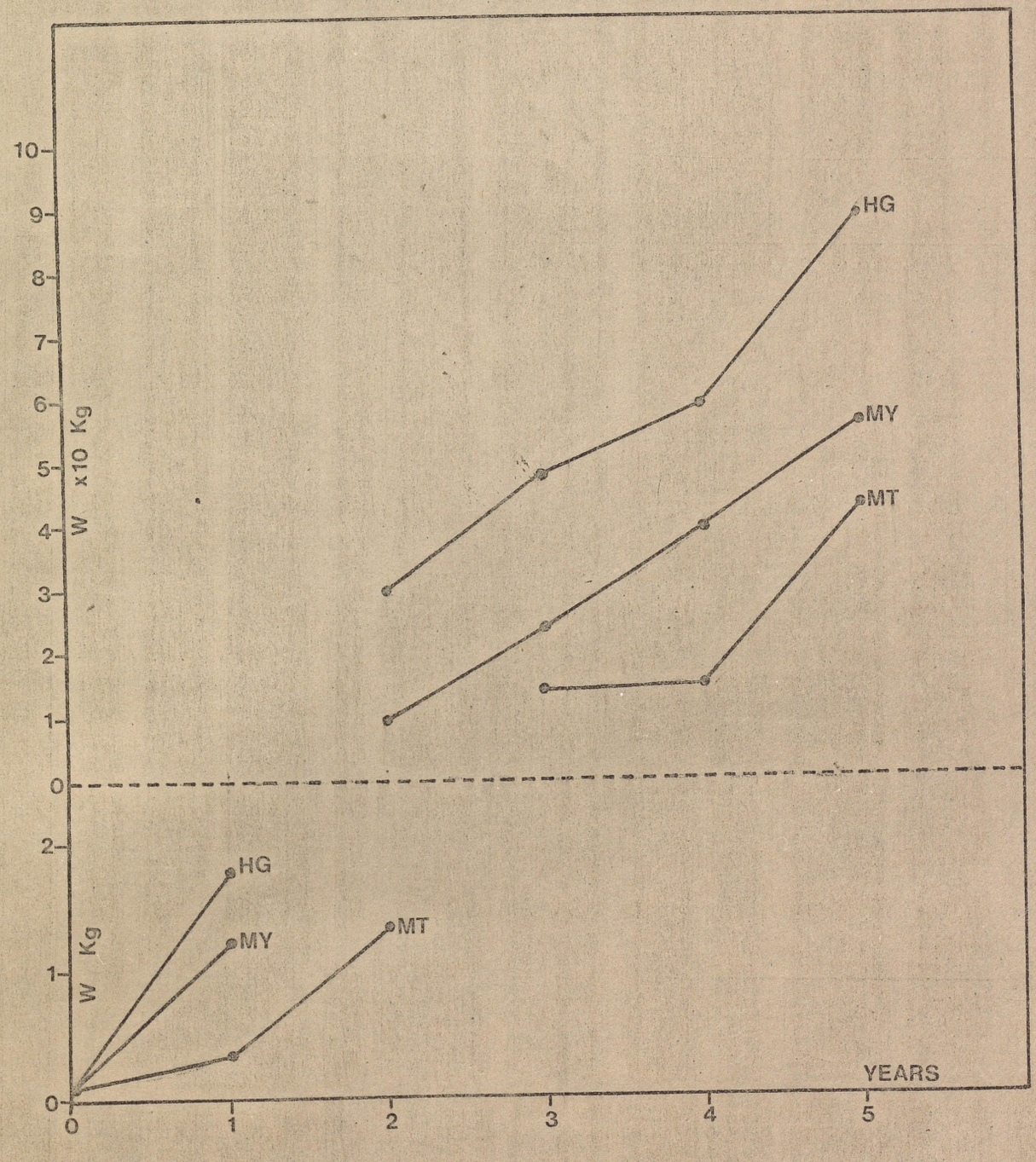
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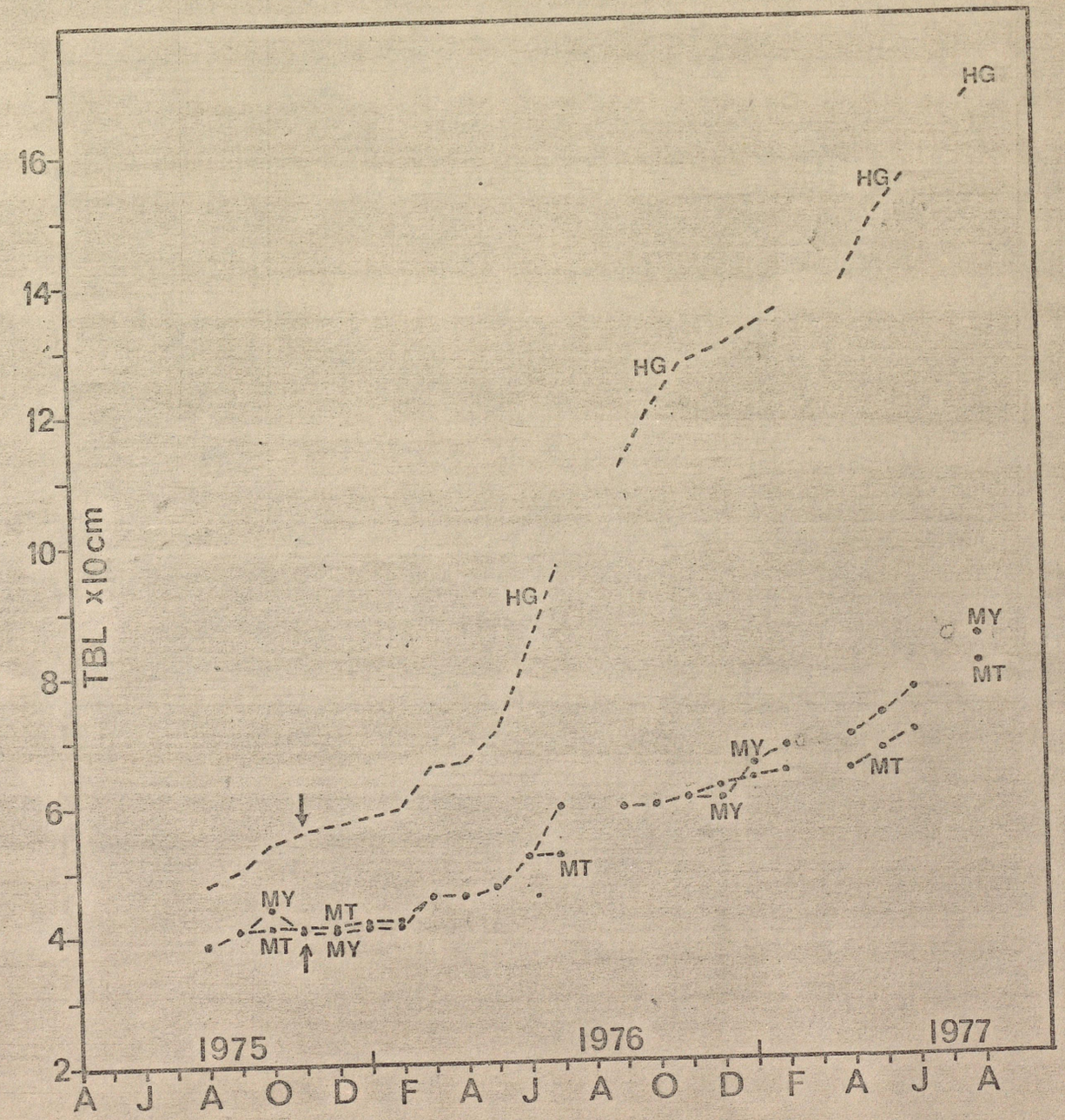
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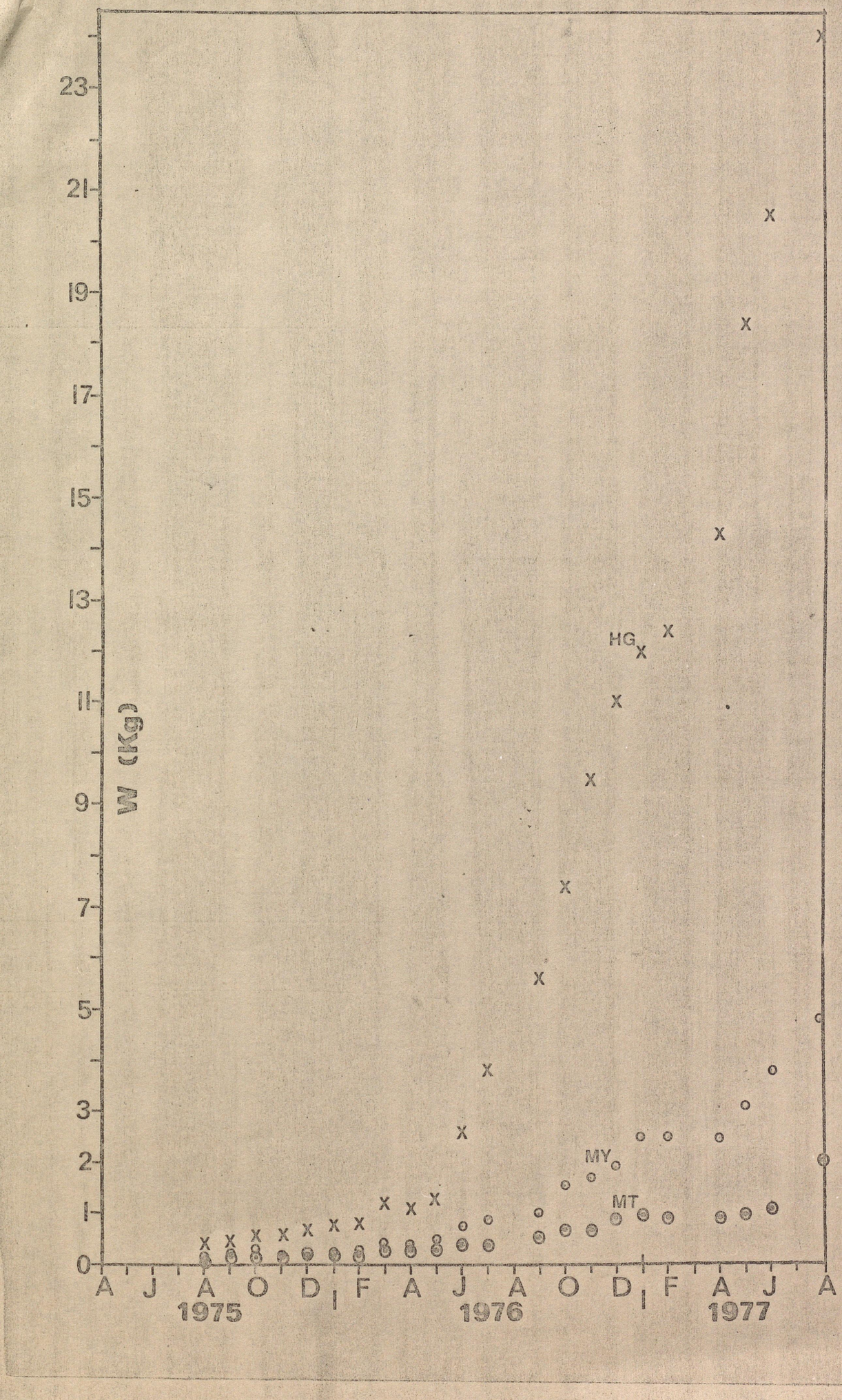
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GROWTH OF INDIAN MUGGER CROCODYLUS PALUSTRIS HATCHLINGS FROM THREE POPULATIONS

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Orissa/ India

A B S T R A C T

Growth rates of juvenile Crocodylus palustris (Reptilia, Crocodilia) from hatchlings collected from two localities and captive-laid eggs from adults collected from a third locality, all within the state of Tamil Nadu, South India, are reported.

M A T E R I A L S A N D M E T H O D S

Hatchling C. palustris, initially five from each locality, were housed in concrete pools 2 x 2 x 0.3m deep with a broad sandy ~~ground~~ surround. The pools contained living Salix sp., and an abundant supply of live fish of species naturally occuring in the adjacent Mahanadi River where wild muggers occur. The pool surrounds were richly planted with vegetation to provide cover.

Length and weight measurements were recorded at fortnightly intervals. The period covered by the present paper extends from 15th August 1975 to 12th February 1976 (24 weeks). The monsoon, which commenced in mid June, atypically persisted to the end of October. From late November until early February is the short, comparatively mild, Oriyan winter. Temperature data throughout this period were recorded using max/min thermometers in a Stevenson screen and at the bottom of the rearing pools. These data are summarised in Table I.

The three populations of C. palustris used in the growth study were from Hogenakal waterfall (12°07'N, 77°80'E) on Cauvery River in ~~Salem~~ DHARMAPURI districts; KEDARHALLI ~~Kedarhalli~~ (11°40'N, 76°45'E) on ~~Kedarhalli~~ Moyar River in Nilgiri district and from captive-laid eggs hatched and raised in the Madras Snake Park, of parents collected from Nettur Dam (11°57'N, 77°80'E) of Salem district, Tamil Nadu. The location of Tamil Nadu in relation to the rest of India is shown in Fig. I, and the precise location of the three localities is in the inset.

At the commencement of measurement recording the Hogenakal and Moyar hatchlings were fifteen weeks old and the Nettur Dam hatchlings were eleven weeks old.

On 28th October 1975 two juvenile crocodiles one each from Hogenakal and Moyar group escaped into the river, at the same time the data of a juvenile of the Nettur Dam group, which had an eye defect, was discarded. Hence the complete data for the full experimental period covers four individuals from each group.

Animals were identified by tail scute clippings. All groups, identically housed, were fed with live fish, an abundant supply of which remained in the pools at all times.

The Hogenakal group did not show any fall in the growth rate in the month of October but there was no growth at all in Moyar group and the Mettur Dam group showed a fall from 11mm in September to 3.5mm in October.

For growth rate studies the following measurements were taken; Snout-Vent length (to the mid point of the vent), Tail length (measured from the mid point of the vent) and weight.

R E S U L T S

Growth rates (length increase) for all three groups are given in Table II and weight increase in Table III.

It was found from study that increase in length was slow compared to weight increase. Length increase varied from 12mm/month for Hogenakal group to 7mm/month for Moyar group and 9mm for Mettur Dam hatchling group.

The Hogenakal group showed a mean length increase of 110mm (24.6% of total length), Moyar group 42mm (11.2%) and Mettur Dam group 46mm (11.9%) length increase in 24 weeks respectively.

With the onset of winter from November the growth rate decreased in all the groups. In October and November the water temperatures of the rearing pool ranged from 33.2 - 23.8 and 28.9 - 14.6 °C respectively (Table I).

The Hogenakal group did not show any fall in the growth rate in the month of October but there was no growth at all in Moyar group and the Mettur Dam group showed a fall from 11mm in September to 3.5mm in October.

In November the growth rate fell for each group. In the Hogenakal group it fell from 20mm to 2mm, in Moyar from 21mm to 2mm and in the Mettur Dam group from 3.5mm to no growth. (Table IV).

Tail length was 50% ±1.4 of the total length (Table II).

Increase in weight was proportionately much greater than length increase and varied markedly between the groups.

The Hogenakal group showed a mean weight increase of 427gms (106.4%) whereas Moyar group and Mettur Dam hatchlings recorded increases of 118g (66.6%) and 112g (71.7%) respectively. The data for weight is shown graphically for each group in Figures II to IV and these graphs are compared in Fig.V.

The Hogenakal group lost weight only twice between II and IV, and again during VI and VIII weeks. Thereafter, the growth was 66g/fortnight (15% of total weight increase) (Fig. II).

Moyar group also lost weight in weeks II to IV and VI to VIII and gained 15g/fortnight thereafter (12% of total weight increase) (Fig. III).

The Mettur Dam group gained 67g (59% of total weight) in the first two weeks and then lost weight from II to VI week by 30g (26% of total growth) and maintained their own weight of II week in the XI week. From XI week to XVI week the growth was 12.4g (10% of total growth) per fortnight. From XVI to XVIII week the loss was negligible and after that the growth was 13g/fortnight (11%) (Fig IV).

The Hogenakal group produced the best growth rate with a high degree of uniformity between the growth of individual members of the group (Fig.II).

The Noyar group showed the greatest divergence in growth. Thereon, three individuals of the group closely approximated the Nettur Dam group (Fig. III). In the Nettur Dam group all the individuals showed closely similar weight to the slower growing cohort of the Nettur Dam hatchlings (Fig. IV). Growth of these three groups is compared graphically in Fig. V.

D I S C U S S I O N

The Rugger Research and Conservation Unit is involved in management of Crocodylus palustris, a rapidly depleting species, in Orissa. The future of the species depends on an active management programme of which cropping may be a key factor in the sustained conservation of the species. Potential growth rates, therefore, assumes the utmost importance. Most growth rate data on captive crocodiles is suspect because of poor husbandary conditions. This is particularly the case when the crocodiles are kept in cooler countries outside their normal geographical range. The present study has attempted to overcome these limitations by housing the crocodiles in spacious pools within the natural habitat of the species.

In the present paper three populations, all from the South Indian state of Tamil Nadu have been investigated. Markedly differing growth rates have been observed between the three populations. Since the husbandary conditions for each were identical it is assumed that these reflect genetic variations in the parental gene pool. The data here presented provide further evidence of the complexity of the crocodilian growth studies. Had the work been carried out solely on the Nettur Dam population or on the Hogenakal population the results would have been most disappointing, and most promising, respectively.

In the new field of crocodile farming it is important to utilise fast growing genetic stock. This involves selection of rapidly growing populations and rejection of all but the top cohort of growing hatchlings. In the present experiment the Nettur Dam hatchlings would all be rejected. The Noyar group is intresting in that, unlike the other two group which show marked homogenity for growth, they demonstrate a very wide range of growth pattern. The two rapidly growing individuals indicate the advantages which could result from selective breeding. They would be selected and the remaining three rejected. Although the Hogenakal group also showed good growth this could be potentiated further by selective breeding.

The experiment commenced during the middle of the monsoon and continued until the end of winter. Hence the hotter months when most rapid growth may be expected were not covered in the experiment. Low 'winter' temperatures were minimised by covering the pools at night, however, some seasonal fluctuations are to be noted (Table. I.). Examination of Table. I indicates that lower growth rate might be expected during the period 5th November 75 to 21 January 76, when the morean minima are noticably lower. However, the winter months remained sunny with no overcast sky so

that banking is readily possible. Hence water temperature may be of greater significance for growth. During the same period (5th Nov75 to21 Jan 76) maxima/minima water temperatures fell markedly. Examination of growth data (Table. IV) show that the growth for length in the rapidly growing Hogenakal group followed this anticipated pattern. The length increase for the other two groups are difficult to interpret. However,a low rate of growth was observed during the winter periods. Increase in weight does not correlate well with length increase and remained at a fairly high level during the winter months.

It is not possible to explain the weight losses which occured in the early part of the experiment notably in the Mettur Dam group but also to some extent in the Mayur and Hogenakal groups.

Mean growth rates/month(length)averaged throughout the experimental period were as follows; Hogenakal 18cm, Mayur 7cm, Mettur Dam 9cm.

Mugger breeding has been a regular feature of the North Indian zoos of Ahmedabad and Jaipur. David Reuben (1970) states that the early growth rate for C. palustris is 2.5cm/month. Malhotra (1975) provided data on three individuals reared at Delhi Zoological Park, two of which died during the experiment. He states that the growth rate was 2.5cm/month during the summer. However, two of the three individuals reared were not alive during summer and careful scrutiny of his table indicates that the actual growth rate/month was 8,6,4cm for the three individuals respectively. His weight increases also appear extremely low. The sole surviving individual at an age of seven months weighing only 128g.

A C K N O W L E D G E M E N T

Binod C. Choudhury and Lala A.K .Singh both are in receipt of Research Scholarships from the State Government of Orissa , through the State Crocodile Project under the Forest Department, to study on the Indian Mugger and Gharial respectively. Mr. Robert Bustard is a FAO Staff Member. We acknowledge our sincere thanks to our respective organisations and the Government of India.

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Table.I. Temperature data from the Stevenson's screen and water of the rearing pools. The fortnightly max/min averages are followed by the range in brackets.

PERIOD	POOL		SCREEN	
	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM
15.8.75 to 4.9.75	29.6 (26.5 - 31.5)	27.5 (26.0 - 28.5)	31.65 (26.5 - 30.5)	25.5 (24.5 - 29.5)
4.9.75 to 24.9.75	31.0 (29.0 - 33.0)	28.4 (27.0 - 30.5)	32.5 (24.7 - 36.5)	24.6 (23.5 - 25.7)
24.9.75 to 8.10.75	31.2 (29.5 - 32.5)	28.1 (26.7 - 29.5)	32.7 (27.5 - 34.7)	24.0 (23.5 - 25.5)
8.10.75 to 22.10.75	31.2 (29.5 - 33.5)	27.5 (26.5 - 28.5)	33.3 (30.5 - 36.2)	24.0 (23.5 - 26.5)
22.10.75 to 5.11.75	30.4 (29.5 - 31.5)	27.0 (24.5 - 28.5)	31.3 (31.5 - 36.5)	22.2 (18.5 - 24.5)
5.11.75 to 19.11.75	25.0 (22.7 - 29.5)	21.2 (17.5 - 25.5)	29.0 (27.7 - 31.0)	14.0 (10.5 - 20.5)
19.11.75 to 3.12.75	23.7 (20.5 - 25.7)	20.0 (19.0 - 21.5)	28.2 (24.5 - 33.2)	11.8 (9.0 - 17.2)
3.12.75 to 22.12.75	23.5 (20.5 - 25.5)	17.9 (12.0 - 20.2)	26.4 (21.5 - 33.0)	7.8 (5.5 - 11.2)
22.12.75 to 14.1.76	23.9 (21.5 - 26.5)	19.3 (17.0 - 19.5)	26.9 (26.5 - 29.0)	7.4 (5.0 - 12.0)
14.1.76 to 28.1.76	23.3 (20.5 - 25.5)	19.5 (18.5 - 20.5)	28.3 (26.5 - 30.5)	9.8 (7.5 - 10.2)
28.1.76 to 12.2.76	23.6 (26.5 - 30.5)	20.5 (19.0 - 22.5)	30.1 (27.0 - 32.5)	11.8 (8.5 - 17.7)

Table II. Range and mean of growth in total length (TL) and length of the tail (T) and ratio of T to TL (T/TL) of *S. salaria* at 2-week intervals.

Date of measurements	GROUP A			GROUP B			GROUP C		
	TL	T	T/TL	TL	T	T/TL	TL	T	T/TL
15.8.75	-	-	-	372 (351-387)	-	-	386 (373-419)	-	-
4.9.75	530 (453-567)	251 (231-263)	50.3	387 (357-430)	186 (177-204)	48.5	409 (396-429)	206 (199-216)	50.3
24.9.75	523 (470-567)	260 (233-285)	49.7	402 (350-445)	195 (181-220)	48.5	419 (403-440)	209 (201-220)	49.8
8.10.75	535 (486-580)	268 (246-286)	50.0	406 (361-460)	197.5 (181-230)	48.4	420 (403-440)	211 (201-222)	50.2
22.10.75	549 (500-600)	273 (251-290)	49.7	408 (361-473)	198 (181-234)	48.5	422 (403-440)	213 (201-226)	50.4
5.11.75	564 (512-603)	279 (254-292)	49.4	408 (361-473)	198 (181-233)	48.5	423.5 (403-440)	213 (201-226)	50.2
19.11.75	565 (512-604)	281 (254-295)	49.8	409.5 (361-476)	200 (181-239)	48.8	423.5 (403-442)	215 (201-226)	50.7
5.12.75	566 (512-607)	280 (254-297)	49.4	410 (361-478)	200 (181-239)	48.7	423.5 (403-442)	215 (201-226)	50.7
22.12.75	569 (512-607)	280 (254-298)	49.4	411 (361-481)	200 (181-239)	48.7	426 (403-442)	215 (204-226)	50.4
14.1.76	576 (520-610)	286 (260-305)	49.6	411 (361-486)	202 (181-247)	49.1	427 (403-446)	215 (204-226)	50.3
28.1.76	583 (530-630)	286 (262-309)	48.7	414 (364-499)	202 (181-247)	48.7	429 (403-446)	215 (205-226)	50.1
12.2.76	586 (530-630)	296 (263-329)	50.3	414 (364-490)	202 (181-247)	48.7	432 (405-449)	219 (205-237)	50.6

588
459
129
Length increase in 6 months -

588
459
129

588 - Tail length
129 - 588
129 x 100
588

Table III. Range and means of growth in weight (in gm) of *O. pluvialis* at 2-weeks interval.

Date of measurement	GROUP A		GROUP B		GROUP C	
	MEAN	RANGE	MEAN	RANGE	MEAN	RANGE
15.8.75	401	321 - 600	177	138 - 195	156	140 - 195
4.9.75	444	321 - 600	216	170 - 261	223	202 - 260
24.9.75	442	305 - 600	231	143 - 304	202	181 - 231
8.10.75	547.5	386 - 730	239	135 - 379	193	170 - 213
22.10.75	530	402 - 720	183	125 - 346	196	177 - 215
5.11.75	596	410 - 780	220	139 - 375	212	194 - 230
19.11.75	651	440 - 807	227	123 - 413	227	205 - 235
5.12.75	691	470 - 837	236	129 - 411	248	220 - 270
22.12.75	722	490 - 899	263	124 - 472	254	227 - 272
14.1.76	759	545 - 940	272	128 - 497	248	227 - 271
28.1.76	866	546 - 955	282	130 - 521	259	228 - 285
12.2.76	828	601 - 997	295	123 - 560	268	241 - 299

Table IV. Mean growth in length (in mm) and weight (in gm) of the three groups of *L. palustris* hatchlings in monthly periods coinciding with temperature data in Table I.

PERIOD	NORMAL GROUP (A)		DWARF GROUP (B)		SLOWER GROWTH RATE GROUP (C)	
	Length	Weight	Length	Weight	Length	Weight
September/ October (4.9-2.10)	36	101.5	21	12.7	21	-30.0
October/ November (3.10-5.11)	20	48.5	0	-1.75	3.5	19.25
November/ December (5.11-3.12)	2	35	2	16	0	35.25
December/ January (3.12-7.1)	10	60.7	1	36	3.5	0.7
January/ February (14.1-12.2)	12	69	3	23	5	19.3

Dear Lala,

Here is the replies of the questions you had sent to me about our paper on growth rate of C.palustris.

1. Page 2. Results: para 3.

Total growth from 15.8 .75 to 12.2.76 was obtained by deducting the weight of (Mean) of 15.8.75 from mean weight of 12.2.76.

Percentage was calculated like this: $\frac{\text{growth in this period}}{\text{FINAL LENGTH ON 12.2.76}} \times 100$

2 Page 4 Line 2.

THIS SHOUD BE FROM 5.Novto 14Jan (Not 21 Jan) when the water temperature was very low .

3. Page 4 , 3rd para.

Mean growth was obtained by dividing: $\frac{\text{total growth during the experimental period}}{\text{Total period (I have taken this as 6 month)}}$

INDIA

T

MADRAS

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TAMILNADU