

## ESTIMATION OF THEORETICAL HARVESTABLE SIZE OF INDIAN MAJOR CARPS IN VALLABH SAGAR RESERVOIR, GUJARAT (INDIA)

N.C.UJJANIA & NANDITA SONI

Department of Aquatic Biology, Veer Narmad, South Gujarat University, Surat, Gujarat, India

### ABSTRACT

The present study describes the method and utility of theoretical harvestable size of Indian major carps (*Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*) from a Vallabhsagar reservoir (Gujarat). For the study, scale samples and morphometric measurements were taken from catla (647), rohu (662) and mrigal (1053) during June 2012 to May 2013. During the investigation, the mean length and weight (78.760 cm and 7587.600 gm) in catla, (66.655 cm and 3956.700 gm) in rohu and (70.160 cm and 3697.0 gm) in mrigal were observed. The results revealed that the fishes of Vallabh Sagar can be harvested at +1 to +2 years of age in the length range 46.16-58.57 cm for catla, 40.68-51.56 cm for rohu and 40.7850.99 for mrigal. Such kind of study on Indian major carps of Vallabhsagar reservoir (Gujarat) was attempted for the first time and it will provide some basic information on fish biology, which would be helpful for the scientific management of fisheries in this water body.

**KEYWORDS:** Catla, Harvestable Size, Mrigal, Rohu, Vallabh Sagra

### INTRODUCTION

Capturing the fish at a theoretical harvestable size has the applicability to increase total biomass production and is appropriately useful for sustainable fisheries (Johal and Kingra, 1989; Jhingran, 1991 and Ujjania, 2003).

Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) are the most preferred and rapid growing fishes which were accepted as a potential aquaculture fish species in different parts of the world, including India, Pakistan, Bangladesh, Myanmar and other South Asian countries (Jhingran, 1968). Thus, the present study elucidated theoretical harvestable size of these cultivable species in large reservoir and such information would be helpful and supportive to manage the water body and maintain the sustainability of aquatic resources.

### MATERIALS AND METHODS

Vallabhsagar reservoir is popularly known as Ukai dam, which is one of the largest reservoirs of Gujarat and is situated on 73° 32' 25" to 78° 36' 30" East longitudes and 20° 5' 0" to 22° 52' 30" North latitudes geographical location and is constructed across the Tapi river in 1972 (Figure. 1). The morphometric features of the reservoir include height 80.772 meters, length 4972 meters, water storage capacity 7414.29 Mm<sup>3</sup>, surface area 612 km<sup>2</sup> and catchment area 62,255 km<sup>2</sup>.

Scale samples were collected from catla (647), rohu (662) and mrigal (1053) specimens during June 2012 to May 2013. About 5-6 scales from each fish were collected in a paper envelope with keynote information (total length in cm, standard length in cm, weight in gm, date of collection fish species, etc.). For the study, scales were dipped in 1 % KOH solution for 5-10 minutes and rubbed with fingertip to remove extraneous matter and mucous, cleaned and transparent

scales were examined for scale radius (S) and radius of each annual ring ( $S_1, S_2, S_3, S_4, \dots, S_n$ ). Was measured with the help of 4P scale reader (Ujjania et al., 2014)

The calculation of length, age and harvestable size were estimated to follow the methodology described as below

#### Length Calculation (Bagenal and Tesch, 1978)

$$L_1 = a + (S_1 / S) \times (L-a)$$

$$L_2 = a + (S_2 / S) \times (L-a)$$

$$L_3 = a + (S_3 / S) \times (L-a)$$

$$L_n = a + (S_n / S) \times (L-a)$$

#### Annual Length Increment (H)

$$\text{Annual length increment for 1}^{\text{st}} \text{ year } (H_1) = L_1$$

$$\text{Annual length increment for 2}^{\text{nd}} \text{ year } (H_2) = L_2 - L_1$$

$$\text{Annual length increment for 3}^{\text{rd}} \text{ year } (H_3) = L_3 - L_2$$

$$\text{Annual length increment for } n^{\text{th}} \text{ year } (H_n) = L_t - L_{t-1}$$

#### The Percentage of Annual Length Increment in Descending Order (A)

$$A \text{ at } 1^{\text{st}} \text{ year } (A_1) = H_1 / H_1 * 100$$

$$A \text{ at } 2^{\text{nd}} \text{ year } (A_2) = H_2 / H_1 * 100$$

$$A \text{ at } 3^{\text{rd}} \text{ year } (A_3) = H_3 / H_1 * 100$$

$$A \text{ at } n^{\text{th}} \text{ year } (A_n) = H_n / H_1 * 100$$

#### Percentage of Annual Length Increment Ascending Order (B)

$$B \text{ at } 1^{\text{st}} \text{ year } (B_1) = L_1 / L_n * 100$$

$$B \text{ at } 2^{\text{nd}} \text{ year } (B_2) = L_2 / L_n * 100$$

$$B \text{ at } 3^{\text{rd}} \text{ year } (B_3) = L_3 / L_n * 100$$

$$B \text{ at } n^{\text{th}} \text{ year } (B_n) = L_n / L_n * 100$$

#### Harvestable Size

For the estimation of the theoretical harvestable size, graph was plotted to calculate length increments (A and B) in that two variables (A and B) along the Y-axis and age classes along X-axis. The intercept of variables and correspondent age class is considered the theoretical harvestable size.

## RESULTS AND DISCUSSIONS

The theoretical harvestable size of catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) in the Vallabh Sagar reservoir were estimated from the back calculated lengths, which were obtained from the scale study and percentage of length increments. During the present study, minimum length and weight (34.0 cm and 490.0 gm), maximum

length and weight (99.0 cm and 16097.0 gm) and mean length and weight (78.760 cm and 7587.600 gm) were observed in catla and minimum length and weight (37.0 cm and 623.0 gm), maximum length and weight (86.0 cm and 8236.0 gm) and mean length and weight (66.655 cm and 3956.700 gm) were observed in rohu, while it was (39.0 cm and 582.0 gm), (88.5 cm and 9700.0 gm) and (70.160 cm and 3697.0 gm) minimum, maximum and mean length and weight respectively in mrigal (Table 1).The theoretical harvestable size of a fish was estimated to recommend the harvest of a fish at a particular age and length. In current study, according to figure 2 (i, ii & iii) fish can be harvested at +1 to +2 year of age and at this age the length range was 46.16-58.57 cm for catla, 40.68-51.56 cm for rohu and 40.7850.99 formrigal (Table 2).

**CONCLUSIONS**

The findings of current observations are more than the legal limit of prohibiting the fish catch (< 30 cm total length) of commercial fishing in northern India (Jhingran, 1991).Johal and Tandon (1987) also reported by minimum harvestable size in the range of 44.9 – 54.0 cm for *L. Rohita* from the reservoirs of northern India. Singh *et al.* (1998) suggested of 46.0 cm as the harvestable size for *L. rohita* from Lake Jaisamand located in district of Udaipur (Rajasthan). Jain (2000) reported the harvestable 56.5 cm, 58.0 cm and 53.5 cm of *C. catla*, *L. rohita* and *C. mrigala* respectively from Siliser reservoir, Alwar (Rajasthan). *C. catla* attained a theoretical harvestable size at an age of 1+ year having an approximate length 42.00, 44.00 and 48.00 cm, *L. Rohita* attained a theoretical harvestable size at a length of 49.00, 51.00 and 49.00 cm between 1 and 1.5 years of age and *C. Mrigala* attained the theoretical harvestable size at a body length of 58.00, 54.00 and 46.00 cm at the age 1 to 1.5 years of age from Mahi Bajaj Sagar, Surwania Dam and Aasan Pond, respectively, which were situated in southern Rajasthan Ujjania (2003) these findings were very close to the present study.

**Table 1: Morphometric Parameters (Total Length and Weight) of Catla in Vallabh Sagar Reservoir**

Species	N	Morphometric parameters		
			TL (cm)	WT (gm)
Catla	647	Minimum	34.000	496.000
		Maximum	99.000	16097.000
		Mean	78.760	7587.600
Rohu	662	Minimum	37.500	623.000
		Maximum	86.000	8236.000
		Mean	66.655	3956.700
Mrigal	1053	Minimum	39.500	582.000
		Maximum	88.200	9700.000
		Mean	70.160	3697.000

**Table 2: Back-Calculated Length and Length Increments for Harvestable Size**

Species	P	Age in years												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Catla	L	46.16	58.57	66.72	72.78	77.58	81.62	85.3	88.72	91.39	92.98	93.84	94.56	95.17
	H	46.16	12.41	8.15	6.06	4.8	4.04	3.68	3.42	2.67	1.59	0.86	0.72	0.61
	A	100.0	26.9	17.7	13.1	10.4	8.8	8.0	7.4	5.8	3.4	1.9	1.6	1.3
	B	48.5	61.5	70.1	76.5	81.5	85.8	89.6	93.2	96.0	97.7	98.6	99.4	100.0
Rohu	L	40.68	51.56	61.15	67.57	72.18	76.19	79.07	81.33	83.35	85.04	-	-	-
	H	40.67	10.89	9.58	6.42	4.61	4.01	2.88	2.26	2.02	1.69	-	-	-
	A	100.0	26.8	23.6	15.8	11.3	9.9	7.1	5.6	5.0	4.2	-	-	-
	B	47.8	60.6	71.9	79.5	84.9	89.6	93.0	95.6	98.0	100.0	-	-	-
Mrigal	L	40.78	50.99	59.82	66.32	70.72	74.56	77.80	80.23	82.51	-	-	-	-
	H	40.78	10.21	8.83	6.50	4.40	3.84	3.24	2.42	2.28	-	-	-	-
	A	100.0	25.0	21.7	15.9	10.8	9.4	7.9	5.9	5.6	-	-	-	-
	B	49.4	61.8	72.5	80.4	85.7	90.4	94.3	97.2	100.0	-	-	-	-

P-parameters, L-length, H-Annual length increments, A-% of the length increment in descending order and B-% of the length increment in Ascending order

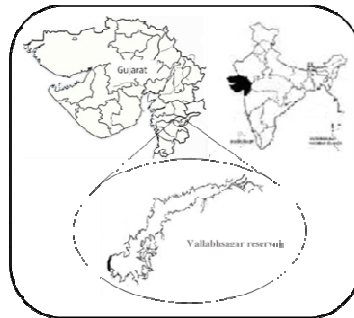


Figure 1: Map Showing the Location of Study Area

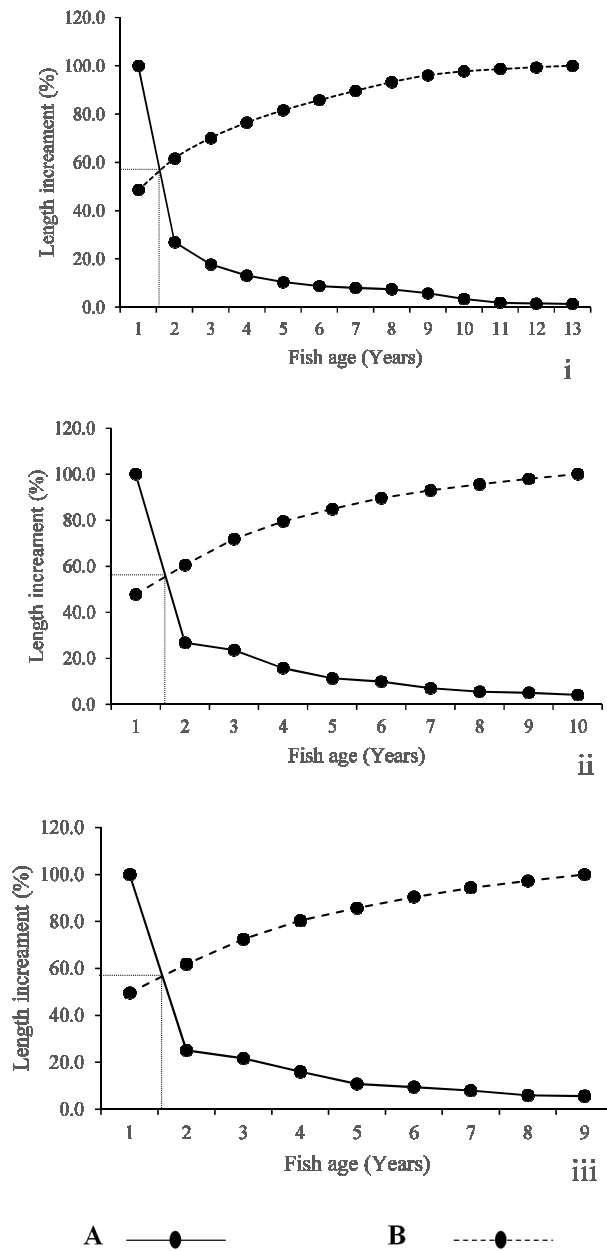


Figure 2: Harvestable Size of Indian Major carps (i - catla, ii - rohu and iii - mrigal)

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