



## Effect of altitudinal variation on Physico-chemistry of Eastern Nayar Garhwal, Uttarakhand, India

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ABSTRACT

An investigation was carried out to study the variation in the physico-chemical parameters in different altitude location (500 to 1600 masl) of the river Eastern Nayar in Garhwal, Uttarakhand. Water temperature 8.5 OC to 29 OC. Water current velocity ranges from 0.28 m/sec to 0.81 m/sec, pH ranges (7.3 to 8.2), Total hardness varies from 56.5 to 94.0 mg/l, Dissolved oxygen (8.2 to 11.6 mg/l), Free CO<sub>2</sub> (0.0 mg/l to 2.1 mg/l), Total alkalinity (19.6 mg/l to 34.6 mg/l), Nitrate (0.03 to 0.084 mg/l), Phosphate (0.017 to 0.052 mg/l) respectively were recorded in the Eastern Nayar. Fluctuation in the date is due to the altitudinal variation

## KEYWORDS

Physico-chemical parameters, altitude, Eastern Nayar

## INTRODUCTION

Ecology of river is considerably influenced by geomorphology and altitude (Ghimire et al., 2013). Nayar is an important spring feed stream of Garhwal Himalaya formed by the confluence of two parent streams the Eastern Nayar and Western Nayar at Nagaon Kamand near Satpuli (630 masl). After travelling a distance of about 22 km from here onwards, the river finally drops in the Holy River Ganga at Vyasgat (447 masl). The river is of great importance the Garhwal region as it forms an abode for many hill stream fishes specially the endangered major sport fish mahseer (*Tor tor* and *T. putitora*). The early investigations (Natuyal, 1982; Dobriyal, 1983) on the fishery system of River Nayar opined that due to good water quality and good benthic life, the river Nayar is conducive for fish life. Also, it has been reported that river have a suitable breeding grounds, Nayar forms an abode for Mahseer. Although several literature exists on the water quality of Garhwal riverine system Singh et. al. (1982, 1994), Sharma (1984), Agarwal et. al. (2003), Khanna et al. (2010) Madan, (2013), Matta (2014). Hence an attempt has been made to study the Effect of altitudinal variation on Physico-chemistry of Eastern Nayar at Thalissain (1550 masl) and Danagal (580 masl) during the year 1996. The preliminary information that was collected from our study will be useful in future to study the aquatic fauna of the Nayar.

## MATERIAL AND METHODS

Water samples were collected as per standard methods APHA (1995) during January 1996 to December 1996. Physical parameters like water temperature, pH were measured immediately by using digital pen type thermometer and digital pH meter by dipping them in the water for five minutes in each sampling station respectively. Water velocity is measured by using floating block (m/s) method. The other chemical parameters like dissolved oxygen, free carbon dioxide, alkalinity, hardness, turbidity, phosphate and nitrate content were analyzed (Trivedy and Goel, 1986). MS Excel was used for the statistical data analysis.

## RESULT AND DISCUSSION

Monthly variation in physico-chemical parameters in the River Eastern Nayar at Thalissain and Danagal spot were presented in Table 1 and 2 respectively.

Water temperature the minimum value of water temperature was 8.5 °C in December and maximum 23.0 °C in June at Thalissain and 13.4 and 29 °C value of water in Danagal during the study

Water current velocity ranges from 0.28 m/sec in spot Thalissain in December 1996 and 0.81 m/sec in July and value re-

corded from Danagal was 0.24 m/sec in December and 62 in July from the observation it has been derived that the water move faster in the Thalissain then Danagal spot

pH the value recorded at the spot Thalissain were 7.3 in July-August and 8.0 December and corresponding 7.3 in July and 8.2 in February-December in Danagal. The water of the eastern Nayar is alkaline as the study indicate

Total harness varies from 56.5 mg/l to 70.4 mg/l in Thalissain in June and February month respectively. Values recorded from Danagal were 65.0 mg/l in June and 94.0 mg/l in July.

Dissolved oxygen the value ranges from 8.2 to 11.6 mg/l in Thalissain during the month August and December respectively. And the value recorded was 8.7 mg/l in July 11.2 mg/l in December from Danagal spot. A good water having solubility of oxygen more than 6 and the similar result our study (Miller, 1994)

Free CO<sub>2</sub> during study the maximum value of free carbon dioxide at Thalissain 2.1 mg/l in August, minimum 0.21mg/l in September. During January –May and October to December, the value were nil. At the Danagal spot maximum free CO<sub>2</sub> recorded was 2.1 mg/l in July and minimum being 0.3 mg/l in June and September. However, no free carbon dioxide was recorded during January- May and October to December

Total alkalinity minimum value was 19.6 mg/l in July, 34.6 mg/l in February and November at Thalissain simultaneously 21.5 mg/l in July, and 42.1 in December in Danagal spot.

Nitrate (NO<sub>3</sub>-N) in Thalissain the minimum nitrate-n was observed in January being 0.03 mg/l, while the maximum value 0.084 mg/l was observed in June. For the Danagal the minimum value nitrate-N was observed 0.035 mg/l in January and maximum 0.078mg/l in august

Phosphate (PO<sub>4</sub>-P) the value of phosphates in spot Thalissain was minimum was 0.017 in February and maximum value obtained in August 0.045 mg/l, in Danagal 0.052 mg/l in July, 0.023 mg/l in January was recorded.

Seasonal variation was also observed during the study by pooling the data in four seasons winter (Dec-Feb) Summer (Mar-May) Monsoon (June-Aug) and Autumn (Sept-Nov) showed in Table 3 and 4. Variation date in between Thalissain and Danagal is presented in Fig 1 show the fluctuation in two selected spot indicate that the physico-chemistry of the water is effected by the environmental factor and also by altitude, physiogeography of the study area (Ghimire et al., 2013). Sim-

ilar information was gathered in present study at Easter Nayar in Uttarakhand India. From over all data it is clear that the Nayar water was not polluted till date but care should be taken to conserve the water from unwanted waste so the aquatic fauna of the river will be conserved in future.

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**Table 1-Monthly variation of the physico- chemical parameters in the upper stretches of river Eastern Nayar during 1996 (Thalisain)**

Months	Water temp. °C	Water velocity (m/sec)	Turbidity (NTU)	pH	Total Hardness (mg/l)	DO (mg/l)	CO <sup>2</sup> (mg/l)	Total alkalinity(mg/l)	Nitrate (mg/l)	Phosphate (mg/l)
January	12.8	0.32	8.8	8.1	80.3	10.9	0	38	0.035	0.023
February	14.6	0.35	9.6	8.2	78.2	10.7	0	37	0.041	0.028
March	19.2	0.34	10.4	7.8	76	10.6	0	40	0.056	0.032
April	23.8	0.28	10.6	7.8	74	10.4	0	34	0.056	0.042
May	26.5	0.29	11.3	7.7	68	10.2	0	28.5	0.042	0.036
June	28.1	0.32	12.4	7.7	65	9.8	0.3	27.4	0.074	0.028
July	27.2	0.62	111.2	7.3	94	8.4	2.1	21.5	0.073	0.052
August	27.3	0.58	94	7.4	86	8.7	1.6	28.5	0.076	0.048
Sept.	23.4	0.36	48.3	7.7	75	9.8	0.3	36.2	0.078	0.036
Oct.	22.8	0.31	21	7.9	80	10.2	0	39.4	0.065	0.037
Nov.	16.4	0.26	12	8.1	82	10.4	0	41.3	0.054	0.031
Dec.	13.2	0.24	10	8.2	84	11.3	0	42.1	0.038	0.029
<b>Mean</b>	<b>21.28</b>	<b>0.36</b>	<b>29.97</b>	<b>7.83</b>	<b>78.54</b>	<b>10.12</b>	<b>0.36</b>	<b>34.49</b>	<b>0.06</b>	<b>0.04</b>
<b>SD±</b>	<b>±5.79</b>	<b>±0.12</b>	<b>±35.82</b>	<b>±0.29</b>	<b>±7.84</b>	<b>±0.85</b>	<b>±0.71</b>	<b>±6.55</b>	<b>±0.02</b>	<b>±0.01</b>

**Table 2-Monthly variation of the physico- chemical parameters in the upper stretches of river Eastern Nayar during 1996 (Danagal)**

Months	Water temp. °C	Water velocity (m/sec)	Turbidity (NTU)	pH	Total Hardness (mg/l)	DO (mg/l)	CO <sup>2</sup> (mg/l)	Total alkalinity(mg/l)	Nitrate (mg/l)	Phosphate (mg/l)
January	8.5	0.39	6	7.7	68.3	11.7	0	32.6	0.03	0.018
February	9.8	0.38	6	7.8	70.4	11.4	0	34.6	0.036	0.017
March	13.6	0.48	8	7.8	72	11	0	33.7	0.038	0.021
April	16.8	0.51	10	7.7	64.3	10.8	0	28.2	0.032	0.026
May	19.2	0.52	9.5	7.6	62.6	10.3	0	26.4	0.046	0.028
June	21.8	0.37	9.5	7.6	56.5	10.1	0.6	31.2	0.084	0.031
July	20.8	0.81	70.3	7.3	63.6	8.7	1.9	19.6	0.076	0.042
August	19.2	0.68	60.4	7.3	68.4	9.2	2.1	24.9	0.052	0.045
Sept.	17.2	0.42	30.3	7.4	66.2	10.8	0.21	30.6	0.056	0.041
Oct.	14.3	0.37	15	7.7	67.3	11.2	0	32.4	0.048	0.043
Nov.	10.6	0.32	7.8	7.8	69.4	11.3	0	34.6	0.043	0.032
Dec.	9.4	0.28	6.6	8	70.2	12.1	0	33.8	0.041	0.028
<b>Mean</b>	<b>15.1</b>	<b>0.46</b>	<b>19.95</b>	<b>7.64</b>	<b>66.6</b>	<b>10.72</b>	<b>0.4</b>	<b>30.22</b>	<b>0.05</b>	<b>0.03</b>
<b>SD±</b>	<b>±4.72</b>	<b>±0.15</b>	<b>±22.32</b>	<b>±0.22</b>	<b>±4.30</b>	<b>±1.00</b>	<b>±0.77</b>	<b>±4.62</b>	<b>±0.02</b>	<b>±0.01</b>

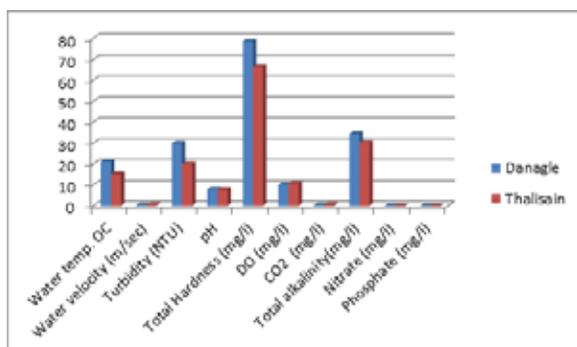
**Table 3-Seasonal variation of the physico- chemical parameters in the upper stretches of river Eastern Nayar during 1996 (Thalisain)**

Season	Winter	Summer	Monsoon	Autumn
Water temp.	9.23±0.67	16.53±2.81	20.60±1.31	14.03±3.31
Water velocity	0.35±0.06	0.50±0.02	0.62±0.23	0.37±0.05
Turbidity	6.20±0.35	9.17±1.04	46.73±32.62	17.70±11.49
pH	7.83±0.15	7.70±0.10	7.40±0.17	7.63±0.21
T. Hardness	69.63±1.16	66.30±5.01	62.83±5.99	67.63±1.63
DO	11.73±0.35	10.70±0.36	9.33±0.71	11.10±0.26
CO <sup>2</sup>	0.00±0.00	0.00±0.00	1.53±0.81	0.07±0.12
T. alkalinity	33.67±1.01	29.43±3.80	25.23±5.81	32.53±2.00
Nitrate	0.04±0.01	0.04±0.01	0.07±0.02	0.05±0.01
phosphate	0.02±0.01	0.03±0.00	0.04±0.01	0.04±0.01

**Table 4-Seasonal variation of the physico- chemical parameters in the upper stretches of river Eastern Nayar during 1996 (Danagal)**

Season	Winter	Summer	Monsoon	Autumn
Water temp.	13.53±0.95	23.17±3.69	27.53±0.49	20.87±3.88
Water velocity	0.30±0.06	0.30±0.03	0.51±0.16	0.31±0.05
Turbidity	9.47±0.61	10.77±0.47	72.53±52.78	27.10±18.90
pH	8.17±0.06	7.77±0.06	7.47±0.21	7.90±0.20
T. Hardness	80.83±2.94	72.67±4.16	81.67±14.98	79.00±3.61
DO	10.97±0.31	10.40±0.20	8.97±0.74	10.13±0.31
CO <sup>2</sup>	0.00±0.00	0.00±0.00	1.33±0.93	0.10±0.17
T. alkalinity	39.03±2.70	34.17±5.75	25.80±3.76	38.97±2.58
Nitrate	0.04±0.00	0.05±0.01	0.07±0.00	0.07±0.01
phosphate	0.03±0.00	0.04±0.01	0.04±0.01	0.03±0.00

**Fig1 Extent of physico-chemical parameters in Thalissain and Danagal spot**



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