



# **DETERMINATION OF PHYTOPLANKTON SINKING RATE IN NORTHERN BAY OF BENGAL: COMPARATIVE STUDY OF SEASONAL CARBON ABSORPTION**

**Mishu Acharjee**

Roll No.: 0119/17

Registration No.: 716

Session: 2019-2020

**A thesis submitted in the partial fulfillment of the requirements for the degree of  
Master of Science in Marine Bioresource Science**

**Department of Marine Bioresource Science**

**Faculty of Fisheries**

**Chattogram Veterinary and Animal Sciences University**

**Chattogram 4225, Bangladesh**

**April, 2021**

## **Authorization**

I hereby declare that I am the sole author of the thesis. I also authorize the Chattogram Veterinary and Animal Sciences University (CVASU) to lend this thesis to other institutions or individuals for the purpose of scholarly research. I further authorize the CVASU to reproduce the thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I, the undersigned, and author of this work, declare that the **electronic copy** of this thesis provided to the CVASU Library, is an accurate copy of the print thesis submitted, within the limits of the technology available.

**Mishu Acharjee**

**April, 2021**

# **DETERMINATION OF PHYTOPLANKTON SINKING RATE IN NORTHERN BAY OF BENGAL: COMPARATIVE STUDY OF SEASONAL CARBON ABSORPTION**

Roll No.: 0119/17

Registration No.: 716

Session: 2019-2020

**This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made**

.....  
**Prof. DR. Omar Faruk Miaz**

**Supervisor**

.....  
**Avijit Talukder**

**Co-supervisor**

.....  
**Dr. Mohammad Sadequr Rahman Khan**

**Chairman of the Examination Committee**

**Department of Marine Bioresource Science**

**Faculty of Fisheries**

**Chattogram Veterinary and Animal Sciences University**

**Khulshi, Chattogram-4225, Bangladesh**

**April, 2021**

*Dedicated  
To  
My Beloved Parents  
And  
Elder Brother*

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE NO.
	<b>AUTHORIZATION</b>	<b>ii</b>
	<b>LIST OF TABLES</b>	<b>viii</b>
	<b>LIST OF FIGURES</b>	<b>ix-x</b>
	<b>LIST OF APPENDICES</b>	<b>xi</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>xii</b>
	<b>ABSTRACTS</b>	<b>xiii</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>01-06</b>
	<b>1.1 Background</b>	<b>1-4</b>
	<b>1.2 Statement of the problem</b>	<b>4</b>
	<b>1.3 Research Queries</b>	<b>4</b>
	<b>1.4 Significance of the study</b>	<b>4</b>
	<b>1.5 Objectives of the research work</b>	<b>5</b>
	<b>1.6 Thesis Roadmap</b>	<b>5</b>
	<b>1.7 Restraints features of the study</b>	<b>5-6</b>
<b>2</b>	<b>REVIEW OF LITERATURE</b>	<b>7-11</b>
<b>3</b>	<b>MATERIALS AND METHODS</b>	<b>12-22</b>
	<b>3.1 Research extend</b>	<b>12</b>
	<b>3.2 Sampling incidences and premeditated parameters:</b>	<b>13</b>
	<b>3.2.1. Water collection for SETCOL and parameter testing</b>	<b>13</b>
	<b>3.3. Analysis of bio chemical parameters</b>	<b>14</b>
	<b>3.3.1. Analysis of physic-chemical water quality parameters</b>	<b>14</b>
	<b>3.3.1.1 Total Suspended Solid (TSS)</b>	<b>14</b>
	<b>3.3.1.2 Nitrite-nitrogen (NO<sub>2</sub>-N)</b>	<b>15</b>
	<b>3.3.1.3 Phosphate-Phosphorus (PO<sub>4</sub>-P)</b>	<b>16</b>
	<b>3.3.1.4 Silicate-Silicon (SiO<sub>3</sub>-Si)</b>	<b>16</b>
	<b>3.4 SETCOL</b>	<b>17</b>

	<b>3.5 Chlorophyll-a measurement</b>	<b>18</b>
	<b>3.6 Phytoplankton sinking rate measurement</b>	<b>19</b>
	<b>3.7 Qualitative and quantitative estimations of plankton</b>	<b>20</b>
	<b>3.8 Carbon flux determination</b>	<b>21</b>
	<b>3.8.1 Total carbon estimation in each cell and a specific depth</b>	<b>22</b>
	<b>3.9 Data Analysis</b>	<b>22</b>
<b>4</b>	<b>RESULTS</b>	<b>23-39</b>
	<b>4.1 Physic-chemical parameters</b>	<b>23</b>
	<b>4.1.1 Temperature</b>	<b>23</b>
	<b>4.1.2 Water pH</b>	<b>24</b>
	<b>4.1.2 Water salinity</b>	<b>24</b>
	<b>4.1.4 Total Dissolve Solid (TDS) and Total Suspended Solid (TSS)</b>	<b>25</b>
	<b>4.1.5 Nutrients (NO<sub>2</sub>-N, PO<sub>4</sub>-P and SiO<sub>3</sub>-Si)</b>	<b>26-27</b>
	<b>4.1.6 Chlorophyll-a</b>	<b>27</b>
	<b>4.2 Phytoplankton Sinking Rate</b>	<b>28</b>
	<b>4.3 Total Carbon</b>	<b>29</b>
	<b>4.4 Carbon flux</b>	<b>30</b>
	<b>4.5 Phytoplankton composition and abundance</b>	<b>30</b>
	<b>4.6 Pearson correlation among the factors</b>	<b>35</b>
	<b>4.6.1 Depth wise PCA of physic-chemical parameters</b>	<b>35</b>
	<b>4.6.2 Station wise PCA of physic-chemical parameters</b>	<b>37</b>
	<b>4.6.3 Season wise PCA of physic-chemical parameters</b>	<b>40</b>
<b>5</b>	<b>DISCUSSION</b>	<b>41-45</b>
	<b>5.1 SETCOL method-it's applicability in field use</b>	<b>41</b>
	<b>5.2 Potential uses and activities of the study</b>	<b>42</b>
	<b>5.3 Phytoplankton abundance and parameters effect</b>	<b>43</b>
	<b>5.4 Phytoplankton sinking rate and associated factors</b>	<b>44</b>
	<b>5.5 Carbon flux</b>	<b>44</b>
	<b>5.6 PCA discussion among depth, station and season</b>	<b>45</b>
<b>6</b>	<b>CONCLUSION</b>	<b>46</b>

<b>7</b>	<b>RECOMMENDATION AND FUTURE PERSPECTIVES</b>	<b>47</b>
	<b>REFERENCES</b>	<b>48-51</b>
	<b>APPENDICES</b>	<b>52-53</b>

## LIST OF TABLES

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
<b>1.</b>	<b>Mean <math>\pm</math> SD value of three stations and two seasons (BM=Bashbaria Monsoon, BW=Bashbaria Winter, PM=Patenga Monsoon, PW=Patenga Winter, TM=Teknaf Monsoon and TW=Teknaf Winter)</b>	<b>33</b>
<b>2.</b>	<b>Pearson correlation among the variables</b>	<b>35</b>



## LIST OF FIGURES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
<b>1.</b>	<b>Sampling locations in three stations</b>	<b>12</b>
<b>2.</b>	<b>Sample collection by Nansen water sampler</b>	<b>13</b>
<b>3.</b>	<b>Phytoplankton sample collection by plankton net</b>	<b>14</b>
<b>4.</b>	<b>SETCOL Bottle</b>	<b>17</b>
<b>5.</b>	<b>Chlorophyll-a estimation</b>	<b>19</b>
<b>6.</b>	<b>Phytoplankton counting and identification</b>	<b>21</b>
<b>7.</b>	<b>Temperature fluctuation among 3 stations</b>	<b>29</b>
<b>8.</b>	<b>pH fluctuation among 3 stations</b>	<b>24</b>
<b>9.</b>	<b>Salinity fluctuation among 3 stations</b>	<b>25</b>
<b>10.</b>	<b>TDS fluctuation among 3 stations</b>	<b>25</b>
<b>11.</b>	<b>Nutrients fluctuation among 3 stations</b>	<b>26</b>
<b>12</b>	<b>Chl-a fluctuation among 3 stations</b>	<b>27</b>
<b>13</b>	<b>Phytoplankton Sinking Rate fluctuation among 3 stations</b>	<b>28</b>
<b>14</b>	<b>TC fluctuation among 3 stations</b>	<b>29</b>
<b>15</b>	<b>Carbon Flux fluctuation among 3 stations</b>	<b>29</b>
<b>16</b>	<b>Phytoplankton abundance fluctuation among 3 stations</b>	<b>30</b>
<b>17</b>	<b>Phytoplankton abundance fluctuation among 3 stations</b>	<b>31</b>

<b>18</b>	<b>Some phytoplankton found during study period</b>	<b>31</b>
<b>19</b>	<b>Average and SD value comparison between two factors</b>	<b>32</b>
<b>20</b>	<b>PC 1 and PC 2(depth)</b>	<b>34</b>
<b>21</b>	<b>PC 3 and PC 4(depth)</b>	<b>36</b>
<b>22</b>	<b>PC 1 and PC 2(station)</b>	<b>36</b>
<b>23</b>	<b>PC 3 and PC 4(station)</b>	<b>37</b>
<b>24</b>	<b>PC 1 and PC 2(season)</b>	<b>38</b>
<b>25</b>	<b>PC 3 and PC 4 (season)</b>	<b>40</b>

## LIST OF APPENDICES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
<b>A</b>	<b>Table of pairwise comparison of sinking rate</b>	<b>52</b>
<b>B</b>	<b>A book of cell volume measurement</b>	<b>53</b>

## LIST OF ABBREVIATION

<b>SETCOL</b>	Setting Column
<b>DO</b>	Dissolve Oxygen
<b>Sig.</b>	Significance
<b>ppm</b>	Parts Per Million
<b>m/d</b>	Meter per day
<b>mg C/m<sup>-2</sup>d<sup>-1</sup></b>	Milligram carbon per square meter per day
<b>et al</b>	And his associates
<b>Min-max</b>	Minimum-Maximum
<b>%</b>	Percentage
<b>NS</b>	No Significance difference
<b>SD</b>	Standard Deviation
<b>MS</b>	Master of Science
<b>µg/L</b>	Microgram Per Liter
<b>g/L</b>	Gram per liter
<b>psu</b>	Practical Salinity Unit

## ABSTRACTS

Seasonal carbon flux via “Biological pump” associated with phytoplankton sinking rate were measured conducting this research during monsoon((August 2019) and winter (January 2019).It was done in the Northern east part of Bay of Bengal included three stations (Teknaf,Patenga and Bashbaria). Sinking rate was determined by homogeneous sample method SETCOL. Phytoplankton community was dominant by Bacillariophyceae, Dinophyceae and Chlorophyceae and ten dominant species. The average value found in Bashbaria was  $2.62 \pm 0.28$  m/d (monsoon) and  $1.89 \pm 0.48$  m/d (winter), in Patenga was  $2.30 \pm 0.15$  m/d (monsoon) and  $2.56 \pm 0.57$  m/d (winter), in Teknaf was  $2.40 \pm 0.06$  m/d (monsoon) and  $2.33 \pm 0.09$  m/d (winter).No significant correlation were found between phytoplankton sinking rate and most of the environmental parameters. During this study average total carbon flux was varied from  $5.69 \pm 0.61$  to  $3.99 \pm 1.02$  mg C/m<sup>2</sup>d<sup>-1</sup> in Bashbaria,  $9.07 \pm 0.61$  to  $8.24 \pm 1.84$  mg C/m<sup>2</sup>d<sup>-1</sup> in patenga and  $19.20 \pm 2.66$  to  $14.69 \pm 1.37$  mg C/m<sup>2</sup>d<sup>-1</sup> in Teknaf during monsoon and winter chlorophyll-a and Total carbon showed strong correlation with carbon flux. Two way ANOVA results Showed that variations in Carbon flux and phytoplankton sinking rate among 3 stations and 2 seasons and depth were significant ( $p < 0.05$ ) and PCA showed that there was a close correlation among Carbon flux,Chl-a and Total carbon but no correlation with sinking rateThis study provides an understanding the seasonal carbon export in the water column by dominant marine phytoplankton with an association of phytoplankton sinking.Teknaf coast is the prime contributor of daily carbon export from surface to the bottom among three stations and during monsoon this contribution is higher than winter Because of higher phytoplankton abundance than the other two stations.

**Keywords:** sinking rate, carbon flux, phytoplankton structure, carbon sequestration