

#### 4.1 SPECIES COMPOSITION OF PHYTOPLANKTON

At Pulau Carey mangrove ecosystem, there were 4 main divisions of phytoplankton found were Bacillariophyta (diatoms), Chlorophyta (green algae), Pyrrophyta (dinoflagellate) and Cyanobacteria (blue-green alga). A total of 84 species of phytoplankton was recorded and listed at Carey Island mangrove ecosystem. The species were classified into 23 orders and 32 families. Table 4.1 shows the list of species of phytoplankton at study site. Phytoplankton community at the study site was dominated, in term of spatio-temporal abundance, by *Skeletonema costatum*, *Leptocylindricus danicus*, *Thalassiothrix frauenfeldii*, *Coscinodiscus centralis*, *Coscinodiscus lineatus*, *Planktoniella sol*, *Pseudo-nitzschia pungens*, *Rhizosolenia* spp., *Biddulphia mobiliensis* and *Biddulphia longicuris*.

Table 4.1: List of species (arranged alphabetically), families, orders, and divisions of phytoplankton found at the study site at Carey Island.

|   | Species                              | Family                  | Order                  | Division               |
|---|--------------------------------------|-------------------------|------------------------|------------------------|
| 1 | <i>Chaetoceros constrictum</i> Gran  | <b>Chaetocerotaceae</b> | <b>Chaetocerotales</b> | <b>Bacillariophyta</b> |
| 2 | <i>Chaetoceros constrictus</i> Gran  |                         |                        |                        |
| 3 | <i>Chaetoceros curvisetus</i> Cleve  |                         |                        |                        |
| 4 | <i>Chaetoceros debilis</i> Cleve     |                         |                        |                        |
| 5 | <i>Chaetoceros decipiens</i> Cleve   |                         |                        |                        |
| 6 | <i>Chaetoceros delicatulum</i> Cleve |                         |                        |                        |
| 7 | <i>Chaetoceros distans</i> Cleve     |                         |                        |                        |
| 8 | <i>Chaetoceros lacinosum</i> Schutt  |                         |                        |                        |

Table 4.1 continued

|    |  |                         |                         |
|----|--|-------------------------|-------------------------|
| 9  | <i>Chaetoceros lauderi</i><br>Ralfs          |                         |                         |
| 10 | <i>Chaetoceros lorenzianus</i><br>Grunow     |                         |                         |
| 11 | <i>Chaetoceros neglectus</i><br>Karsten      |                         |                         |
| 12 | <i>Chaetoceros socialis</i><br>Lauder        |                         |                         |
| 13 | <i>Chaetoceros</i> sp.2                      |                         |                         |
| 14 | <i>Chaetoceros</i> sp.3                      |                         |                         |
| 15 | <i>Chaetoceros</i> sp.4                      |                         |                         |
| 16 | <i>Chaetoceros subtilis</i><br>Cleve         |                         |                         |
| 17 | <i>Chaetoceros tenuissimus</i><br>Meunier    |                         |                         |
| 18 | <i>Bacteriastrum comosum</i><br>Pavilliard   |                         |                         |
| 19 | <i>Bacteriastrum delicatulum</i><br>Cleve    |                         |                         |
| 20 | <i>Bacteriastrum varians</i><br>Lauder       |                         |                         |
| 21 | <i>Rhizosolenia alata</i><br>Brightwell      | <b>Rhizosoleniaceae</b> | <b>Rhizosoleniales</b>  |
| 22 | <i>Rhizosolenia hebetata</i><br>Grun         |                         |                         |
| 23 | <i>Rhizosolenia imbricate</i><br>Brightwell  |                         |                         |
| 24 | <i>Rhizosolenia setigera</i><br>Brightwell   |                         |                         |
| 25 | <i>Rhizosolenia striata</i><br>Greville      |                         |                         |
| 26 | <i>Guinardia flaccid</i><br>Castracane       |                         |                         |
| 27 | <i>Coscinodiscus asteromphalus</i><br>Ehr.   | <b>Coscinodiscaceae</b> | <b>Coscinodiscineae</b> |
| 28 | <i>Coscinodiscus centralis</i><br>A. Schimdt |                         |                         |
| 29 | <i>Coscinodiscus concinnus</i><br>W. Smith   |                         |                         |

Table 4.1 continued

|    |  |                          |                    |
|----|--|--------------------------|--------------------|
| 30 | <i>Coscinodiscus gigas</i><br>Ehr.       |                          |                    |
| 31 | <i>Coscinodiscus lineatus</i><br>Ehr.    |                          |                    |
| 32 | <i>Coscinodiscus rothii</i><br>Grunow    |                          |                    |
| 33 | <i>Coscinodiscus</i> sp.1                |                          |                    |
| 34 | <i>Coscinodiscus</i> sp.2                |                          |                    |
| 35 | <i>Coscinodiscus subtilis</i><br>Ehr.    |                          |                    |
| 36 | <i>Gyrosigma spencerii</i><br>W. Smith   | <b>Pleurosigmataceae</b> | <b>Naviculales</b> |
| 37 | <i>Gyrosigma scalproides</i><br>Cleve    |                          |                    |
| 38 | <i>Pleurosigma angulatum</i><br>W. Smith |                          |                    |
| 39 | <i>Pleurosigma directum</i><br>Grunow    |                          |                    |
| 40 | <i>Pleurosigma elongatum</i><br>W. Smith |                          |                    |
| 41 | <i>Pleurosigma</i> sp.1                  |                          |                    |
| 42 | <i>Navicula peticolasii</i><br>Peregrin  | <b>Naviculaceae</b>      |                    |
| 43 | <i>Navicula radiosa</i><br>Kutz.         |                          |                    |
| 44 | <i>Pinnularia acuminata</i><br>W. Smith  | <b>Pinnulariaceae</b>    |                    |
| 45 | <i>Pinnularia tabellaria</i><br>Ehr.     |                          |                    |
| 46 | <i>Pinnularia</i> sp.                    |                          |                    |
| 47 | <i>Frustulia vulgaris</i><br>Thwaites    | <b>Amphipleuraceae</b>   |                    |
| 48 | <i>Mastogloia smithii</i><br>Ehr.        | <b>Mastogloiaceae</b>    |                    |
| 49 | <i>Stauroneis obtusa</i><br>Lagerst.     | <b>Stauroneidaceae</b>   |                    |
| 50 | <i>Stauroneis pusilla</i><br>Cleve       |                          |                    |

Table 4.1 continued

|    |   |                            |                           |
|----|---|----------------------------|---------------------------|
| 51 | <i>Biddulphia longicuris</i> Grunow                 | <b>Biddulphiaceae</b>      | <b>Biddulphiales</b>      |
| 52 | <i>Biddulphia mobiliensis</i> Grunow                |                            |                           |
| 53 | <i>Bacillaria paradoxa</i> Gmelin                   | <b>Bacillariaceae</b>      | <b>Bacillariales</b>      |
| 54 | <i>Nitzschia acicularis</i> var. <i>reversa</i>     |                            |                           |
| 55 | <i>Nitzschia longissima</i> Ralfs                   |                            |                           |
| 56 | <i>Pseudo-nitzschia pungens</i> Cleve               |                            |                           |
| 57 | <i>Pseudo-nitzschia cuspidata</i> Hasle             |                            |                           |
| 58 | <i>Triceratium favus</i> Ehr. f. <i>quadrata</i>    | <b>Triceratiaceae</b>      | <b>Triceratiales</b>      |
| 59 | <i>Triceratium</i> sp. <i>Ehrenberg</i> Grun        |                            |                           |
| 60 | <i>Melosira moniliformis</i> Agardh                 | <b>Melosiraceae</b>        | <b>Melosirales</b>        |
| 61 | <i>Melosira nummuloides</i> Agardh                  |                            |                           |
| 62 | <i>Skeletonema costatum</i> (Greville) Cleve        | <b>Skletonemaceae</b>      | <b>Thalassiosirales</b>   |
| 63 | <i>Planktoniella sol</i> Schutt                     | <b>Thalassiosiraceae</b>   |                           |
| 64 | <i>Lauderia borealis</i> Gran                       | <b>Lauderiaceae</b>        |                           |
| 65 | <i>Cyclotella meneghiana</i> Kutz.                  | <b>Stephanodiscaceae</b>   |                           |
| 66 | <i>Thalassionema nitzschoides</i> Grunow            | <b>Thalassionemataceae</b> | <b>Thalassionematales</b> |
| 67 | <i>Thalassiothrix frauenfeldii</i> Grunow           |                            |                           |
| 68 | <i>Amphiprora alata</i> Kutz.                       | <b>Amphiproraceae</b>      | <b>Thalassiophysales</b>  |
| 69 | <i>Amphora quadrata</i> Breb                        | <b>Catenulaceae</b>        |                           |
| 70 | <i>Fragillaria pinnata</i> var. <i>trigona</i> Ehr. | <b>Flagilariaceae</b>      | <b>Flagilariales</b>      |

Table 4.1 continued

|    |   |                          |                         |                |
|----|---|--------------------------|-------------------------|----------------|
| 71 | <i>Fragilaria</i> sp.                           |                          |                         |                |
| 72 | <i>Diatoma elongatum</i><br>Agardh              |                          |                         |                |
| 73 | <i>Asterionellopsis glacialis</i><br>Castracane |                          |                         |                |
| 74 | <i>Bellerochea horologicalis</i><br>Brightwell  | <b>Bellerocheaceae</b>   | <b>Hemiaulales</b>      |                |
| 75 | <i>Leptocylindrus danicus</i><br>Cleve          | <b>Leptocylindraceae</b> | <b>Leptocylindrales</b> |                |
| 76 | <i>Ditylum brightwelli</i><br>West              | <b>Lithodesmiaceae</b>   | <b>Lithodesmiales</b>   |                |
| 77 | <i>Campylodiscus daemilianus</i>                | <b>Surirellaceae</b>     | <b>Surirellales</b>     |                |
| 78 | <i>Cymbella tumida</i> Ehr.                     | <b>Cymbellaceae</b>      | <b>Cymbellales</b>      |                |
| 79 | <i>Corethron criophilum</i><br>Castracane       | <b>Corethraceae</b>      | <b>Corethrales</b>      |                |
| 80 | <i>Cosmarium humile</i><br>Breb                 | <b>Desmidiaceae</b>      | <b>Desmidiales</b>      | Chlorophyta    |
| 81 | <i>Mougeotia</i> sp.                            | <b>Zygnemataceae</b>     | <b>Zygnematales</b>     |                |
| 82 | <i>Rhizoclonium</i> sp.                         | <b>Chladophoraceae</b>   | <b>Chladophorales</b>   |                |
| 83 | <i>Peridinium cinctum</i><br>West               | <b>Peridiniaceae</b>     | <b>Peridinales</b>      | Dinoflagellata |
| 84 | <i>Oscillatoria tenuis</i><br>Roth              | <b>Oscillatoriaceae</b>  | <b>Oscillatoriales</b>  | Cyanobacteria  |

Division Bacillariophyta was represented by the highest number of orders (18), families (27), species (79). This followed by Chlorophyta (3 species), Dinoflagellata (1 species) and Cyanobacterium (1 species). Order Chaetocerotales that comprised of 2 main genera, the *Bacteriastrum* and *Chaetoceros* were recorded to have the highest number of species being sampled with total of 19 species. Correspondingly to its species richness, division Bacillariophyta was the largest division represented by 18 orders (78%), followed by division Chlorophyta (3 orders) (13%), and Dinoflagellate and Cyanobacteria both recorded 1 order (4.5%) (Figure 4.1).

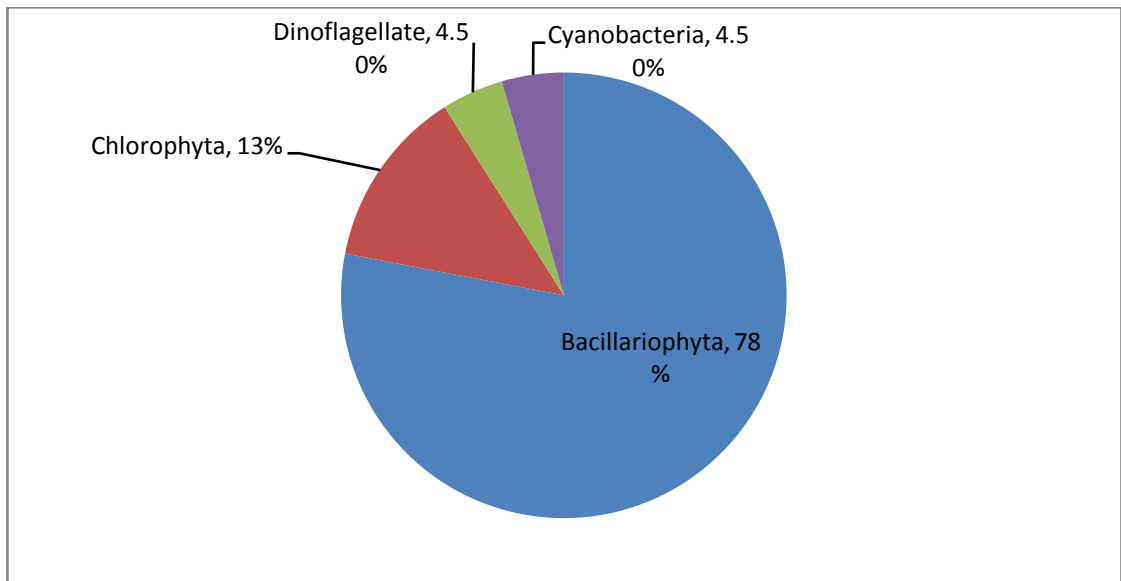


Figure 4.1: Percentage of phytoplankton divisions in term of number of order at study site.