LIST OF FIGURES

Fig. 1.1  Location map of the study area.  7
Fig. 1.2  Study area showing the sampling locations in the shallow marine environment.  8
Fig. 1.3  Bathymetry of the study area.  10
Fig. 1.4  Triangulated Irregular Network (TIN) model of the study area.  12
Fig. 1.5  3D view of the shallow marine environment off Betul – Karwar in the eastern Arabian Sea.  12
Fig. 2.1  Secchi depth (m) observed at all the stations in the study area during the post-monsoon and summer seasons.  30
Fig. 2.2  Distribution of Secchi depth (m) during the post-monsoon season of 2010.  31
Fig. 2.3  Distribution of Secchi depth (m) during the summer season of 2011.  31
Fig. 2.4  Wave height (m) observed at all the stations in the study area during the post-monsoon and summer seasons.  32
Fig. 2.5  Distribution of wave height (m) during the post-monsoon season of 2010.  33
Fig. 2.6  Distribution of wave height (m) during the summer season of 2011.  33
Fig. 2.7  Wave period (s) observed at all the stations in the study area during the post-monsoon and summer seasons.  34
Fig. 2.8  Distribution of wave period (s) during the post-monsoon season of 2010.  35
Fig. 2.9  Distribution of wave period (s) during the summer season of 2011.  35
Fig. 2.10 Wind speed (m/s) observed at all the stations in the study area during the post-monsoon and summer seasons.  36
Fig. 2.11  Distribution of wind speed (m/s) during the post-monsoon season of 2010. 37
Fig. 2.12  Distribution of wind speed (m/s) during the summer season of 2011. 37
Fig. 2.13  Wind direction during the post-monsoon season of 2010. 38
Fig. 2.14  Wind direction during the summer season of 2011. 38
Fig. 2.15  Current speed (m/s) observed at all the stations in the study area during the post monsoon and summer seasons. 39
Fig. 2.16  Distribution of current speed (m/s) during the post-monsoon season of 2010. 40
Fig. 2.17  Distribution of current speed (m/s) during the summer season of 2011. 40
Fig. 2.18  Current direction during the post-monsoon season of 2010. 41
Fig. 2.19  Current direction during the summer season of 2011. 41
Fig. 2.20  Salinity (‰) observed at all the stations in the study area during the post-monsoon and summer seasons. 43
Fig. 2.21  SST (°C) observed at all the stations in the study area during the post-monsoon and summer seasons. 43
Fig. 2.22  Dissolved Oxygen (mg/l) observed at all the stations in the study area during the post-monsoon and summer seasons. 43
Fig. 2.23  Distribution of Salinity (‰) during the post-monsoon season of 2010. 44
Fig. 2.24  Distribution of Salinity (‰) during the summer season of 2011. 44
Fig. 2.25  Distribution of SST (°C) during the post-monsoon season of 2010. 48
Fig. 2.26  Distribution of SST (°C) during the summer season of 2011. 48
Fig. 2.27  Distribution of Dissolved Oxygen (mg/l) during the post-monsoon season of 2010. 50
<table>
<thead>
<tr>
<th>Figure Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig. 2.28</td>
<td>Distribution of Dissolved Oxygen (mg/l) during the summer season of 2011.</td>
<td>50</td>
</tr>
<tr>
<td>Fig. 2.29</td>
<td>pH observed at all the stations in the study area during the post monsoon and summer seasons.</td>
<td>51</td>
</tr>
<tr>
<td>Fig. 2.30</td>
<td>Distribution of pH during the post-monsoon season of 2010.</td>
<td>52</td>
</tr>
<tr>
<td>Fig. 2.31</td>
<td>Distribution of pH during the summer season of 2011.</td>
<td>52</td>
</tr>
<tr>
<td>Fig. 2.32</td>
<td>CDOM (m$^{-1}$) observed at all the stations in the study area during the post monsoon and summer seasons.</td>
<td>54</td>
</tr>
<tr>
<td>Fig. 2.33</td>
<td>Distribution of CDOM (m$^{-1}$) during the post-monsoon season of 2010.</td>
<td>54</td>
</tr>
<tr>
<td>Fig. 2.34</td>
<td>Distribution of CDOM (m$^{-1}$) during the summer season of 2011.</td>
<td>55</td>
</tr>
<tr>
<td>Fig. 3.1</td>
<td>Spatial distribution of sand (%) in the shallow marine environment off Betul-Karwar, west coast of India.</td>
<td>71</td>
</tr>
<tr>
<td>Fig. 3.2</td>
<td>Spatial distribution of silt (%) in the shallow marine environment off Betul-Karwar, west coast of India.</td>
<td>72</td>
</tr>
<tr>
<td>Fig. 3.3</td>
<td>Spatial distribution of clay (%) in the shallow marine environment off Betul-Karwar, west coast of India.</td>
<td>73</td>
</tr>
<tr>
<td>Fig. 3.4</td>
<td>Textural nomenclature of the sediments of the shallow marine environment off Betul-Karwar for the summer season of 2011 based on sand - silt - clay ratios (Folk and Ward, 1957).</td>
<td>73</td>
</tr>
<tr>
<td>Fig. 3.5</td>
<td>Textural nomenclature of the sediments of the shallow marine environment off Betul-Karwar for the summer season of 2011 based on sand - silt - clay ratios (Blott and Pye, 2012).</td>
<td>74</td>
</tr>
<tr>
<td>Fig. 3.6</td>
<td>Variogram of sediment mean-size (Ø) in the shallow marine environment off Betul-Karwar.</td>
<td>75</td>
</tr>
<tr>
<td>Fig. 3.7</td>
<td>Spatial distribution of sediment mean size (Ø) in the study area.</td>
<td>76</td>
</tr>
<tr>
<td>Fig. 3.8</td>
<td>Variogram of standard deviation in the shallow marine environment off Betul-Karwar.</td>
<td>77</td>
</tr>
<tr>
<td>Fig. 3.9</td>
<td>Spatial Distribution of sediment sorting (Ø) in the study area.</td>
<td>77</td>
</tr>
</tbody>
</table>
Fig. 3.10  Variogram of skewness in the shallow marine environment off Betul-Karwar.

Fig. 3.11  Variogram of kurtosis in the shallow marine environment off Betul-Karwar.

Fig. 3.12  Sediment texture of the study area.

Fig. 3.13  Sahu's (1983) Multigroup Discriminant Diagram.

Fig. 3.14  Scatter plot Friedman (1967-dotted line) and Mohan et al., (2000 solid line).

Fig. 3.15  CM pattern of the sediments of the Betul-Karwar coast.

Fig. 3.16  SEM of representative sediments recovered from the study area.

Fig. 3.17  SEM Micrograph.

Fig. 3.18  SEM Micrograph.

Fig. 3.19  SEM Micrograph.

Fig. 4.1  Spatial distribution of Total Foraminifera in the study area.

Fig. 4.2  Bar diagram showing the distribution of suborders of Foraminifera.

Fig. 4.3  Margalef’s Species Richness Index for the Foraminifers in the shallow marine environment.

Fig. 4.4  R-mode cluster analysis depicting the association of foraminifera with the other parameters in the shallow marine environment.

Fig. 4.5  Scanning Electron Microscope image of Globigerinoides sacculifer.

Fig. 4.6  Scanning Electron Microscope image of Globigerinoides ruber.

Fig. 4.7  Scanning Electron Microscope image of Globorotalia menardii.

Fig. 4.8  Scanning Electron Microscope image of Bolivina striatula.
Fig. 4.9  Scanning Electron Microscope image of Virgulinella gunteri.  

Fig. 4.10 Scanning Electron Microscope image of Fursenkoina schreibersiana.  

Fig. 4.11 Scanning Electron Microscope image of Bulimina exilis.  

Fig. 4.12 Scanning Electron Microscope image of Ammonia beccarii.  

Fig. 4.13 Scanning Electron Microscope image of Ammonia dentate.  

Fig. 4.14 Scanning Electron Microscope image of Nonionides elongatum.  

Fig. 4.15 Scanning Electron Microscope image of Ammonia tepida.  

Fig. 4.16 Scanning Electron Microscope image of Spiroloculina corrugate.  

Fig. 4.17 Scanning Electron Microscope image of Spiroloculina depressa.  

Fig. 4.18 Scanning Electron Microscope image of Procerolagena distomapolita.  

Fig. 5.1 Study area showing the stations where the Satlantic® Hyperspectral radiometer was deployed.  

Fig. 5.2 Vertical profiles of CDOM (ppb/l) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.  

Fig. 5.3 Vertical profiles of Chlorophyll (µg/l) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.  

Fig. 5.4 Vertical profiles of Fluorescence (µg/l) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.  

Fig. 5.5 Vertical profiles of PAR (µMol/m² 2s) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.  

Fig. 5.6 Vertical profiles of Salinity (psu) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic®
Hyperspectral Radiometer.

Fig. 5.7 Vertical profiles of Temperature (°C) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.8 Vertical profiles of Downwelling irradiance (Ed)(μW/cm²/nm) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.9 Vertical profiles of Upwelling radiance (Lu)(μW/cm²/nm/sr) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.10 Vertical profiles of Attenuated downwelling irradiance (K-Ed) (m⁻¹) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.11 Vertical profiles of Attenuated upwelling radiance (K-Lu) (m⁻¹) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.12 Vertical profiles of Water leaving radiance (Lw) (μW/cm²/nm/sr) in the shallow marine environment off Betul - Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 5.13 Vertical profiles of Irradiance reflectance (R) (μW/cm²/nm) in the shallow marine environment off Betul – Karwar as retrieved from a Satlantic® Hyperspectral Radiometer.

Fig. 6.1 Comparison of Chlorophyll-a concentrations in the study area during the post-monsoon and summer seasons.

Fig. 6.2 Distribution of Chlorophyll-a (mg/m³) during the post-monsoon season of 2010.

Fig. 6.3 Distribution of Chlorophyll-a (mg/m³) during the summer season of 2011.

Fig. 6.4 Comparison of Algal Biomass concentration in the study area during the post-monsoon and summer seasons.

Fig. 6.5 Distribution of Algal Biomass (mg/m³) during the post-monsoon season of 2010.
Fig. 6.6 Distribution of Algal Biomass (mg/m³) during the summer season of 2011. 167
Fig. 6.7 Comparison of Total Suspended Matter (mg/l) concentrations in the study area during the post-monsoon and summer seasons. 168
Fig. 6.8 Distribution of Total Suspended Matter (mg/l) during the post-monsoon season of 2010. 168
Fig. 6.9 Distribution of Total Suspended Matter (mg/l) during the summer season of 2011. 169
Fig. 6.10 OCM-2 derived Chlorophyll-a (mg/m³) distribution during the post-monsoon season of 2010. 170
Fig. 6.11 OCM-2 derived Chlorophyll-a (mg/m³) distribution during the summer season of 2011. 170
Fig. 6.12 OCM-2 derived TSM (mg/l) distribution during the post-monsoon season of 2010. 171
Fig. 6.13 OCM-2 derived TSM (mg/l) distribution during the summer season of 2011. 171
Fig. 6.14 Comparison of in-situ vs OCM-2 derived chlorophyll-a concentration during the post-monsoon season of 2010. 175
Fig. 6.15 Comparison of in-situ vs OCM-2 derived chlorophyll-a concentration during the summer season of 2011. 176
Fig. 6.16 Comparison of in-situ vs OCM-2 derived TSM concentration during the post-monsoon season of 2010. 176
Fig. 6.17 Comparison of in-situ vs OCM-2 derived TSM concentration during the summer season of 2011. 177
Fig. 7.1 Thematic layer of Coloured Dissolved Organic Matter for the post-monsoon season of 2010. 221
Fig. 7.2 Thematic layer of Chlorophyll-a for the post-monsoon season of 2010. 221
Fig. 7.3 Thematic layer of Dissolved Oxygen for the post-monsoon season of 2010. 222
Fig. 7.4  Thematic layer of pH for the post-monsoon season of 2010.

Fig. 7.5  Thematic layer of Salinity for the post-monsoon season of 2010.

Fig. 7.6  Thematic layer of Secchi Depth for the post-monsoon season of 2010.

Fig. 7.7  Thematic layer of Sea Surface Temperature for the post-monsoon season of 2010.

Fig. 7.8  Thematic layer of Total Suspended Matter for the post-monsoon season of 2010.

Fig. 7.9  Thematic layer of Wave Period for the post-monsoon season of 2010.

Fig. 7.10 Integrated thematic layer of CDOM, Chlorophyll-a, D.O, pH, Salinity, Secchi Depth, SST, TSM and Wave Period for the post-monsoon season of 2010.

Fig. 7.11 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 20.02 sq km during the post-monsoon season of 2010.

Fig. 7.12 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 20.22 sq km during the post-monsoon season of 2010.

Fig. 7.13 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 93.68 sq km during the post-monsoon season of 2010.

Fig. 7.14 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 10.00 sq km during the post-monsoon season of 2010.

Fig. 7.15 Integrated thematic layer of representative heterogeneous bodies of water with an area covering 33.15 sq km during the post-monsoon season of 2010.

Fig. 7.16 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 14.97 sq km during the post-monsoon season of 2010.

Fig. 7.17 Integrated thematic layer of representative heterogeneous
Fig. 7.18  Integrated thematic layer of representative heterogeneous bodies of water with an area covering 7.22 sq km during the post-monsoon season of 2010.

Fig. 7.19  Integrated thematic layer of representative heterogeneous bodies of water covering an area of 76.58 sq km during the post-monsoon season of 2010.

Fig. 7.20  Integrated thematic layer of representative heterogeneous bodies of water covering an area of 11.29 sq km during the post-monsoon season of 2010.

Fig. 7.21  Thematic layer of Coloured Dissolved Organic Matter for the summer season of 2011.

Fig. 7.22  Thematic layer of Chlorophyll-a for the summer season of 2011.

Fig. 7.23  Thematic layer of Dissolved Oxygen for the summer season of 2011.

Fig. 7.24  Thematic layer of pH for the summer season of 2011.

Fig. 7.25  Thematic layer of Salinity for the summer season of 2011.

Fig. 7.26  Thematic layer of Secchi Depth for the summer season of 2011.

Fig. 7.27  Thematic layer of Sea Surface Temperature for the summer season of 2011.

Fig. 7.28  Thematic layer of Total Suspended Matter for the summer season of 2011.

Fig. 7.29  Thematic layer of Wave Period for the summer season of 2011.

Fig. 7.30  Integrated thematic layer of CDOM, Chlorophyll-a, D.O, pH, Salinity, Secchi Depth, SST, TSM and Wave Period for the summer season of 2011.

Fig. 7.31  Integrated thematic layer of representative heterogeneous bodies of water covering an area of 78.37 sq km during the
summer season of 2011.

Fig. 7.32 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 20.00 sq km during the summer season of 2011.

Fig.7.33 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 33.00 sq km during the summer season of 2011.

Fig. 7.34 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 12.05 sq km during the summer season of 2011.

Fig. 7.35 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 7.72 sq km during the summer season of 2011.

Fig. 7.36 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 22.85 sq km during the summer season of 2011.

Fig. 7.37 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 15.22 sq km during the summer season of 2011.

Fig. 7.38 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 18.80 sq km during the summer season of 2011.

Fig. 7.39 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 10.88 sq km during the summer season of 2011.

Fig. 7.40 Integrated thematic layer of representative heterogeneous bodies of water covering an area of 42.02 sq km during the summer season of 2011.