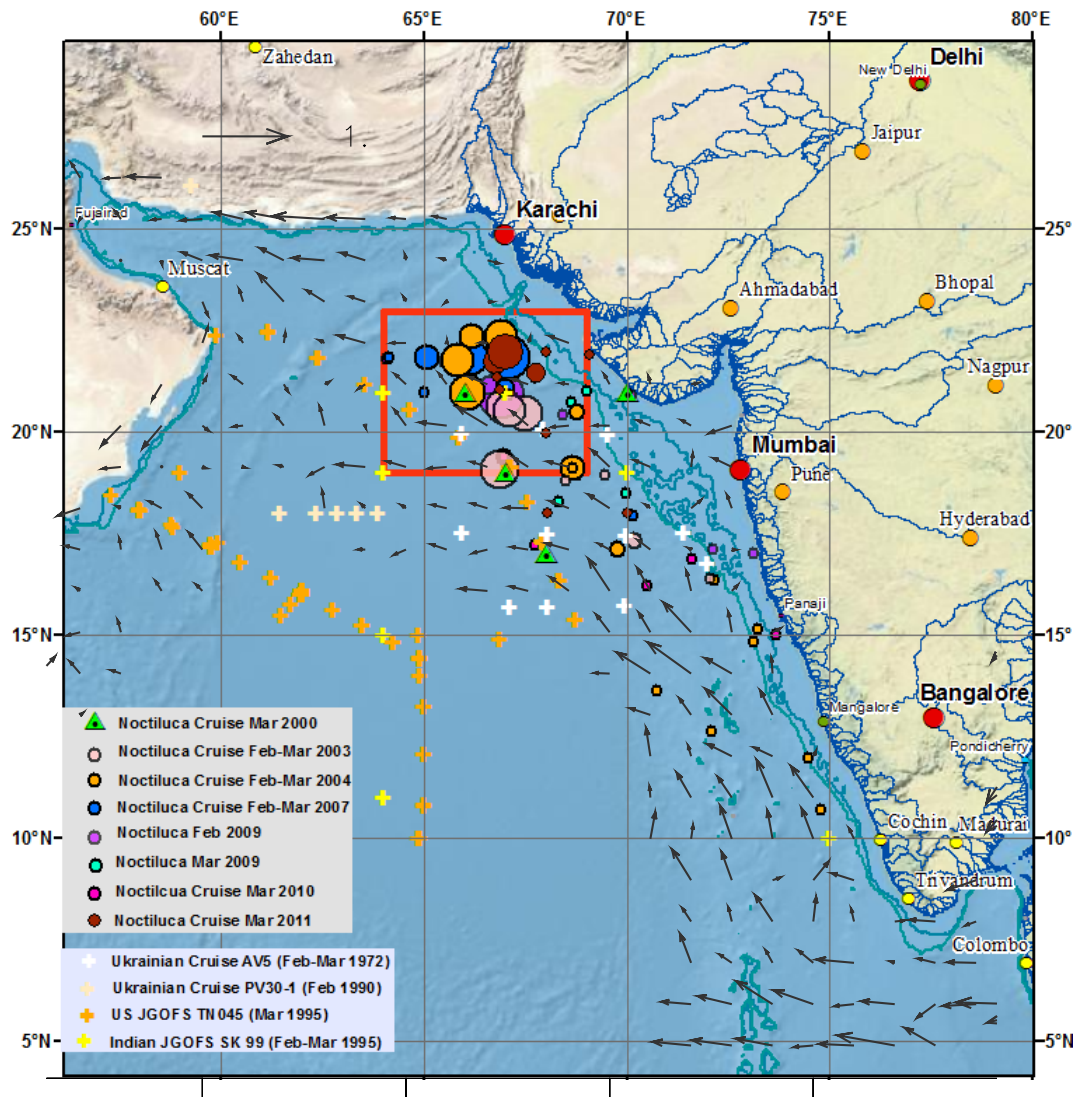
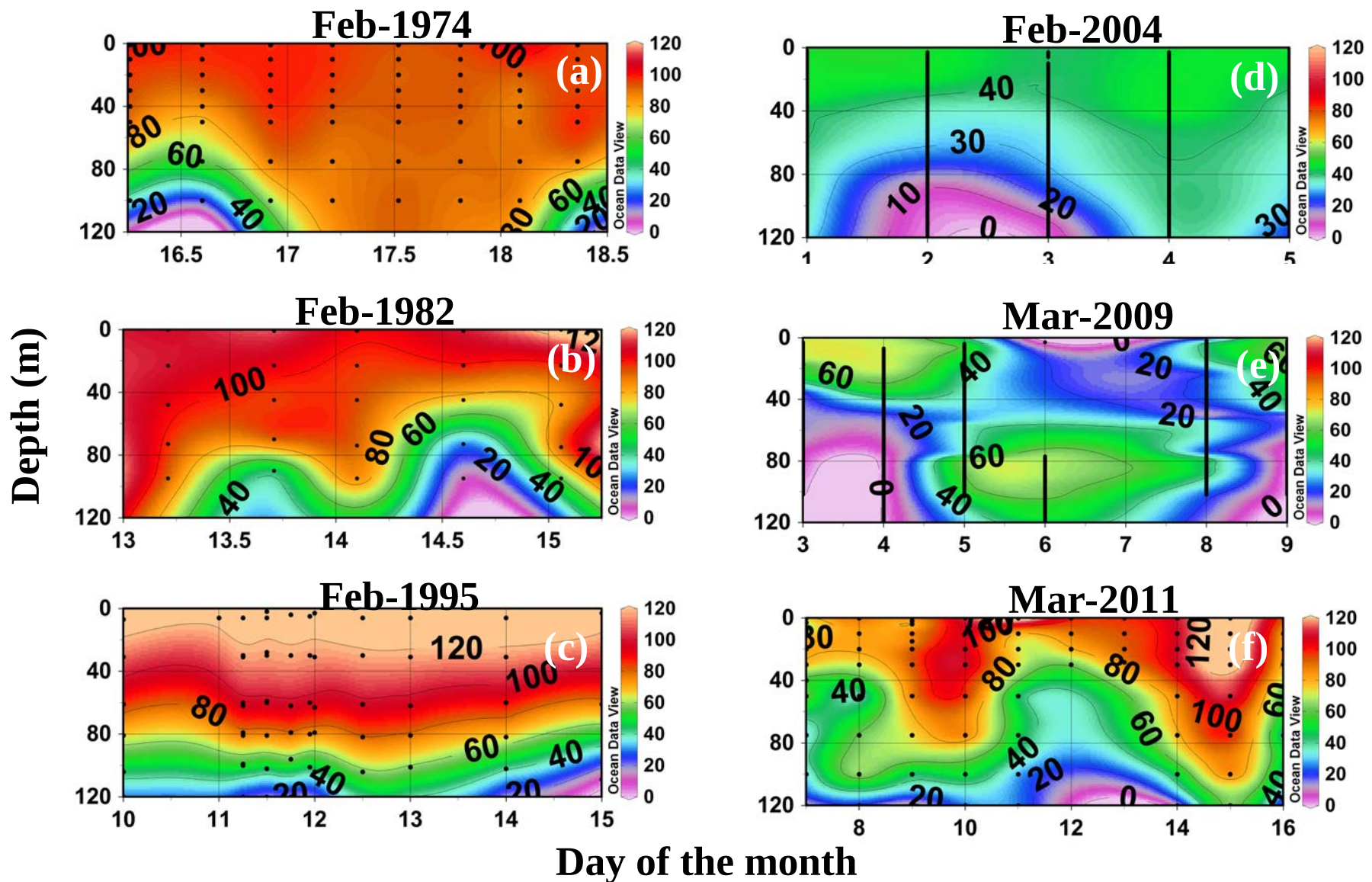
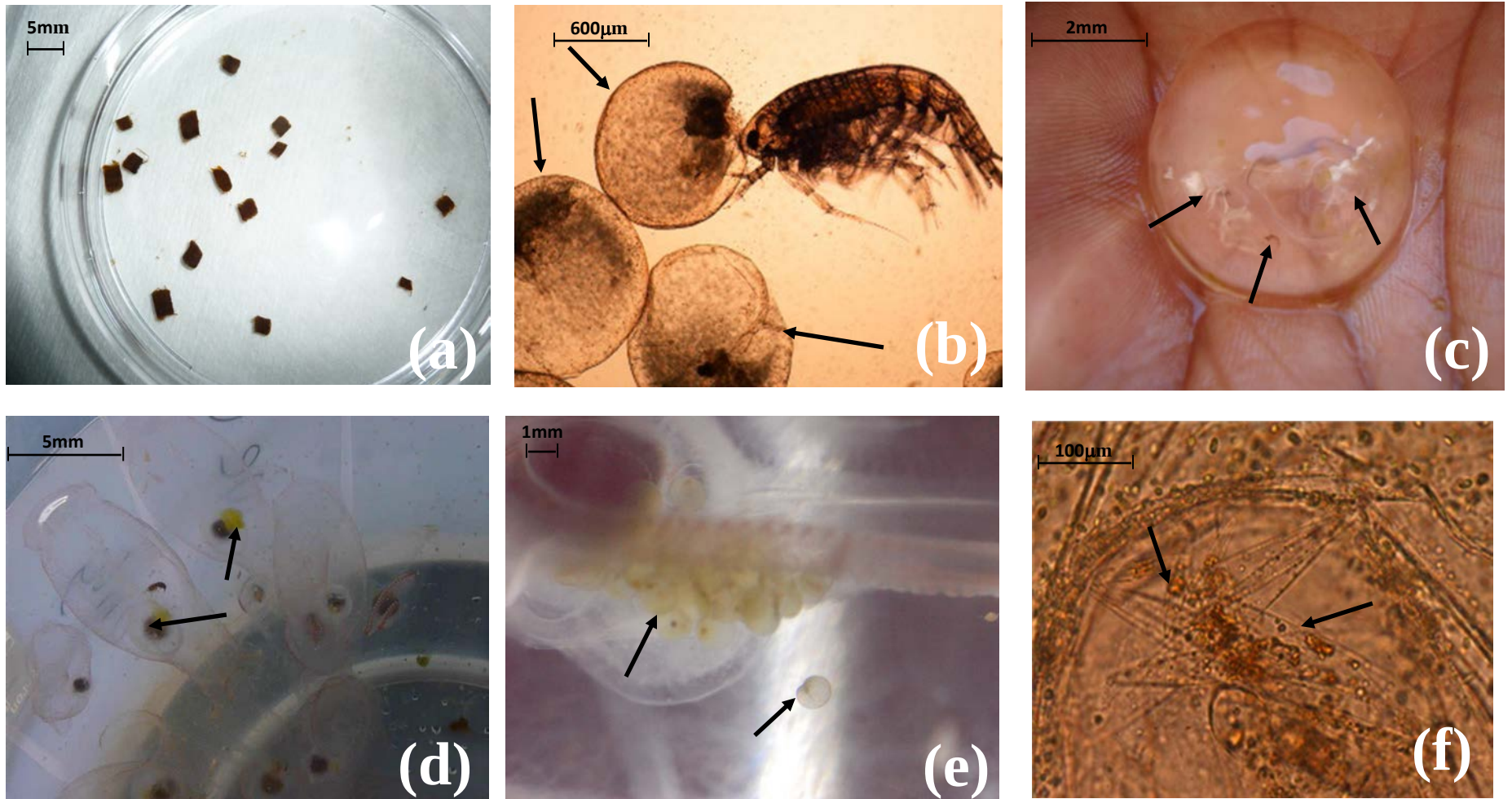




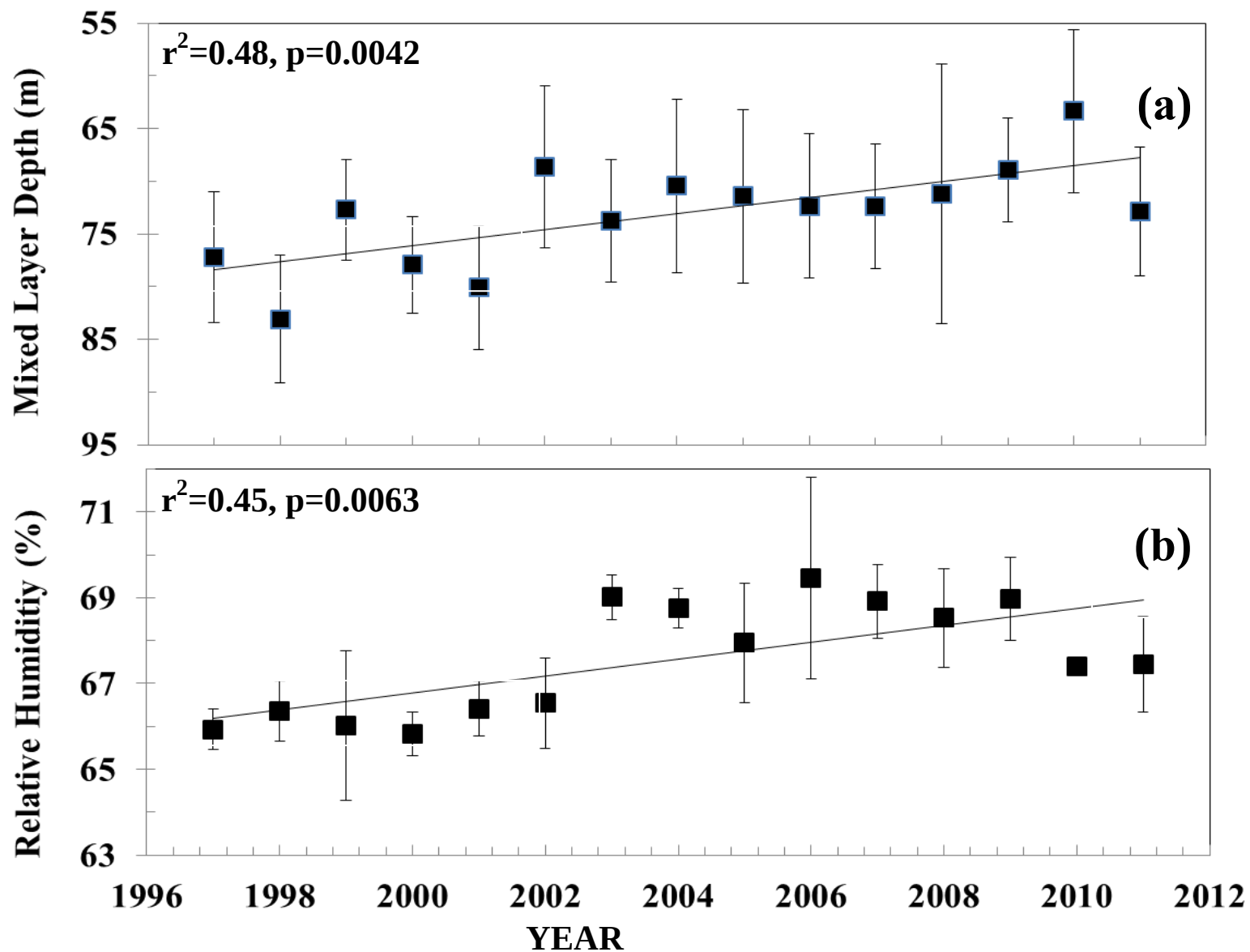
Supplementary Figure 1: Surface distribution and concentration of the dinoflagellate *N. scintillans* (cells l^{-1}) in the Arabian Sea during the winter monsoons of 2000-2011 (1-100 cells l^{-1} , ● 8000-10,000 cells l^{-1}). Also shown as crosses are station locations of historic cruises (1965-1995) when *N. scintillans* was not observed. These cruises include the International Indian Ocean Expedition Meteor Cruise (Feb.-Mar. 1965), Ukrainian cruises AV5 (Feb-Mar. 1972) and PV30_1 in (Feb. 1990), US JGOFS TN045 (Mar. 1995) and Indian JGOFS SK 99 (Feb-Mar. 1995). Cruises from 2003-2011 where *N. scintillans* blooms were observed have been named 'Noctiluca Cruise'. Cruise of Mar 2000¹, the only cruise which did not form part of our study, reported average cell counts of 3×10^6 cells l^{-1} but as no station wise cell counts were provided only station locations are shown as green triangles. Red Box (23°- 19°N, 64°- 69°W) demarcates area where the largest concentrations of *N. scintillans* were observed and from where all hydrographic, chemical and biological data is described. Velocity vectors show the northward flowing West India Coastal Current during the winter monsoon. The surface currents are derived from ship-drift observations². Rivers and their network of watershed and drainage area are shown for the west coast of India. Circles denote location and population in cities: Red >10 million, orange <5 million, yellow < 1 million.



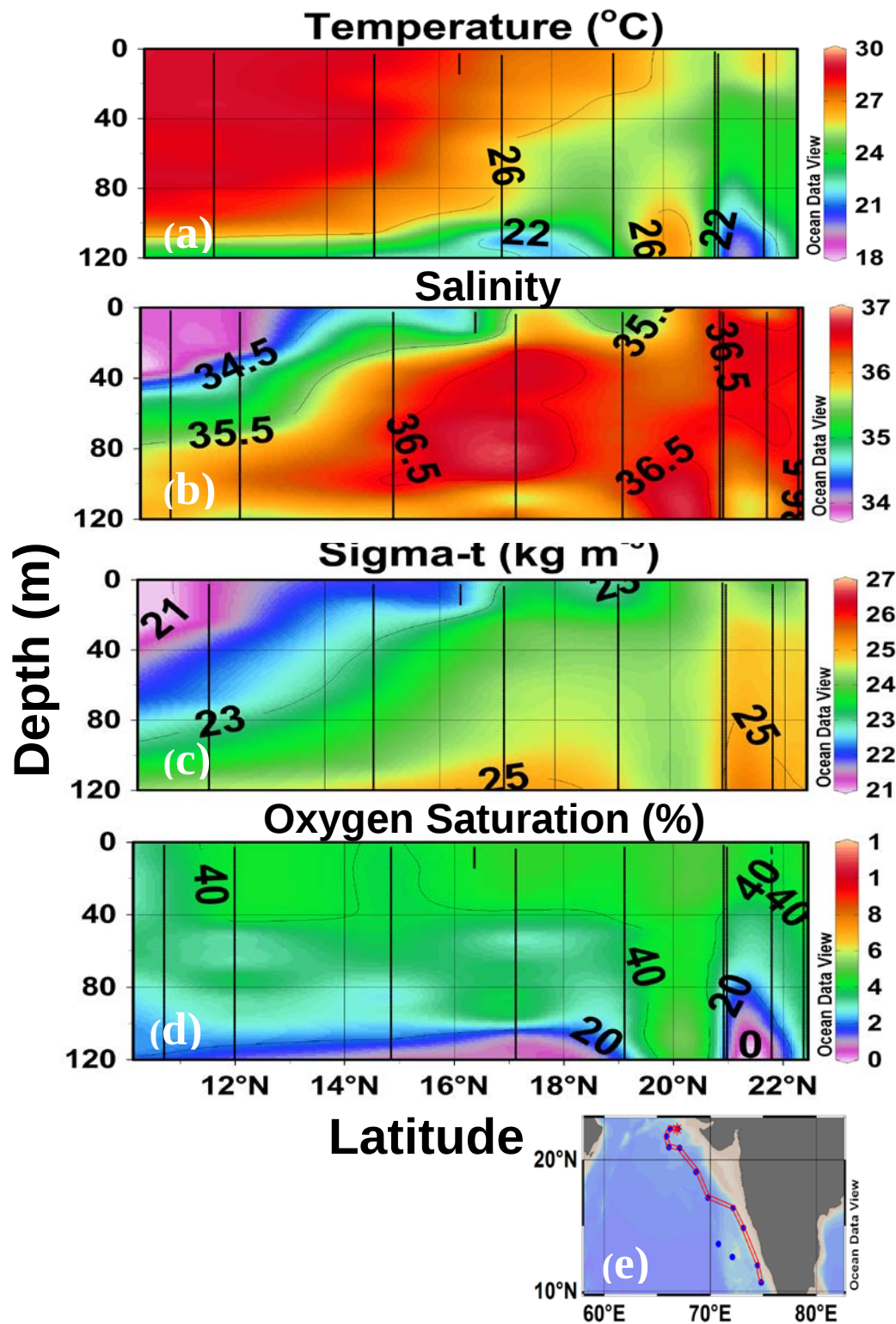
Supplementary Figure 2a-f: Percent O₂ saturation during the winter monsoon for historic data (1974-1997) and recent measurements (2004-2011). Data shows the appearance of hypoxic waters into the upper euphotic zone in the early 2000s (Data from 23°- 19°N and 64°- 69°E, Red Box in Supplementary Fig. 1). Black dots show discrete sample locations and thick black lines show measurements from a profiling pre-calibrated O₂ sensor.



Supplementary Figure 3a-f: Grazing and carbon cycling during the *N. scintillans* bloom a) Large fecal pellets egested by salp after feeding on *N. scintillans* b) *N. scintillans* cell (~ 1 mm in diameter) in the vicinity of an amphipod showing that its large size precludes it from being grazed by similar sized zooplankton particularly copepods c) Jelly fish with ingested *N. scintillans* d) Salps with ingested *N. scintillans* e) Close-up of a salp with intact cells of *N. scintillans* bloom inside its gut f) Food vacuole of *N. scintillans* with arrows showing ingested diatoms . In Figures 3b-f arrows indicate cells of *N. scintillans*.



Supplementary Figure 4a-b: Mean Winter Mixed Layer Depth (MLD) and Relative Humidity (RH) for the northern Arabian Sea during 1996-2012. a) Average winter-time MLD (m, Dec - Mar) and b) RH (% , Nov - Feb) for the northern Arabian Sea (60°E-70°E, 14°N-25°N). The progressive shallowing of winter-time MLD indicates weakening of convective mixing in the northern Arabian Sea. Increase in RH is consistent with the idea that winter monsoon air is becoming more humid, resulting in decrease in convective mixing due to reduction in total heat loss into the atmosphere from the ocean. Vertical bars with each symbol indicate standard error associated with seasonal averages. Significance levels of trend lines are shown in top left corner of each panel.



Supplementary Figure 5a-e: Distribution of a) Temperature °C b) Salinity c) Sigma-t (kg m⁻³) and d) Percent O₂ Saturation along e) North-South coastal transect in Feb-Mar 2004. The terrestrial influence of hypoxic waters along the eastern boundary of the Arabian Sea in winter is evident from their warm, low salinity, low density characteristics. Thick black lines show measurements from a profiling pre-calibrated O₂ sensor.

TREATMENT	N	NO FOOD +LIGHT	FOOD +LIGHT	NO FOOD +LIGHT+NUTRIENTS	FOOD +LIGHT+NUTRIENTS	ALL DARK	ALL LIGHT
NO FOOD +LIGHT	6	-	0.013*	0.01*	<0.001*	-	-
FOOD +LIGHT	6	0.013*	-	0.721	0.048	-	-
NO FOOD +LIGHT+NUTRIENTS	8	0.01*	0.721	-	0.645	-	-
FOOD +LIGHT+NUTRIENTS	8	<0.001*	0.048	0.645	-	-	-
ALL DARK	28	-	-	-	-	-	<0.001*
ALL LIGHT	28	-	-	-	-	<0.001*	-

Supplementary Table 1: Statistically significant levels for comparison of various treatments shown in Figure 4 to assess the relative importance of internal nutrition from symbionts and external phagotrophy in the growth of *N. scintillans*. P values were obtained using a two-sample t-test. All statistically significant levels ($p < 0.05$) for p values are denoted by *.

SUPPLEMENTARY REFERENCES LIST:

- 1 Madhu, N. V., Jyothibabu, R., Maheswaran, P. A., Jayaraj, K. A. & Achuthankutty, C. T. Enhanced chlorophyll a and primary production in the northern Arabian Sea during the spring intermonsoon due to green *Noctiluca scintillans* bloom. Mar. Biol. Res. **8**, 182-188, doi:10.1080/17451000.2011.605143 (2012).
- 2 Mariano, A. J., E. H. Ryan, B. D. Perkins & S. Smithers. The Mariano Global Surface Velocity Analysis 1.0. USCG Report CG-D-34-95, 55 pp (1995).