Adelaide Desalination Plant Plankton Monitoring Program

June 2013 report

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This report provides data from samples collected on the 14th of June 2013 from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens. This was the first sampling event for the plankton monitoring program and included training of ADP staff in the correct methods for sample collection and preservation. Samples were collected for the analysis of phyto-, zoo-, and ichthyoplankton biomass and abundance using the methods outlined in appendix 1.

Water samples for the analysis of pigment composition were filtered through stacked mesh (to retain cells >5 µm) and Whatman GF/F filters (nominal pore size 0.4 µm, to retain cells <5 µm), allowing the examination of size fractionated phytoplankton biomass. Filters were frozen and stored at -80°C prior to analysis via the gradient elution procedure of (Van Heukelem and Thomas 2001) on an Algilent 1200 series High Pressure Liquid Chromatography (HPLC) system in the environmental chemistry laboratory at SARDI Aquatic Sciences. Enumeration and identification of phytoplankton to genus or species level was carried out by Microalgal Services, Victoria, Australia, using traditional taxonomic methods.

Zooplankton samples were rinsed through a 35 µm mesh sieve to remove all traces of preservative. The contents of the sieve were rinsed into 100ml measuring cylinders and allowed to settle for 24 hours, after which settling volumes (biomass) were recorded. Samples were then decanted into 120 ml jars and resuspended in 100ml of water (i.e. concentrated 10x). Samples were viewed, identified and enumerated with a compound microscope. Counts were continued until 100 specimens of the dominant taxa were counted. Organism numbers were recorded as individuals m^{-3} in the water column using the volume swept by the net, calculated distances travelled by the net (recorded by a flow meter suspended in the mouth of the net) multiplied by the area of the net mouth. Settling volumes were recorded as ml m^{-3} using the volume swept.

Ichthyoplankton samples were collected with a 350 µm mesh bongo net (30 cm net mouth diameter. The contents of the nets were pooled into a sample jar, topped up to 1 litre with seawater, and fixed with formalin (5% final volume). The three samples were pooled during rinsing through a 35 µm mesh sieve to remove all traces of preservative. The entire sample was sorted under a dissecting microscope at up to 60x magnification. Egg and larvae numbers were recorded as individuals m^{-3} in the water column using the volume swept by the net, calculated using distances travelled by the net (recorded by a flow meters suspended in the mouth of the net) multiplied by the area of the net mouth.

Phytoplankton biomass, abundance, and community composition

Mean total chlorophyll *a* concentration was 0.6 (±0.04) µg L^{-1}, with most of the biomass in the small size fraction (cells <5 µm in diameter, figure 1). These are typical values for June in waters off Port Stanvac (van Ruth 2010, 2012). Analysis of marker pigments normalised to chlorophyll *a* indicate that the small size fraction of phytoplankton biomass was dominated by small flagellates (Chlorophytes, Cryptophytes, Chrysophytes, Euglenophytes, Haptophytes, Prasinophytes) and Cyanobacteria (figure 2). The large size fraction was dominated by diatoms, with dinoflagellates also present (figure 3).

Mean total phytoplankton abundance was 150,717 (±3,931) cells L^{-1}, and was dominated by small flagellates, in agreement with pigment analysis (figure 4). Dinoflagellates were more abundant than diatoms, in contrast to suggestions from marker pigment analysis in the large size fraction, most likely because the much larger diatoms contain relatively more pigment per cell than the smaller dinoflagellates. Phytoplankton abundances were dominated by the dinoflagellates *Gymnodinium* spp. (22,000 ± 2,082 cells L^{-1}), *Gyrodinium* spp. (12,667 ± 1,453 cells L^{-1}) and *Heterocapsa rotundata* (11,000 ± 2,082 cells L^{-1}). Dominant small flagellates were the haptophyte *Chrysochromulina* spp. (9,333 ± 1,202 cells L^{-1}), the Cryptophytes *Hemiselmis* spp. (11,667 ± 882 cells L^{-1}) and *Plagioselmis* spp. (13,667 ± 2,028 cells L^{-1}), and the prasinophyte *Pyramimonas* spp. (24,333 ± 1,202 cells L^{-1}).

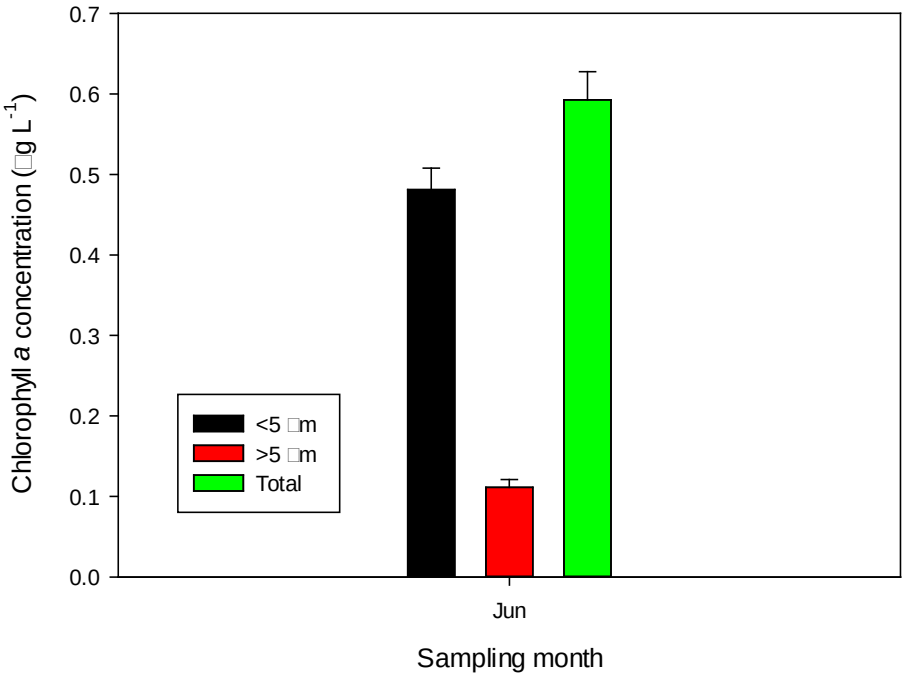

Figure 1. Mean total chlorophyll *a* concentrations, and concentrations in the small (<5 µm) and large (>5 µm) size fractions of phytoplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error.

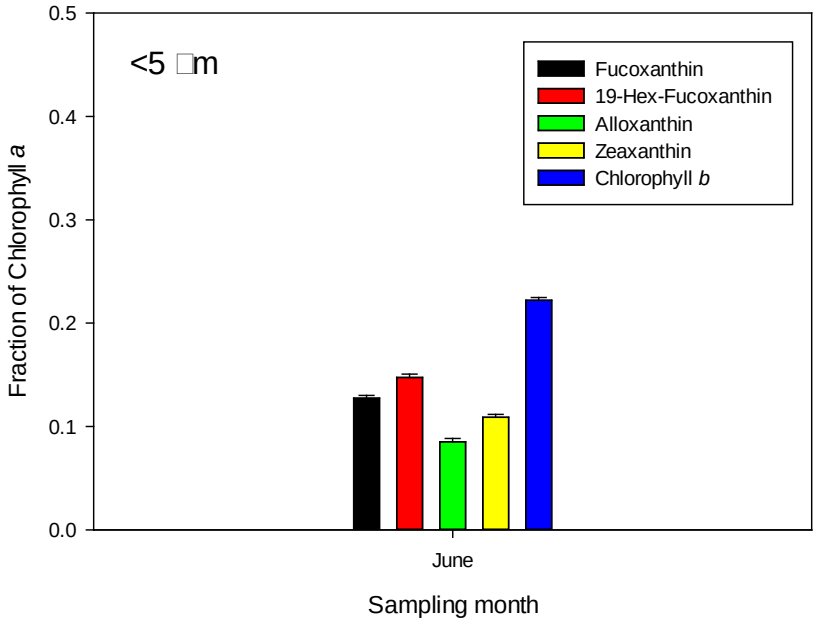

Figure 2. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the small size fraction of phytoplankton biomass (<5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error. Fucoxanthin is an indicator of chrysophytes, 19-hexanoyloxyfucoxanthin is an indicator of haptophytes, alloxanthin is an indicator of cryptophytes zeaxanthin is an indicator of cyanobacteria, and chlorophyll *b* is an indicator of chlorophytes, euglenophytes and prasinophytes.

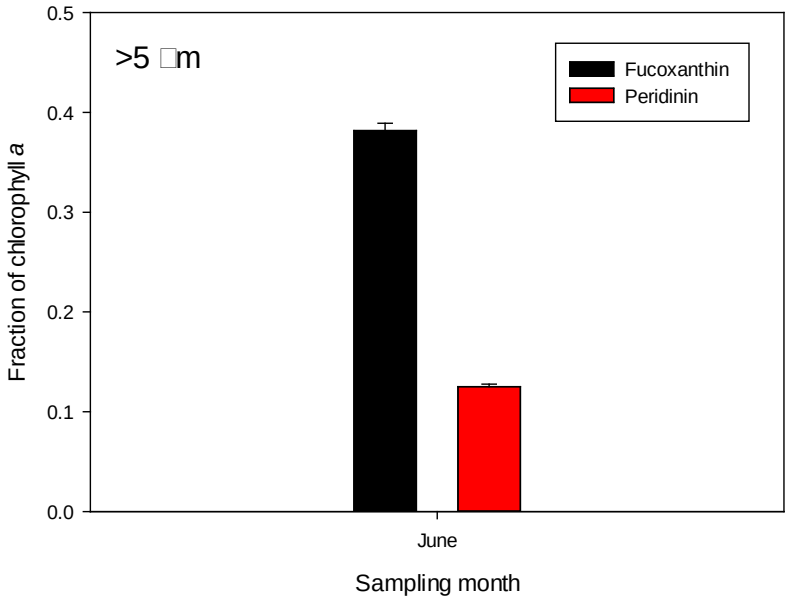

Figure 3. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the large size fraction of phytoplankton biomass (>5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error. Fucoxanthin is an indicator of diatoms, peridinin is an indicator of dinoflagellates.

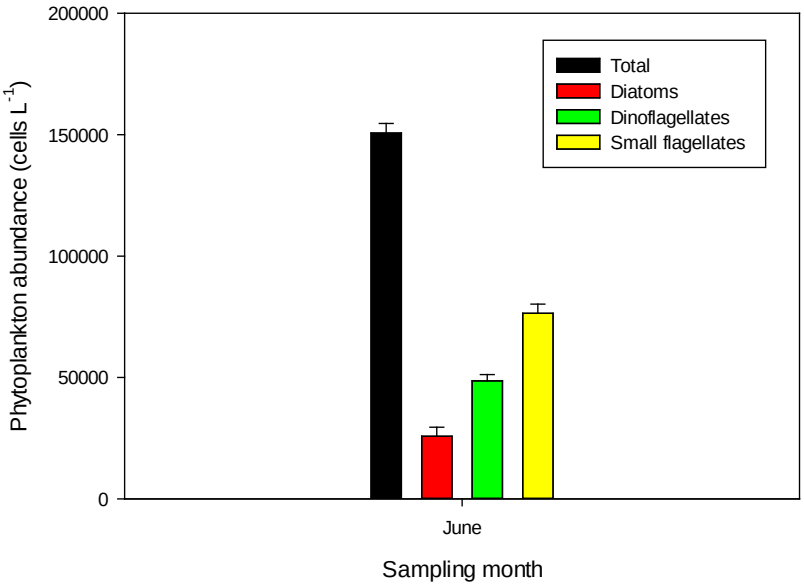

Figure 4. Mean phytoplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error.

Zooplankton biomass, abundance, and community composition

Mean zooplankton biomass was 4.7 (±1.2) ml m^{-3} (figure 5), and mean abundance was 31,490 (±1,3577) individuals m^{-3} (figure 6), values typical for Port Stanvac in June (van Ruth 2010, 2012). The zooplankton community was dominated by bivalve larvae, with copepods and polychaete larvae also relatively abundant.

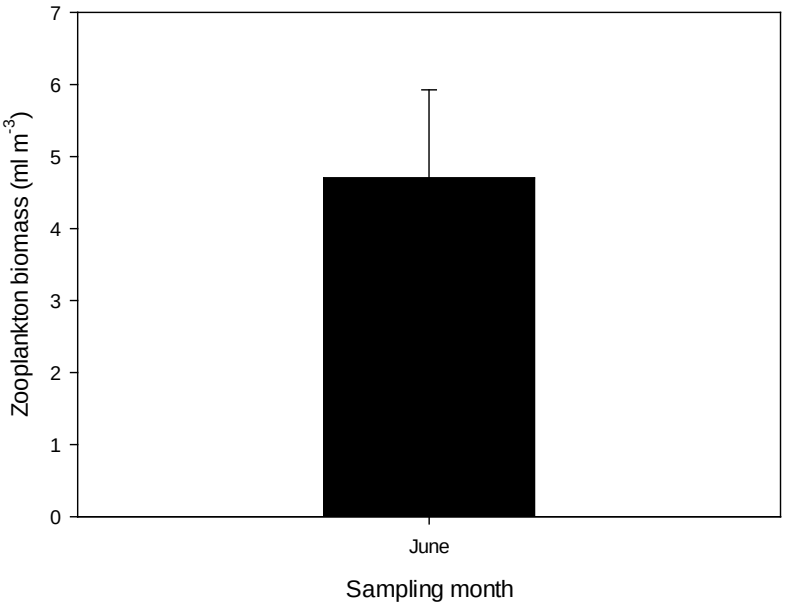

Figure 5. Mean zooplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error.

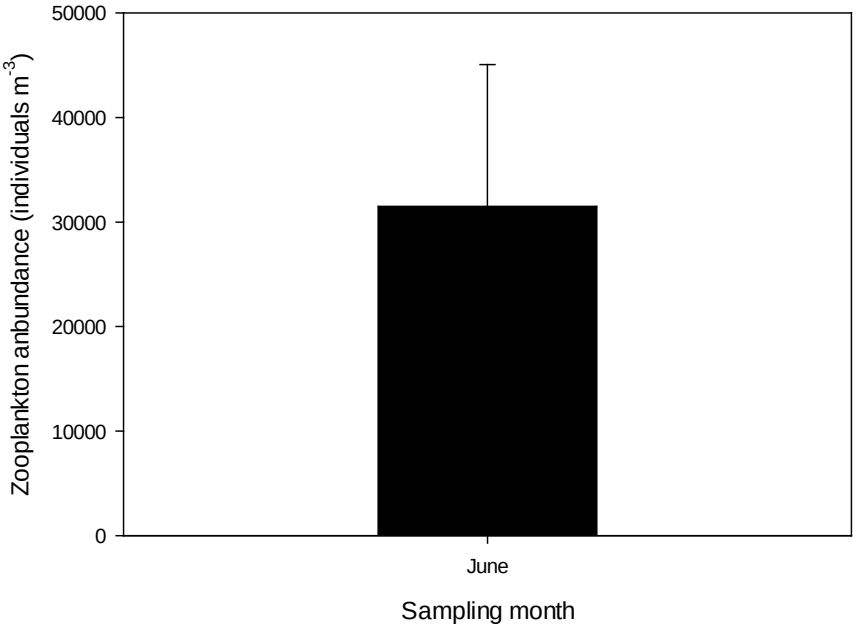

Figure 6. Mean zooplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in June 2013. Error bars indicate standard error.

Ichthyoplankton biomass, abundance, and community composition

There were no fish eggs or larvae detected in samples collected in June 2013. This may be because no ichthyoplankton are being drawn in the ADP, but may also be due to limitations with sampling. It is important to ensure that sampling for ichthyoplankton sweeps a sufficient volume of water to ensure that an adequate sample is collected. When we are confident that we have put sufficient effort into collecting an adequate sample, we can be confident that results are being attributed to the correct cause (i.e. we can be sure that if none are found, none are being entrained, rather than wondering whether it is because we haven't looked hard enough). For this reason, I propose a slight modification to sampling protocols so that they are in line with methods used for the ADP Plankton Characterisation Studies of 2010 and 2012 (van Ruth 2010, 2012). These modifications are outlined in the new sampling protocol detailed in appendix 2.

References

Van Heukelem, L. and Thomas, C. S. (2001). Computer-assisted high-performance liquid chromatography method development with applications to the isolation and analysis of phytoplankton pigments. Journal of Chromatography A, 910: 31 – 49.

van Ruth, P.D. (2012) Adelaide Desalination Project Plankton Characterisation Study – Phase 2. Prepared for Adelaide Aqua. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2010/000378-2. SARDI Research Report Series No. 606. 40pp.

van Ruth, P. D. (2010) Adelaide desalination project plankton characterisation study, prepared for Adelaide Aqua. SARDI Publication. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2010/000378-1. SARDI Research Report Series No. 487. 39 pp.

Appendix 1

Adelaide Desalination Project Plankton Monitoring Program

Sampling protocol

1). Phytoplankton biomass, abundance and community composition:

- Samples to be collected from surface waters with a bucket.

  Pigments (biomass)

  - 3 x independent **2 L** samples collected
  - Fill jars to the 2 L line
  - Samples to be stored in the dark immediately after collection

  Abundance and community composition

  - 3 x independent **1 L** samples collected
  - Fill jars to the 1 L line
  - Samples to be preserved with 2 ml Lugol's iodine solution

2). Zooplankton biomass, abundance and community composition

- 3 x independent samples collected by lowering a weighted 20 µm mesh net to 5 m depth below the water surface
  - Record flow meter reading prior to deployment of net
  - Lower net to collect sample
  - Wash net down to rinse entire contents into the cod-end
  - Rinse contents of cod-end into a 1 L jar, top up with water
- Samples to be preserved with 50 ml of formalin

3). Ichthyoplankton biomass, abundance and community composition

- 3 x independent samples collected by lowering a weighted 350 µm mesh net to 5 m depth below the water surface
  - Record flow meter readings prior to deployment of net
    - **Note:** Net 1 has green and yellow striped tape on the frame
  - Lower net to collect sample
  - Wash both nets down to rinse entire contents into the cod-ends
  - Rinse contents of both cod-ends into a 1 L jar, top up with water
- Samples to be preserved with 50 ml of formalin

Appendix 2

Adelaide Desalination Project Plankton Monitoring Program

Sampling protocol

1). Phytoplankton biomass, abundance and community composition:

- Samples to be collected from surface waters with a weighted bucket.

  Pigments (biomass)

  - 3 x independent **2 L** samples collected
  - Fill jars to the 2 L line
  - Samples to be stored in the dark immediately after collection

  Abundance and community composition

  - 3 x independent **1 L** samples collected
  - Fill jars to the 1 L line
  - Samples to be preserved with 2 ml Lugol's iodine solution

2). Zooplankton biomass, abundance and community composition

- 3 x independent samples collected by lowering a weighted 20 µm mesh net to 5 m depth below the water surface
  - Record flow meter reading prior to deployment of net
  - Lower net to collect sample
  - Wash net down to rinse entire contents into the cod-end
  - Rinse contents of cod-end into a 1 L jar, top up with water
- Samples to be preserved with 50 ml of formalin

3). Ichthyoplankton biomass, abundance and community composition

- 5 x independent samples collected by lowering a weighted 350 µm mesh net to 5 m depth below the water surface
  - Record flow meter readings prior to deployment of net
    - **Note:** Net 1 has green and yellow striped tape on the frame
  - Lower net to collect sample
  - Wash both nets down to rinse entire contents into the cod-ends
  - Rinse contents of both cod-ends into a 1 L jar, top up with water
- Samples to be preserved with 50 ml of formalin