Adelaide Desalination Plant Plankton Monitoring Program

January 2014 report

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This report provides data from samples collected on the 16th of January 2014 from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens. Samples were collected for the analysis of phyto-, zoo-, and ichthyoplankton biomass and abundance using the methods outlined in appendix 1. Note; a 150 µm mesh net was used to sample zooplankton due to catastrophic equipment failure with the 20 µm mesh net. A new net has been ordered and will be used for future sampling events. Adelaide Aqua staff responsible for sampling had expressed concerns about sampling methodology, given the apparently low volumes being swept through the net during sampling, and difficulties deploying equipment during high flow periods. New sampling methodology was developed and used at this sampling event, and is detailed in Appendix 2 below. The main difference in methodology is in the technique used to ensure a sufficient volume of water is swept for an adequate sample to be collected. The new method uses the flow of intake water through the open mouth of the net for a set time to ensure sufficient volume is swept through the net, rather than hauling the net vertically from 5 m depth to try to sweep a large enough volume. The new method worked well, and will be adopted for use from now on.

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 100 ml 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 as the distance 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 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 larval numbers m^{-3} were recorded using the volume swept by the net, calculated as the distance travelled by the net (recorded by a flow meter suspended in the mouth of the net) multiplied by the area of the net mouth.

Phytoplankton biomass, abundance, and community composition

Mean chlorophyll *a* (chl *a*) concentrations in January were similar to concentrations in December. Total chl *a* was 0.1 (±0.002) µg L^{-1}, with most of the biomass in the small size fraction (cells <5 µm in diameter, figure 1). This is ~1/2 – 1/3 the typical values reported for January in waters off Port Stanvac (van Ruth 2010, 2012). Analysis of marker pigments normalised to chl *a* indicate that the small size fraction of phytoplankton biomass was dominated by cyanobacteria with small flagellates (chlorophytes, haptophytes, chrysophytes, euglenophytes, prasinophytes) also present (figure 2). There was ~50% decrease in the presence of chlorophytes, euglenophytes and prasinophytes, a slight increase in the presence of cyanobacteria and chrysophytes, and a marked increase in the presence of haptophytes from December to January. The large size fraction of phytoplankton biomass was dominated by diatoms (figure 3).

Mean total phytoplankton abundance was 34,267 (±1,421) cells L^{-1}, and was dominated by dinoflagellates and small flagellates (figure 4). *Gymnodinium* spp. were the dominant dinoflagellates (15,000 ± 1,000 cells L^{-1}), which explains the lack of a peridinin signature in pigment samples since these dinoflagellates do not contain that pigment. Small flagellates were dominated by the Cryptomonad *Plagioselmis* spp. (2,933 ± 1,035 cells L^{-1}).

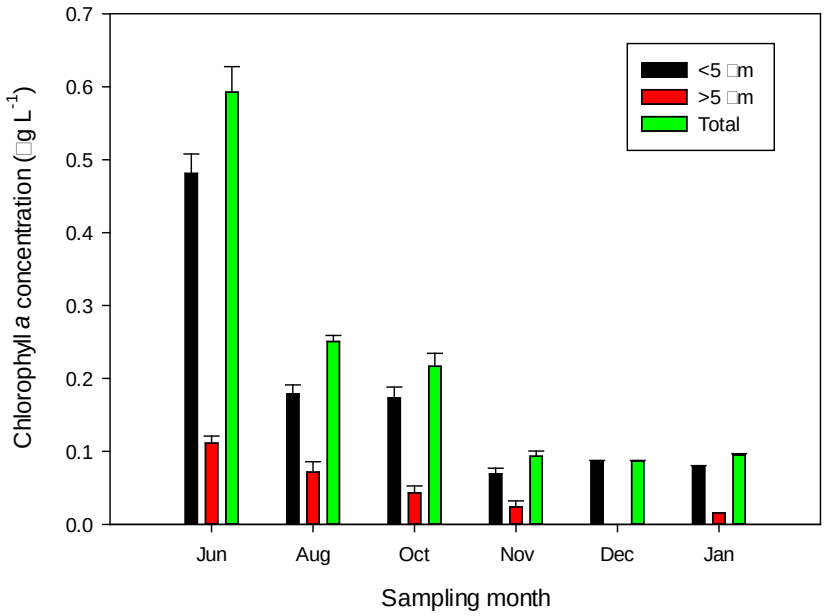

Figure 1. Mean total chlorophyll *a* concentrations, and concentrations in the small (<5 µm) and large (>5 µm) size fractions of phytoplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error bars indicate standard error.

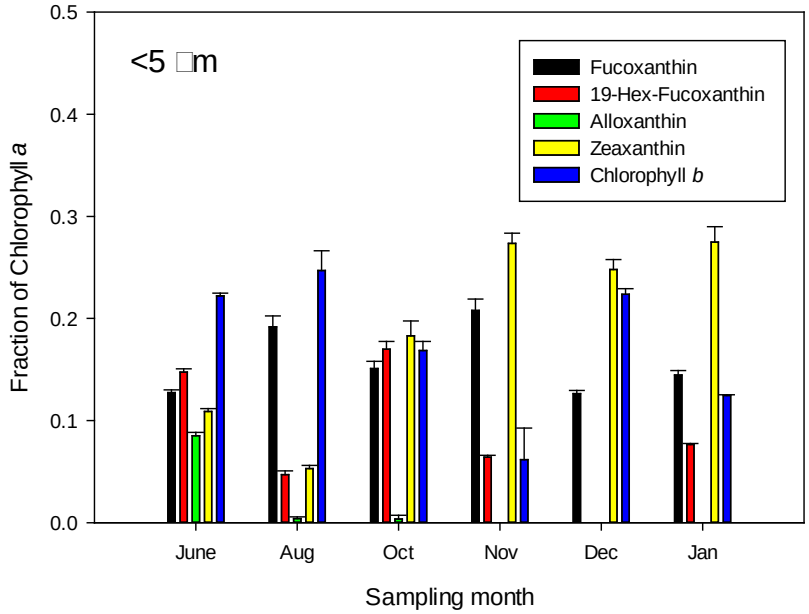

Figure 2. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the small size fraction of phytoplankton biomass (<5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error 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.

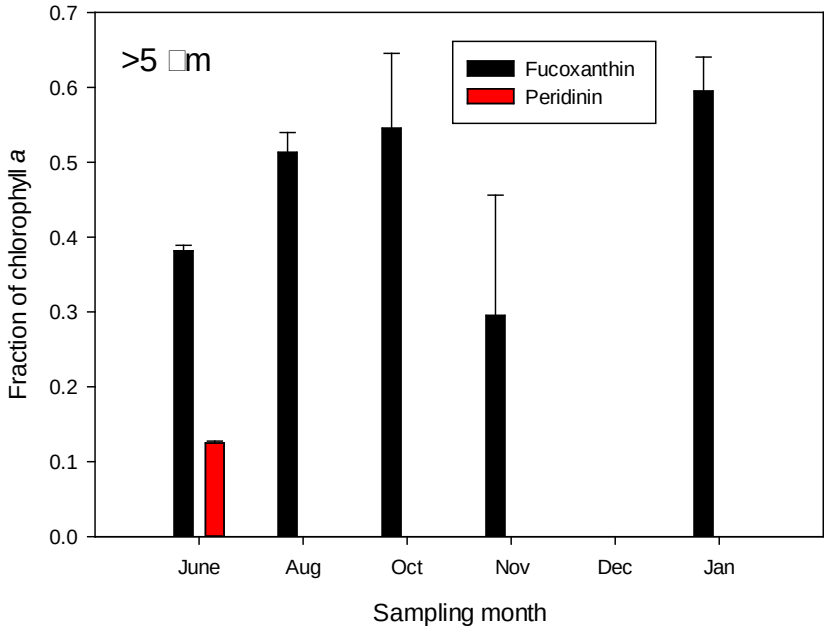

Figure 3. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the large size fraction of phytoplankton biomass (>5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error bars indicate standard error. Fucoxanthin is an indicator of diatoms, peridinin is an indicator of dinoflagellates.

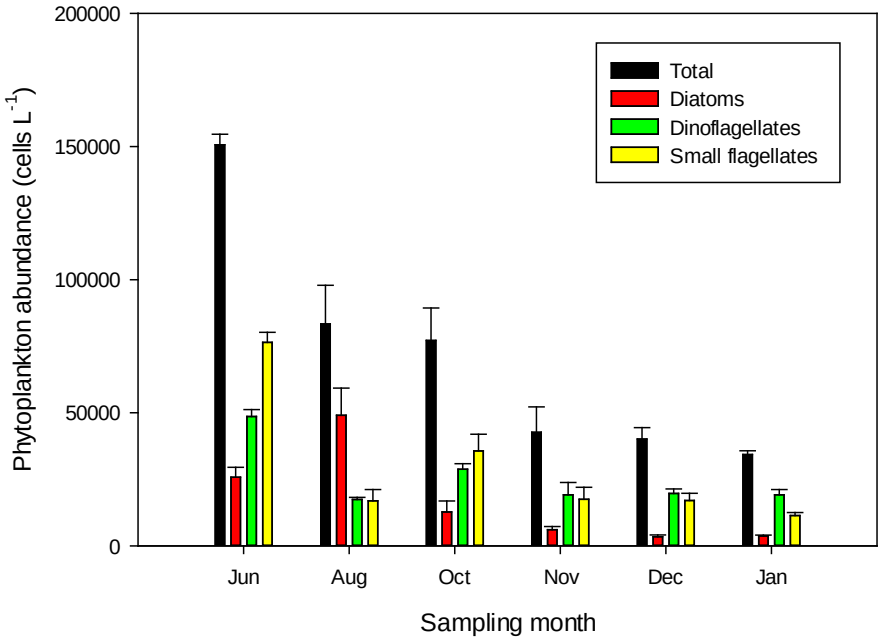

Figure 4. Mean phytoplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error bars indicate standard error.

Zooplankton biomass, abundance, and community composition

Mean zooplankton biomass was 20.2 (±3.4) ml m^{-3} (figure 5), which is 5 times the biomass previously reported for Port Stanvac in January (van Ruth 2010, 2012). This was due to the presence of a large amount of detritus and plant matter in the samples which was impossible to separate out prior to settling. Mean abundance was 15,622 (±3,561) individuals m^{-3} (figure 6), ~1/2 values previously reported for Port Stanvac in January (van Ruth 2010, 2012), probably due to the unavoidable change in net mesh size. In the absence of data on baseline natural conditions it is impossible to confirm that this is the case. The zooplankton community was dominated by copepods, with gastropod larvae also relatively abundant.

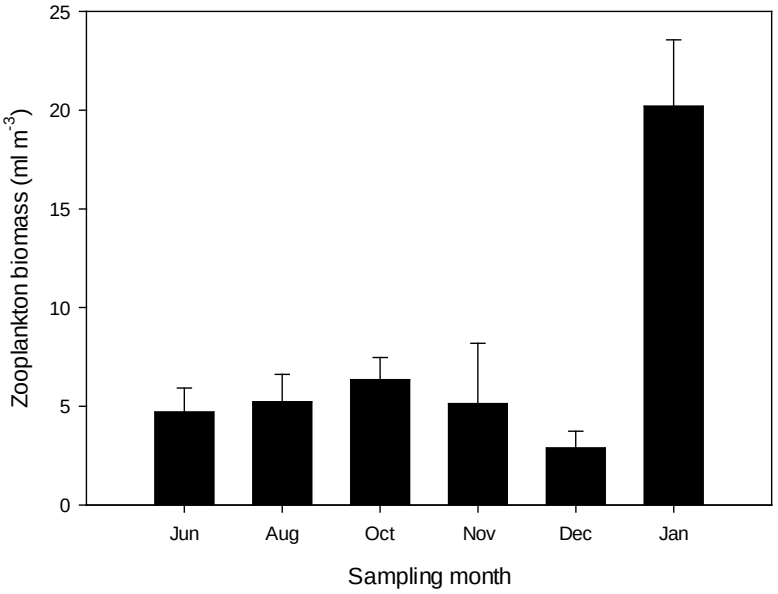

Figure 5. Mean zooplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error bars indicate standard error.

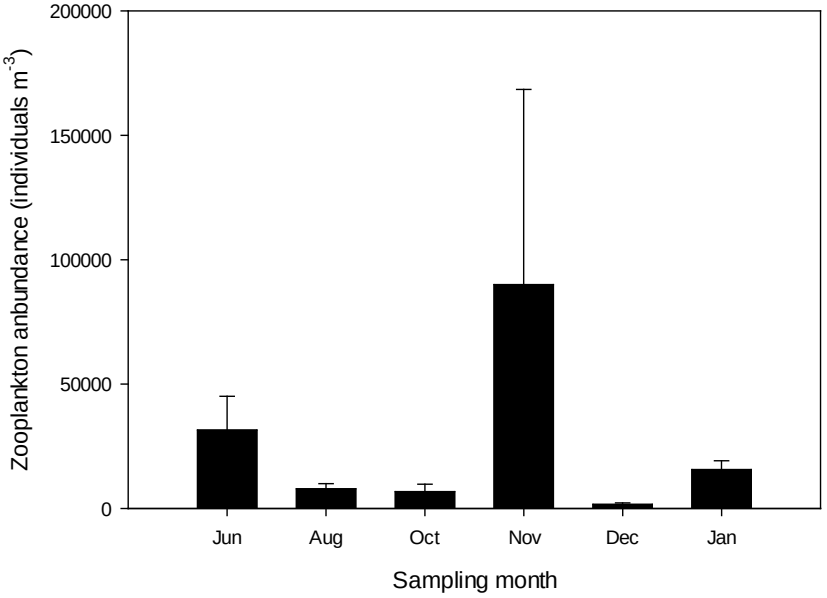

Figure 6. Mean zooplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013/2014. Error bars indicate standard error.

Ichthyoplankton biomass, abundance, and community composition

There were no fish eggs or larvae detected in samples collected in January 2014. This may be because no ichthyoplankton are being drawn in the ADP, but in the absence of data on “natural conditions” in the marine environment outside the plant at Port Stanvac at the time of sampling, it is impossible to definitively state that this is the case. Plankton samples from waters outside the plant at Port Stanvac will be collected at the same time as samples are collected from the intake tunnel in the ADP beginning with the February sampling event. This will assist in defining “natural conditions”, providing a baseline against which data from the intake tunnel can be compared.

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 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 150 µm mesh net to 5 m depth below the water surface and retrieving vertically
  - 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 and retrieving vertically
  - 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

Revised 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 150 µm mesh net below the water surface, with the net mouth open to the flow for 1 minute
  - Record flow meter reading prior to deployment of net
  - Lower net to collect sample
  - Record flow meter reading after sampling
  - 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 below the water surface, with the net mouth open to the flow for 1 minute
  - 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
  - Record flow meter readings after sampling
  - 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