

# Adelaide Desalination Plant Plankton Monitoring Program

## December 2013 report

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This report provides data from samples collected on the 12<sup>th</sup> of December 2013 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  $\mu\text{m}$  mesh net was used to sample zooplankton due to catastrophic equipment failure with the 20  $\mu\text{m}$  mesh net. A new net has been ordered and will be used for future sampling events.

Water samples for the analysis of pigment composition were filtered through stacked mesh (to retain cells  $>5 \mu\text{m}$ ) and Whatman GF/F filters (nominal pore size 0.4  $\mu\text{m}$ , to retain cells  $<5 \mu\text{m}$ ), allowing the examination of size fractionated phytoplankton biomass. Filters were frozen and stored at  $-80^{\circ}\text{C}$  prior to analysis via the gradient elution procedure of (Van Heukelem and Thomas 2001) on an Agilent 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  $\mu\text{m}$  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  $\text{m}^{-3}$  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  $\text{ml m}^{-3}$  using the volume swept.

Ichthyoplankton samples were pooled during rinsing through a 35  $\mu\text{m}$  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  $\text{m}^{-3}$  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 December were similar to concentrations in November. Total chl a was  $0.1 (\pm 0.001) \mu\text{g L}^{-1}$ , with all of the biomass in the small size fraction (cells  $<5 \mu\text{m}$  in diameter, figure 1). This is  $\sim 1/2 - 1/3$  the typical values reported for December 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 small flagellates (chlorophytes, chrysophytes, euglenophytes, prasinophytes) and cyanobacteria (figure 2). There was  $\sim 50\%$  decrease in the presence of chrysophytes, a slight decrease in the presence of cyanobacteria, and  $\sim$ triple the presence of chlorophytes, euglenophytes and prasinophytes from November to December. There was no phytoplankton biomass detected in the large size fraction in December (figure 3).

Mean total phytoplankton abundance was  $40,133 (\pm 4,268) \text{ cells L}^{-1}$ , and was dominated by small flagellates, in agreement with pigment analysis (figure 4). Dinoflagellates and small flagellates were more abundant than diatoms. Small flagellates were dominated by the Prasinophyte *Pyramimonas* spp. ( $8,767 \pm 2,307 \text{ cells L}^{-1}$ ). *Gymnodinium* spp. were the dominant dinoflagellates ( $17,333 \pm 2,028 \text{ cells L}^{-1}$ ).

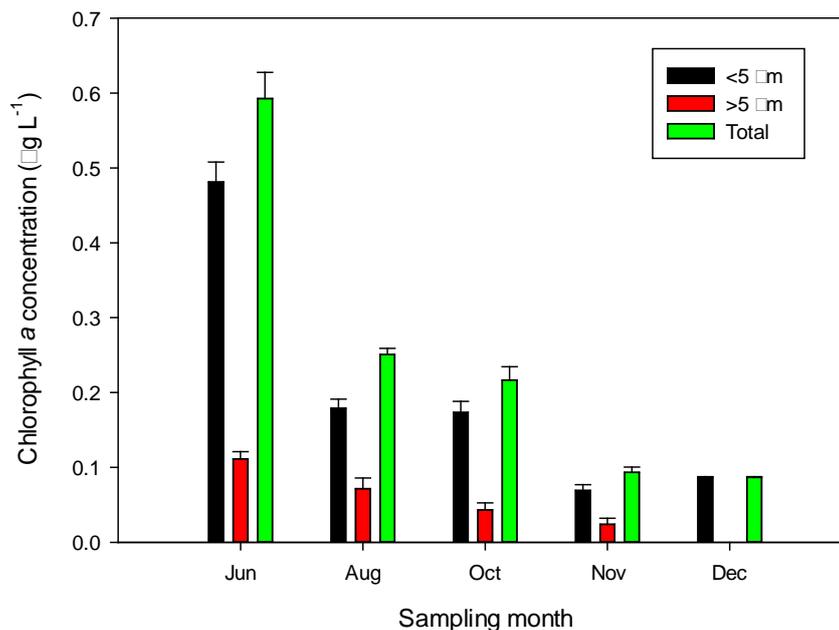


Figure 1. Mean total chlorophyll a concentrations, and concentrations in the small ( $<5 \mu\text{m}$ ) and large ( $>5 \mu\text{m}$ ) size fractions of phytoplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error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

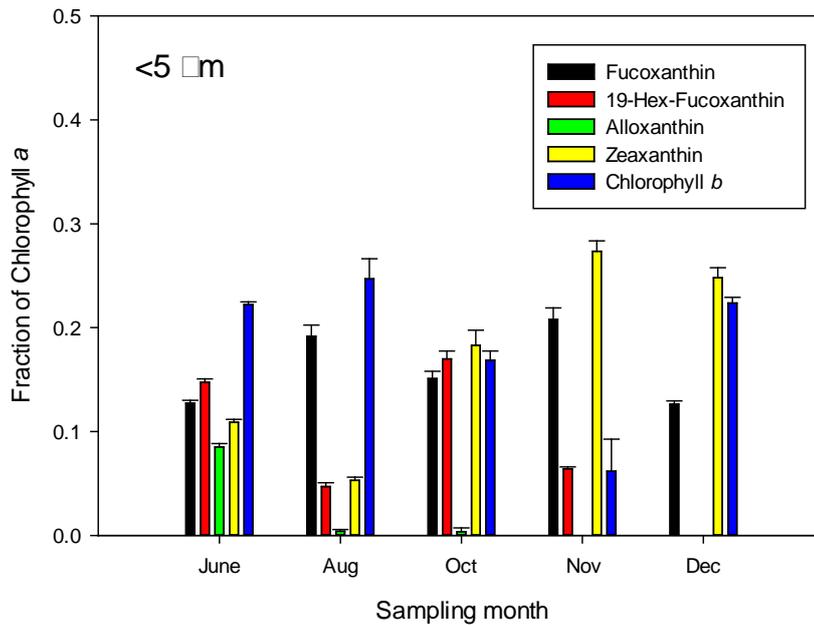


Figure 2. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the small size fraction of phytoplankton biomass (<5 μm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error bars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

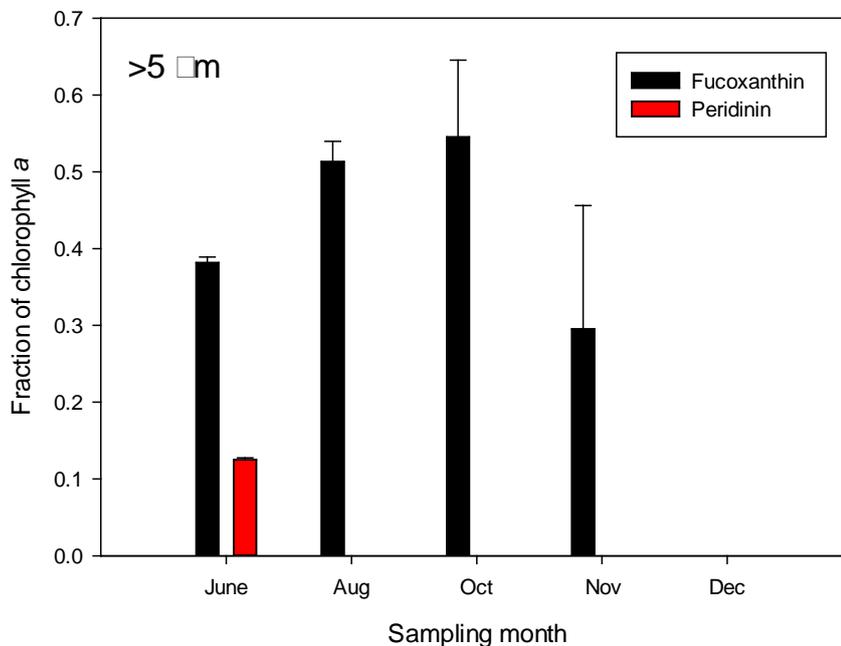


Figure 3. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the large size fraction of phytoplankton biomass (>5 μm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error bars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

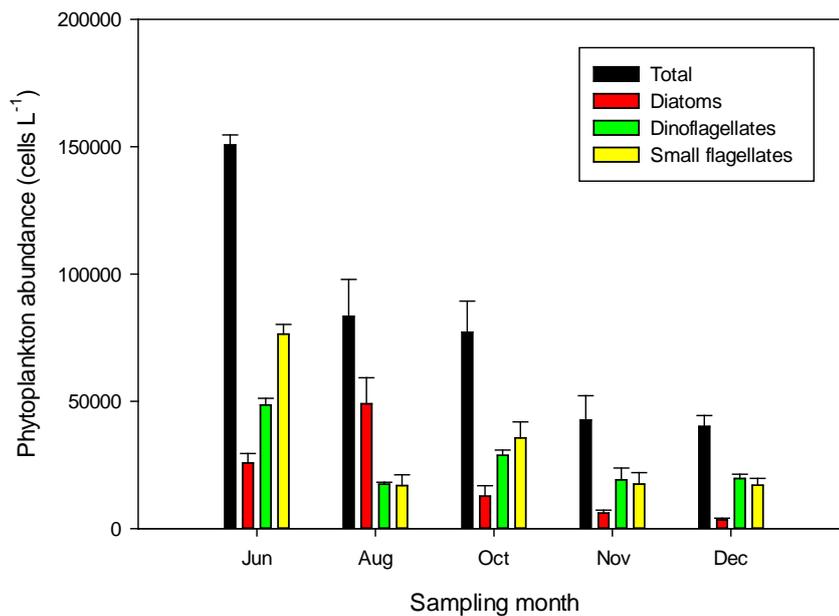


Figure 4. Mean phytoplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error bars indicate standard error.

### Zooplankton biomass, abundance, and community composition

Mean zooplankton biomass was  $2.9 (\pm 0.9) \text{ ml m}^{-3}$  (figure 5), which is  $\sim 1/2$  the biomass reported in December 2009 and  $\sim 3/4$  the biomass reported for Port Stanvac in December 2010 (van Ruth 2010, 2012). Mean abundance was  $1,611 (\pm 594)$  individuals  $\text{m}^{-3}$  (figure 6), an order of magnitude lower than values previously reported for Port Stanvac in December (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 bivalve (mussel) larvae, with cladocera also relatively abundant.

Adelaide Aqua staff responsible for sampling have 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. These concerns will be taken on-board and sampling strategies will be modified, with the assistance of Adelaide Aqua, to ensure that sufficient volumes of water are swept for adequate samples to be collected. New sampling methodology will be used at the next sampling event and will be detailed in the next monthly report.

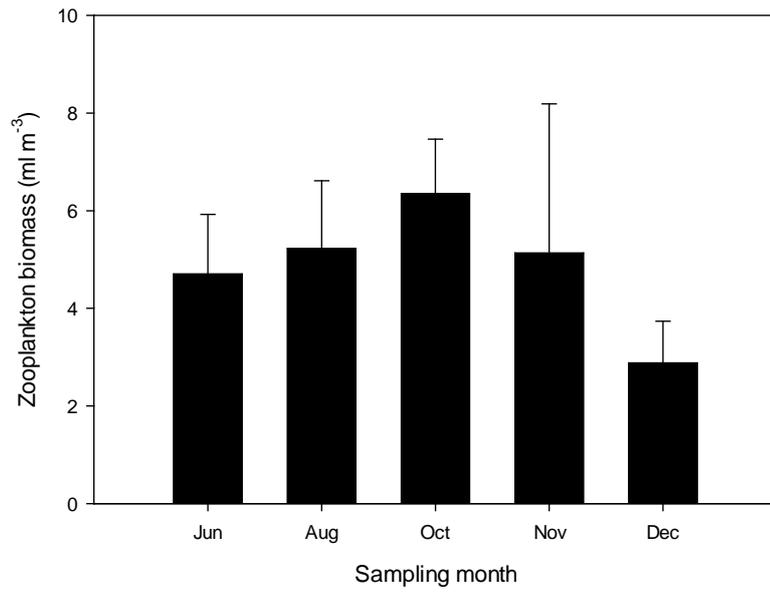


Figure 5. Mean zooplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error bars indicate standard error.

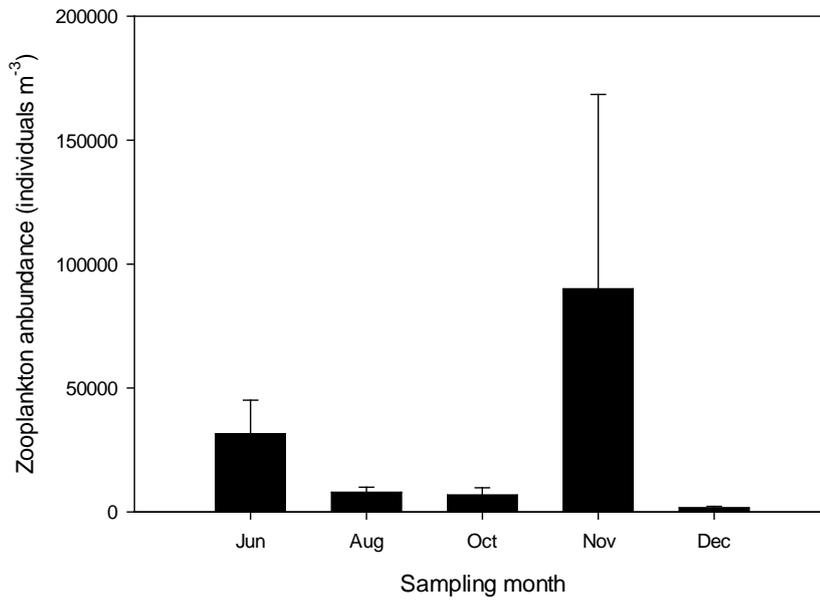


Figure 6. Mean zooplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens in 2013. Error bars indicate standard error.

## **Ichthyoplankton biomass, abundance, and community composition**

There were no fish eggs or larvae detected in samples collected in December 2013. 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 cycles are highly variable both between and within years, strongly influenced by inter- and intra-annual variations in meteorology and oceanography. Indeed the annual cycle of productivity and plankton abundance off Port Stanvac changed from 2009-10 to 2010-11 (van Ruth 2012). Plankton samples from waters outside the plant at Port Stanvac should be collected at the same time as samples are collected from the intake tunnel in the ADP. In this way, “natural conditions” could be established, providing a baseline against which data from the intake tunnel could be compared. This would clarify the fate of plankton entering the plant, and ensure changes in plankton dynamics are attributed to the correct cause (i.e: natural cycles or plant impacts).

## **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
  - 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