Adelaide Desalination Plant Plankton Monitoring Program

February 2014 report

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This report provides data from samples collected on the 27th of February 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. This report also includes data from offshore sampling conducted to provide an indication of natural environmental conditions offshore from the ADP for comparison with data from in-plant samples. Offshore sampling was also conducted on the 27th of February 2014, with methods outlined in appendix 2.

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 100 ml 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 the plant in February were ~1/2 the concentrations in January. Total chl *a* was 0.04 (±0.007) µg L^{-1}, with all of the biomass in the small size fraction (cells <5 µm in diameter, figure 1). This is ~1/4 the values previously reported for February 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 chrysophytes with small flagellates (haptophytes, chlorophytes, euglenophytes, prasinophytes) and cyanobacteria also present (figure 2). There was ~50% increase in the presence of chrysophytes and haptophytes, ~25% increase in the presence of chlorophytes, euglenophytes, and prasinophytes, and a ~50% decrease in the presence of cyanobacteria from January to February. The large size fraction of phytoplankton biomass was dominated by diatoms (figure 3).

Offshore total chl *a* was 0.2 (±0.009) µg L^{-1}, with most of the biomass in the small size fraction (figure 1), typical results for Port Stanvac in February (van Ruth 2010, 2012). Analysis of normalised marker pigments in offshore samples revealed similar results to in-plant samples, though haptophytes were more dominant than chrysophytes (figure 2). Similarly to in-plant samples, diatoms dominated the large size fraction of offshore samples (figure 3).

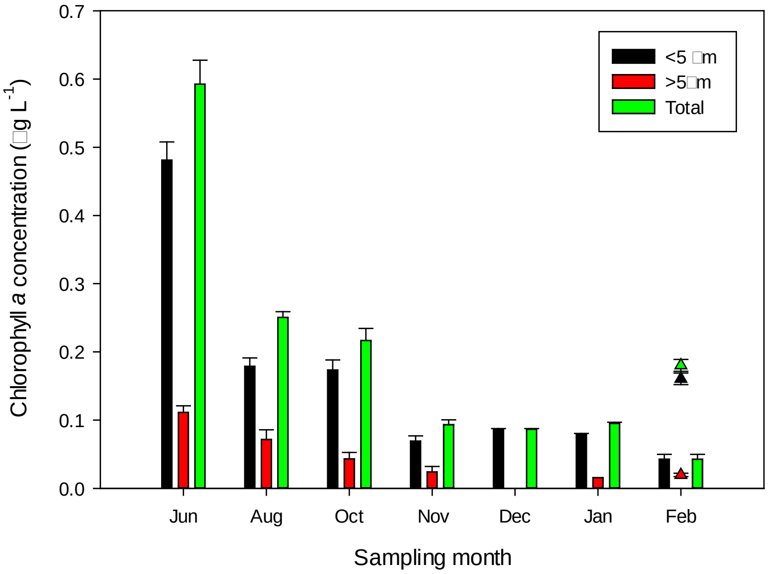

Figure 1. Mean total chlorophyll *a* concentrations, and concentrations in the small (<5 µm) and large (>5 µm) size fractions of phytoplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser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

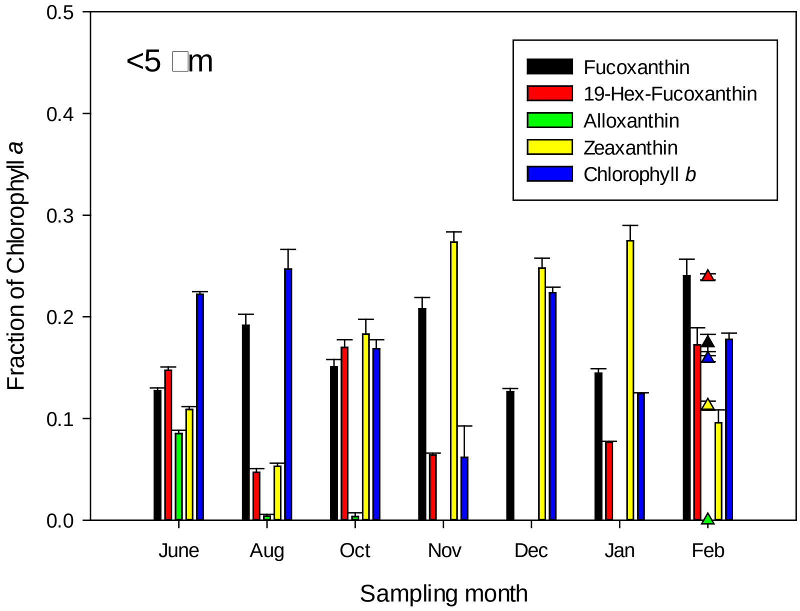

Figure 2. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the small size fraction of phytoplankton biomass (<5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore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

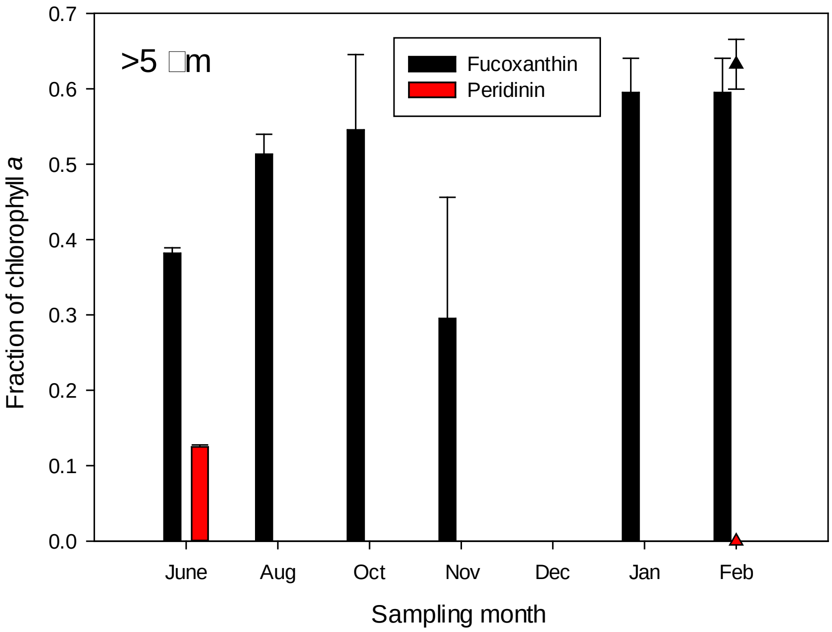

Figure 3. Mean concentrations of selected marker pigments normalised to total chlorophyll *a* (weight:weight) in the large size fraction of phytoplankton biomass (>5 µm) in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore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

In-plant mean total phytoplankton abundance was 40,277 (±1,779) cells L^{-1}, and was dominated by diatoms (figure 4), in particular *Ceratoneis closterium* (4,267 ± 145 cells L^{-1}), *Navicula* spp. (1,933 ± 233 cells L^{-1}), and *Guinardia flaccida* (1,600 ± 379 cells L^{-1}). Dinoflagellates were dominated by *Gyrodinium* spp. (4,600 ± 600 cells L^{-1}) and *Gymnodinium* spp. (4,200 ± 493 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 Cryptomonads *Hemiselmis* spp. (2,767 ± 433 cells L^{-1}) and *Plagioselmis* spp. (2,633 ± 333 cells L^{-1}).

Mean total phytoplankton abundance in offshore samples was 88,467 (±973) cells L^{-1}, more than double in-plant abundances (figure 4). Diatoms dominated the community, with *Ceratoneis closterium* (9,500 ± 866 cells L^{-1}), *Chaetoceros* spp. (9,167 ± 1,364 cells L^{-1}), *Leptocylindrus danicus* (5,833 ± 1,014 cells L^{-1}), and *Guinardia flaccida* (5,333 ± 441 cells L^{-1}) particularly abundant. The offshore dinoflagellate community was also dominated by *Gyrodinium* spp. (2,167 ± 441 cells L^{-1}) and *Gymnodinium* spp. (6,833 ± 601 cells L^{-1}), with the Cryptomonad *Plagioselmis* spp. (8,667 ± 882 cells L^{-1}), and the Prasinophyte *Pyramimonas* spp. (3,500 ± 764 cells L^{-1}) the most abundant small flagellates in offshore samples.

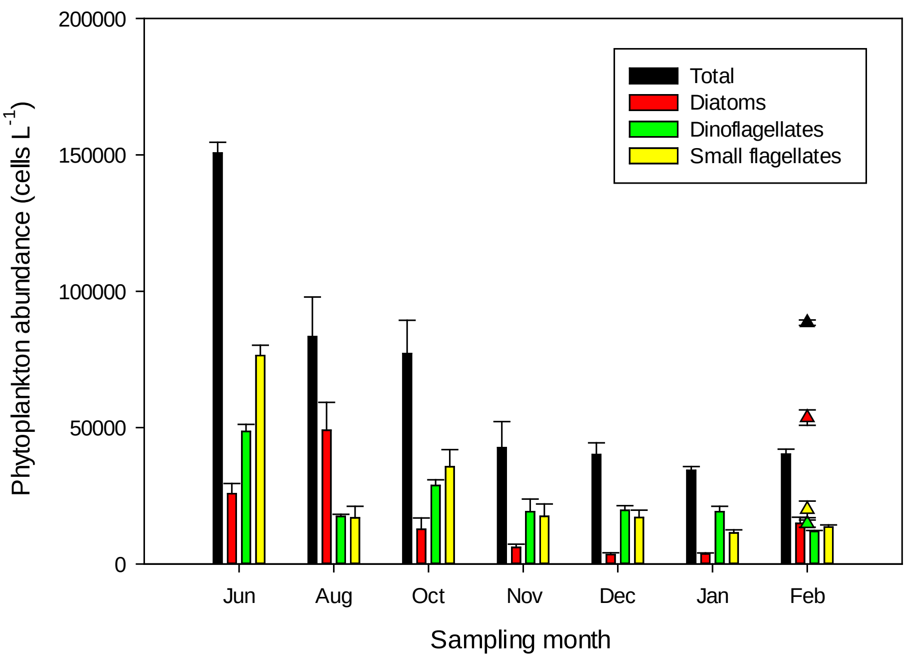

Figure 4. Mean phytoplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser pipe (triangles) in 2013/2014. Error bars indicate standard error.

Zooplankton biomass, abundance, and community composition

Mean in-plant zooplankton biomass was 2.3 (±0.9) ml m^{-3} (figure 5), 1/8 the biomass reported for January (due to the absence of the detritus and plant matter in settled samples that caused problems in January as flagged in the previous report), and ~1/4 the biomass previously reported for Port Stanvac in February (van Ruth 2010, 2012). Mean abundance was 9,250 (±1,746) individuals m^{-3} (figure 6), ~1/4 values previously reported for Port Stanvac in February (van Ruth 2010, 2012). The zooplankton community was dominated by copepod nauplii, with copepods and mollusc larvae also relatively abundant.

In offshore samples, mean zooplankton biomass was 9.7 (±3.0) ml m^{-3} (figure 5), which is similar to values previously reported for the area in February (van Ruth 2010, 2012). Mean abundance in offshore samples was 141,179 (±50,261), twice the abundance previously reported for Port Stanvac (van Ruth 2010, 2012), with the community dominated by copepod nauplii, copepods and mollusc larvae, similar to in-plant samples.

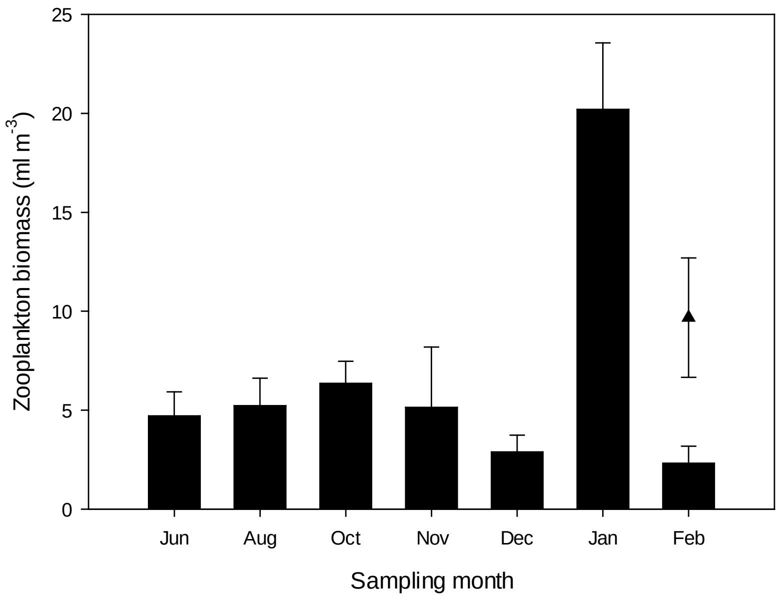

Figure 5. Mean zooplankton biomass in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser pipe (triangles) in 2013/2014. Error bars indicate standard error.

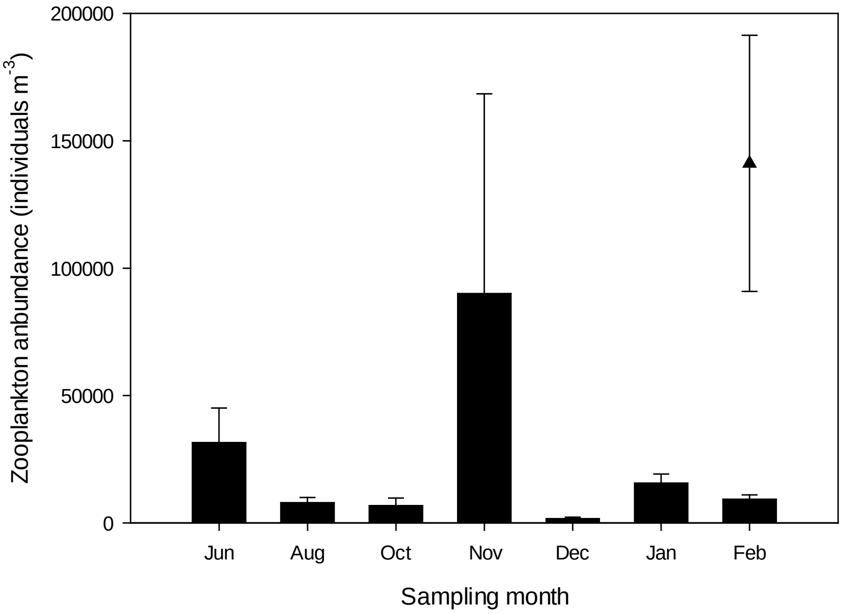

Figure 6. Mean zooplankton abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser pipe (triangles) in 2013/2014. Error bars indicate standard error.

Ichthyoplankton biomass, abundance, and community composition

There were no fish eggs or larvae detected in in-plant samples collected in February 2014 (figures 7 and 8). In contrast, eggs were present in offshore samples at concentrations of 1.8 eggs m^{-3} (figure 7), similar to abundances previously reported for Port Stanvac (van Ruth 2010, 2012). All eggs present were identified as sardine (*Sardinops sagax)*. Fish larvae were also identified in offshore samples, in concentrations of 0.8 larvae m^{-3} (figure 8), again, similar to abundances previously reported for Port Stanvac (van Ruth 2010, 2012). Larvae were dominated by sardine, with leatherjackets also present.

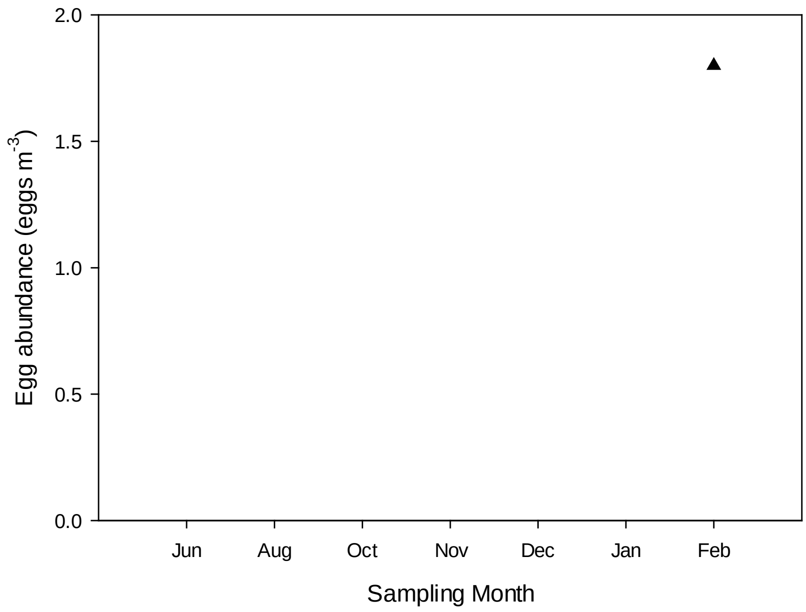

Figure 7. Fish egg abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser pipe (triangles) in 2013/2014.

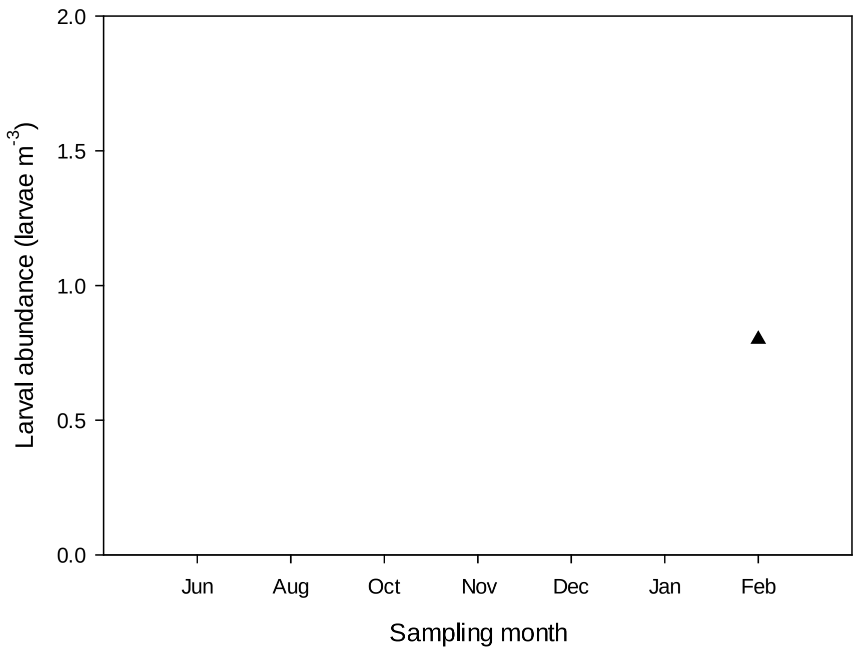

Figure 8. Fish larval abundance in samples collected from the intake tunnel of the Adelaide Desalination Plant (ADP) prior to the band screens (bars), and offshore at the intake riser pipe (triangles) in 2013/2014.

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

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 20 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

Appendix 2

Adelaide Desalination Project Plankton Monitoring Program

Offshore sampling protocol

Samples collected on the same day as in-plant sampling, above the intake riser pipe, offshore from the Adelaide Desalination Plant, 138.4679 ° E, 35.09059° S.

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 within 1 m of the sea floor and retrieving vertically
  - 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 to mid – depth and towing horizontally 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