



Mercury Independent Review – Stage 2

Final Report
March 2015

WSP



Contents

| | |
|---|----|
| List of figures | ii |
| 1 Introduction | 3 |
| 2 Methods..... | 4 |
| 2.1 Fish collection | 4 |
| 2.2 Sample preparation..... | 4 |
| 2.3 Permits | 5 |
| 2.4 Data analysis | 5 |
| 2.4.1 Guideline comparison | 5 |
| 2.4.2 Statistical analysis..... | 5 |
| 3 Summary of findings | 7 |
| 3.1 Previous datasets | 7 |
| 3.2 Survey results | 9 |
| 3.3 Correlations analyses | 9 |
| 3.4 Comparison among years | 11 |
| 4 Conclusion..... | 13 |
| References | 14 |
| Appendix 1 Field proforma | 15 |
| Appendix 2 Laboratory Certificate of Analysis | 18 |
| Appendix 3 Mercury concentrations in fish tissue..... | 25 |

List of figures

Figure 1 Mercury concentration (mg/kg) \pm standard error (SE) within each fish species..... 12

List of tables

Table 1 Summary of available data for mercury concentrations in fish samples collected within the Penhryn estuary 8

Table 2 Mean, standard error (se), minimum and maximum values for fish length, weight and mercury for each species collected in the Penhryn estuary..... 10

Table 3 Pearson's product-moment correlation between fish mercury concentrations and fish length and weight..... 10

Table 4 Number of samples (*N*), mean, degrees of freedom, and p values for two sample t-test..... 11

1 Introduction

Ecosure was commissioned by WSP Group (WSP) to undertake biotic (fish) sampling of middle trophic species in the Penhryn Estuary of Botany Bay. The fish tissue mercury analyses form part of the larger NSW Environment Protection Authority (EPA) *Orica Botany Mercury Independent Review – Stage 2*.

Ecosure prepared a proposal entitled “*Orica Botany Mercury Independent Review – Stage 2*” which was awarded to WSP in 2014. The scope of works for the tissue mercury analyses includes:

- a desktop review of past literature and reports on mercury contamination within aquatic biota of the broader study area to:
 - (i) confirm and refine the current proposed scope of works,
 - (ii) provide data to be used for comparison within the current assessment
- field sampling to collect a range of fish species and replicates for tissue metal analysis, with the sole focus being mercury
- reporting with interpretation of results, including comparison to relevant guidelines.

This report presents the results from the most recent survey conducted in February 2015. Comparisons have been made with data collected within previous surveys.

2 Methods

Fish sampling was conducted within the Penrhyn Estuary commencing on the 17th and concluding on the 18th of February 2015. As the uptake of mercury can vary within and between species, a range of fish (including fish at various life history stages) were targeted for analysis. This approach therefore accounted for a range of factors/variables including age, diet, movement and micro habitat use, and thus the potential variation of concentrations within individual species and between other species.

Considering previous surveys (Cardno 2015, URS 2004) and requests from WSP, the survey targeted the following species:

- sea mullet (*Mugil cephalus*)
- sand mullet (*Myxus elongatus*)
- yellow-fin bream (*Acanthopagrus australis*)
- silver biddy (*Gerres subfasciatus*)
- dusky flathead (*Platycephalus fuscus*)
- flat-tail mullet (*Liza argentea*)
- whiting (*Sillago ciliata*)
- luderick (*Girella tricuspidata*)
- trevalley (*Pseudocaranx spp.*)
- smooth toadfish (*Tetractenos glaber*).

2.1 Fish collection

Fish sampling was conducted via active (seine nets, hand reels) and passive (fyke nets) methods. Seine netting was conducted in wadable water depths within the upper estuary on the ebbing tide. Double-winged fyke nets and blocker nets were deployed across the upper estuary channel at high tide and were set for several hours until reaches upstream had sufficiently drained.

2.2 Sample preparation

To maintain consistency with previous investigations and where sufficient individuals were captured, 10 individuals from each species were assessed for mercury concentrations. Prior to tissue collection, individuals were euthanised via overdose of Aqui-S[®] solution and then were measured and weighed.

Sea mullet, whiting, yellowfin bream and luderick individuals were rinsed well in clean water and placed on a sterile plastic sheet. A clean scalpel was then used to remove the flesh from each specimen. The skin from the removed flesh was then cut from the sample in a method

similar to filleting a fish. An extreme level of care was taken to ensure no contamination, including complete avoidance of the stomach. The remaining flesh was then rinsed in distilled water, weighed and placed in a labelled sterile bag. Smooth toadfish and silver biddy individuals were not dissected, rather were kept whole (as per previous collection techniques), rinsed in distilled water and placed in a labelled sterile bag. All samples were transferred to a chilled esky and kept on ice for delivery to a NATA accredited laboratory (Advanced Analytical Australia) for mercury analysis. As a minimum, 5 g of sample from each individual was sent to the laboratory for analysis.

2.3 Permits

Fish surveys were conducted in accordance with Ecosure's NSW Fisheries Scientific Collection Permit (permit P09/0024-3.0) and Animal Ethics Committee approval.

2.4 Data analysis

2.4.1 Guideline comparison

The Australia New Zealand Food Standards Code - Standard 1.4.1 - Contaminants and Natural Toxicants (ANZFSC 2011) is administered by the bi-national government agency Food Standards Australia New Zealand (FSANZ). This Standard sets out the maximum levels (MLs) of specified metal and non-metal contaminants and natural toxicants in nominated foods.

A conservative approach was applied, where results obtained in the current study have been compared to the most stringent permissible concentration of mercury in fish and fish products, being 0.5 mg/kg (ANZFSC 2011).

2.4.2 Statistical analysis

Mean concentrations of mercury and standard errors (se) were calculated for each species.

Differences in mercury concentrations for each assessed species were tested using a two sample t-test. This test was selected as the limitations of the datasets met the required assumptions, including:

- the dataset must be normally distributed
- the data is not paired (i.e. uneven dataset)
- the variance of the two samples may be assumed to be equal or unequal.

As the species and number of individuals collected varied among previous sampling events the following species could only be statistically tested:

- whiting, collected during the 2014 and 2015 survey events
- silver biddy, collected during the 2004 and 2015 survey events
- sea mullet, collected during the 2004 and 2015 survey events

- luderick, collected during the 2004 and 2015 survey events.

Other survey events, such as those conducted in Stage two (1993, 1994) and stage three (1996 to 1998) were not incorporated into the analyses; as no raw data could be sourced and previous reports provide conflicting values.

Pearson product-moment correlation among mercury tissue concentrations and physical parameters (fish length and weight) were carried out to identify any significant correlations between measured variables. Due to minimal replication, correlation tests were not run for luderick or bream.

All statistical procedures were performed using the statistical software package Minitab v17[®].

3 Summary of findings

3.1 Previous datasets

Four assessments have been undertaken between 1993 and 2014 examining mercury concentrations within estuarine fish captured within the Penhryn estuary. During this period ten species have been sampled, of these, sea mullet (*Mugil cephalus*) silver biddy (*Gerres subfasciatus*) and yellow-fin bream (*Acanthopagrus australis*) were the most commonly assessed, with each species being collected on three occasions (Table 1).

Previous results indicate:

- no specimens previously collected recorded mercury concentrations in flesh tissue or whole body samples greater than the ANZFSC (2011) maximum concentration of mercury within fish for human consumption (1 mg/kg)
- the maximum concentration of mercury previously recorded is 0.45 mg/kg from a luderick flesh tissue sample (URS 2004)
- mercury concentrations in mullet species and tarwhine did not exceed 0.10 mg/kg on any occasion
- mercury was undetected in sand mullet specimens collected on two occasions
- the maximum mercury concentration recorded in other species ranged from 0.25 mg/kg in yellow-fin bream, to 0.40 mg/kg recorded in a silver biddy and dusky flathead (*Platycephalus fuscus*) sample.

Table 1 Summary of available data for mercury concentrations in fish samples collected within the Penhryn estuary

| Species (common name) | Stage 2 1993 - 1994 | | | | Stage 3 1996 - 1998 | | | | URS 2004 | | | | Cardno 2015 ¹ | | | |
|-----------------------|---------------------|----|------|----------------|---------------------|----|-----|-------------|----------|-------|-------|-------------|--------------------------|-------|------|-------------|
| | mean | SE | min | max | mean | SE | min | max | mean | SE | min | max | mean | SE | min | max |
| sea mullet | - | - | <0.1 | 0.10 | - | - | ND | 0.10 | 0.03 | 0.004 | <0.01 | 0.06 | | | | |
| flat-tail mullet | | | | | - | - | ND | ND | 0.04 | 0.010 | 0.01 | 0.10 | | | | |
| sand mullet | - | - | <0.1 | <0.1 | - | - | ND | ND | | | | | | | | |
| yellow-fin bream | - | - | <0.1 | 0.25 | - | - | ND | 0.20 | | | | | 0.13 | 0.015 | 0.08 | 0.17 |
| tarwhine | | | | | | | | | 0.07 | 0.020 | 0.02 | 0.10 | | | | |
| trevally | - | - | <0.1 | 0.20 | | | | | | | | | 0.18 | 0.018 | 0.09 | 0.26 |
| luderick | - | - | <0.1 | 0.20 | | | | | 0.26 | 0.060 | 0.13 | 0.45 | | | | |
| whiting spp. | | | | | | | | | | | | | 0.13 | 0.024 | 0.04 | 0.32 |
| dusky flathead | - | - | <0.1 | 0.10 | - | - | ND | 0.40 | | | | | | | | |
| silver biddy** | - | - | <0.1 | 0.10 | - | - | ND | 0.40 | 0.16 | 0.020 | 0.05 | 0.26 | | | | |

Note: ** indicates whole fish samples were retained for analysis, rather than flesh tissue, ND = Not Detected, where limit of reporting cannot be determined, **Bold** indicates maximum historic concentration for a particular species.

¹ Data collected by Cardno 2015, was undertaken in 2014

3.2 Survey results

The current survey resulted in the collection of 35 individuals, encompassing six species (Table 2, Figure 1). With the exception of luderick (adult specimens only), various life history stages (i.e. juvenile and mature specimens) were also collected for each species. This is evident in the variability between minimum and maximum length values shown in Table 2. Raw data for fish length, fish weight and tissue sample weight is provided in Appendix 1, and laboratory certificates are provided in Appendix 2.

Results obtained can be summarised as follows:

- Mercury concentrations in all tissue samples conformed to the ANZFSC (2011) maximum concentration of mercury within fish for human consumption (0.50 mg/kg).
- The maximum concentration recorded was 0.300 mg/kg within a yellow-fin bream sample.
- Two luderick samples recorded a mean concentration of 0.175 mg/kg \pm 0.005 (se).
- Ten toadfish samples recorded a mean concentration of 0.100 mg/kg \pm 0.010 (se).
- Eight whiting samples recorded a mean concentration of 0.068 mg/kg \pm 0.007 (se).
- Four silver biddy samples recorded a mean concentration of 0.060 mg/kg \pm 0.003 (se).
- Ten sea mullet samples recorded a mean concentration of 0.056 mg/kg \pm 0.005 (se).

3.3 Correlations analyses

Correlation analysis was undertaken between fish attributes (size and weight) and mercury concentrations where suitable replicates were obtained (Table 3). Key findings can be summarised as follows:

- The strongest correlation was exhibited between sea mullet samples and mercury concentrations, showing a significant negative correlation between both fish weight ($r = -0.92$, $p < 0.01$) and length ($r = -0.96$, $p < 0.01$). This indicates that as fish size increased the mercury concentration in flesh tissue decreased. This result may reflect the residence time of juvenile specimens within the upper estuary, as opposed to more mobile adult specimens likely to be transient visitors.
- Smooth toadfish samples showed a significant positive correlation in mercury samples when compared to fish length ($r = 0.79$, $p = <0.01$) and fish weight ($r = 0.68$, $p = 0.03$).
- Whiting samples showed a significant positive correlation in mercury samples and fish length ($r = 0.87$, $p = <0.01$) though the positive correlation between mercury concentrations and fish weight was not significant ($r = 0.71$, $p = 0.05$).
- Silver biddy samples showed a strong positive correlation between mercury concentrations and fish length ($r = 0.86$) and weight ($r = 0.90$), though were not significant ($p = 0.14$ and 0.10 respectively). This likely indicates the number of replicates and the resulting lower degrees of freedom.

Table 2 Mean, standard error (se), minimum and maximum values for fish length, weight and mercury for each species collected in the Penhryn estuary.

| Fish | Number of samples | Metric | Fish length (mm) | Fish weight (g) | Mercury* (mg/kg) | ANZFSC 2011 guideline (mg/kg) |
|--|-------------------|---------|------------------|-----------------|------------------|-------------------------------|
| sea mullet (<i>Mugil cephalus</i>) | 10 | mean | 180 | 149 | 0.056 | 0.50 |
| | | se | 39 | 90 | 0.005 | |
| | | minimum | 110 | 12 | <0.01 | |
| | | maximum | 430 | 797 | 0.068 | |
| silver biddy (<i>Gerres subfasciatus</i>) | 4 | mean | 110 | 21 | 0.060 | 0.50 |
| | | se | 20 | 5 | 0.003 | |
| | | minimum | 50 | 6 | 0.054 | |
| | | maximum | 139 | 31 | 0.068 | |
| luderick (<i>Girella tricuspidata</i>) | 2 | mean | 357 | 613 | 0.175 | 0.50 |
| | | se | 5 | 32 | 0.005 | |
| | | minimum | 352 | 581 | 0.170 | |
| | | maximum | 361 | 645 | 0.180 | |
| whiting (<i>Sillago ciliata</i>) | 8 | mean | 224 | 224 | 0.068 | 0.50 |
| | | se | 13 | 13 | 0.007 | |
| | | minimum | 148 | 35 | 0.019 | |
| | | maximum | 260 | 156 | 0.095 | |
| smooth toadfish (<i>Tetractenos glaber</i>) | 10 | mean | 94 | 24 | 0.100 | 0.50 |
| | | se | 5 | 2 | 0.010 | |
| | | minimum | 69 | 11 | 0.052 | |
| | | maximum | 110 | 33 | 0.160 | |
| yellow-fin bream (<i>Acanthopagrus australis</i>) | 1 | mean | - | - | - | 0.50 |
| | | se | - | - | - | |
| | | minimum | 160 | 232 | 0.3 | |
| | | maximum | 160 | 232 | 0.3 | |

*If reported value was less than the LOR, the LOR was used to calculate means.

Table 3 Pearson's product-moment correlation between fish mercury concentrations and fish length and weight.

| Species | Weight | Length |
|--------------|----------------------------|----------------------------|
| sea mullet | $r = -0.92$ $p = <0.01$ | $r = -0.96$ $p = <0.01$ |
| silver biddy | $r = 0.90$ $p = 0.10$ | $r = 0.86$ $p = 0.14$ |
| whiting | $r = 0.71$ $p = 0.05$ | $r = 0.87$ $p = <0.01$ |
| toadfish | $r = 0.68$ $p = 0.03$ | $r = 0.79$ $p = <0.01$ |

Note: Cell contents indicated Pearson's product-moment correlation r value followed by p value (significant correlation where $p < 0.05$).

3.4 Comparison among years

Raw data from the 2004 and 2014 survey events was compared to data collected within the current survey for each species where applicable (Table 4, Figure 1), and can be summarised as follows:

- Mercury concentrations differed significantly among survey years, with silver biddy ($p = 0.002$) and whiting ($p = 0.031$) samples recording significantly less mercury in the current survey.
- Mercury concentrations in sea mullet were significantly greater in the current survey ($p = 0.012$) when compared to recorded concentrations in 2004. It should be noted, no data is available to determine the relationship between fish size and mercury concentrations in the historic dataset. The observed difference between years may simply reflect a varying composition of fish specimens used (i.e. fish length).
- Luderick was the only species where mercury concentrations did not differ significantly between survey events.

Table 4 Number of samples (N), mean, degrees of freedom, and p values for two sample t-test

| Year | N | Mean | Degrees of freedom | p value |
|--------------|-----|------|--------------------|--------------|
| sea mullet | | | | |
| 2004 | 12 | 0.03 | 14 | 0.012 |
| 2015 | 10 | 0.05 | | |
| silver biddy | | | | |
| 2004 | 10 | 0.16 | 9 | 0.002 |
| 2015 | 4 | 0.06 | | |
| luderick | | | | |
| 2004 | 7 | 0.27 | 6 | 0.121 |
| 2015 | 2 | 0.18 | | |
| whiting | | | | |
| 2014 | 10 | 0.13 | 10 | 0.029 |
| 2015 | 8 | 0.07 | | |

Note: **Bold** indicates a significant difference, i.e. $p < 0.05$.

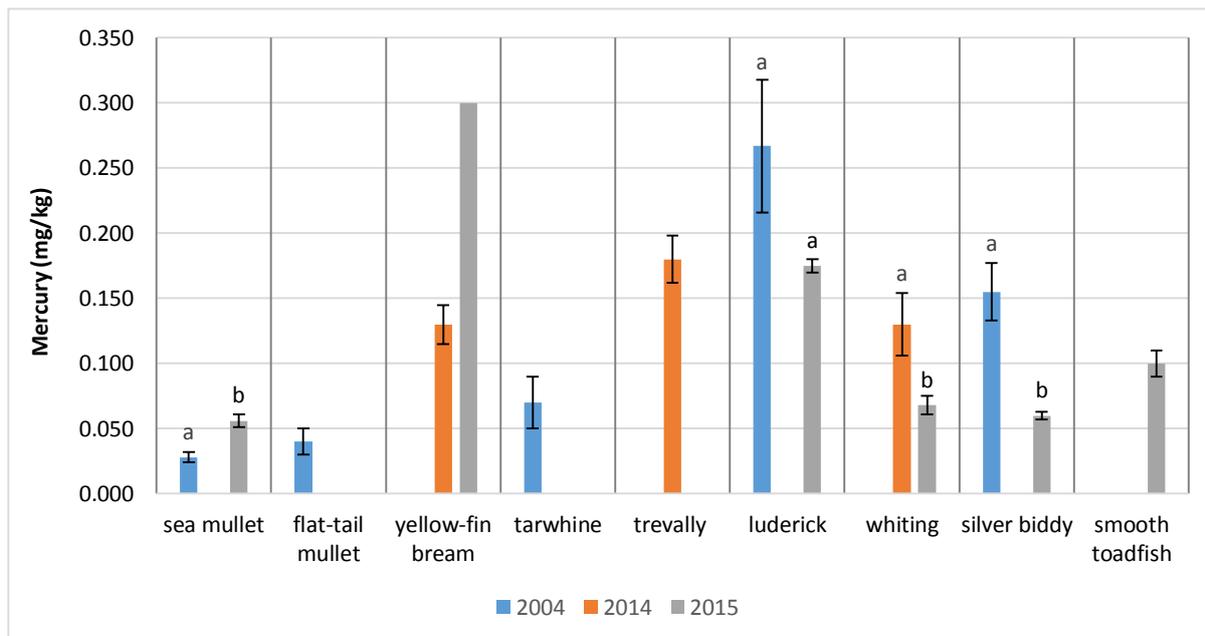


Figure 1 Mercury concentration (mg/kg) ± standard error (SE) within each fish species. Means with different letters are significantly different ($p < 0.05$) among survey events for each species.

4 Conclusion

This report presents the findings of an assessment undertaken to determine the concentrations of mercury present within various estuarine fish species residing within the Penhryn estuary. Results obtained have been compared to food consumption standards, and statistically assessed to determine if mercury concentrations have changed amongst sampling episodes, or if there is correlation to fish attributes (size and weight).

Findings of this assessment can be summarised by the following:

- Mercury concentrations in all tissue samples conformed to the ANZFSC (2011) maximum concentration of mercury within fish for human consumption (0.50 mg/kg). In general, mean mercury concentrations were considerably lower than the designated guideline value (maximum value of 0.300 mg/kg).
- The mean concentration of mercury within silver biddy (whole samples) was 0.060 mg/kg \pm 0.003(se). No significant correlation was found to occur between fish length / weight and mercury concentrations, though this likely reflects the small sample size. Concentrations were found to be significantly less in samples collected in the current survey than to those collected in 2004 ($p = 0.002$).
- The mean concentration of mercury recorded within whiting was 0.068 mg/kg \pm 0.007(se). A significant positive correlation was identified between fish length and mercury concentrations ($r = 0.87$, $p < 0.01$), indicating concentrations increase with fish length. Concentrations recorded in the current survey were significantly less than those recorded in 2014 ($p = 0.031$).
- The mean concentration of mercury within sea mullet flesh tissue was 0.056mg/kg \pm 0.005(se). A significant negative correlation was identified between mercury concentrations and fish length ($r = -0.96$, $p < 0.01$), indicating the larger the specimen the lower the concentration of mercury. Concentrations were significantly greater in 2014 than concentrations recorded in 2004 ($p = 0.012$). It should be noted, no data is available to determine the relationship in fish size and mercury concentrations in the historic dataset. With the observed difference between years may simply reflect a varying composition fish specimens used (i.e. fish length).
- The mean concentrations of mercury within toadfish (whole samples) was 0.100 mg/kg \pm 0.010(se).
- The mean concentration of mercury within luderick flesh tissue was 0.175 mg/kg \pm 0.005(se). There was no significant difference in concentrations between sampling events (2004 and 2015).
- A single sample collected from a yellow-fin bream recorded a concentration of 0.300 mg/kg. This value is greater than those previously recorded for this species.

References

Australia New Zealand Food Standards Code (ANZFA), 2011, Australia New Zealand Food Standards Code - Standard 1.4.1 - Contaminants and Natural Toxicants, accessed 9th of March 2015, <http://www.comlaw.gov.au/Details/F2011C00542>

Cardno 2015 - *Technical Note: Preliminary Findings Biota Sampling in Botany Bay*. Internal report for Orica Dated January 2015.

URS, 2004, HCB and Mercury in Sediment and Biota, Penhryn Estuary, NSE, August 2004, a report prepared for Orica Australia Pty Ltd on behalf of URS.

Appendix 1 Field proforma

Factors affecting capture

| Factor | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Weighting |
|---------------------------------|--------|--------|--------|--------|--------------------------|
| depth | | | | | 0 = no influence |
| slipperiness / bogginess | | | | | 1 = minor influence |
| turbidity | | | | | 2 = moderate influence |
| woody debris | | | | | 3 = major influence |
| macrophytes / filamentous algae | | | | | 4 = very major influence |
| conductivity | | | | | 5 = prevented fishing |
| other | | | | | |
| Total | | | | | |

Habitat characteristics

| Unit | Habitat characteristics |
|--------|-------------------------|
| Unit 1 | |
| Unit 2 | |
| Unit 3 | |
| Unit 4 | |

Notes

Smooth toad fish = *tetractenos glaber* x 10

Silver biddy = *Gerris subfasciatus*

Whiting = *Sillago sp*

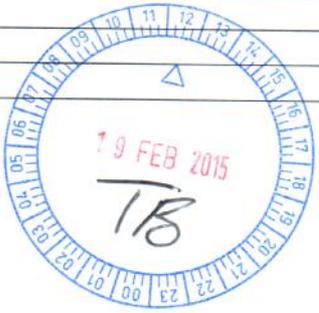
Sea mullet sample 2 Stomach ruptured

" " sample 6 " "

Appendix 2 Laboratory Certificate of Analysis

A1510944

| Company Name | Ecosure | Contact Number | | |
|----------------|-----------------------|----------------|--|----------------------------|
| Contact Name | Justin Cutajar | email results | (07) 36061030 | |
| Project Name | Mercury Investigation | Quote # | jcutajar@ecosure.com.au | |
| Project Number | TH092 | | EN147_111 | |
| Sample ID: | Date | Species | Analysis | Comments |
| 1 | 17/02/2014 | silver biddy | Mercury Analysis by CVASS | process entire fish sample |
| 2 | 18/02/2014 | silver biddy | Mercury Analysis by CVASS | process entire fish sample |
| 3 | 18/02/2014 | silver biddy | Mercury Analysis by CVASS | process entire fish sample |
| 4 | 18/02/2014 | silver biddy | Mercury Analysis by CVASS | process entire fish sample |
| 5 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 6 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 7 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 8 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 9 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 10 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 11 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 12 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 13 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 14 | 18/02/2014 | sea mullet | Mercury Analysis by CVASS | process sample provided |
| 15 | 18/02/2014 | Bream | Mercury Analysis by CVASS | process sample provided |
| 16 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 17 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 18 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 19 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 20 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 21 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 22 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 23 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 24 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 25 | 17/02/2014 | Toad fish | Mercury Analysis by CVASS | process entire fish sample |
| 26 | 18/02/2014 | luderick | Mercury Analysis by CVASS | process sample provided |
| 27 | 18/02/2014 | luderick | Mercury Analysis by CVASS | process sample provided |
| 28 | 17/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 29 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 30 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 31 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 32 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 33 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 34 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |
| 35 | 18/02/2014 | whiting | Mercury Analysis by CVASS | process sample provided |



SAMPLE RECEIPT NOTIFICATION



Attention : Justin Cutajar

Client : Ecosure Pty Ltd
Suite 10, 43 Tallebudgera Creek Road
West Burleigh QLD 4219

Telephone : 07 5508 2046

Facsimile : 07 5508 2544

Project : Mercury in Biota

Order Number :

Laboratory Reference : **A15/0944**

| | |
|---|------------|
| Completed Chain of Custody accompanied samples. | YES |
| Samples were received in good condition and correctly preserved for all tests. | YES |
| Samples were received in sufficient time to allow laboratory to meet holding times. | YES |
| Samples were received chilled/chilling (if required). | YES |

Date samples received : **19/02/2015**

Matrix : **biota (fish)**

No. of samples : **35**

Scheduled reporting date : **2/03/15**

Customer Services Officer : **Trent Biggin**

Telephone : 07 3268 1228

Email : brisbane@advancedanalytical.com.au

Contact your Customer Services Officer for all queries and issues regarding this sample batch.

Note: Turnaround time begins at time of receipt at laboratory, surcharges may apply for fast turnaround.

Water samples will be appropriately stored for 1 month from date of receipt of samples.

Soil / Sediment samples will be appropriately stored for 2 months from date of receipt of samples.

COMMENTS:

Advanced Analytical Australia Pty Ltd

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REPORT OF ANALYSIS

Laboratory Reference: A15/0944 [R00]

Client: Ecosure Pty Ltd
Suite 10, 43 Tallebudgera Creek Road
West Burleigh QLD 4219

Contact: Justin Cutajar

Order No: TH092
Project: Mercury in Fish
Sample Type: Fish
No. of Samples: 35
Date Received: 19/02/2015
Date Completed: 26/02/2015

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Rama Nimmagadda
Technical Manager

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release. This is the Final Report and supersedes any reports previously issued with this reference number. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.



Accreditation No. 15109

Issue Date: 27 February 2015

Page 1 of 4

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Batch Number: A15/0944 [R00]
Project Reference: Mercury in Fish

| | | | | | | |
|------------------------------|---------------|--------------|----------------|----------------|----------------|----------------|
| Laboratory Reference: | - | - | /1 | /2 | /3 | /4 |
| Client Reference: | - | - | Silver Biddy 1 | Silver Biddy 2 | Silver Biddy 3 | Silver Biddy 4 |
| Date Sampled: | - | - | 17/02/2015 | 18/02/2015 | 18/02/2015 | 18/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.054 | 0.068 | 0.067 | 0.058 |

| | | | | | | |
|------------------------------|---------------|--------------|--------------|--------------|--------------|--------------|
| Laboratory Reference: | - | - | /5 | /6 | /7 | /8 |
| Client Reference: | - | - | Sea Mullet 1 | Sea Mullet 2 | Sea Mullet 3 | Sea Mullet 4 |
| Date Sampled: | - | - | 18/02/2015 | 18/02/2015 | 18/02/2015 | 18/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.065 | 0.068 | 0.046 | 0.061 |

| | | | | | | |
|------------------------------|---------------|--------------|--------------|--------------|--------------|--------------|
| Laboratory Reference: | - | - | /9 | /10 | /11 | /12 |
| Client Reference: | - | - | Sea Mullet 5 | Sea Mullet 6 | Sea Mullet 7 | Sea Mullet 8 |
| Date Sampled: | - | - | 18/02/2015 | 18/02/2015 | 18/02/2015 | 18/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.056 | 0.059 | 0.063 | 0.062 |

| | | | | | | |
|------------------------------|---------------|--------------|--------------|---------------|------------|-------------|
| Laboratory Reference: | - | - | /13 | /14 | /15 | /16 |
| Client Reference: | - | - | Sea Mullet 9 | Sea Mullet 10 | Bream 1 | Toad Fish 1 |
| Date Sampled: | - | - | 18/02/2015 | 18/02/2015 | 18/02/2015 | 17/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.014 | <0.01 | 0.30 | 0.13 |

| | | | | | | |
|------------------------------|---------------|--------------|-------------|-------------|-------------|-------------|
| Laboratory Reference: | - | - | /17 | /18 | /19 | /20 |
| Client Reference: | - | - | Toad Fish 2 | Toad Fish 3 | Toad Fish 4 | Toad Fish 5 |
| Date Sampled: | - | - | 17/02/2015 | 17/02/2015 | 17/02/2015 | 17/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.16 | 0.081 | 0.082 | 0.14 |



Batch Number: A15/0944 [R00]
Project Reference: Mercury in Fish

| | | | | | | |
|------------------------------|---------------|--------------|--------------------|--------------------|--------------------|--------------------|
| Laboratory Reference: | - | - | /21 | /22 | /23 | /24 |
| Client Reference: | - | - | Toad Fish 6 | Toad Fish 7 | Toad Fish 8 | Toad Fish 9 |
| Date Sampled: | - | - | 17/02/2015 | 17/02/2015 | 17/02/2015 | 17/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.071 | 0.080 | 0.13 | 0.099 |

| | | | | | | |
|------------------------------|---------------|--------------|---------------------|-------------------|-------------------|-------------------|
| Laboratory Reference: | - | - | /25 | /26 | /27 | /28 |
| Client Reference: | - | - | Toad Fish 10 | Luderick 1 | Luderick 2 | Whiting 1 |
| Date Sampled: | - | - | 17/02/2015 | 18/02/2015 | 18/02/2015 | 17/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.052 | 0.17 | 0.18 | 0.019 |

| | | | | | | |
|------------------------------|---------------|--------------|-------------------|-------------------|-------------------|-------------------|
| Laboratory Reference: | - | - | /29 | /30 | /31 | /32 |
| Client Reference: | - | - | Whiting 2 | Whiting 3 | Whiting 4 | Whiting 5 |
| Date Sampled: | - | - | 18/02/2015 | 18/02/2015 | 18/02/2015 | 18/02/2015 |
| Analysis Description | Method | Units | | | | |
| Trace Elements | | | | | | |
| Mercury | 04-006 | mg/kg | 0.070 | 0.067 | 0.083 | 0.095 |

| | | | | | |
|------------------------------|---------------|--------------|-------------------|-------------------|-------------------|
| Laboratory Reference: | - | - | /33 | /34 | /35 |
| Client Reference: | - | - | Whiting 6 | Whiting 7 | Whiting 8 |
| Date Sampled: | - | - | 18/02/2015 | 18/02/2015 | 18/02/2015 |
| Analysis Description | Method | Units | | | |
| Trace Elements | | | | | |
| Mercury | 04-006 | mg/kg | 0.064 | 0.074 | 0.056 |

| | |
|---------------|---------------------------------|
| Method | Method Description |
| 04-006 | Mercury in food by CVAAS, mg/kg |

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.

Sample results are reported on a wet weight basis.

Issue Date: 27 February 2015

Page 3 of 4

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Batch Number: A15/0944 [R00]
Project Reference: Mercury in Fish

QUALITY ASSURANCE REPORT

| TEST | UNITS | Blank | Duplicate Sm# | Duplicate Results | Spike Sm# | Spike Results |
|---------|-------|-------|---------------|--------------------------|------------|---------------|
| Mercury | mg/kg | <0.01 | A15/0944-1 | 0.054 0.054 RPD: 0 | A15/0944-1 | 105% |

| TEST | Units | Blank | Duplicate Sm# | Duplicate Results | Spike Sm# | Spike Results |
|---------|-------|-------|---------------|--------------------------|-------------|---------------|
| Mercury | mg/kg | <0.01 | A15/0944-11 | 0.063 0.068 RPD: 8 | A15/0944-21 | 104% |

| TEST | Units | Blank | Duplicate Sm# | Duplicate Results |
|---------|-------|-------|---------------|--------------------------|
| Mercury | mg/kg | [NT] | A15/0944-21 | 0.071 0.072 RPD: 1 |

| TEST | Units | Blank | Duplicate Sm# | Duplicate Results |
|---------|-------|-------|---------------|--------------------------|
| Mercury | mg/kg | [NT] | A15/0944-31 | 0.083 0.083 RPD: 0 |

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: 30%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.

Appendix 3 Mercury concentrations in fish tissue

| Fish | Sample number | Replicate | Date sampled | Mercury (mg/kg) |
|---------------|---------------|-----------|--------------|-----------------|
| Silver Bidy 1 | 1 | 0 | 17/02/2015 | 0.054 |
| Silver Bidy 1 | 1 | 1 | 17/02/2015 | 0.054 |
| Silver Bidy 2 | 2 | 0 | 18/02/2015 | 0.068 |
| Silver Bidy 3 | 3 | 0 | 18/02/2015 | 0.067 |
| Silver Bidy 4 | 4 | 0 | 18/02/2015 | 0.058 |
| Sea Mullet 1 | 5 | 0 | 18/02/2015 | 0.065 |
| Sea Mullet 2 | 6 | 0 | 18/02/2015 | 0.068 |
| Sea Mullet 3 | 7 | 0 | 18/02/2015 | 0.046 |
| Sea Mullet 4 | 8 | 0 | 18/02/2015 | 0.061 |
| Sea Mullet 5 | 9 | 0 | 18/02/2015 | 0.056 |
| Sea Mullet 6 | 10 | 0 | 18/02/2015 | 0.059 |
| Sea Mullet 7 | 11 | 0 | 18/02/2015 | 0.063 |
| Sea Mullet 7 | 11 | 1 | 18/02/2015 | 0.068 |
| Sea Mullet 8 | 12 | 0 | 18/02/2015 | 0.062 |
| Sea Mullet 9 | 13 | 0 | 18/02/2015 | 0.014 |
| Sea Mullet 10 | 14 | 0 | 18/02/2015 | <0.01 |
| Bream 1 | 15 | 0 | 18/02/2015 | 0.300 |
| Toad Fish 1 | 16 | 0 | 17/02/2015 | 0.130 |
| Toad Fish 2 | 17 | 0 | 17/02/2015 | 0.160 |
| Toad Fish 3 | 18 | 0 | 17/02/2015 | 0.081 |
| Toad Fish 4 | 19 | 0 | 17/02/2015 | 0.082 |
| Toad Fish 5 | 20 | 0 | 17/02/2015 | 0.140 |
| Toad Fish 6 | 21 | 0 | 17/02/2015 | 0.071 |
| Toad Fish 6 | 21 | 1 | 17/02/2015 | 0.072 |
| Toad Fish 7 | 22 | 0 | 17/02/2015 | 0.080 |
| Toad Fish 8 | 23 | 0 | 17/02/2015 | 0.130 |

| Fish | Sample number | Replicate | Date sampled | Mercury (mg/kg) |
|--------------|---------------|-----------|--------------|-----------------|
| Toad Fish 9 | 24 | 0 | 17/02/2015 | 0.099 |
| Toad Fish 10 | 25 | 0 | 17/02/2015 | 0.052 |
| Luderick 1 | 26 | 0 | 18/02/2015 | 0.170 |
| Luderick 2 | 27 | 0 | 18/02/2015 | 0.180 |
| Whiting 1 | 28 | 0 | 17/02/2015 | 0.019 |
| Whiting 2 | 29 | 0 | 18/02/2015 | 0.070 |
| Whiting 3 | 30 | 0 | 18/02/2015 | 0.067 |
| Whiting 4 | 31 | 0 | 18/02/2015 | 0.083 |
| Whiting 4 | 31 | 1 | 18/02/2015 | 0.083 |
| Whiting 5 | 32 | 0 | 18/02/2015 | 0.095 |
| Whiting 6 | 33 | 0 | 18/02/2015 | 0.064 |
| Whiting 7 | 34 | 0 | 18/02/2015 | 0.074 |
| Whiting 8 | 35 | 0 | 18/02/2015 | 0.056 |

Revision History

| Revision No. | Revision date | Details | Prepared by | Reviewed by | Approved by |
|--------------|---------------|--------------------------------------|---|---|--|
| 00 | 17/03/2014 | Mercury Independent Review – Stage 2 | Justin Cutajar, Aquatic Ecologist | Chris Pietsch, Senior Aquatic Ecologist | Leigh Knight, Senior Environmental Planner |
| 01 | 29/04/2015 | Mercury Independent Review – Stage 2 | Justin Cutajar, Aquatic Ecologist | Chris Pietsch, Senior Aquatic Ecologist | Leigh Knight, Senior Environmental Planner |
| 02 | 28/09/2015 | Mercury Independent Review – Stage 2 | Chris Pietsch, Senior Aquatic Ecologist | | |

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| 1 | 28/09/2015 | Electronic | WSP Group | Colin McKay |
| 2 | 28/09/2015 | Electronic | Ecosure | Administration |

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Report compiled by Ecosure Pty Ltd

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