Government of South Australia
Department of Primary Industries and Regions

Our ref: CORP F2025/000101
Receipt No: 21524686

CORPORATE SERVICES
Level 20
11 Waymouth Street
Adelaide SA 5000
GPO Box 1671
Adelaide SA 5001
DX 667
Tel 8429 0422
www.pir.sa.gov.au

19 August 2025

The Hon Dr Nicola Centofanti MLC
Member of the Legislative Council
Parliament House
ADELAIDE SA 5000

Dear Dr Centofanti

Determination under the *Freedom of Information Act 1991*

I refer to your application made under the *Freedom of Information Act 1991* which was transferred from the Department for Environment and Water to the Department of Primary Industries and Regions (PIRSA) on 26 May 2025, seeking access to the following:

> *"A copy of all correspondence and meeting documents, including but not limited to hard copy or electronic briefings, minutes, emails, letters, meeting agendas, and any other correspondence in relation to the algal bloom affecting South Australian waters held by the Department of Primary Industries and Regions SA."*
>
> Timeframe: 15/03/2025 to 19/05/2025

In its original form, your application was too broad. On 27 May 2025, contact was made with your office by PIRSA's Freedom of Information team seeking to refine the scope of your application.

On 23 June 2025, your application was confirmed as being amended as follows:

> *"A copy of all correspondence and meeting documents, including but not limited to hard copy or electronic briefings, minutes, emails, letters, meeting agendas, and any other correspondence in relation to the algal bloom affecting South Australian waters held by the Department of Primary Industries and Regions, relating specifically to the following:*
>
> - *Testing for identification of the species,*
> - *The Size of the bloom*
> - *Communications with fishing and aquaculture industries."*
>
> Timeframe: 15/03/2025 to 19/05/2025

The application was unable to be processed from 27 May 2025 until 23 June 2025 while negotiations were being undertaken to refine the scope. On 23 June 2025, your office accepted an extension to the legislative timeframe until 22 July 2025. This accounted for the time period where PIRSA was unable to process your application, enabling PIRSA to be provided with the thirty-day legislative timeframe.

Subsequently, a document discovery process was undertaken revealing more than eight hundred documents in scope. On 3 July 2025, contact was made with your office by PIRSA's Senior Freedom of Information Advisor seeking further clarification of your application which was revised as follows:

> *"A copy of all correspondence and meeting documents, including but not limited to hard copy or electronic briefings, minutes, emails, letters, meeting agendas, and any other correspondence in relation to the algal bloom affecting South Australian waters held by the Department of Primary Industries and Regions, relating specifically to the following:*
>
> - *Outcomes (results) of testing for identification of the marine species*
> - *The size of the bloom*
> - *Communications with fishing and aquaculture industries."*
>
> Timeframe: 15/03/2025 to 19/05/2025

Given the large volume of documents required to be searched and after it was established that third party consultation would be required, on 23 July 2025, your office accepted an extension of the legislative timeframe in which to provide a determination until 19 August 2025.

Accordingly, the following determination has been finalised.

I have located sixty-four documents that are captured within the scope of your amended request which address the second and third dot points of your application.

With regard to the first dot point of your application, there were no documents located regarding outcomes (results) of testing for the identification of the marine species.

Determination 1

I have determined that access to the following documents is **granted in full**:

Doc No.	Description of document	No. of Pages
2a	Attachment to Document 2 – Journal article titled "A review of *karenia mikimotoi:* Bloom events, physiology, toxicity and toxic mechanism" dated 20/11/2019	18
4a	Attachment to Document 4 – RecFish SA – PIRSA Meeting Agenda – 15/5/2025	1
6	Email from Executive Director, Fisheries and Aquaculture, PIRSA to PIRSA officers dated 16/4/2025 re Streaky Bay – Port Lincoln Visit April 2025	1

8a	Attachment to Document 8 – SARDI Advice Note from Executive Director, Fisheries and Aquaculture, PIRSA to SARDI Aquatic and Livestock Sciences dated 16/5/2025 re Sardine Fishery – Risks to the Sardine Stock of Proposed Transfer of Uncaught Quota from the Gulf St Vincent Zone to the Spencer Gulf Zone for the 2025 Season	6
12a	Attachment to Document 12 – Factsheet – Aquaculture emergency leases – Instructions for aquaculture leases and licence holders	3
13b	Attachment to Documents 13 and 13a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 11/4/2025	3
14b	Attachment to Documents 14 and 14a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 15/4/2025	3
15b	Attachment to Documents 15 and 15a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 18/4/2025	4
16b	Attachment to Documents 16 and 16a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 24/4/2025	6
17a	Attachment to Document 17 - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 28/4/2025	10
18b	Attachment to Documents 18 and 18a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 2/5/2025	10
19b	Attachment to Documents 19 and 19a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 6/5/2025	10
20b	Attachment to Documents 20 and 20a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 9/5/2025	10
21b	Attachment to Documents 21 and 21a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 13/5/2025	10
22b	Attachment to Documents 22 and 22a - PIRSA SARDI South Australian Harmful Algal Bloom (HAB) Situation Update dated 16/5/2025	9
25a	Attachment to Document 25 – Photograph of a Facebook status re the spread of the algal bloom	1
26	Sea surface chlorophyll-a and temperature maps – 8/4/2025 and 9/4/2025	3
27	SARDI Presentation - Harmful Algal Bloom Situation Update dated 15/5/2025	9

31a	Attachment to Document 31 – Notice Pursuant to Regulation 8 (2) *Primary Produce (Food Safety Schemes) (Seafood) Regulations 2017* – South Australian Shellfish Quality Assurance Program – Status of the Stansbury Harvesting Area: Closed	1

The information removed from Documents 4a and 6 is outside of the scope of your request.

Determination 2

I have determined that access to the following documents is **granted in part**:

Doc No.	Description of document	No. of Pages
2	Emails between Marine Ecosystems – Oceanography Sub-program Leader, SARDI, PIRSA and Clean Seas Seafood Limited dated 16/4/2025 and 17/4/2025 re Karenia information	2
3	Email thread between Yumbah Aquaculture and Senior Fisheries Officer – Kangaroo Island, Fisheries and Aquaculture, PIRSA dated 15/4/2025 to 10/5/2025 re karin Mikimotoi water sample results	5
4	Email thread between Fisheries Manager, Fisheries & Aquaculture, PIRSA and RecFish SA dated 9/5/2025 to 14/5/2025 re PIRSA – RecFish SA meeting	4
5	Email from South Australia Shellfish Quality Assurance Program, PIRSA to PIRSA and SA Health officers and fisheries and aquaculture industry organisations dated 16/4/2025 re extension of Coorong exclusion zone	1
5a	Attachment to Document 5 – Letter from South Australian Shellfish Quality Assurance Program, PIRSA to harvesters dated 16/4/2025 re extension of Coorong exclusion zone	1
6a	Attachment to Document 6 – Actions from West Coast – Port Lincoln Port Visit 14-16 April 2025	2
7	Email from Fisheries and Aquaculture, PIRSA to PIRSA officers and fisheries and aquaculture industry organisations dated 11/4/2025 re draft meeting minutes – Fisheries Aquaculture Industry EO meeting held 27/3/2025	1
7a	Attachment to Document 7 – Draft Meeting Minutes – Fisheries & Aquaculture Industry EO Quarterly Meeting – 27/3/2025	6
8	Email from General Manager Fisheries Management, Fisheries and Aquaculture, PIRSA to South Australian Sardine Association Inc dated 19/5/2025 re SARDI Advice Note re Sardine Fishery	2
9	Email thread between Abalone Industry Association of South Australia Inc and PIRSA officers dated 31/3/2025 re Algal Bloom and Abalone Mortality	3

10	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 14/5/2025 and responding emails from Marine Fishers Association Inc re Algal bloom update 13/5/2025	6
11	Email from Executive Director, Fisheries and Aquaculture, PIRSA to RecFish SA dated 22/4/2025 re RecFish samples	1
11a	Attachment to Document 11 – Pathology results – Reef fish, rock crab	10
12	Email from General Manager, Aquaculture, Fisheries and Aquaculture, PIRSA to fisheries and aquaculture industry organisations dated 17/4/2025 re Emergency Lease information	1
13	Email from Executive Director, Fisheries and Aquaculture, PIRSA to PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 re Algal bloom update 11/4/2025	2
13a	Email from Executive Director, Fisheries and Aquaculture, PIRSA to RecFish SA dated 12/4/2025 re Algal bloom update 11/4/2025	1
14	Emails between Executive Director, Fisheries and Aquaculture, PIRSA to RecFish SA dated 15/4/2025 re Algal bloom update	2
14a	Emails between Executive Director, Fisheries and Aquaculture, PIRSA and RecFish SA dated 15/4/2025 re Algal bloom update 15/4/2025	2
14c	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations and forwarding email to Clean Seas Seafood Limited dated 12/4/2025 and 15/4/2025 re Algal bloom update 15/4/2025	2
15	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 and 18/4/2025 re Algal bloom update 18/4/2025	2
15a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 and 18/4/2025 re Algal bloom update 18/4/2025	2
16	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 24/4/2025 re Algal bloom update 24/4/2025	2
16a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 24/4/2025 re Algal bloom update	2
17	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 29/4/2025 and responding email from Yumbah Aquaculture dated 1/5/2025 re Algal bloom update 28/4/2025	4

18	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 2/5/2025 re Algal bloom update 2/5/2025	3
18a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 to 2/5/2025 re Algal bloom update 2/5/2025	2
19	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 6/5/2025 re Algal bloom update 6/5/2025	4
19a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 to 6/5/2025 re Algal bloom update 6/5/2025	3
19c	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 7/5/2025 and 7/5/2025 and responding emails from Marine Fishers Association Inc re Algal bloom update 6/5/2025	4
20	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 10/5/2025 re Algal bloom update 9/5/2025	4
20a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 to 10/5/2025 re Algal bloom update 9/5/2025	3
20c	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 12/5/2025 and responding emails from Marine Fishers Association Inc re Algal bloom update 9/5/2025	5
20d	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture organisations dated 12/4/2025 to 12/5/2025 and responding emails from South Australian Professional Fishers Association re Algal bloom update 9/5/2025	5
21	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 13/5/2025 re Algal bloom update 13/5/2025	5
21a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 to 13/5/2025 re Algal bloom update 13/5/2025	3
22	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and fisheries and aquaculture industry organisations dated 12/4/2025 to 17/5/2025 re Algal bloom update 16/5/2025	5
22a	Email thread between Executive Director, Fisheries and Aquaculture, PIRSA, PIRSA officers and RecFish SA dated 12/4/2025 to 17/5/2025 re Algal bloom update 16/5/2025	3

23	Email thread between General Manager, Aquaculture, Fisheries and Aquaculture, PIRSA and Oysters South Australia dated 23/4/2025 and 24/4/2025 re Stansbury algae intel	6
25	Email from Clean Seas Seafood to PIRSA officers dated 21/4/2025 and 22/4/2025 re Gunyah beach report	3
28	Email thread between Yumbah Aquaculture and PIRSA officers dated 29/3/2025 to 31/3/2025 re algal bloom	3
29	Email from PIRSA officer to Environment Protection Authority and PIRSA officers dated 28/3/2025 re HAB situation update and watch	2
30	Emails between PIRSA officers and Yumbah Aquaculture dated 4/4/2025 re K mikimotoi	2
31	Email from Business Support Officer, South Australia Shellfish Quality Assurance Program, PIRSA to Health, PIRSA and Department of Agriculture officers and fisheries and aquaculture industry organisations dated 5/5/2025 and 6/5/2025 re Stansbury Harvesting Area closure	4

The information removed from the above documents is pursuant to Clause 6(1) of Schedule 1 of the Freedom of Information Act which states:

> *"**6 - Documents affecting personal affairs***
> *(1) A document is an exempt document if it contains matter the disclosure of which would involve the unreasonable disclosure of information concerning the personal affairs of any person (living or dead)."*

The information removed consists of the following:

- Documents 2, 3, 4, 5 and 25:
  - Mobile telephone numbers of Departmental officers from PIRSA and other agencies
  - Names, mobile telephone numbers and email addresses of staff members of fishing and aquaculture industry companies where consent has not been provided to release this personal information

- Documents 5a and 9:
  - Mobile telephone numbers of Departmental officers

- Document 6a:
  - Name of a staff member of a fishing industry organisation

- Documents 7, 8, 10, 11, 13, 13a, 14, 14a, 14c, 15, 15a, 16, 16a, 18, 18a, 19, 19a, 19c, 20, 20a, 21, 21a, 22, 22a:
  - Email addresses of officers of fishing industry organisations

- Documents 7a and 29:
  - Names of Departmental officers

- Document 11a:
  - Names of veterinarians

- Document 12:
  - Names identified in email addresses of officers of fishing industry organisations
  - Mobile telephone number of a Departmental officer

- Documents 17, 23 and 28:
  - Names, mobile telephone numbers and email addresses of staff members of an aquaculture industry company where consent has not been provided to release this personal information

- Document 20d:
  - Names and mobile telephone number of a staff member of a fishing industry company where consent has not been provided to release this personal information

- Document 30:
  - Mobile telephone number of a Departmental officer
  - Email addresses of staff members of an aquaculture industry company where consent has not been provided to release this personal information

- Document 31:
  - Mobile telephone number of a Departmental officer
  - Email addresses of officers of fishing industry organisations

The remaining information removed from Documents 4, 6a and 7a is outside of the scope of your request.

The term ‘personal affairs’ has been held to involve ‘matters of private concern to an individual’ and the ‘composite collection of activities personal to the individual concerned’.

Consent has not been provided to disclose the names of the Departmental officers and other individuals and, accordingly, there would be an expectation that their personal information would not be released in this way.

As a mobile telephone number allows a person, including an officer of an agency, to be contacted outside of business hours and is information that is not ordinarily available to the public, the information is taken to concern the personal affairs of an individual.

Accordingly, it is considered that disclosure of this information would be an unreasonable intrusion into the privacy rights of the individuals concerned.

Determination 3

I have determined that access to the following document is **granted in part**:

Doc No.	Description of document	No. of Pages
24	Email thread between General Manager, Aquaculture, Fisheries and Aquaculture, PIRSA and Oysters South Australia dated 23/4/2025 and 24/4/2025 re Stansbury algae intel	7

The information removed from the above document is pursuant to Clause 6(1) and Clause 9(1) of Schedule 1 of the Freedom of Information Act.

The information removed pursuant to Clause 6(1) consists of the following:

- names of individuals
- other personal and identifying information of the individuals concerned
- email address
- mobile telephone number

Accordingly, it is considered that disclosure of this information would be an unreasonable intrusion into the privacy rights of the individuals concerned.

Clause 9(1) states:

> ***"9—Internal working documents***
> *(1) A document is an exempt document if it contains matter—*
> *(a) that relates to -*
> *(i) any opinion, advice or recommendation that has been obtained, prepared or recorded; or*
> *(ii) any consultation or deliberation that has taken place,*
> *in the course of, or for the purpose of, the decision-making functions of the Government, a Minister or an agency; and*
> *(b) the disclosure of which would, on balance, be contrary to the public interest."*

The information removed pursuant to Clause 9(1) consists of information from a third party for internal decision-making purposes.

In addressing the public interest test for the Clause 9(1) exemption, I have balanced the following factors:

In favour of the public interest:

- Meeting the objects of the Freedom of Information Act favouring access to documents.
- Ensuring optimal use of public resources.
- High level of interest in the accountability of public office holders.
- The importance of transparency and openness and the interest that the public has in the decision-making processes of Government.
- High level of media and community interest in this matter.

Contrary to the public interest:

- The recent age of the information was considered.
- The matter refers to a microalgal bloom whereby the outbreak is a current ongoing matter.
- Protection of the deliberative processes of Government.
- The information contains the views of a third party upon which is being considered for internal decision-making purposes and is not widely published.
- Providing an agency with the ability to consider the views of industry without unnecessary interference.
- Allowing the views of industry communications to occur in a reasonably uninhibited manner, where the discussion may be sensitive.
- If information of this nature was released, this would discourage third parties from providing their views to Government for internal decision-making purposes.
- Disclosing this information may compromise the manner in which information is gathered and considered in the future for the decision-making processes of Government to the detriment of the betterment for South Australia.

Having considered the various factors weighing for and against disclosure, I have determined that disclosure of this information would, on balance, be contrary to the public interest.

Determination 4

I have determined that access to the following document is **granted in part**:

Doc No.	Description of document	No. of Pages
1	Email from Goolwa PipiCo to Minister for Primary Industries and Regional Development, Minister for Tourism, Chief Executive PIRSA, Executive Director, Fisheries and Aquaculture, PIRSA, Chief Executive, Department of State Development and responding email from PIRSA dated 30/4/2025 re Goolwa PipiCo – Algae Bloom impact on business	3

The information removed from the above document is pursuant to Clause 9(1) of Schedule 1 of the Freedom of Information Act.

The information removed pursuant to Clause 9(1) consists of information from a third party for internal decision-making purposes.

In addressing the public interest test for the Clause 9(1) exemption, I have balanced the following factors:

In favour of the public interest:

- Meeting the objects of the Freedom of Information Act favouring access to documents.
- Ensuring optimal use of public resources.

- High level of interest in the accountability of public office holders.
- The importance of transparency and openness and the interest that the public has in the decision-making processes of Government.
- High level of media and community interest in this matter.

Contrary to the public interest:

- The recent age of the information was considered.
- The matter refers to a microalgal bloom whereby the outbreak is a current ongoing matter.
- Protection of the deliberative processes of Government.
- The information contains opinion from a third party upon which is being considered for internal decision-making purposes and is not widely published.
- Providing an agency with the ability to consider the views of industry without unnecessary interference.
- Allowing the views of industry communications to occur in a reasonably uninhibited manner, where the discussion may be sensitive.
- If information of this nature was released, this would discourage third parties from providing their views to Government for internal decision-making purposes.
- Disclosing this information may compromise the manner in which information is gathered and considered in the future for the decision-making processes of Government to the detriment of the betterment for South Australia.

Having considered the various factors weighing for and against disclosure, I have determined that disclosure of this information would, on balance, be contrary to the public interest.

If you are dissatisfied with this determination, you are entitled to exercise your right of review and appeal as outlined in the attached documentation Making a Freedom of Information Application | State Records of South Australia (archives.sa.gov.au), by completing the "FOI Application Form for Internal Review of a Determination" and returning the completed form to:

Freedom of Information Principal Officer
Department of Primary Industries and Regions
GPO Box 1671
ADELAIDE SA 5001

or via email PIRSA.FOI@sa.gov.au

In accordance with the requirements of Premier and Cabinet Circular PC045, details of your application, and the documents to which you are given access, will be published in PIRSA's disclosure log. A copy of PC045 can be found at http://dpc.sa.gov.au/__data/assets/pdf_file/0019/20818/PC045-Disclosure-Log-Policy.pdf

If you disagree with publication, please advise the undersigned in writing within fourteen calendar days from the date of this determination.

Should you require further information or clarification with respect to this matter, please contact Ms Lisa Farley, Senior Freedom of Information Advisor on 8429 0422 or email PIRSA.FOI@sa.gov.au.

Yours sincerely

Michelle Griffiths
Accredited Freedom of Information Officer
DEPARTMENT OF PRIMARY INDUSTRIES AND REGIONS

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Wednesday, 30 April 2025 1:16 PM
To: Tom Robinson - Goolwa PipiCo; PIRSA:Minister Scriven; minister.bettison@sa.gov.au; Doroudi, Mehdi (PIRSA); Reid, Adam (DSD)
Subject: RE: Goolwa PipiCo - Algae Bloom impact on business

Thanks Tom for the update – appreciate the feedback. Will continue to work with you on the small pipi discussion.
Regards
Gavin

From: Tom Robinson - Goolwa PipiCo
Sent: Wednesday, 30 April 2025 11:25 AM
To: PIRSA:Minister Scriven ; minister.bettison@sa.gov.au; Doroudi, Mehdi (PIRSA) ; Begg, Gavin (PIRSA) ; Reid, Adam (DSD)
Subject: Goolwa PipiCo - Algae Bloom impact on business

Dear Minister Scriven (Fisheries), Minister Bettison (Tourism), Mehdi (PIRSA), Gavin (PIRSA) and Adam (DSD),

Following various requests over the past four weeks, I thought you might appreciate a quick update on the impacts of the Algal Bloom and how it has affected Goolwa PipiCo. We appreciate that the issue is still with us, however (touch wood), seems to be improving.

We genuinely appreciate the support given to us during this challenging time by all government stakeholders.

Current biomass status

1) The commercial pipi beach looks to be in good shape following the 'die off' that occurred on Tuesday 15/4/25.
2) Our crews are seeing dead empty shells washing up on the beach as far 30km from the 'die off' area, which was the 2 to 5km section from the Murray Mouth.
3) Interestingly, over 90% of the 'dead clams' were the largest pipis (50mm+), mixed in with 'Matra' clams which are not a quota species and rarely seen on the beach by our crews. We believe that this biomass lives in deeper waters.
4) It looks to us like the smaller, younger pipis were better able to cope with the bloom, than the larger, older pipis.
5) After two weeks of observation by our crews, we believe the remaining biomass is returning to normal, with the pipis behaving in a normal fashion. We are even seeing live pipis showing up in the epicentre of the die off area.

Clause 9(1)

Positive fall-out from the event

1) Both PIRSA and SARDI have been exceptional during the last four weeks. Taking a very measured approach and avoiding the easy option to shut everything down as a conservative response. Clause 9(1)
2) Clause 9(1)
3)
4) Relations between Goolwa PipiCo (70%) and the SFM (30%) have been excellent. Thank you to Neil McDonald and Keith Rawling who have been measured in all their responses on behalf of the pipi fishers who are not part of Goolwa PipiCo.

Key learnings from the past four weeks

1) If an algal bloom was to occur again (fingers crossed it doesn't), I don't believe that we would be as scared of it as we have been for the last four weeks. This is because:
    a. It looks like the bloom only impacted a narrow zone on both the recreational and commercial beaches. We suspect this is because the bloom was concentrated in areas where ocean current funnelled the algae into a narrow, highly intensified zone, driven by currents.
    b. It doesn't look like the algae affected all the biomass. Instead, it looks to have targeted weaker animals. In this case it looks to have been larger (older / weaker) pipis that were likely close to the end of their life.
    c. It looks like some of the pipis that were knocked around, but not killed by the bloom, seem to have recovered over the past couple of weeks.
2) Clause 9(1)
3) Working closely with government agencies as the Algal Bloom intensified helped keep us open. Yes, we have taken some blows, however these could have been a lot worse if we didn't have a measured response from the government departments who could have taken the easier option to close us down. This allowed us to communicate the facts as opposed to the hysteria being driven by others.

What can be done by Government to help the pipi industry moving forward

1) The excellent 'Pipi to Plate' commercial produced as part of the SATC 'Simple Pleasures' campaign went to air on the same day as the first 'Algal Bloom' was detected on the recreational beach. It was immediately pulled off air, which we respect. However, now that things look to be returning to normal, it would be helpful if that commercial could be put back into rotation to help support this industry. Particularly in the lead up to Tasting Australia.

2) Goolwa PipiCo currently has an application in for the State Government, Global Expansion Program (Application number: GEP-053-R5). The costs of developing these new export markets are significant and unfortunately will not be supported in any way by the 30% of the pipi industry who sit outside of Goolwa PipiCo, through the cost recovery process. To this background, the $50,000 GEP would be extremely helpful in continuing to develop these export markets through trade shows etc. *For interest, Goolwa PipiCo will be attending the Barcellona Seafood Expo next week, where we hope to secure more sales to European customers for the FY26 fishing season.
3) Clause 9(1) [redacted]

We are not out of the woods yet, however things do look to be improving on a daily basis, as the waters continue to get colder and the sea conditions become rougher. Hopefully we will see the back of this soon and start focusing on growth again instead of putting out fires.

Please call me if you require any additional information from our end.

Thank you for the cool heads during a challenging time.

Regards,

TOM

Tom Robinson
Director

0427 262 553
tom@goolwapipico.com
www.goolwapipico.com

50 Hill Street, PO BOX 370
Port Elliot, SA 5212

GOOLWA PIPICO.

We acknowledge the Traditional Owners of the land where we work and live, the Ngarrindjeri People of the nation and pay our respects to Elders past and present.

Farley, Lisa (PIRSA)

From: Clause 6(1) <Clause 6(1)>
Sent: Thursday, 17 April 2025 8:22 AM
To: Doubell, Mark (PIRSA)
Cc: Mellor, Emily (PIRSA)
Subject: RE: Karenia information

OFFICIAL

Good Morning Mark,

Thank you for this. I have read a few papers now but this one looks really good so far.

Thank you,

Clause 6(1)
Planning and Performance Manager
CLEAN SEAS SEAFOOD LIMITED
Mobile: Clause 6(1)
E: Clause 6(1)
W: www.cleanseas.com.au

From: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Sent: Wednesday, 16 April 2025 3:03 PM
To: Clause 6(1) <Clause 6(1)>
Cc: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: Karenia information

OFFICIAL

Hi Clause 6(1)
Attached is some information on Karenia miki blooms.
In addition , warm waters tend to be a common stimulant.
Mark

Dr Mark Doubell | Marine Ecosystems – Oceanography Sub-program Leader
South Australian Research and Development Institute - SARDI | **Department of Primary Industries and Regions**
Government of South Australia | Street Address
GPO Box 397 Adelaide SA 5001
P: +61 8 8429 0982 | **M:** Clause 6(1) | **E:** mark.doubell@sa.gov.au
pir.sa.gov.au

Service I Professionalism I Trust I Respect I Collaboration & Engagement I Honesty & Integrity I Courage & Tenacity I Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Harmful Algae 90 (2019) 101702

Contents lists available at ScienceDirect

Harmful Algae

journal homepage: www.elsevier.com/locate/hal

A review of *karenia mikimotoi*: Bloom events, physiology, toxicity and toxic mechanism

Xiaodong Li[a,b,*], Tian Yan[b,c,d,*], Rencheng Yu[b,c,d], Mingjiang Zhou[b]

[a] Key Laboratory of Marine Biotechnology of Fujian Province, Institute of Oceanology, College of Animal Sciences, Fujian Agriculture and Forestry University, Fuzhou, Fujian Province, 350002, China
[b] Key Laboratory of Marine Ecology and Environmental Sciences, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, Shandong Province, 266071, China
[c] Laboratory of Marine Ecology and Environmental Science, Qingdao National Laboratory for Marine Science and Technology, Qingdao, Shandong Province, 266071, China
[d] Centre for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao, China

ARTICLE INFO

Keywords:
Harmful algal blooms
Karenia mikimotoi
Physiology
Toxicity
Toxic mechanism

ABSTRACT

Karenia mikimotoi is a worldwide bloom-forming dinoflagellate in the genus *Karenia*. Blooms of this alga have been observed since the 1930s and have caused mass mortalities of fish, shellfish, and other invertebrates in the coastal waters of many countries, including Japan, Norway, Ireland, and New Zealand. This species has frequently bloomed in China, causing great financial losses (more than 2 billion yuan, Fujian Province, 2012). *K. mikimotoi* can adapt to various light, temperature, salinity, and nutrient conditions, which together with its complex life history, strong motility, and density-dependent allelopathy, allows it to form blooms that are lethal to almost all marine organisms. However, its toxicity differs between subspecies and some target-species-specific toxicity has also been recorded. Significant gill disorder is observed in affected fish, to which the massive fish kills are attributed, rather than to the hypoxia that occurs in the fading stage of a bloom. However, although this species is haemolytic and cytotoxic, and generates reactive oxygen species, none of the isolated toxins or lipophilic extracts have toxic effects as extreme as those of the intact algal cells. The toxic effects of *K. mikimotoi* are strongly related to contact with intact cells. Several reasonable hypotheses of how and why this species blooms and causes mass mortalities have been proposed, but further research is required.

1. Introduction

The huge increase in human interference in marine environments has entailed many problems and secondary disasters. Nutrient inputs cause eutrophication, the movement of vessels causes bio-invasion, and together they generate blooms of harmful algae worldwide, which damage aquatic organisms, marine environments, and ultimately human health and the economy (Glibert et al., 2011; Heisler et al., 2008). Long ago, our ancestors observed marine colour changes, such as the red tide reported in the Bible, but only in recent decades have harmful algal blooms (HABs) been studied as ecocatastrophes that kill fish and shellfish and poison humans (Glibert and Pitcher, 2001).

More than 200 species of algae, ranging in size from pico- to mega-algae, including Cyanophyta, Cryptophyta, Pyrrophyta (dinoflagellates), Bacillariophyta (diatoms), etc., can form HABs (Sournia, 1995), and increasing numbers of toxic dinoflagellate blooms have been recorded in recent decades (Furuya et al., 2018; Glibert et al., 2018). Toxins and the toxic effects of bloom-forming dinoflagellates have been hotspots of marine ecotoxicological research.

Karenia mikimotoi is a HAB-forming dinoflagellate species that has damaged the aquaculture industry for more than 80 years by causing mass mortalities in the halobios throughout the world. This species has mainly caused massive fish and shellfish kills in the coastal waters of Europe and Asia, which have led to huge financial losses for marine aquaculture. Previous research has shown that *K. mikimotoi* is a haemolytic, cytotoxic species, and its toxicity and toxic mechanism against many valuable or typical marine organisms have been tested and verified. Its bloom-forming process is dependent on its physiological and ecological characteristics. However, there are still many unresolved questions about this species.

Several excellent reviews have summarized the relevant research into this alga, such as those by Gentien (1998); Honjo (2004), and

* Corresponding authors at: Key Laboratory of Marine Ecology and Environmental Sciences, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, Shandong Province, 266071, China.
E-mail addresses: lixiaodong11@163.com (X. Li), tianyan@qdio.ac.cn",0,0,2
>tianyan@qdio.ac.cn (T. Yan).

https://doi.org/10.1016/j.hal.2019.101702
Received 21 June 2019; Received in revised form 10 September 2019; Accepted 28 October 2019
Available online 20 November 2019
1568-9883/ © 2019 Elsevier B.V. All rights reserved.

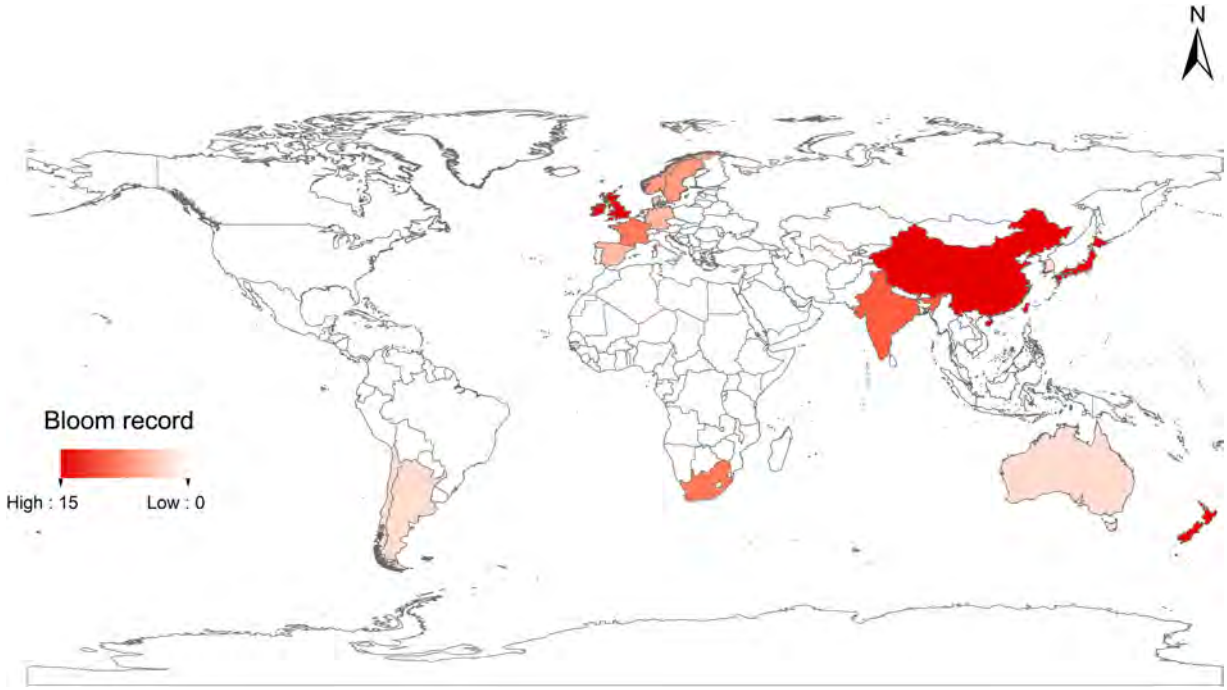


Fig. 1. World distribution of blooms formed by *Karenia mikimotoi* (1934–2018). Countries colored in red mean that bloom was recorded in their coastal waters, and degree of red mean bloom frequency counted from reference data (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

Brand et al. (2012), but there are still some missing data and misunderstanding about its bloom events and toxicity, and the latest developments in *K. mikimotoi* research have not yet been reported. Therefore, in this review, we comprehensively describe this toxic species, focusing on bloom events, its physiology, toxicity, and toxic mechanism, to extend our understanding of it and advance future research about its bloom and toxicity mechanism.

2. Classification and morphology

K. mikimotoi has a long and complicated classification history, and has had many names. It was first described as *Gymnodinium mikimotoi* by Oda (1935) and named by Dr. Shoichi Miyake and Konan Kiyo from samples collected in the coastal water of Gokasho Bay, Watarai District, Honshu, Japan.

Another former name, *Gyrodinium aureolum*, was first ascribed by Hulburt (1957) from samples collected from a coastal lagoon close to Woods Hole (Massachusetts, USA), and Tangen (1977) described *G. aureolum* in Norway, with a detailed review of a bloom of this species in northern European waters in 1966–1977, then cell and chloroplast ultrastructure of this species also reported (Kite and Dodge, 1988). *G. aureolum* was also described in New Zealand, where it formed blooms in 1993–1994, and was considered it to be conspecific with *G. mikimotoi* based on its morphology and toxicity (Chang, 1996). This species was also found in the coastal waters of Virginia, USA (Marshall, 1980), but later results revealed that the species called '*G. aureolum*' in North America and Europe were two different species, and that '*G. aureolum*' observed in Europe was actually *K. mikimotoi* (Hansen et al., 2000).

This species was also known as *Gymnodinium nagasakiense* in Japan, and was fully described by Takayama and Adachi (1984) from samples collected near Nagasaki, Japan. It had previously been isolated from several bays in Nagasaki and given many names by local researchers, such as *Gymnodinium* sp., *Gymnodinium* type-'65, *Gymnodinium* sp. 1, and *G. nagasaki*. In 1991, Takayama and Matsuoka (1991) considered *G. mikimotoi* to be conspecific with *G. nagasakiense* and that the former was a senior synonym of the latter, based on microscopic and submicroscopic morphological features, by which *G.* cf. *aureolum* and *G. nagasakiense* also consider as same species by Prtensky et al. (1988).

The species was finally identified as a member of the genus *Karenia* by Hansen et al. (2000) in an analysis that combined light and electron microscopy, nuclear-encoded large subunit rDNA sequences, and pigment composition. Their results showed that the European isolates, formerly identified as *G. aureolum*, *G.* cf. *aureolum*, or *G.* cf. *nagasakiense*, were conspecific with the Japanese *G. mikimotoi*, whereas the isolate of Hulburt (1957) should be considered *G. aureolum*.

Because many subgroups of *K. mikimotoi* are found worldwide, this species has been described multiple times by different researchers. Oda (1935) quoted a description by Dr. Miyake as "28–32 μm single cell with flat dorsoventral surface and prominent ventral surface, girdle offset on both sides and left is higher than right, longitudinal groove is from top epicone to hypocone, and intersected with girdle in the middle of ventral surface, flagella are present in groove and no flagella or cilia in other parts of the body. A flagellum is longer than the length of the cell body with a major motor function. One oval nucleus is at the centre left of the cell; cytoplasm contains 10–20 plastids".

Tangen (1977) described *K. mikimotoi* (*G. aureolum*) in Norway, and this description was consistent with the description of Hulburt (1957). Tangen (1977) reported that this species showed relatively great morphological variability across its culture stages, and was more flattened dorsoventrally than was reported by Hulburt (1957). Takayama and Adachi (1984) described *K. mikimotoi* (*G. nagasakiense*) in a similar way to Oda (1935) as 18–37 μm long and 14–35 μm wide, with an average size range of 25–35 μm in length and 23–33 μm in width. They provided detailed descriptions of the epicone, hypocone, sulcus, flagellum, nucleus, chloroplasts, oil drops, phosphorescence, and movement behaviour, and the first electron micrograph (Takayama and Adachi, 1984). The ultrastructure of *K. mikimotoi* (*G. aureolum*) was first described by Kite and Dodge (1988), who showed that it has external, stalked pyrenoids and extremely vacuolated cytoplasm. Prtensky et al. (1988) compared the morphology of *G.* cf. *aureolum* and *G. nagasakiense*, with full descriptions of the theca and chromosomes. Takayama and Matsuoka (1991); Chang (1996), and Hansen et al. (2000) also

Table 1
List of mass occurrence of *Karenia mikimotoi* worldwide, with reports on adverse effects on marine life.

Year	Area	Max cell conc.	Reports on adverse effects	Reference
	Asia			
1934	Japan; Gokasho Bay, Honshu	Transparency < 0.5 m	Fish and shellfish mortality; fish gills disorder and mucus spawn	Oda (1935)
1965	Japan; Omura Bay, Nagasaki		Fish and shellfish mortality	Takayama and Adachi (1984)
1972	Japan; Omura Bay, Nagasaki			Hirayama (1972); Gentien (1998)
1981	Korea; Geoje coast	6.25×10^4 cells/mL		Park et al. (2013)
1985	Japan; Suo-Nada and Iyo-Nada	Over 10^4 cells/mL	Fisheries damage over 10^6 US$	Yanagi et al. (1995)
1989	India; Kodi, Karnataka	4×10^5 cells/mL	Fish mortality	D'Silva et al. (2012)
1991	Japan; Tanabe Bay			Nakamura et al. (1995)
1992	Japan; Hoketsu Bay	3.9×10^4 cells/mL		Koizumi et al. (1996)
1992	Japan; Suo-Nada inshore waters	Over 10^3 cells/mL		Kimura et al. (1999)
1993	Japan; Suo-Nada inshore waters	2.5×10^3 cells/mL		Kimura et al. (1999)
1994	Japan; near Ie-shima Islands	2.0×10^3 cells/mL		Nakamura et al. (1995)
1995	Japan; Hiroshima Bay	1.87×10^3 cells/mL	Shellfish sustained valves and killed	Matsuyama et al. (1999)
1998	China; Zhujiang River Estuary and Daya Bay		Fish kills (*Seriola* sp., *Pagrosomus major* etc.)	Dickman (2001); Qi et al. (2004)
2002	China; Fujian coast		Shellfish and fish kills	Li et al. (2017)
2003	China; coast of East China Sea			Li et al. (2017)
2004	China; Bohai Sea and East China Sea			Li et al. (2017)
2004	India; Kerala coast	90 cells/mL	Mass mortality of fish	D'Silva et al. (2012)
2005	China; coast of East China Sea and Zhujiang River Estuary	8×10^3 cells/mL	Massive shellfish and fish kills	Li et al. (2009), 2010; Li et al. (2017)
2006	China; coast of East China Sea			Li et al. (2017)
2007	China; Bohai Sea and East China Sea			Li et al. (2017)
2008	China; coast of East China Sea			Li et al. (2017)
2008	Japan; Suo-Nada and Beppu Bay	4.7×10^4 cells/mL	Fish mortality	Siswanto et al. (2013)
2009	China; coast of East China Sea			Li et al. (2017)
2009	India; Cochin barmouth	56.8 mg chI a/m^3	Massive fish mortality	Hartman et al. (2014)
2010	China; coast of East China Sea			Li et al. (2017)
2010	Japan; Beppu Bay	Over 16 mg chI a/m^3		Siswanto et al. (2013)
2011	Singapore; Johor Straits	Over 200 cells/mL		Sandric Leong et al. (2015)
2012	China; coast of East China Sea	3.4×10^4 cells/mL	Massive abalone kills and mortality of fish	Li et al. (2017)
2013	India; Gulf of Mannar		Mass mortality of fish	Babu et al. (2016)
2014	Singapore; Johor Straits	Over 5×10^3 cells/mL		Sandric Leong et al. (2015)
2014	Japan; Imari Bay	Over 1×10^4 cells/mL		Aoki et al. (2017)
2014	China; coast of East China Sea			SOAC (2015)
2015	Japan; Hakodate Bay	1.15×10^4 cells/mL	Mortality of fish (chum salmon), squid and abalone	Shimada et al. (2016)
2015	China; coast of East China Sea			SOAC (2016)
2015	Japan; Sasebo Bay	800 cells/mL		Higo et al. (2017)
2015	India; Kochi estuary	600 cells/mL		Kumar et al. (2018)
2018	China; coast of East China Sea		Mortality of fish and abalone	FDOF (2019)
	Europe			
1966	Norwegian; Oslo-Bergen	7.0×10^4 cells/mL	Fish mortality (sea trout, rainbow trout, cod, eel, coalfish) in submerged containers	Braarud and Heimdal (1970); Tangen (1977)
1968	Danish west coast	8.6×10^3 cells/mL	Fish killed (several species, mainly cod). Mortality of lugworms and other invertebrates	Tangen (1977)
1968	German Bight near Helgoland	7.8×10^3 cells/mL		Hickel et al. (1971)
1971	Irish Sea; North Wales coast, River Conwy	5.2×10^3 cells/mL	Mortality of lugworms, *Echinus*	Helm et al. (1974)
1975	English Channel; Southwestern part	1.7×10^3 cells/mL		Pingree et al. (1975)
1976	English Channel; Southwestern part	128 mg chI a/m^3		Tangen (1977)
1976	Norwegian, Oslo-Bergen	2.3×10^4 cells/mL	Fish mortality (salmon, rainbow trout, coalfish, sprat, cod, eel, black goby); Mortality of invertebrates (lugworms, starfishes, mussels)	Tangen (1977)
1976	Ireland, south coast to Youghal		Mortality of fish and invertebrates (lugworms, ragworms, sole, plaice, flounder, eels, gapers, razor fish and cockles)	Ottway (1979); Silke et al. (2005)
1978	England; Mounts Bay to St Austell Bay		Mortality of fish and invertebrates; clearance rates reduction of *Mytilus edulis*	Boalch (1979); Widdows et al. (1979)
1978	Southwest Ireland; Dunmanus Bay, Roaringwater Bay		Fish kills; Mortalities of intertidal organisms	Pybus (1980); Leahy (1980), 1980
1979	Southwest Ireland;		Widespread mortalities of shellfish (gastropods and echinoids), fish (rainbow trout) and crabs	Cross and Southgate (1980); Roden et al. (1981); Southgate et al. (1984)
1980	Scotland; Sea lochs in the north of the Firth of Clyde	2×10^4 cells/mL	Salmon killed for pumped water	Jones et al. (1982)
1981	Swedish west coast, Gullmar fjord	1.14×10^4 cells/mL	Fish kills	Lindahl (1983)
1981	Norway	7×10^4 cells/mL		Lindahl (1983)
1982	Swedish west coast	830 cells/mL 9.5 mg chI a/m^3	Fish kills	Lindahl (1986)
1984	Southwest Ireland; Roaringwater Bay	500 cells/mL		Silke et al. (2005)
1986	England; Plymouth Breakwater	Over 1.5×10^3 cells/mL	Mortality and avoidance of young fish	Potts and Edwards (1987)
1987	Southwest Ireland; Bantry Bay	~500 cells/mL		Silke et al. (2005)
1987	Western English Channel	2.56×10^3 cells/mL		Garcia and Purdie (1994)
1988	Swedish west coast	683 mg chI a m^{-3}		Granéli et al. (1989)

(*continued on next page*)

Table 1 (*continued*)

Year	Area	Max cell conc.	Reports on adverse effects	Reference
1989	Dutch; North-Sea Waters			Zevenboom et al. (1991)
1989	Spain; estuary of Pontevedra	7×10^4 cells/mL		Jimenez et al. (1992)
1990	Denmark; Kattegat	3.25×10^3 cells/mL		Bjornsen and Nielsen (1991)
1991	Southwest Ireland; Bantry Bay	1.92×10^3 cells/mL		Raine et al. (1993)
1993	Western English Channel off Plymouth	Over 2×10^3 cells/mL		Rodriguez et al. (2000)
1995	Ireland; between Sherkin Island and Cork Harbour	4×10^3 cells/mL		Silke et al. (2005)
1998	Ireland; Galway Bay	Over 900 cells/mL		Ediger et al. (2001); Raine et al. (2001)
1999	Ireland; west and southwest of the Aran Islands	750 cells/mL		Silke et al. (2005)
2001	Spain; Ria de Vigo	3×10^3 cells/mL		Crespo et al. (2007)
2003	Western English Channel	Over 1×10^3 cells/mL		Vanhoutte-Brunier et al. (2008)
2004	Western English Channel; Southwest Approaches			Kurekin et al. (2014)
2005	Northern half of the western Irish coastline		Major mortalities of benthic and pelagic marine organisms; fish and shellfish kills	Mitchell and Rodger (2007); Silke et al. (2005)
2006	Scottish waters	Over 1×10^3 cells/mL	Extensive mortalities of benthic organisms including annelids and molluscs and some species of fish. Farmed fish mortalities were absent but gill damage was reported.	Davidson et al. (2009)
2009	England; coasts of Cornwalland Devon	5.4×10^3 cells/mL	dead marine animals (dogfish, turbot, eel, dover sole and sea potatoes)	Shutler et al. (2015)
2010	English Channel; Western approaches	14 mg chI a/m^3		Gohin et al. (2010); Hartman et al. (2014)
2011	UK; Brings Deep, Orkney Islands	Near 1×10^3 cells/mL		Taylor et al. (2013)
	Oceania			
1981	New Zealand; Tasman Bay			Chang (1996)
1986	New Zealand; Tennyson Inlet			Chang (1996)
1987	New Zealand; Tennyson Inlet		Salmon kill	Chang (1996)
1989	Australia; south-east Tasmania		Fish kills	Hallegraeff (1992)
1993	New Zealand; northeast coast of North Island			Chang (1996)
1994	New Zealand; Southland area		toxic shellfish event	Chang (1996)
2002	New Zealand; Orewa, Whangaparaoa, and eastern Coromandel Peninsula		Mortalities of fish (parore, floundel, mullet, eel, goby and spotty) and abalone	Chang and Ryan (2004)
2003	New Zealand; Tasmanian		Mortality of Atlantic salmon	De Salas et al. (2004)
	Africa and America			
1982	Argentina; estuary of Río de la Plata			Negri et al. (1992)
1988	South Africa; False bay	1.7×10^4 cells/mL	Faunal mortalities (sardine, alikreukel, octopus, chitons and starefish) and eye, nose, and lung irritations in bathers and fishermen	Horstman et al. (1991)
1989	South Africa; False bay	2.4×10^4 cells/mL	Faunal mortalities and eye, nose, and lung irritations in bathers and fishermen, great losses in abalone culture	Horstman et al. (1991)
1996	South Africa; Walker bay		Mortality of abalone larva	Pitcher and Calder (2000)
1999	Chile; Southern coast	8-9 $\times 10^3$ cells/mL	High mortality in shellfish (clam, sea urchins, abalone), farmed salmon and wild fish species	Carreto et al. (2001)
2016	South Africa;	516 cells/mL		Lemley et al. (2018)

Note: Not all bloom events were listed, just the reported ones, and some bloom related to species suspected to *K. mikimotoi* (but not authenticate) were also not listed.

described this species for classification.

K. mikimotoi was considered closed to *Karlodinium* species, and its phylogenic position and evolutionary linage were explored through multiple gene analysis, such as D1-D3 regions of the LSU rDNA (Daugbjerg et al., 2000; Hansen et al., 2000; Haywood et al., 2004), rDNA ITS regions (Guillou et al., 2002), SSU rDNA (Saldarriaga et al., 2001), and plastid genes (Dorrell et al., 2016; Kamikawa et al., 2018; Klinger et al., 2018). Al-Kandari et al. (2011) suggest a sub-species diversity vary region, that New Zealand strains and Europe strains should consider as one sub-species group, and Japan strains should be considered as another species group. However, the relationship of Asia strains of *K. mikimotoi*, including strains from China, India and Singapore, was still not clear.

3. Bloom formation and toxic events

As shown in Fig. 1 and Table 1, *K. mikimotoi* is distributed worldwide, and HABs have been reported in the coastal waters of almost all continents. In rare cases, no bloom has been reported, although the species has been detected (Bizsel and Bizsel, 2002). Blooms of this species are lethal to many creatures, including fish, shellfish, and other invertebrates (Brand et al., 2012; Gentien, 1998).

Before *K. mikimotoi* was first described in 1935, blooms formed by this species had existed in Japan for a long time. Oda (1935) recorded five blooms in Ago Bay, Shima, Honshu, of a suspected *Gymnodinium* species in 1905–1918. He published a full description of a *K. mikimotoi* (*G. mikimotoi*) bloom in Gokasho Bay, Watarai District, Honshu, Japan, that began at the beginning of January 1934, and gradually faded in late February. Massive numbers of fish and shellfish were killed and the financial losses of fisherman were huge. The same situation was observed in the coastal waters near Omura Bay, Nagasaki, Japan, where a *K. mikimotoi* (*G. nagasakiense*) bloom was recorded, with the consequent mortality of valuable fish stocks (Takayama and Adachi, 1984). Blooms of *K. mikimotoi* became a common, almost annual ecological disaster in the coastal waters of southwest Japan (Gentien, 1998; Hayakawa et al., 1996; Higo et al., 2017; Hirayama, 1972; Takeuchi et al., 1995). For example, blooms lasted for weeks in the Seto Inland Sea during the summers of 1994 and 1995 (Matsuyama et al., 1999; Nakamura et al., 1996, 1995). Other blooms in the Seto Inland Sea were also observed by SeaWiFS in 2008 and 2010, with cell counts of $> 10^4$ cells/mL, which caused mass mortalities among both fish and shellfish (Siswanto et al., 2013). In Imari Bay, *K. mikimotoi* blooms have occurred repeatedly in

2012 and 2014 (Aoki et al., 2017; Nishiyama et al., 2013), and have caused severe mortality in cultured fish farms in the eastern area, where the cell densities exceeded 4×10^3 cells/mL (Yamatogi et al., 2016). A bloom was recorded in Hakodate Bay, Hokkaido, for the first time in northern Japan during mid-October to late-November 2015, and mortalities of chum salmon (*Oncorhynchus keta*), Japanese common squid (*Todarodes pacificus*), and Pacific abalone (*Haliotis discus hannai*) were observed (Shimada et al., 2016).

The coastal waters of western Europe have also been affected by *K. mikimotoi* blooms since the 1960s, especially in southwest Scandinavia, Ireland, and the UK. Tangen (1977) has given a detailed review of the *K. mikimotoi* (*G. aureolum*) blooms before 1977. The first bloom recorded in Europe was in an upwelling area of Oslo-Bergen, Norway, in 1966, when the cell count reached 7.0×10^4 cells/mL and fish mortalities were also noted, including in trout, cod, and eel, (Braarud and Heimdal, 1970; Tangen, 1977). In 1968, a bloom expanded to the Danish west coast (July–November) and the German Bight near Helgoland (August–September), with cell counts of $> 7.0 \times 10^3$ cells/mL, which killed fish, lugworms, and other invertebrates (Hickel et al., 1971; Tangen, 1977). Helm et al. (1974) surveyed a *K. mikimotoi* bloom in the eastern Irish Sea in 1971, and showed that the major impact was on the lugworm (*Echinocardium*) population. Blooms also occurred in the southwestern part of the English Channel in 1975 and 1976 (Pingree et al., 1975; Tangen, 1977). In 1976, a *K. mikimotoi* bloom occurred at the same location as in 1966, with massive fish and shellfish kills (Tangen, 1977). Another bloom occurred in Wexford Harbour and extended along the south coast to Youghal, on the southern Irish Sea in 1976, also with great fish and shellfish mortalities (Ottway, 1979; Silke et al., 2005). Many blooms were recorded near southwest Scandinavia, Ireland, and the UK in the next few decades, and most of them caused mortalities among marine organisms. *K. mikimotoi* blooms have also occurred in the coastal waters of the western Mediterranean. For instance, a dinoflagellate bloom of *K.* cf. *mikimotoi*, together with *Prorocentrum minimum*, developed in the interior section of the Ria de Vigo in 2001, coincident with the onshore flow induced by the autumn downwelling (Crespo et al., 2007).

Gymnodinium aureolum blooms have been recorded in the coastal waters of the eastern USA, including off Long Island, New Jersey, in 1973, 1982, 1983, 1984, and 1985 (Mahoney et al., 1990; Young, 1973), and in Maquoit Bay, Maine (Mahoney et al., 1990), which also caused fish and shellfish mortalities. In 1993, *G. aureolum* was observed along the entire coast of Quebec and in the offshore waters of the Gulf of St Lawrence (Blasco et al., 1996; Cantin et al., 1996). However, since Hansen et al. (2000) classified the *G. aureolum* isolate of Hulburt (1957) from the coastal water of the eastern USA as a different species from *K. mikimotoi*, it is difficult to say whether the blooms located near New Jersey before 2000 were caused by *K. mikimotoi*. A bloom was also recorded in southern Chile in 1999, but *K. mikimotoi* was only one of the suspected species (Carreto et al., 2001). Another bloom of *K. mikimotoi* (*G.* cf. *aureolum*) in South America occurred in the estuary of Río de la Plata, Argentina, in 1982 (Negri et al., 1992).

Lee et al. (2013) presented a detailed review of HABs in Korea, showing that *K. mikimotoi* was the most abundant and problematic red tide species, accounting for 93 % of red tide events in 1981, with maximum cell densities as high as 6.25×10^4 cells/mL. This species mainly bloomed near Geoje and Tongyeong in 1981–1985, and another six blooms were recorded in 1991–2000.

In New Zealand, *K. mikimotoi* (*G.* cf. *aureolum*) was first recorded in a Tasman Bay bloom in 1981 (Chang, 1996), and between 1986 and 1987, it was associated with a salmon kill episode in Akaroa Harbour (Boustead, 1987). During 1993, a *K. mikimotoi* (*G.* cf. *mikimotoi*) bloom was recorded on the northeast coast of the North Island that was toxic to shellfish, and another bloom was reported in the Southland area in 1994 (Chang, 1996; Jones et al., 1997; Seki et al., 1995; Whittington et al., 1997). In mid-October 2002, tens of thousands of dead fish were reported on beaches near the Orewa and Whangaparaoa areas north of Auckland, together with a kill of about 8500 abalone at a marine farm in Kennedy Bay on the eastern Coromandel Peninsula, which resulted from *K. mikimotoi* blooms (Chang and Ryan, 2004). A further more serious mortality event involving 1×10^5 Atlantic salmon (*Salmo salar*), associated with *K. mikimotoi* (*G. mikimotoi*) bloom, occurred at a neighbouring Tasmanian site in May 2003 (De Salas et al., 2004).

In India, *Gymnodinium* sp. blooms and avoidance behaver of fish were recorded on the Malabar and Kanara coasts in 1921 and 1948 (D'Silva et al., 2012). *K. mikimotoi* (*G. nagasakiense*) bloomed on a brackish-water fish farm at Kodi, Karnataka, in 1989, and fish mortality was reported (D'Silva et al., 2012). Another four blooms were recorded on the Kerala coast in 2004, 2009, and 2013, and at Kochi in 2015, and all these blooms caused massive fish kills (Babu et al., 2016; D'Silva et al., 2012; Kumar et al., 2018; Madhu et al., 2011).

K. mikimotoi blooms have also occurred in other countries. Several countries have long records of blooms of this species, including South Africa, where the first bloom occurred in 1988 and lasted until 2016, causing massive abalone mortality (Table 1). However, *K. mikimotoi* blooms have occurred just once in other countries, such as Chile, and have never been reported again. However, this species has recently formed new blooms, such as those reported in Singapore in 2011 and 2014 (Sandric Leong et al., 2015).

K. mikimotoi blooms in China

K. mikimotoi blooms are one of the most notorious ecological disasters to occur in China, based on their massive killing of valuable fish and shellfish. This species blooms frequently and has caused great economic losses, particularly in the East China Sea (ECS; including the Changjiang River Estuary and coastal areas of Fujian Province), where blooms have occurred almost every year since 2002 (Li et al., 2017). A suspected *Gymnodinium* sp. was recorded as forming a bloom in the coastal waters of ECS in 1989, and caused the mortality of about 10^8 razor clam (*Sinonovacula constricta*) individuals (SOAC, 1990). However, the alga was first formally recorded as forming a vast bloom in the coastal waters of Hongkong in March and April 1998. Almost all the fish in the affected cages in the bloom area died, and the estimated economic loss caused by the HAB was HK $\$3.15 \times 10^8$ (equivalent to $\$4.00 \times 10^7$) (Dickman, 2001; Fang and Tang, 2009; Hodgkiss, 2001; Lu and Hodgkiss, 2004; Qi et al., 2004). In the next few years, the bloom expanded to the coastal waters of ECS and the Bohai Sea (Li et al., 2017; Liang, 2012). The largest bloom ever occurred in the Changjiang River estuary in 2005, with a bloom area of over 1.5×10^3 km^2 and a maximum cell density of 8.0×10^3 cells/mL (Huang et al., 2007; Lou et al., 2006). High value aquacultural fish (*Sciaenops ocellatus*, *Miichthys miiuy*, *Epinephelus* spp., and *Monotaxis grandoculis*) worth about US$2.5 million were lost during this bloom (Li et al., 2010, 2009). The most severe damage caused by *K. mikimotoi* ever recorded was reported in the coastal waters of Fujian Province in March–May 2012. The bloom area (over 300 km^2) covered most abalone farms in Quanzhou, Fuzhou, Putian, and Ningde, and countless abalone were killed by this alga, with an estimated economic loss of 2.01 billion yuan (about $330 million) (Li et al., 2017). Blooms of *K. mikimotoi* have now become a common and almost annual environmental disaster in China, with over 100 blooms reported in 2006–2018 (Li et al., 2017). It is anticipated that blooms will be recorded frequently off the coasts of China long into the future.

4. Physiology

The physiologies of the bloom-forming algae have often been studied, together with their bloom-inducing factors and mechanisms. It has been demonstrated that *K. mikimotoi* has a wide ecological distribution and strong motility. The physiology characters may help this species outcompetes other species to dominate global blooms.

4.1. Adaptation

4.1.1. Light

K. mikimotoi contains chlorophylls a and c, together with the accessory pigments fucoxanthin, 19′-butanoyl-oxyfucoxanthin, 19′-hexanoyl-oxyfucoxanthin, and 19-hexanoyl-oxyparacentrone-3-acetate (gyroxanthin-diester), rather than peridinin (Brand et al., 2012). Tangen and BjÖrnland (1981) analysed the chlorophylls and carotenoids of an isolates from Norway, and found that it contained β,ε-carotene, β,β-carotene, diatoxanthin, diadinoxanthin, 19′-hexanoyloxyfucoxanthin, and 3-xanthophylls, as well as chlorophyll *a*. Zapata et al. (2012) and Chang and Gall (2013) analysed the pigment composition of *K. mikimotoi* and reported that it has more kinds of pigment than any other *Karenia* species, which suggested *K. mikimotoi* may adapt to wide range photo-environment.

K. mikimotoi grows well in low light and is particularly well suited to exploit low light environments rather than high light environments, and its light saturation occurs approximately around 200 μE/(m^2 s) (Honjo, 2004; Yamaguchi and Honjo, 1989). However, it is not photo-inhibited by high light intensities [up to 500 μE/(m^2 s)], and its light saturation level is higher than that of many other dinoflagellates (Mahoney et al., 1990). Therefore, *K. mikimotoi* is adapted to the light at both the water surface and water bottom. Johnsen and Sakshaug (1993) reported that its pigment composition is strongly affected by its photo-adaptional status, and that it generates more Chl a under low light conditions than under high light conditions (Garcia and Purdie, 1994). Therefore, its adaptation to different light levels may allow this species to take advantage in species succession (Wang et al., 2008). A recent study showed that the adaptations of *K. mikimotoi* to light, temperature, and nutrient levels act synergistically (Wen et al., 2018), and that N-deficiency in the surface layer induces photo-inhibition (Yuasa et al., 2018). Ultraviolet B (UVB) irradiation also strongly inhibits the motility (especially its phototactic orientation) and photosynthesis of *K. mikimotoi* (Guan and Li, 2017; Nielsen et al., 1995; Nielsen and Ekelund, 1993), though it was proved relatively resistant to UVB (Wang et al., 2019a). Transcriptome analyse showed a complex process in UVB inhibition, including 716 unigenes down-regulated and 6 unigenes up-regulated belonged to different pathways (Wang et al., 2019b).

4.1.2. Temperature and salinity

K. mikimotoi is adapted to a wide range of temperatures, and survives at temperatures of 4–30 °C (Gentien, 1998). However, some subspecies are adapted to a narrower temperature range, such as a Norway isolate (10–25 °C) (Tangen, 1977) and a European isolate (6–20 °C) (Holligan, 1985). Blooms are generated over a temperature range that is narrower than the adapted range, and often at 13–22 °C (Mahoney et al., 1990), and a relationship between water tempeutre and bloom was recorded (Honjo et al., 1991). A slightly elevated temperature may induce a faster growth rate (Munir et al., 2015), a higher photosynthesis rate, and greater rubisco gene expression than those of other competitors, such as *Prorocentrum donghaiense* (Shen et al., 2016). Dai et al. (2014) suggested that *K. mikimotoi* has a relatively narrow range of suitable temperatures and a high optimum temperature (T-opt). They also found that temperature affects the ability of *K. mikimotoi* to assimilate nitrate (Dai et al., 2014).

Like temperature, *K. mikimotoi* has a wide tolerance range for salinity of 9–35 (Gentien, 1998). Therefore, it is a euryhaline species and its blooms have been observed in estuaries, upwelling areas, etc. Nielsen and Tonseth (1991) analysed the effects temperature and salinity on its growth rate with a multiple regression of the growth rate (A) on temperature (T) and salinity (S), which yielded: $A = 0.150T + 0.150S - 0.004T^2 - 0.003S^2 + 0.001ST - 3.142$, and the optimal ranges (comprising 90%–100% of optima) were 17.5–22.5 °C and 24.5–34 °C, respectively.

4.1.3. Nutrition

K. mikimotoi is considered primarily autotrophic, but it has some capacity to use organic compounds and to ingest microbes (Brand et al., 2012; Richardson and Corcoran, 2015). Its complex alimentation mode permits this species a wide distribution and allows it to take advantages of several specific situations.

K. mikimotoi has been observed to utilize nitrate, nitrite, and ammonium as nitrogen sources (Huang and Xie, 2009; Lv and Huang, 2007), but neither urea nor uric acid was utilized well in laboratory studies (Yamaguchi and Itakura, 1999). It also cannot utilize dissolved free amino acids as a sole nitrogen source (Xu et al., 2013). The addition of humic substances significantly induced *K. mikimotoi* proliferation (Granéli et al., 1989). Lecorre et al. (1993) suggested that ammonium is the preferred form of N and provided 90% of the N required for the efficient regenerative flux through microbial loops of bacteria by a bloom near the Ushant frontal region. The nitrate uptake of *K. mikimotoi* is related to the rhythmicity of light and its nutritional status and is highest in the daytime, although ammonium is assimilated faster than nitrate (Mahoney et al., 1990). The alga does not take up nitrate in the dark, when it is in a state of nitrogen sufficiency, but takes it up after nitrogen starvation (Paasche et al., 1984). Very low light intensities are sufficient to allow the nitrogen uptake necessary for this species (Paasche et al., 1984). *K. mikimotoi* cultured in urea produced more short-chain fatty acids, whereas when cultured in NH_4^+, it produced more non-fatty-acid compounds, indicating a potential change in toxin production when cultured with various N sources (Zhao et al., 2017). The latest research about the RNA-Seq analysis of dinoflagellates nutrition related genes by Shikata et al. (2019) revealed a strong uptake ability of $N\text{-}NO_3^-$, $N\text{-}NO_2$-, NH_4^+ in *K. mikimotoi*, as well as the initial metabolism of nitrogen inside cytoplasm and chloroplast.

K. mikimotoi is also capable of using a wide variety of inorganic and organic phosphorus (P) compounds of different molecular structures as a sole P source (Yamaguchi and Itakura, 1999), e.g., NaH_2PO_4 and glycerophosphate (Pang et al., 2016). Other studies showed that useful organic P compounds include phosphomonoesters and adenosine phosphates (ADP and ATP) (Yamaguchi et al., 2004), but that it cannot utilize lecithin well (Pang et al., 2016). The alkaline phosphatase activity in *K. mikimotoi* is very high and a survey of a Chinese bloom in 2005 showed that this enzyme accounted for the highest level (by percentage) of enzyme-labelled fluorescence (Huang et al., 2007). Phosphate stress markedly inhibits the growth and cell-cycle progression of *K. mikimotoi* and its chlorophyll fluorescence intensity (Lei and Lu, 2011). An increase in cell size and growth inhibition were noted under P-limited conditions, but recovered soon after P was restored (Shen and Li, 2016). Shikata et al. (2019) suggested *K. mikimotoi* was capable to utilize $P\text{-}PO_4^{3-}$, nucleotides, and P- monoesters as phosphorus source, and its metabolism to PolyP and ATP were also presented.

The N/P ratio also affects the growth of *K. mikimotoi*, and Guan and Li (2017) demonstrated that *K. mikimotoi* cells grown under the Redfield ratio (16:1) had the highest growth rate, highest pigment concentrations, and maximum superoxide dismutase (SOD) activity compared with those grown under the N/P ratio at different degrees, such as 1:1 or 50:1.

Iron (Fe) is a fundamental element to *K. mikimotoi*, and this species can utilize both particulate $FePO_4$ and particulate FeS for growth, whereas FeO(OH) and Fe_2O_3 do not support the growth of *K. mikimotoi* (Kuma and Matsunaga, 1995; Naito et al., 2005). It also proved to utilize organic iron, like ferrichrome, for growth in a long incubation period (Naito et al., 2008).

K. mikimotoi can gain extra nutrition by phagotrophic ingestion. Zhang et al. (2011a), (2013a) demonstrated that *K. mikimotoi* could ingest fluorescently labelled microspheres (diameters 0.5 and 2.0 μm), bacteria, and microalgae. Under nutrient-depleted conditions, the growth of *K. mikimotoi* fuelled by prey algae, such as *Isochrysis galbana*, was significantly greater than that of the controls, and phagocytosis

provides an important competitive strategy for *K. mikimotoi* (Zhang et al., 2013a, b).

4.1.4. Pollutant utilization or tolerance

K. mikimotoi does not seem to exploit the utilization or tolerance of pollution as a competitive strategy. Although the elutriates from the granules used for fish farming stimulated the growth of some algae, particularly *Gymnodinium* species (Arzul et al., 1996), *K. mikimotoi* could not utilize glyphosate as a sole P source to support its growth, and was inhibited by high glyphosate levels (Wang et al., 2016). However, it showed a higher tolerance of decabromodiphenyl ether (BDE-209) than *Heterosigma akashiwo*, although BDE-209 shifted the competitive balance in favour of *H. akashiwo* (Zhang et al., 2013b). In contrast, another tetrabromodiphenyl ether (BDE-47) is highly toxic to *K. mikimotoi* (Zhang et al., 2013c). Effect of anthracene between *Platymonas helgolandica* and *K. mikimotoi* was also observed similar to BDE-209 (Zhang et al., 2014). Antibiotics, such as oxytetracycline, inhibit the growth of *Gymnodinium* species (Arzul et al., 1996), whereas other antibiotics, such as ampicillin, penicillin, kanamycin, and streptomycin, only inhibit algae at very high concentrations, and induce algal growth at low concentrations (Wang et al., 2012). The genotoxicity of H_2O_2 at the lowest concentration tested (5 μM) was only demonstrated in *K. mikimotoi* and not in other algae, and common pesticides also caused gene damage at low concentrations (Akcha et al., 2008).

4.2. Motility

The vertical migration of *K. mikimotoi* within the water column has been shown to depend on the column stability, occurring when stratification is weak or the water column is well mixed (Brand et al., 2012; Honjo, 2004). When stratification is stronger, most of the population remains in the pycnocline (Brand et al., 2012; Dahl and Brockmann, 1989). The vertical migration of *K. mikimotoi* has been observed during blooms in many areas (Kristiansen et al., 1995; Nielsen et al., 1993). Bjornsen and Nielsen (1991) also reported that *K. mikimotoi* was confined to a 1 m thick layer that contained more chlorophyll than the rest of the water column during a bloom. Its migration is diurnal, with upward migration beginning around a couple of hours before sunrise, and it reaches the surface before noon. It thus traverses about 20 m daily at a velocity of about 2.2 m/h (Koizumi et al., 1996). The migration mode of *K. mikimotoi* has been established with laboratory tests by Gentien et al. (2007). The algal cells tend to be evenly distributed throughout the culture volume during the dark phase, but crowd at the air-water interface in a very thin layer (2–5 mm in thickness) in the light. When most cells have reached the surface, plumes descending from the surface layer are observed, and once the maximum vertical extent of the plume is reached, the cells separate from the plume and progressively move to the surface layer at average instantaneous speeds of 90–100 μm/s. Gentien et al. (2007) also measured the descent speed of *K. mikimotoi* in the plume, which was approximately 200 μm/s. Another recent study showed that the diurnal vertical migration of *K. mikimotoi* can be triggered by very low light (1 μmol quanta/[m^2 s]), and that the surface accumulation period is changed by the photoperiod (particularly of blue light) (Shikata et al., 2015). Shikata et al. (2017) also observed a negligibly correspond of surface accumulation to the pycnocline, and that the photosynthetic photon flux density (PPFD) of each layer can affect the cell distribution depth, with mean PPFDs of 59–65 μmol/(m^2 s). They suggested that the vertical cell distribution of *K. mikimotoi* with depth during the daytime is regulated by the underwater transmission of light and that green light is valuable for the growth and photosynthesis of this alga. It also proved that the surface accumulation of this algal was relative with vertical salinity gradient, and accumulation happened only at surface salinity over 15 (Shikata et al., 2014).

This vertical migration is an important adaptation strategy for *K. mikimotoi*, because it allows the algal cells to reach the surface to access enough light in the daytime and to access the nutrients in the deep water at night. This strategy allows *K. mikimotoi* to obtain all the substances and energy necessary for growth under different water-mixing and illumination conditions.

4.3. Life cycle

K. mikimotoi displays both the typical primary eukaryotic cell cycle and a minor form of sexual reproduction via conjugation. It grows at a rate about 0.3 day^{-1} in the field, and the growth rate increases to 1.0 day^{-1} under ideal conditions (Gentien, 1998). As previously noted, subgroups of this species vary in size (small: 16–27 μm; large: 26–37 μm). However, this may be not be related to the bloom stage or nutritional conditions, but to the cell division period (Gentien, 1998; Partensky and Vaulot, 1989; Silva and Faust, 1995). Silva and Faust (1995) reviewed the small cells of dinoflagellates and suggested that they play a role in the sexual reproductive cycle.

Under most conditions, *K. mikimotoi* proliferates by division, which usually happens at night. Oda (1935) reported that this species usually divides after 22:00 h. Yamaguchi (1992) presented a detail description of this process by measuring DNA synthesis, and showed that DNA synthesis and cell division are tightly linked to a particular period of the light:dark cycle. DNA synthesis (S phase) occurs from 10:00 to 22:00 h and is followed by cytokinesis. Diel changes in cell size frequently show the same rhythm with DNA synthesis.

Ouchi et al. (1994) reported the occurrence of sexual reproduction in *K. mikimotoi* cultures. Pairs of isogamous gametes conjugate to form a spherical aplanozygote, lacking red pigment and a thick wall, which then transforms into a broad and slowly swimming planozygote. Conjugation is completed within 1–3 days of the initial pairing. Pairs of gametes form at a very low rate (below 3%) in populations of algal cells.

Previous observations of *K. mikimotoi* cultures grown for molecular and morphological analyses did not detect the presence of temporary cysts (Hansen et al., 2000). No vegetative cells appeared when bottom sediments from bloom areas were incubated for cyst germination (Yamaguchi, 1992). Recently, Zhao et al. (2017) reported the formation of temporary cysts of *K. mikimotoi* under totally N-depleted conditions, and the cysts were round in shape and much larger than vegetative cells. However, the shape, colour, and generation frequency of these "temporary cysts" were very like those of the aplanozygotes described by Ouchi et al. (1994). Therefore, it is still hard to say whether either temporary or resting cysts occur in the life cycle of *K. mikimotoi* and whether they play a role in blooms.

4.4. Phycosphere

Studies of the phycosphere of *K. mikimotoi* have often cited the biointeractions between the alga and non-algal microscopic species. Bacteria were considered as influence factors in bloom decay stage (Fukami et al., 1991; Lu et al., 2016; Park, 2013). Several bacteria, such as *Flavobacterium* sp. (Fukami et al., 1992; Iwata et al., 2004), *Cytophaga* sp. (Imai et al., 1993), *Vibrio* sp. (Yoshinaga et al., 1997), *Pseudoalteromonas* sp. (Imai et al., 2006), Rhodobacteraceae (Imai et al., 2006), *Formosa*, *Erythrobacter*, *Shewanella*, *Marinobacter* (Gong et al., 2014), *Thalassospira* sp. (Lu et al., 2016), and *Halomonas* sp. (Wang et al., 2018), were isolated from blooms and their inhibitory effects on the growth of *K. mikimotoi* tested (Doucette et al., 1999; Fukami et al., 1997; Park et al., 2010; Zheng et al., 2018). There are also virus-like agents Onji et al. (2003) and parasitic alga Li et al. (2014) reported, however, whether and how they infect *K. mikimotoi* bloom is still not clear.

4.4.1. Allelopathy and feeding inhibition

A time-limited anti-algal activity against other algae (*Chaetoceros gracile*, *Dunaliella tertiolecta*, *Isochrysis galbana*, *Skeletonema costatum*,

Tetraselmis suecica) has been reported in *K. mikimotoi* (*G.* cf. *aureolum*) by Gentien and Arzul (1990). They also suggested that this activity probably plays an important role in bloom development (Vanhoutte-Brunier et al., 2008). The allelopathy of *K. mikimotoi* is quite weak at low cell densities, but quite strong at high densities (Riegman et al., 1996; Uchida et al., 1999; Wang et al., 2017), so the competitiveness of *K. mikimotoi* for nutrients is weaker than that of other algae (Shen et al., 2015, 2014), and allelopathic compounds (or toxins) are its main anti-algal mechanism. Lipophilic extracts of *K. mikimotoi* destroyed other algal cells within 10 min to hours (Chang, 2011). The allelochemicals released by *K. mikimotoi* were both heat sensitive and heat stable, and although they better inhibited *Prorocentrum donghaiense* at a low temperature of 16 °C (Shen et al., 2015), the exudate inhibited *Dunaliella salina* at 25 °C (He et al., 2016). *K. mikimotoi* is also inhibited by many other algae, such as the large seaweed *Corallina pilulifera* (Jeong et al., 2000), the brown alga *Ecklonia kurome* (Nagayama et al., 2003), and *Ishige sinicola* (Hirao et al., 2012), *Ulva fasciata*, *U. pertusa* (Alamsjah et al., 2008; Liu et al., 2018), and micro-algae *P. micans*, *Skeletonema costatum* (Ji et al., 2011), *P. donghaiense*, *Alexandrium tamarense* (Yang et al., 2011b), *Heterocapsa circularisquama* (Nishiguchi et al., 2016), and *Hizikia fusiformis* (Ma et al., 2017).

Previous research suggested the gazing pressure may play an important role in bloom decay stage of *K. mikimotoi*, for instance, the heterotrophic dinoflagellates (*Gyrodinium dominans* and *Gyrodinium spirale*) and tintinnid ciliate (*Favella ehrenbergii*) were observed increased during decay stage of *K. mikimotoi* in the Seto Inland Sea, Japan (Nakamura et al., 1996, 1995). However, recently research indicated that this algal may be lacking of critical nutrition and have feeding inhibition to larger predators such as copepods. Song (2014) reported that this species is of low nutritional value and lacks the poly-unsaturated fatty acids and amino acids essential for zooplankton, such as arachidonic acid and histidine. These deficiencies cause nutritional imbalance and diapause when *K. mikimotoi* is ingested as the only food source. Many phytoplankton feeders have selective feeding habits and avoid ingesting *K. mikimotoi*. Schultz and Kiorboe (2009) reported a low ingestion rate of *K. mikimotoi* in two species of marine copepods, *Pseudocalanus elongatus* and *Temora longicornis*, and the copepods ingested *G. instriatum* in preference to *K. mikimotoi* in algal mixtures. Very high rejection rates were noted in *T. longicornis* feeding on *K. mikimotoi* (Xu and Kiorboe, 2018). Schultz and Kiorboe (2009) also observed prey rejection frequencies (caught and then released cells) and suggested that the selection of prey cells occurs before capture and is based on the remote characterization of the cells. This suggested that the bloom duration may infected by dominant algal-gazing species.

5. Toxicity

Blooms of *K. mikimotoi* have caused countless catastrophes among marine organisms, especially fish and shellfish, which are valuable to humans and cultured as food sources. However, the direct effects of *K. mikimotoi* blooms on human health have rarely been reported. Mahoney et al. (1990) reported the human impact of two blooms caused by *G. aureolum* in coastal water of the eastern USA, but it is hard to say whether the *G. aureolum* blooms in the USA were actually *K. mikimotoi* (Hansen et al., 2000). Furthermore, no shellfish poisons, such as DSP and PSP, have yet been detected in this species, so it does not harm human health via the food chain.

Although harmless to human health, *K. mikimotoi* is extremely lethal to marine life. A vast bloom can kill almost all marine creatures, whether planktonic, nektonic, or benthic (Silke et al., 2005). Most *K. mikimotoi* blooms have been associated with mass fish or shellfish mortalities, as listed in Table 1. The toxicity and toxic mechanisms of this species have been investigated by many researchers, but further research is still required.

5.1. Toxicity to fish, shellfish, and other invertebrates

5.1.1. Fish

K. mikimotoi is toxic to fish, especially to fish gills, in most field observations and laboratory tests. The fish show abnormal behaviours and increased opercular rates before death. Mucus generation and gill disorders have also been recorded in the moribund fish. Oda (1935) reported that fish and shellfish, both wild and cultured, were massively killed by a *K. mikimotoi* bloom, and that their survival rates decreased when the water transparency was less than 2 m (ca. $3.5–5.0 \times 10^3$ cells/mL). Oda (1935) also observed fish gill disorders, with mucus overproduction and tangled filaments, which may have suffocated the fish. Jones et al. (1982) reported immediate abnormal behaviours in salmon after bloom water entered their tanks, including movement to the surface and circling, before the fish turned over and sank. Mucus overproduction and gill lesions in the moribund fish, coupled to sloughing and oedematous epithelia, were also observed (Jones et al., 1982). The same phenomena were also observed in rainbow trout, and in an acute toxicity test, all the test fish died within 24 h, even at low algal densities. The gills of the dead fish showed no mechanical occlusion by the alga, but all displayed marked histological changes, characterized by the necrotic degeneration and disintegration of the lamellar epithelium (Roberts et al., 1983). Rheological stickiness of water, caused by algal itself and mucus produced by fish, was also recorded by Jenkinson and Arzul (2001), which suggested play a role in toxicity of *K. mikimotoi* (Jenkinson and Sun, 2010). Wang et al. (2001) also observed heavy gill damage in cultured fish during the 1998 bloom in Hong Kong waters. A clinical examination by Mitchell and Rodger (2007) not only showed tissue damage in the gills, but also multifocal coagulative necrosis in the livers of salmon. Li et al. (2017) reported the lethal impact of *K. mikimotoi* on the turbot *Scophthalmus maximus*, even in water with high dissolved oxygen (DO), and the mortality rate increased when the DO concentration was not controlled. However, no other toxic effects, apart from death, behavioural disorders, and gill damage, have been reported. Whether *K. mikimotoi* has a sublethal effect on fish, such as an immunotoxic effect or developmental toxicity, is still unknown.

5.1.2. Shellfish

K. mikimotoi blooms also cause mass mortalities among shellfish. The alga has many toxic effects, not only on the survival rate but also on the clearance rate or developmental processes. Helm et al. (1974) tested the impact of bloom water (500 or 1200 cells/mL) on *Crassostrea gigas* embryos. The survival rate of the oyster embryos treated with bloom water was lower than that of animals treated with filtered sea water (irrespective of its source). The scallop *Argopecten irradians* is highly sensitive to *K. mikimotoi* (*G. aureolum*), and mantle and gill lesions have been noted in many other shellfish (Lesser and Shumway, 1993; Smolowitz and Shumway, 1997). *K. mikimotoi* blooms have also caused mass mortalities among abalone in South Africa and China. Botes et al. (2003) reported that *K. mikimotoi* caused significant abalone larval and spat mortalities, with a median lethal dose (LD_{50}) of 1.1×10^3 cells/mL, and toxicity of filtration and lysed cells to abalone larva were also noticed.

Widdows et al. (1979) demonstrated that the bloom water of *K. mikimotoi* significantly reduced the clearance rate (from 2.52 L/h to 0.18 L/h after exposure for 5 h) of the mussel *Mytilus edulis* at a low algal density of 300 cells/mL, and caused gut tissue damage. The same inhibition of the clearance rate was observed in oysters. Matsuyama et al. (1999) reported a reduction in the mean clearance rate of mussels and oysters (19.8% and 14.4% of the control, respectively) and the inhibition of oyster filtration activity by bloom water. The inhibition by *K. mikimotoi* of the cleavage, movement, hatching, and formation of D-larvae and pre-settling larva in the pearl oyster was shown to be both algal-cell-density- and time-dependent (Basti et al., 2015; Go et al., 2016).

K. mikimotoi only inhibited the growth rate of *Mytilus edulis* when it was cultured with algal cells, and algal filtrates without cells had no effect (Nielsen and Stromgren, 1991). The larval settling rate and spat collection rate of oysters were inhibited by *K. mikimotoi* at densities above 5×10^3 cells/mL. Its effect on the haemocyte profiles of clams was also reported (Hegaret et al., 2007). Further research showed that *K. mikimotoi* inhibited the immune functions of shellfish, including the adhesion of lymphocytes and their production of reactive oxygen species (ROS) (Hegaret et al., 2011). De Rijcke et al. (2016) also suggested that *K. mikimotoi* inhibits phenoloxidase-based innate immune systems, as well as larval viability and development. Lin et al. (2016) reported that the antioxidant enzymes of the abalone *Haliotis discus hannai* were significantly negatively affected by *K. mikimotoi*, and suggested that *K. mikimotoi* blooms cause oxidative damage to abalone organs during short-term exposure.

5.1.3. Other invertebrates

Some marine model organisms were used to test the toxicity of harmful algae. Helm et al. (1974) reported that the survival rate, growth rate, and development of *Artemia salina* nauplii were significantly inhibited by *K. mikimotoi* bloom water. Zou et al. (2010) demonstrated the lethal effects of two *K. mikimotoi* strains (SUO-1 and FUK) on the rotifer *Brachionus plicatilis*. Chang and Gall (2013) also used *A. salina* and *B. plicatilis* to test the effects of the liposoluble toxins of *K. mikimotoi*. A low density of the alga significantly inhibited the developmental processes of the rotifer (Lin et al., 2015). Li et al. (2017) reported a severe toxic effect of *K. mikimotoi* on the rotifer *B. plicatilis* and significant mortality at a very low algal density of 30 cells/mL. The lethal effects on other zooplankton, such as the copepod *Calanus sinicus* and the mysid *Neomysis awatschensis*, were also demonstrated (Li et al., 2017).

The toxicity of *K. mikimotoi* to plankton feeders was also investigated. For instance, the ciliate *Favella ehrenbergii* was unable to sustain growth when it used this alga as its only food source, and its survival rate decreased at very high concentrations of *K. mikimotoi* (Hansen, 1995). The same toxic effect or nutritional inadequacy was also observed in multiple grazers, including the cladoceran *Moina mongolica*, the copepod *Pseudodiaptomus annandalei*, and the crustacean *A. salina* (Dang et al., 2015).

5.2. Toxicity characteristics

The toxicity of *K. mikimotoi* is roughly species-specific. It is very lethal to most fish, including trout, salmon, and turbot. When Ou (2006) tested the toxicity of this species to several fish, all of them were killed in a few hours, with significant gill damage. Although it seems that *K. mikimotoi* is toxic to most kinds of fish, Shi et al. (2012) reported no acute symptoms in fish after their exposure to *K. mikimotoi* at 3.4×10^3 cells/mL for 48 h. Lesser and Shumway (1993) and Smolowitz and Shumway (1997) suggested that the lethal impact of *K. mikimotoi* (*G. aureolum*) on shellfish differs between the target species, with high rates of mortality noted in *Argopecten irradians* but not in other shellfish. A New Zealand strain of *K. mikimotoi* only significantly reduced the survival rate of the larvae of paua (*Haliotis iris*), but not those of other invertebrates, even at a high density of 5.6×10^4 cells/mL (Shi et al., 2012). A lipophilic extract of *K. mikimotoi* was also toxic to rotifers but had no effect on brine shrimp (Chang and Gall, 2013). Li et al. (2017) tested the lethality of an ECS strain of *K. mikimotoi* on six species, and found that it was more toxic to rotifers than to other species, consistent with the observations of Sun et al. (2010). Li et al. (2017) suggested that this target-species-specific toxicity may be explained by the diversity of body structures and different defence mechanisms used by organisms, and that organisms with less protection of their critical organs had higher mortality rates. For instance, the most sensitive species are only protected by a thin layer of corneum, whereas the brine shrimp produces floccules to separate itself from the algal cells, securing more protection. Because fish produce mucus, mortality only occurs at relatively high densities of the alga, which may explain why Shi et al. (2012) reported that no fish were harmed by it. However, Li et al. (2017) suggested that all forms of protection have their limits, so that very high densities *K. mikimotoi* can wipe out almost all animals, as observed in the Irish bloom of 2005 (Silke et al., 2005).

The toxicity of *K. mikimotoi* strains from different regions also varies. The toxicity of European strains against fish is much more lethal than the toxicity of New Zealand or ECS strains. Mortality was observed in fish treated with European strains of *K. mikimotoi* at algal densities of about 1000 cells/mL (Jones et al., 1982; Roberts et al., 1983), but was not reported when they were treated with New Zealand or ECS strains at similar or even higher densities (Li et al., 2017; Shi et al., 2012). A South African strain caused a significant abalone larval kill at a density below 330 cells/mL (Botes et al., 2003), whereas an ECS strain only caused significant mortality of abalone larvae at a density above 1×10^4 cells/mL (Zhang et al., 2018). Deaths of juvenile abalone have also been observed with ECS strains, but no significant abalone kills have been observed with a South China Sea (SCS) strain (Lin, 2015). Rotifers are considered the organisms most sensitive to *K. mikimotoi*, and can be killed by very low algal densities, including of an SCS strain (Sun et al., 2010), an ECS strain (Li et al., 2017), and two strains from Japan (SUO-1 and FUK) (Zou et al., 2010). However, the rotifers were much less susceptible to the toxicity of the FUK strain than to those of the other three strains, to which they were similarly susceptible. New Zealand strains had no toxic effect on the brine shrimp *Artemia salina* at a density of 5.6×10^4 cells/mL (Shi et al., 2012), whereas SCS and ECS strains had lethal effects on *A. salina* at densities of 2×10^3 cells/mL (48 h) (Dang et al., 2015) and 3×10^4 cells/mL (72 h) (Li et al., 2017).

The toxicity of *K. mikimotoi* is also related to its growth stage and several environmental factors. However, few direct experiments have investigated how its growth stage or environmental factors affect the toxic impact of *K. mikimotoi* on one or several specific organisms, such as rotifers, fish, or shellfish. Nonetheless, conclusions can be drawn from the results of other tests of *K. mikimotoi* toxicity on these species. Lin (2015) suggested that the production of haemolytic cytotoxin varies according to growth stage and strain of *K. mikimotoi*. SCS strains produce most toxins in the early exponential stage and this production declines with growth, whereas ECS strains produce most toxins in the late stable stage, and similar levels of toxin in the other stages. Neely (2006) found that the haemolytic activity varied across five strains of *K. mikimotoi* and was strongly affected by salinity and temperature. Gentien and Arzul (1990) observed the high toxicity of *K. mikimotoi* in bloom water, but that this toxicity faded during 9-month culture in the laboratory. Yang et al. (2011b) demonstrated that *K. mikimotoi* produced more haemolytic substances when cultured with other algae or grazers, suggesting that the toxicity of this species is associated with its competitive strategies and plays an important role in bloom formation and persistence.

6. Toxicity mechanism

Unlike other species of the genus *Karenia*, *K. mikimotoi* does not produce brevetoxin, which is strongly toxic to humans and marine fauna (Brand et al., 2012). It also does not produce paralytic shellfish poison (PSP) or diarrheic shellfish poison (DSP) (Tangen, 1977). Therefore, it is difficult to know how this species causes such massive mortalities. Decades of research have suggested that there are many explanations of how *K. mikimotoi* blooms kill fish, shellfish, and other species.

6.1. Hypoxia

Most HABs appear to be massive reproduction or the accumulation of harmful algae in a certain marine area, which involve extremely high biomass. In the late stage of a bloom, the decomposition of this biomass

by aerobic microorganisms, such as bacteria, consumes vast amounts of the DO in the bloom area. If a bloom occurs in a semi-enclosed sea or in an area where seawater exchange is inadequate, an oxygen-deficient or even an anaerobic environment will form and suffocate every oxybiontic species present (Glibert and Pitcher, 2001; Pitcher et al., 2003). Hypoxia is the main reason for the fish and shellfish mortality caused by non-toxic algal blooms. For instance, a *Skeletonema costatum* bloom was recorded in coastal water near the Isle of Arran, Scotland, and a hypoxic area was observed with a DO concentration below 2.0 ± 0.3 mg/L, which led to 98% mortality in herring (*Clupea harengus*) eggs (Morrison et al., 1991). A bloom collapse also entails the incomplete decomposition of organic matter, which increases the concentrations of toxic ammonia nitrogen and sulfide. The survival and growth of shellfish, such as *Meretrix meretrix* and *Haliotis midae*, are inhibited by ammonia nitrogen at a few micromoles per litre (Branch et al., 2013; Reddy-Lopata et al., 2006).

High density *K. mikimotoi* blooms that influence wide areas have also been recorded. In most cases, the maximum cell density recorded exceeded 1000 cells/mL, or 1×10^4 cells/mL in Asia and Europe (Table 1). The maximum area influenced was over 1.7×10^4 km^2 near the Changjiang Estuary in China in 2005 (Li et al., 2017). The decomposition of such high density biomass inevitably reduces the DO levels in bloom areas. O'Boyle et al. (2016) suggested that bloom collapse is directly related to oxygen depletion in the waters off western Ireland, and proposed an approximate relationship between the *K. mikimotoi* cell concentration and the biochemical oxygen demand after sampling the bloom area. According to this relationship, a cell density of 1.0×10^4 cells/mL consumes about 14 mg O_2/L (O'Boyle et al., 2016), which means that hypoxic, even anoxic, waters are highly likely in the bloom collapse areas in Japan, China, and western Europe. Lin (2015) recorded the terrible smell of decay cultures of *K. mikimotoi* in both the laboratory and in seawater from a bloom collapse area in ECS in 2012, and also observed increased ammonia nitrogen (from 0.5 μmol/L to 5.8 μmol/L in 24 h) in abalone toxic test.

However, the hypoxia caused by the collapse of a *K. mikimotoi* bloom and the toxic ammonia nitrogen produced may not contribute greatly to the ensuing massive fish and shellfish mortalities. The mass mortality of fish and shellfish has often been recorded before a bloom collapses. Oda (1935) recorded DO levels of > 5.5 mg/L in both the surface and bottom waters when huge numbers of fish and shellfish were killed. In a laboratory test, the survival rates of fish, shellfish, and other invertebrates were significantly reduced by high density *K. mikimotoi*, even when the DO levels remained at appropriate levels (Li et al., 2017; Lin, 2015). Lin (2015) also recorded the pH and ammonia nitrogen levels under both aerated and non-aerated conditions when testing the toxicity of *K. mikimotoi* against abalone, and the levels were quite similar to those of the control group (with a survival rate of 100%). Li et al. (2017) showed that fish that tolerated low oxygen waters died before DO decreased to an unsuitable level, suggesting that hypoxia is not the main cause of these fish and shellfish kills. However, the results of Lin (2015) and Li et al. (2017) also showed that the fish and shellfish died faster at lower algal cell densities at low DO levels, which indicates that low DO conditions promote the harmful effects of algal blooms. These data suggest that the gill disorders caused by *K. mikimotoi* may be more responsible for fish mortality than hypoxia, however, it also indicated that the low DO conditions and mucus fish produced in algal treatment may contributed to massive fish morality in bloom environment (Jenkinson and Sun, 2010; Li et al., 2017).

6.2. Lipophilic toxins: haemolytic and cytotoxic effects

Although *K. mikimotoi* contains no shellfish poisons (Helm et al., 1974; Jones et al., 1982), brevetoxins (Brand et al., 2012), or karlotoxin (Mooney et al., 2009), this alga produces lipophilic toxins, whereas its water-soluble extracts do not affect other species, even at three times the concentrations in blooms (Li, unpublished data). Polar lipids, including glycolipids (32%–43%) and phospholipids (10%–25%), are the major types of lipids in the *K. mikimotoi* cells and exudates. Triacylglycerols are prominent within the cells (16%–27%), whereas free fatty acids (17%–28%) and glycolipids (59–90 μg/L) are prominent in the exudates (Parrish et al., 1994, 1993). Analysis of a Japanese strain detected high levels of compound lipids (79.75%) and triacylglycerol (12.19%) (Mochizuki et al., 1999). Mooney et al. (2007) examined the lipid class, fatty acid, and sterol composition of a New Zealand strain of *K. mikimotoi*, with similar results, and polar lipids comprised 88.0 ± 0.6% of the total lipids. This suggests that this species expresses multiple lipophilic toxins, but none has yet been identified.

K. mikimotoi cells and their lipophilic extracts show haemolytic and cytotoxic activity against fish, shellfish, and other test animals. Gentien and Arzul (1990) analysed their haemolytic effects on the red blood cells of rainbow trout, and detected at least three haemolytic fractions in the lipophilic extract. The cytotoxicity of crude and partially purified extracts of *K. mikimotoi* was tested on human KB cells by Partensky et al. (1989). However, both their haemolytic toxicity and cytotoxicity are defined by their impacts on erythrocytes or other cells, not by the presence of certain substance or toxins. Therefore, a certain toxin may have both haemolytic and cytotoxic activities, and its identification will depend on the method used to test the toxicity of an extract. The structures and mechanisms of haemolytic substances vary greatly across different haemolytic algae, as do those of their cytotoxins (Aanesen et al., 1998; Oda et al., 2001; Zou et al., 2010). It is even more difficult to determine whether the haemolytic or cytotoxic effects are more important in a particular toxicity test. Even so, haemolytic or cytotoxic tests are widely used to test the toxicity of *K. mikimotoi* because only a few specific toxins have been isolated from this species. Haemolysis is commonly cited as the main mechanism of the fish or shellfish kills by algal blooms, although no clear evidence has been presented.

6.2.1. Haemolysis

After the first report of the haemolytic effect of a French isolate of *K. mikimotoi* on trout erythrocytes by Gentien and Arzul (1990), they established a standard method for testing the haemolytic effects of harmful algae. They suggested that the haemolytic effect of *K. mikimotoi* was clearly evident in a sample with a concentration of 3.38×10^3 cells/mL, although the results were highly variable (Arzul et al., 1994). With a similar method, strong haemolytic activity has been reported in *K. mikimotoi* strains from England (Neely and Campbell, 2006), the USA (Neely and Campbell, 2006), Japan (Cho et al., 2017; Zou et al., 2010), and China (Li et al., 2017, 2018; Yang et al., 2011b), in tests that were conducted on the erythrocytes of different animals, including fish (Neely and Campbell, 2006) and land mammals (Cho et al., 2017; Li et al., 2017, 2018; Yang et al., 2011b; Zou et al., 2010). The haemolytic activity of *K. mikimotoi* varies across different strains. The test animal also influences the experimental result (Zou et al., 2010), which may be attributable to differences in the compositions and proportions of their erythrocyte membranes. Shi et al. (2011) investigated the effects of some membrane lipids on the haemolysis induced by the haemolytic toxin of *K. mikimotoi*, and found that only gangliosides significantly inhibited this haemolysis. This suggests a correlation between the sensitivity of different erythrocytes to the haemolytic toxin and the amount of gangliosides in the different erythrocyte membranes. The haemolysis induced by *K. mikimotoi* is also affected by temperature, pH, and different divalent cations (Hg^{2+}, Cu^{2+}, etc.) (Cui et al., 2009).

Although the haemolytic activity of a lipophilic extract of *K. mikimotoi* has been demonstrated, only a few toxins have been isolated and shown to be haemolytic. Parrish et al. (1993) and Mooney et al. (2007) noted that all-cis-3,6,9,12,15-octadecapentaenoic acid (18:5n3, constituting 12%–21% of unsaturated fatty acids) is the major unsaturated fatty acid present in the algal cells, and exerts toxic effects on fish gills. It induces strong mucus production and alters ionocytes by their inhibiting ATPase activities (Fossat et al., 1999; Sola et al., 1999). Parrish et al. (1998) localized the haemolytic activity of the *K. mikimotoi* extract

to monogalactosyl (MGDG) and digalactosyl diacylglycerol (DGDG), which was confirmed by Yasumoto et al. (1990).

6.2.2. Cytotoxicity

The cytotoxicity of crude and partially purified extracts of *K. mikimotoi* was tested in human KB cells, and the results indicated that this dinoflagellate contains at least one weakly active, fat-soluble cytotoxin, which transforms into a potent, stable derivative (Partensky et al., 1989). The polar lipid-soluble component of *K. mikimotoi* significantly inhibited the proliferation of mammalian cell lines, which became spherical and swollen, with disrupted membranes (Chen et al., 2011; Liu et al., 2012). Ohkubo et al. (2017) confirmed the cytotoxicity of *K. mikimotoi* with fluorescence-microscopic observations. Zou et al. (2013) suggested that the lactate dehydrogenase (LDH) release assay is an easier and faster method of detecting the cell lysis caused by toxic algae than cell counts or direct microscopic observation. With a similar test, Dorantes-Aranda et al. (2015) demonstrated that *K. mikimotoi* caused significant cytolysis in the rainbow trout gill, reducing cell viability and inducing LDH released.

Kajiwara et al. (1992) showed that cubenol, a characteristic volatile compound that is excreted by *K. mikimotoi*, causes cell burst in other swimming plankton at low concentrations. Interestingly, the polyunsaturated fatty acids isolated from *K. mikimotoi*, such as 18:4n3, 18:5n3, and 20:5n3, which are known haemolytic toxins, also caused strong cytotoxic and inhibitory effects on the cleavage of urchin eggs, with an median inhibitory concentration (IC_{50}) of $< 0.5\,\mu M$ (Sellem et al., 2000). Two brevetoxin-like polyethers, gymnocin-A and -B, were isolated and shown to be cytotoxic for mouse lymphoid P388 cells at 1.3 and 1.7 μg/mL, respectively (Sasaki et al., 2002; Satake et al., 2002, 2005). Gymnocin-A is characterized by 14 (15 for gymnocin-B) contiguous and saturated ether rings and a 2-methyl-2-butenal side chain, and studies have shown that the α,β-unsaturated aldehyde functionality of the side chain and the molecular length of the polycyclic ether skeleton are the crucial structural elements required for its cytotoxicity (Tsukano and Sasaki, 2006). Analogues of gymnocin, such as gymnocin-A carboxylic acid and gymnocin-A2, have also been isolated from *K mikimotoi* and shown to be cytotoxic for P388 cells (Tanaka et al., 2013).

6.2.3. Hypotoxicity of toxins

Many studies have demonstrated the haemolytic and cytotoxic effects of lipophilic extracts of *K. mikimotoi*, and some toxins have also been isolated and tested. However, these toxins are only hypotoxic, and cause hardly any damage or mortality in marine fauna. The cytotoxins gymnocin-A and -B are only weakly toxic to fish. When a mixture of gymnocins was tested on the freshwater fish *Tanichthys albonubes*, its toxicity was 250 times less potent than that of 42-dihydro BTXb (brevetoxin) (Satake et al., 2002, 2005). Chang and Gall (2013) tested the toxicity of lipophilic extracts of *K. mikimotoi* on brine shrimp (*Artemia salina*) and rotifers (*Branchinus* sp.) at a concentration equivalent to 6×10^3 cells/mL. However, the extract had no effect on either the nauplian or mature brine shrimp, and showed only weak toxicity against rotifers, with a median lethal time after exposure (LT_{50}) of 20 h, which was much longer than those of *K. concordia* and *K. brevisulcata* extracts (60 and 20 min at concentration equal to 3×10^3 cells/mL, respectively). Other toxicity tests confirmed that the algal lipophilic extract was hypotoxic to other organisms, even at higher concentrations than were used by Chang and Gall (2013). For instance, no mortality was observed in the abalone *Haliotis discus hannai* cultured with the extract at a concentration equal to 3×10^4 cells/mL for 96 h (Lin, 2015); nor did it cause mortality among zooplankton (*Brachionus plicatilis*, *A. salina*, *Calanus sinicus*, and *Neomysis awatschensis*) or aquaculture species (*Penaeus vannamei* and *Scophthalmus maximus*) at same concentration and for the same time (Li et al., 2017). Lin (2015) also reported that two strains of *K. mikimotoi* were differentially toxic to abalone, whereas their haemolytic activities were similar, which suggests that the haemolytic toxins in the extracts are not the main cause of shellfish mortality. Recent molecular analyses have indicated that *K. mikimotoi* is capacity to produce more toxins, for it is associated with several putative toxin-related genes (Kimura et al., 2015; Shikata et al., 2019), however, it still need solid evidences to prove their role in toxicity mechanism of *K. mikimotoi*.

6.3. Reactive oxygen species

The term “reactive oxygen species” (ROS) encompasses molecules such as hydrogen peroxide (H_2O_2), radicals like the hydroxyl radical (·OH), and the superoxide anion ($\cdot O_2^-$) (Marshall et al., 2005b). Plants often produce ROS, such as superoxide, through the NADPH cycle during photosynthesis (Marshall et al., 2005a), and sometimes use them as necessary or toxic metals (Palenik et al., 1987).

6.3.1. Direct damage and indirect toxic enhancement

Superoxide is a well-known toxigenic product of biological systems and has been linked to apoptosis and the destruction of cell membranes (Marshall et al., 2005a). A study of the ichthyotoxic alga *Chattonella marina* first drew attention to the fact that fish kills may be attributable to the direct damage caused by algal-borne ROS, because this alga produces amazing amounts of ROS (206 CCU (unit for fluorescence intensity per cell), about a hundred times more than normal algae) (Marshall et al., 2005a). Cytolysis and mucus production were observed in fish treated with *C. marina*, and ROS were considered the main cause (Ishimatsu et al., 1996). Oda et al. (1992) suggested that the ROS produced by *C. marina* trigger an over-reactive defence response in the fish gill. However, research has shown that the fish kills caused by *C. marina* might be more accurately attributed to ichthyotoxins, rather than to ROS such as H_2O_2, which barely affects the fish gill directly at the bloom concentration (Tang et al., 2007, 2005).

Like *C. marina*, *K. mikimotoi* is both ichthyotoxic and capable of generating ROS, although ROS in most *K. mikimotoi* strains are at concentrations less than those in *C. marina* (Zou et al., 2010). Yamasaki et al. (2004) detected a slightly lower but significant level of $\cdot O_2^-$ in *K. mikimotoi* than in *C. marina*. H_2O_2 was also detected in a *K. mikimotoi* cell suspension, but its level was approximately 10% of that in *C. marina* (Yamasaki et al., 2004). A survey of ROS production in 37 species from six classes of algae by Marshall et al. (2005a) classed *Karenia* species as high level superoxide producers, but *K. mikimotoi* was categorized into the nontoxic group based on its ROS production. Li et al. (2017) also detected $\cdot O_2^-$ (0.014 ± 0.004 OD/10^4 cells) and H_2O_2 (3.00 ± 0.00 nmol/10^4 cells) in *K. mikimotoi* and these values dropped to 0.000 ± 0.007 OD/(10^4 cells) and 0.21 ± 0.35 nmol/(10^4 cells), respectively, when SOD and catalase were added. Rotifers are only significantly affected by H_2O_2 at extremely high concentrations (more than 300 mmol/L), which means that the ROS produced by *K. mikimotoi* contribute negligibly to rotifer mortality.

Marshall et al. (2003) also suggested that ROS ichthyotoxically enhance the effect of eicosapentaenoic acid in *C. marina*, which accounts for the high fish killing potential of *C. marina*. They may also enhance the toxicity of unsaturated fatty acids in *K. mikimotoi*. Although a newly discovered strains *K. mikimotoi* NGU04 generates O_2– at a level almost equal to that of *C. marina*, the toxicity of this alga to rotifers was not affected when ROS were removed from the medium with SOD and catalase (Kim et al., 2019; Li et al., 2017). Therefore, the superoxide released into the water by *K. mikimotoi* negligibly enhances its toxicity.

6.3.2. Antioxidase system disturbance

Although *K. mikimotoi* does not produce ROS that directly harm marine fauna, this alga does compromise the antioxidase systems of marine organisms. Lin et al. (2016) investigated the effects of *K. mikimotoi* on the antioxidant enzymes of the abalone *Haliotis discus hannai*, including SOD, catalase, and glutathione peroxidase (GSH-Px). Their results showed that exposure to a low cell concentration of *K. mikimotoi*

(not exceeding 10^4 cell/mL) had significant adverse effects on the SOD and catalase activities in the abalone gills, but no adverse effects on GSH-Px activity. Similar results were also observed by Zhang et al. (2018). Therefore, the occurrence of a *K. mikimotoi* bloom could cause oxidative damage to the organs of marine animals during short-term exposure.

6.4. Contact-dependent toxicity of intact cells

The mechanisms of harmful algae are related not only to the kinds of toxin they produce, but also to how the toxic alga itself or its compounds act on other organisms, i.e., the "toxic pathway". Although *K. mikimotoi* is primarily an exotoxic agent (Gentien and Arzul, 1990), research has shown that the toxicity of this alga is contact-dependent, so direct or extremely close contact with intact algal cells is necessary for its toxic effect.

An early study reported that the filtered seawater from a bloom area of *K. mikimotoi* was not toxic to the test organisms, including shellfish embryos and *Artemia* nauplii, whereas unfiltered seawater caused mass mortality and diapause (Helm et al., 1974). It has also been reported that filtered seawater does not significantly inhibit the clearance rate of shellfish (Widdows et al. (1979), only slightly inhibits the filtration activity of oysters (Matsuyama et al., 1999), and only affects the survival rate of abalone at high cell densities (Botes et al., 2003).

The filtrates and ruptured cell suspensions of several strains of *K. mikimotoi* were nontoxic to fish and invertebrates. A toxicity test of an SCS strain on a rotifer, brine shrimp, and mysid showed that the intact algal cells were necessary for faunal mortality (Sun et al., 2010). The same results were also observed in a toxicity test of an ECS strain against abalone, copepod, prawn, and fish (Li et al., 2017). Zou et al. (2010) also reported that the filtrates and ruptured cell suspensions of two Japanese strains were not only nontoxic to rotifers, but were also non-haemolytic to erythrocytes. Eschbach et al. (2001) reported that a Norwegian strain of *K. mikimotoi* showed almost no haemolytic activity. The discrepancy between the observed mass fish kills in the field and the weak toxicity of the alga in laboratory assays may be attributable to the fact that the extremely low solubility of gymnocins in water prevents them reaching the gills of fish, whereas in red tide events, *K. mikimotoi* cells are observed to fill the fish gills, thereby allowing direct contact between the gymnocins and the gills (Satake et al., 2002, 2005). The LDH release assay also showed that cell-free culture supernatants and ruptured cell suspensions of two strains of *K. mikimotoi* were less effective on rainbow trout gill (RTgill-W1) cells than were suspensions of whole algal cells (Zou et al., 2013). However, the same test on another strain showed that the toxicity of lysed algal cells was only slightly weaker than that of whole cells, and in some tests, the algal cell lysates were even more toxic than the whole cells (Dorantes-Aranda et al., 2015). Recently, it has been demonstrated that the toxicity of *K. mikimotoi* cells was weakened when the cells were ruptured, and almost disappeared when the algal cells were removed from the culture by filtration. However, significant cytotoxicity was detected in the concentrated ruptured cells and in the concentrated ruptured cells after freeze–thawing, although it was weakened by this process. However, the cytotoxicity of *K. mikimotoi* cells almost disappeared after heat treatment (Ohkubo et al., 2017).

When rotifers were separated from *K. mikimotoi* cells with a membrane filter (3.0 mm pore size, which allowed the transfer of soluble materials between the two compartments), no rotifer mortality was observed, even at an algal cell density of 8–10 × 10^4 cells/mL (Zou et al., 2010). Zou et al. inferred that this was direct evidence of the contact-dependent toxicity of intact *K. mikimotoi* cells.

7. Discussion

7.1. Worldwide spread of blooms

The rough time-based analysis shown in Table 1 suggested that blooms of *K. mikimotoi* originate in many locations (sources), and spread within relatively narrow areas between countries rather than by cross-ocean invasion. For instance, in Asian coastal waters, blooms have started in Japan and spread to Korea, China, India, and Singapore, and this spread is time-dependent. In Europe, blooms have started on the coast of the British Isles and the Scandinavian Peninsula at almost the same time, and spread to almost the whole western coast of Europe and the south-western Mediterranean. Gomez (2008) suggested the North Atlantic current circulation might support the transport of *G. aureolum* from the USA to Europe. However, *G. aureolum* from the USA is considered to be a different species from *K. mikimotoi* (Hansen et al., 2000). Therefore, it seems that near-shore currents rather than the ocean circulation support the spread of *K. mikimotoi*.

It has also been suggested that human behaviour, such as increased shipping, facilitates the spread of algal blooms. Hegaret et al. (2008) observed this alga in tubes inoculated with the faeces of the shellfish *Mytilus edulis* or *Venerupis philippinarum* after 24 h, and suggested that it is transported across seas and constitutes a "bio-invasion", although this type of biological transport is inefficient. Ship ballast waters may also play a role in spreading this species because it has been detected in the ballast waters of foreign ships entering major ports in China (Yang et al., 2009, 2011a; Zhou et al., 2012). However, other surveys found no trace of this alga in ship ballast waters (Chen et al., 2016). Therefore, whether and how *K. mikimotoi* spreads is still unclear. Whether this alga should be considered an invasive species requires further research, particularly an analysis of the genetic relationships between different geographic populations with molecular methods. For example, Al-Kandari et al. (2011) suggested that isolates from Europe and New Zealand were more closely related to each other than either was to isolates from Japan. This may support the notion of long-distance bio-invasion or transport of this species. It is suggested more strains of *K. mikimotoi* should be isolated from different bloom regions, and global genetic relationship and linage on sub-species level were need, as well as their spread methods, mechanism, and the relationship with globe change (climate and marine) caused by human.

7.2. Advantages or strategies in forming blooms

Brand et al. (2012) have suggested that *Karenia* species have no unusual physiological characteristics that distinguish them from other dinoflagellate species and predict that they could outcompete other species to predominate as blooms. Many researchers have tried to explain their success in many ways, including modelling bloom events with environmental factors, and have suggested that the blooms of these species are have multiple causes (Aleynik et al., 2016; Chang and Carpenter, 1985; Gillibrand et al., 2016; Hayakawa et al., 1996; Smayda and Reynolds, 2001; Sophie, 2001; Takeuchi et al., 1995; Vanhoutte-Brunier et al., 2008). However, blooms of *K. mikimotoi* are always of extremely long duration, and involve many co-bloom-forming species, such as *Prorocentrum donghaiense*, a species with a similar ecological niche (Li et al., 2010, 2009; Li et al., 2017). These factors make it even more difficult to explain the causes of *K. mikimotoi* blooms.

As well as environmental reasons, the physiological features of *K. mikimotoi* may be more important than previously thought. *K. mikimotoi* a species with a relatively low reproduction rate and poor nutritional competence (Liang et al., 2013, 2015; Long et al., 2013), but its strong adaptive capacity, motility, and allelopathy (toxicity) may support its formation of blooms in specific marine environments. The hypothesis about its bloom mechanism was presented in Fig. 2 that this species may take advantage in the bloom succession, for most *K. mikimotoi* bloomed after a diatom bloom (Zhou, 2017; Zhou et al., 2017). Its wide

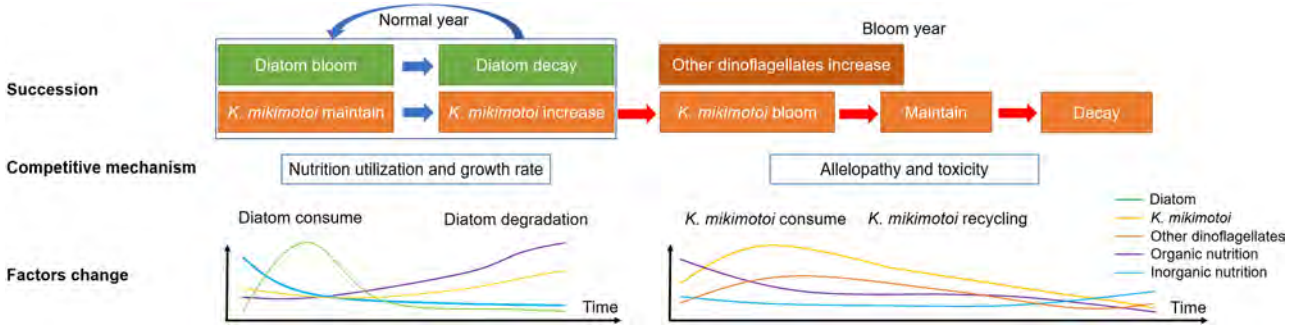


Fig. 2. A succession sketch illustrating the bloom process of *Karenia mikimotoi,* blue arrows represent normal years circulation of diatom bloom, with density change of *K. mikimotoi*, and red arrows represent the bloom process of *K. mikimotoi* after diatom bloom decay in a *K. mikimotoi* bloom year. The main competitive mechanism and main environmental factors change in both normal year and bloom year were added blow, part factors changes were referred *K. mikimotoi* bloom data in the East China Sea (Zhou, 2017) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

tolerance of environmental variability and its mixotrophism mean that this species can survive harsh environments and competition during the blooms of other algae, such as those of diatoms and Cyanophyta species, which bloom under circumstances of rich dissolved inorganic nutrients. The blooms of other algae then decay when their inorganic nutrients are exhausted, and this decomposition makes the area rich in organic nutrients and microscopic bio-detritus. *K. mikimotoi* can take advantage of these nutrients (it may take more than one circulation until its final form blooms), and its rhythmic vertical migration produces a high density of cells in a specific layer of the water column. The allelopathy and toxicity of this species are efficient competitive strategies that prevent other algae taking advantage and inhibits the ingestion of *K. mikimotoi* by zooplankton. During the bloom stage, *K. mikimotoi* might utilize their own degradation products, thus creating a small cycle that prolongs the duration of the bloom. Because this species migrates diurnally and mainly subsists on organic nutrients, the space and nutrients that become available during the degradation of a bloom might allow other algae to increase, such as *P. donghaiense*, which is highly tolerant of the allelopathy and toxicity of *K. mikimotoi*. Interestingly, a correlation between *K. mikimotoi* and ocean acidification has recently been noted, because this alga seems more strongly adapted to acidic water (caused by CO_2) than other algae, such as *Dunaliella salina* (Hu et al., 2017). It is suggested that the in situ and numerical modelling of different scales (from large to small, surface to bottom) bloom succession were needed in the future, especially for the role that environmental factors paly in those succession.

7.3. Hypotheses and doubts about the toxicity mechanism

Bloom densities of *K. mikimotoi* cause mortality among almost all kinds of marine fauna. However, why this species is so toxic is not yet fully understood. Its blooms cause fish mortality long before the decline stage, so an oxygen deficit is not the main reason for fishery losses. Many studies have shown that the toxicity of algal cells is to blame for these fish and shellfish kills, but when researchers have tried to isolate toxins from *K. mikimotoi*, toxicity tests proved them barely kill fish or shellfish. There is direct evidence that intact cells are necessary for the toxicity of *K. mikimotoi*, and that its toxic effects are contact-dependent. By combining these findings with the hypotoxicity of algal extracts, Li et al. (2017) have presented several hypotheses to explain the toxicity of *K. mikimotoi*, including: (1) toxins other than haemolysins and cytotoxins are involved, which are much more toxic but delicate, and decompose easily or are attenuated during their extraction; (2) toxins only exist on or near the cell membrane at high, lethal concentrations, so that close or direct contact with the algal cell is required; or (3) the toxicity of the alga increases under environmental or grazing pressures. It also possible that the toxic effect is instantaneous, so the algal cell releases its toxin or toxicysts only when it touches its victim. These processes resemble the immune reaction of natural killer cells in mammals (although they are not as specific) (Smyth et al., 2005) or ciliates (Buonanno et al., 2014). However, each of these hypotheses requires further research and detailed evidence to confirm it, for instance, molecular difference between *K. mikimotoi* strains varied toxicity, toxins change with distance away from cytomembrane or encountered stimulus, characterised more toxins and tested their toxicity.

8. Conclusion

K. mikimotoi is a typical toxic bloom-forming species, which has caused mass fish and shellfish mortalities worldwide. This species shows characteristic adaptability, nutrient use, and motility, and a unique life cycle, which when combined with its density-dependent allelopathy and toxicity, may help *K. mikimotoi* form blooms. The cells of *K. mikimotoi* are toxic to many types of marine fauna, but why this alga is so toxic is still not fully understood. Several mechanism and hypotheses have been proposed to answer this question, including the presence of lipophilic toxins and contact-dependent toxicity. However, further research is required to determine how this species blooms and why it is so damaging to marine life.

Acknowledgements

This work was supported by the Science & Technology Basic Resources Investigation Program of China (2018FY100206), the National Nature Science Foundation of China (NSFC 41476102 and U1406403), the National Marine Laboratory Key Program (2015ASKJ02) and the Sino-Australian Centre for Healthy Coasts (2016YFE0101500). We thank Dr Kai-jie Yang (Fujian Agriculture and Forestry University) for drawing the globe map and International Science Editing for polishing this manuscript. We are grateful to the anonymous reviewers and the editor for their valuable comments that resulted in improvement of the manuscript.[CG]

References

Aanesen, R.T., Eilertsen, H.C., Stabell, O.B., 1998. Light-induced toxic properties of the marine alga *Phaeocystis pouchetii* towards cod larvae. Aquat. Toxicol. 40 (2-3), 109–121.

Akcha, F., Arzul, G., Rousseau, S., Bardouil, M., 2008. Comet assay in phytoplankton as biomarker of genotoxic effects of environmental pollution. Mar. Environ. Res. 66 (1), 59–61.

Al-Kandari, M.A., Highfield, A.C., Hall, M.J., Hayes, P., Schroeder, D.C., 2011. Molecular tools separate harmful algal bloom species, *Karenia mikimotoi*, from different geographical regions into distinct sub-groups. Harmful Algae 10 (6), 636–643.

Alamsjah, M.A., Hirao, S., Ishibashi, F., Oda, T., Fujita, Y., 2008. Algicidal activity of polyunsaturated fatty acids derived from *Ulva fasciata* and *U. Pertusa* (Ulvaceae, Chlorophyta) on phytoplankton. J. Appl. Phycol. 20 (5), 713–720.

Aleynik, D., Dale, A.C., Porter, M., Davidson, K., 2016. A high resolution hydrodynamic model system suitable for novel harmful algal bloom modelling in areas of complex coastline and topography. Harmful Algae 53, 102–117.

Aoki, K., Kameda, T., Yamatogi, T., Ishida, N., Hirae, S., Kawaguchi, M., Syutou, T., 2017. Spatio-temporal variations in bloom of the red-tide dinoflagellate *Karenia mikimotoi* in Imari Bay, Japan, in 2014: factors controlling horizontal and vertical distribution. Mar. Pollut. Bull. 124 (1), 130–138.

Arzul, G., Clement, A., Pinier, A., 1996. Effects on phytoplankton growth of dissolved substances produced by fish farming. Aquat. Living Resour. 9 (2), 95–102.

Arzul, G., Gentien, P., Crassous, M.P., 1994. A hemolytic test to assay toxins excreted by the marine dinoflagellate *Gyrodinium* cf.*aUreolum*. Water Res. 28 (4), 961–965.

Babu, M.J., Geetha, P., Soman, K.P., 2016. MODIS-aqua data based detection and classification of algal blooms along the coast of India using RLS classifier. Procedia Comput. Sci. 93, 424–430.

Basti, L., Nagai, S., Go, J., Okano, S., Nagai, K., Watanabe, R., Suzuki, T., Tanaka, Y., 2015. Differential inimical effects of *Alexandrium* spp. And *Karenia* spp. On cleavage, hatching, and two larval stages of Japanese pearl oyster *Pinctada fucata martensii*. Harmful Algae 43, 1–12.

Bizsel, N., Bizsel, K.C., 2002. New records of toxic algae *Heterosigma* cf. *Akashiwo* and *Gymnodinium* cf. *Mikimotoi* in the hypereutrophic Izmir Bay (Aegean Sea): coupling between organisms and water quality parameters. Israel J Plant Sci 50 (1), 33–44.

Bjornsen, P.K., Nielsen, T.G., 1991. Decimeter scale heterogeneity in the plankton during a pycnocline bloom of Gyrodinium aureolum. Mar. Ecol. Prog. Ser. 73 (2-3), 263–267.

Blasco, D., BerardTherriault, L., Levasseur, M., Vrieling, E.G., 1996. Temporal and spatial distribution of the ichthyotoxic dinoflagellate *Gyrodinium aureolum* Hulburt in the St Lawrence, Canada. J. Plankton Res. 18 (10), 1917–1930.

Boalch, G.T., 1979. The dinoflagellae bloom on the coast of south west England, August-September 1978. J. Mar. Biol. Assoc. U.K. 59 (2), 515–517.

Botes, L., Smit, A., Cook, P.A., 2003. The potential threat of algal blooms to the abalone (*Haliotis midae*) mariculture industry situated around the South African coast. Harmful Algae 2 (4), 247–259.

Boustead, N.C., 1987. Plankton blooms and salmon farming. Aquacult Infor Leaflet 1, 2–3.

Braarud, T., Heimdal, B.R., 1970. Brown Water on the Norwegian Coast in Autumn 1966. Nytt Magasin for Nytt Magasin Botanikk.

Branch, G.M., Bustamante, R.H., Robinson, T.B., 2013. Impacts of a' black tide' harmful algal bloom on rocky-shore intertidal communities on the west coast of South Africa. Harmful Algae 24, 54–64.

Brand, L.E., Campbell, L., Bresnan, E., 2012. *Karenia*: the biology and ecology of a toxic genus. Harmful Algae 14, 156–178.

Buonanno, F., Anesi, A., Guella, G., Kumar, S., Bharti, D., La Terza, A., Quassinti, L., Bramucci, M., Ortenzi, C., 2014. Chemical offense by means of toxicysts in the freshwater ciliate, Coleps hirtus. J. Eukaryot. Microbiol. 61 (3), 293–304.

Cantin, G., Levasseur, M., Gosselin, M., Michaud, S., 1996. Role of zooplankton in the mesoscale distribution of surface dimethylsulfide concentrations in the Gulf of St Lawrence, Canada. Mar. Ecol. Prog. Ser. 141 (1-3), 103–117.

Carreto, J.I., Seguel, M., Montoya, N.G., Clement, A., Carignan, M.O., 2001. Pigment profile of the ichthyotoxic dinoflagellate *Gymnodinium* sp from a massive bloom in southern Chile. J. Plankton Res. 23 (10), 1171–1175.

Chang, F.H., 1996. A review of knowledge of a group of closely related, economically important toxic *Gymnodinium/Gyrodinium* (Dinophyceae) species in New Zealand. J Roy Soc New Zeal 26 (3), 381–394.

Chang, F.H., 2011. Toxic effects of three closely-related dinoflagellates, *Karenia concordia*, *K. Brevisulcata* and *K. Mikimotoi* (Gymnodiniales, Dinophyceae) on other microalgal species. Harmful Algae 10 (2), 181–187.

Chang, F.H., Gall, M., 2013. Pigment compositions and toxic effects of three harmful karenia species, *Karenia concordia*, *Karenia brevisulcata* and *Karenia mikimotoi* (Gymnodiniales, Dinophyceae), on rotifers and brine shrimps. Harmful Algae 27, 113–120.

Chang, F.H., Ryan, K.G., 2004. *Karenia concordia* sp nov (Gymnodiniales, Dinophyceae), a new nonthecate dinoflagellate isolated from the New Zealand northeast coast during the 2002 harmful algal bloom events. Phycologia 43 (5), 552–562.

Chang, J., Carpenter, E.J., 1985. Blooms of the dinoflagellate gyrodinium-aureolum in a Long-Island Estuary - Box model analysis of bloom maintenance. Mar. Biol. 89 (1), 83–93.

Chen, X.F., Zhou, Q.J., Duan, W.J., Zhou, C.X., Duan, L.J., Zhang, H.L., Sun, A.L., Yan, X.J., Chen, J., 2016. Development and evaluation of a DNA microarray assay for the simultaneous detection of nine harmful algal species in ship ballast and seaport waters. Chin. J. Oceanol. Limnol. 34 (1), 86–101.

Chen, Y., Yan, T., Yu, R.C., Zhou, M.J., 2011. Toxic effects of *Karenia mikimotoi* extracts on mammalian cells. Chin. J. Oceanol. Limnol. 29 (4), 860–868.

Cho, K., Kasaoka, T., Ueno, M., Basti, L., Yamasaki, Y., Kim, D., Oda, T., 2017. Haemolytic activity and reactive oxygen species production of four harmful algal bloom species. Eur. J. Phycol. 52 (3), 311–319.

Crespo, B.G., Figueiras, F.G., Groom, S., 2007. Role of across-shelf currents in the dynamics of harmful dinoflagellate blooms in the northwestern Iberian upwelling. Limnol. Oceanogr. 52 (6), 2668–2678.

Cross, T.F., Southgate, T., 1980. Mortalities of fauna of rocky substrates in southwest Ireland associated with the occurrence of *Gyrodinium aureolum* blooms during autumn 1979. J. Mar. Biol. Assoc. U.K. 60 (4), 1071–1073.

Cui, W.M., Yang, W.D., Liu, J.S., Hong-Ye, L.I., 2009. Hemolytic properties of hemolytic extracts from *Karenia mikimotoi* Hasen. Journal of Tropical & Subtropical Botany 17 (3), 237–241.

D'Silva, M.S., Anil, A.C., Naik, R.K., D'Costa, P.M., 2012. Algal blooms: a perspective from the coasts of India. Nat. Hazards 63 (2), 1225–1253.

Dahl, E., Brockmann, U.H., 1989. Does *gyrodinium aureolum* Hulbert perform diurnal vertical migrations? In: Okaichi, T., Anderson, D.M., Nemoto, T. (Eds.), Red Tides: Biology, Environmental Science and Technology. Elsevier, New York.

Dai, A.Q., Shi, X.Y., Ding, Y.Y., Tang, H.J., Wang, L.S., Wang, X.L., 2014. Effects of temperature on the growth and nitrate reductase activity of chaetoceros curvisetus and Karenia mikimotoi. Prog Biochem Biophys 41 (9), 896–903.

Dang, L.X., Li, Y., Liu, F., Zhang, Y., Yang, W.D., Li, H.Y., Liu, J.S., 2015. Chemical response of the toxic dinoflagellate *Karenia mikimotoi* against grazing by three species of zooplankton. J. Eukaryot. Microbiol. 62 (4), 470–480.

Daugbjerg, N., Hansen, G., Larsen, J., Moestrup, Ø., 2000. Phylogeny of some of the major genera of dinoflagellates based on ultrastructure and partial LSU rDNA sequence data, including the erection of three new genera of unarmoured dinoflagellates. Phycologia 39 (4), 302–317.

Davidson, K., Miller, P., Wilding, T.A., Shutler, J., Bresnan, E., Kennington, K., Swan, S., 2009. A large and prolonged bloom of *Karenia mikimotoi* in Scottish waters in 2006. Harmful Algae 8 (2), 349–361.

De Rijcke, M., Van Acker, E., Nevejan, N., De Schamphelaere, K.A.C., Janssen, C.R., 2016. Toxic dinoflagellates and *Vibrio* spp. Act independently in bivalve larvae. Fish Shellfish Immun 57, 236–242.

De Salas, M.F., Bolch, C.J.S., Hallegraeff, G.M., 2004. *Karenia umbella* sp nov (Gymnodiniales, Dinophyceae), a new potentially ichthyotoxic dinoflagellate species from Tasmania, Australia. Phycologia 43 (2), 166–175.

Dickman, M.D., 2001. Hong Kong's worst red tide induced fish kill (March–April 1998). In: The IX International Symposium on Harmful Algal Blooms, Feb 7–11, 2000, Hobart. Australia. pp. 58–61.

Dorantes-Aranda, J.J., Seger, A., Mardones, J.I., Nichols, P.D., Hallegraeff, G.M., 2015. Progress in understanding algal bloom-mediated fish kills: the role of superoxide radicals, phycotoxins and fatty acids. PLoS One 10 (7), e0133549.

Dorrell, R.G., Hinksman, G.A., Howe, C.J., 2016. Diversity of transcripts and transcript processing forms in plastids of the dinoflagellate alga Karenia mikimotoi. Plant Mol. Biol. 90 (3), 233–247.

Doucette, G.J., McGovern, E.R., Babinchak, J.A., 1999. Algicidal bacteria active against *Gymnodinium breve* (Dinophyceae). I. Bacterial isolation and characterization of killing activity. J. Phycol. 35 (6), 1447–1454.

Ediger, D., Raine, R., Weeks, A.R., Robinson, I.S., Sagan, S., 2001. Pigment signatures reveal temporal and regional differences in taxonomic phytoplankton composition off the west coast of Ireland. J. Plankton Res. 23 (8), 893–902.

Eschbach, E., Scharsack, J.P., John, U., Medlin, L.K., 2001. Improved erythrocyte lysis assay in microtitre plates for sensitive detection and efficient measurement of haemolytic compounds from ichthyotoxic alga. J. Appl. Toxicol. 21 (6), 513–519.

Fang, H.D., Tang, S.M., 2009. Comparative study of hydrographic conditions for algal bloom formation in the coastal waters of east and west of Hong Kong during 1998. Chin. J. Oceanol. Limnol. 27 (1), 13–21.

FDOF, 2019. Report of Marine Disaster at Fujian in 2018. ed. Fisheries, F.d.o.o.a.

Fossat, B., Porthe-Nibelle, J., Sola, P., Masoni, A., Gentien, P., Bodennec, G., 1999. Toxicity of fatty acid 18:5n3 from *Gymnodinium* cf. *mkimotoi*: II. Intracellular pH and K^+ uptake in isolated trout hepatocytes. J. Appl. Toxicol. 19 (4), 275–278.

Fukami, K., Nishijima, T., Ishida, Y., 1997. Stimulative and inhibitory effects of bacteria on the growth of microalgae. Hydrobiologia 358, 185–191.

Fukami, K., Nishijima, T., Murata, H., Doi, S., Hata, Y., 1991. Distribution of bacteria influential on the development and the decay of *Gymnodinium nagasakiense* red tide and their effects on algal growth. Nippon Suisan Gakkai Shi 57 (12), 2321–2326.

Fukami, K., Yuzawa, A., Nishijima, T., Hata, Y., 1992. Isolation and properties of a bacterium inhibiting the growth of Gymnodinium nagasakiense. Nippon Suisan Gakkai Shi 58 (6), 1073–1077.

Furuya, K., Iwataki, M., Lim, P.T., Lu, S., Leaw, C.-P., Azanza, R.V., Kim, H.-G., Fukuyo, Y., 2018. Overview of harmful algal blooms in Asia. In: Glibert, P.M., Berdalet, E., Burford, M.A., Pitcher, G.C., Zhou, M. (Eds.), Global Ecology and Oceanography of Harmful Algal Blooms. Springer International Publishing, Cham, pp. 289–308.

Garcia, V.M.T., Purdie, D.A., 1994. Primary production studies during a *Gyrodinium* cf. *Aureolum* (Dinophyceae) bloom in the western English Channel. Mar. Biol. 119 (2), 297–305.

Gentien, P., 1998. Bloom dynamics and ecophysiology of the *gymnodinium mikimotoi* species complex. In: Anderson, D.M., Cembella, A.D., Hallegraeff, G.M. (Eds.), Physiological Ecology of Harmful Algal Blooms. Springer, pp. 155–173.

Gentien, P., Arzul, G., 1990. Exotoxin production by *Gyrodinium* cf. *Aureolum* (Dinophyceae). J. Mar. Biol. Assoc. U.K. 70 (3), 571–581.

Gentien, P., Lunven, M., Lazure, P., Youenou, A., Crassous, M.P., 2007. Motility and autotoxicity in *Karenia mikimotoi* (Dinophyceae). Philosophical Transactions of the Royal Society of London Series B-Biological Sciences 362 (1487), 1937–1946.

Gillibrand, P.A., Siemering, B., Miller, P.I., Davidson, K., 2016. Individual-based modelling of the development and transport of a *Karenia mikimotoi* bloom on the North-west European continental shelf. Harmful Algae 53, 118–134.

Glibert, P.M., Berdalet, E., Burford, M.A., Pitcher, G.C., Zhou, M., 2018. Harmful Algal Blooms and the Importance of Understanding Their Ecology and Oceanography.

Glibert, P.M., Pitcher, G., 2001. Global Ecology and Oceanography of Harmful Algal Blooms: Science Plan: an International Programme Sponsored by the Scientific Committee on Oceanic Research (Scor) and the Intergovernmental Oceanographic Commission (Unesco) Scientific Committee on Oceanic Research; Intergovernmental Oceanographic Commission, Baltimore, MD Paris.

Glibert, P.M., Zhou, M.J., Zhu, M.Y., Burford, M.A., 2011. Preface to the special issue on eutrophication and HABs: the GEOHAB approach. Chin. J. Oceanol. Limnol. 29 (4), 719–723.

Go, J., Nagai, K., Segawa, S., Honjo, T., 2016. Mortality and impact on life activity of Akoya pearl oysters caused by red tides of dinoflagellate Karenia mikimotoi. Nippon Suisan Gakkai Shi 82 (5), 737–742.

Gohin, Francis, Le, B., Claude, Jane, 2010. Note on the Real-time Time Detection of a *Karenia Mikimotoi* Bloom From Space in the Western English Channel in July 2010.

Gomez, F., 2008. Phytoplankton invasions: comments on the validity of categorizing the non-indigenous dinoflagellates and diatoms in European seas. Mar. Pollut. Bull. 56

(4), 620–628.
Gong, S.Y., Yan-Ping, T.U., Xie, Z.H., 2014. Molecular identification of four strains of heterotrophic bacteria isolated from Karenia mikimotoi. Oceanologia Et Limnologia Sinica 45 (5), 1099–1104.
Granéli, E., Carlsson, P., Olsson, P., Sundström, B., Granéli, E., Lindahl, O., 1989. From Anoxia to Fish Poisoning: The Last Ten Years of Phytoplankton Blooms in Swedish Marine Waters Vol. 35. pp. 407–427.
Guan, W.C., Li, P., 2017. Dependency of UVR-induced photoinhibition on atomic ratio of N to P in the dinoflagellate Karenia mikimotoi. Mar. Biol. 164 (2).
Guillou, L., Nezan, E., Cueff, V., Erard-Le Denn, E., Cambon-Bonavita, M.A., Gentien, P., Barbier, G., 2002. Genetic diversity and molecular detection of three toxic dinoflagellate genera (*Alexandrium*, *Dinophysis*, and *Karenia*) from French coasts. Protist 153 (3), 223–238.
Hallegraeff, G.M., 1992. Harmful algal blooms in the Australian region. Mar. Pollut. Bull. 25 (5-8), 186–190.
Hansen, G., Daugbjerg, N., Henriksen, P., 2000. Comparative study of *Gymnodinium mikimotoi* and *Gymnodinium aureolum*, comb. Nov. (=*Gyrodinium aureolum*) based on morphology, pigment composition, and molecular data. J. Phycol. 36 (2), 394–410.
Hansen, P.J., 1995. Growth and grazing response of a ciliate feeding on the red tide dinoflagellate *Gyrodinium aureolum* in monoculture and in mixture with a nontoxic alga. Mar. Ecol. Prog. Ser. 121 (1-3), 65–72.
Hartman, S.E., Hartman, M.C., Hydes, D.J., Smythe-Wright, D., Gohin, F., Lazure, P., 2014. The role of hydrographic parameters, measured from a ship of opportunity, in bloom formation of *Karenia mikimotoi* in the English Channel. J. Mar. Syst. 140, 39–49.
Hayakawa, Y., Takeuchi, T., Yamamoto, S., Ichihashi, O., 1996. Simulation of the *Gymnodinium mikimotoi* bloom in Tanabe bay 1990 based on a one-layer box model. Nippon Suisan Gakkai Shi 62 (4), 598–613.
Haywood, A.J., Steidinger, K.A., Truby, E.W., Bergquist, P.R., Bergquist, P.L., Adamson, J., MacKenzie, L., 2004. Comparative morphology and molecular phylogenetic analysis of three new species of the genus *Karenia* (*Dinophyceae*) from New Zealand. J. Phycol. 40 (1), 165–179.
He, D., Liu, J., Hao, Q., Ran, L.H., Zhou, B., Tang, X.X., 2016. Interspecific competition and allelopathic interaction between *Karenia mikimotoi* and *Dunaliella salina* in laboratory culture. Chin. J. Oceanol. Limnol. 34 (2), 301–313.
Hegaret, H., da Silva, P.M., Wikfors, G.H., Haberkorn, H., Shumway, S.E., Soudant, P., 2011. In vitro interactions between several species of harmful algae and haemocytes of bivalve molluscs. Cell Biol. Toxicol. 27 (4), 249–266.
Hegaret, H., da Silva, P.M., Wikfors, G.H., Lambert, C., De Bettignies, T., Shumway, S.E., Soudant, P., 2007. Hemocyte responses of Manila clams, *Ruditapes philippinarum*, with varying parasite, *Perkinsus olseni*, severity to toxic-algal exposures. Aquat. Toxicol. 84 (4), 469–479.
Hegaret, H., Shumway, S.E., Wikfors, G.H., Pate, S., Burkholder, J.M., 2008. Potential transport of harmful algae via relocation of bivalve molluscs. Mar. Ecol. Prog. Ser. 361, 169–179.
Heisler, J., Glibert, P.M., Burkholder, J.M., Anderson, D.M., Cochlan, W., Dennison, W.C., Dortch, Q., Gobler, C.J., Heil, C.A., Humphries, E., Lewitus, A., Magnien, R., Marshall, H.G., Sellner, K., Stockwell, D.A., Stoecker, D.K., Suddleson, M., 2008. Eutrophication and harmful algal blooms: a scientific consensus. Harmful Algae 8 (1), 3–13.
Helm, M.M., Hepper, B.T., Spencer, B.E., Walne, P.R., 1974. Lugworm mortalities and a bloom of *Gyrodinium aureolum* Hulburt in Eastern Irish Sea, autumn 1971. J. Mar. Biol. Assoc. U.K. 54 (4), 857–869.
Hickel, W., Hangmeier, E., Drebes, G., 1971. *Gymnodinium* blooms in the Helgoland Bight (North Sea) during August, 1968. Helgolã¤nder Wiss. Meeresunters. 22, 410–416.
Higo, S., Maung-Saw-Htoo-Thaw, Yamatogi, T., Ishida, N., Hirae, S., Koike, K., 2017. Application of a pulse-amplitude-modulation (PAM) fluorometer reveals its usefulness and robustness in the prediction of *Karenia mikimotoi*blooms: A case study in Sasebo Bay, Nagasaki, Japan. Harmful Algae 61, 63–70.
Hirao, S., Tara, K., Kuwano, K., Tanaka, J., Ishibashi, F., 2012. Algicidal activity of glycerolipids from brown alga *Ishige sinicola* toward red tide microalgae. Biosci. Biotechnol. Biochem. 76 (2), 372–374.
Hirayama, K., 1972. Growth of *Gymnodinium* type-'65, causative organism of red tide in Omura Bay, in medium supplied with bottom mud extract. Bull. Plankton Soc. Jpn 19, 13–21.
Hodgkiss, I.J., 2001. New and dominant species from Sam Xing Wang, Sai Kung during the 1998 massive fish killing red tide in Hong Kong. Harmful Algal Blooms 2000.
Holligan, P.M., 1985. Marine dinoflagellate blooms growth strategies and environmental exploitation. In: Andersen, D.M., White, A.W., Baden, D.G. (Eds.), Third International Conference on Toxic Dinoflagellates. Elsevier, New York. pp. 133–139.
Honjo, T., 2004. *Karenia* (formarly *gymnodinium*) *mikimotoi*. In: Okaichi, T. (Ed.), Red Tides. Terra Scientific Publishing Company, Sansei Jiyugaoku Haimu, pp. 345–356.
Honjo, T., Yamaguchi, M., Nakamura, O., Yamamoto, S., Ouchi, A., Ohwada, K., 1991. A relationship between winter water temperature and the timing of summer *Gymnodinium nagasakiense* red tides in Gokasho Bay. Nippon Suisan Gakkai Shi 57 (9), 1679–1682.
Horstman, D.A., Mcgibbon, S., Pitcher, G.C., Calder, D., Hutchings, L., Williams, P., 1991. Red tides in False Bay, 1959-1989, with particular reference to recent blooms of *Gymnodinium* sp. T Roy Soc S Afr 47, 611–628.
Hu, S.X., Yang, D., Tang, X.X., Zang, Y., Zhou, B., 2017. Ocean acidification on population growth and inter-species competition between *Karenia mikimotoi* and *Dunaliella salina*. Oceanologia Et Limnologia Sinica 48 (4), 777–785.
Huang, B.Q., Ou, L.J., Wang, X.L., Huo, W.Y., Li, R.X., Hong, H.S., Zhu, M.Y., Qi, Y.Z., 2007. Alkaline phosphatase activity of phytoplankton in East China Sea coastal waters with frequent harmful algal bloom occurrences. Aquat. Microb. Ecol. 49 (2), 195–206.
Huang, K.X., Xie, Y.H., 2009. Effects of nitrogen availability on growth of Karenia mikimotoi. Ecology & Environmental Sciences 18 (2), 453–457.
Hulburt, E.M., 1957. The taxonomy of unarmored Dinophyceae of shallow embayments on Cape-cod, Massachusetts. Biol Bull-Us 112 (2), 196–219.
Imai, I., Fujimaru, D., Nishigaki, T., Kurosaki, M., Sugita, H., 2006. Algicidal bacteria isolated from the surface of seaweeds from the coast of Osaka Bay in the Seto Inland Sea, Japan. Afr. J. Mar. Sci. 28 (2), 319–323.
Imai, I., Ishida, Y., Hata, Y., 1993. Killing of marine phytoplankton by a gliding bacterium *Cytophaga* sp, isolated from the coastal sea of Japan. Mar. Biol. 116 (4), 527–532.
Ishimatsu, A., Sameshima, M., Tamura, A., Oda, T., 1996. Histological analysis of the mechanisms of *Chattonella* induced hypoxemia in yellowtail. Fisheries Sci 62 (1), 50–58.
Iwata, Y., Sugahara, I., Kimura, T., Kowa, H., Matsumoto, A., Noritake, K., 2004. Properties of an algicidal bacterium (*Flavobacterium* sp.) against *Karenia mikimotoi* isolated from Ise Bay, Japan. Nippon Suisan Gakkai Shi 70 (4), 537–541.
Jenkinson, I.R., Arzul, G., 2001. Mitigation by cysteine compounds of rheotoxicity, cytotoxicity and fish mortality caused by the dinoflagellates, *gymnodinium mikimotoi* and *G.*Cf. *maguelonnense*. In: Hallegraeff, G.M., Blackburn, S.I., Lewis, R.J. (Eds.), 9th Intrenational Conference of Harmful Algal Blooms International Oceanographic Commission. Paris.
Jenkinson, I.R., Sun, J., 2010. Rheological properties of natural waters with regard to plankton thin layers. A short review. J. Mar. Syst. 83 (3-4), 287–297.
Jeong, J.H., Jin, H.J., Sohn, C.H., Suh, K.H., Hong, Y.K., 2000. Algicidal activity of the seaweed *Corallina pilulifera* against red tide microalgae. J. Appl. Phycol. 12 (1), 37–43.
Ji, X.Q., Han, X.T., Zheng, L., Yang, B.J., Yu, Z.M., Zou, J.Z., 2011. Allelopathic interactions between *Prorocentrum micans* and *Skeletonema costatum* or *Karenia mikimotoi* in laboratory cultures. Chin. J. Oceanol. Limnol. 29 (4), 840–848.
Jimenez, C., Niell, F.X., Figueiras, F.G., Clavero, V., Algarra, P., Buela, J., 1992. Green mass aggregations of *Gyrodinium* cf *aureolum* Hulburt in the Ria of Pontevedra (northwest Spain). J. Plankton Res. 14 (5), 705–720.
Johnsen, G., Sakshaug, E., 1993. Biooptical characteristics and photoadaptive responses in the toxic and bloom-forming dinoflagellates *Gyrodinium aureolum*, *Gymnodinium galatheanum*, and 2 Strains on *Prorocentrum minimum*. J. Phycol. 29 (5), 627–642.
Jones, J.B., Hyatt, A.D., Hine, P.M., Whittington, R.J., Griffin, D.A., Bax, N.J., 1997. Australasian pilchard mortalities. World J Microb Biot 13 (4), 383–392.
Jones, K.J., Ayres, P., Bullock, A.M., Roberts, R.J., Tett, P., 1982. A red tide of *Gyrodinium aurelum* in sea lochs of the firth of Clyde and associated mortality of pond-reared salmon. Journal of Marine Biology Assay 62, 771–782.
Kajiwara, T., Ochi, S., Kodama, K., Matsui, K., Hatanaka, A., Fujimura, T., Ikeda, T., 1992. Cell-destroying sesquiterpenoid from red tide of Gymnodinium nagasakiense. Phytochemistry 31 (3), 783–785.
Kamikawa, R., Yazaki, E., Tahara, M., Sakura, T., Matsuo, E., Nagamune, K., Hashimoto, T., Inagaki, Y., 2018. Fates of evolutionarily distinct, plastid-type glyceraldehyde 3-phosphate dehydrogenase genes in Kareniacean dinoflagellates. J. Eukaryot. Microbiol. 65 (5), 669–678.
Kim, D., Li, W.C., Matsuyama, Y., Cho, K., Yamasaki, Y., Takeshita, S., Yamaguchi, K., Oda, T., 2019. Extremely high level of reactive oxygen species (ROS) production in a newly isolated strain of the dinoflagellate Karenia mikimotoi. Eur. J. Phycol. 1–9.
Kimura, B., Kamizono, M., Etoh, T., Koizumi, Y., Murakami, M., Honjo, T., 1999. Population development of the red tide dinoflagellate *Gymnodinium mikimotoi* in inshore waters of Japan. Plankton Biology and Ecology 46 (1), 37–47.
Kimura, K., Okuda, S., Nakayama, K., Shikata, T., Takahashi, F., Yamaguchi, H., Skamoto, S., Yamaguchi, M., Tomaru, Y., 2015. RNA sequencing revealed numerous polyketide synthase genes in the harmful dinoflagellate Karenia mikimotoi. PLoS One 10 (11), e0142731.
Kite, G.C., Dodge, J.D., 1988. Cell and chloroplast ultrastructure in *Gyrodinium aureolum* and *Gymnodinium galatheanum*. Two marine dinoflagellates containing an unusual carotenoid. Sarsia 73 (2), 131–138.
Klinger, C.M., Paoli, L., Newby, R.J., Wang, M.Y., Carroll, H.D., Leblond, J.D., Howe, C.J., Dacks, J.B., Bowler, C., Cahoon, A.B., Dorrell, R.G., Richardson, E., 2018. Plastid transcript editing across dinoflagellate lineages shows lineage-specific application but conserved trends. Genome Biolology and Evolution 10 (4), 1019–1038.
Koizumi, Y., Uchida, T., Honjo, T., 1996. Diurnal vertical migration of *Gymnodinium mikimotoi* during a red tide in Hoketsu Bay, Japan. J. Plankton Res. 18 (2), 289–294.
Kristiansen, S., Egge, J.K., Farbrot, T., Johnsen, T.M., Lomsland, E.R., Myklestad, S.M., Thingstad, T.F., 1995. Growth and vertical migration of *Gyrodinium aureolum* during a bloom in Norwegian fjords. Ecology of Fjords and Coastal Waters 275–289.
Kuma, K., Matsunaga, K., 1995. Availability of colloidal ferric oxides to coastal marine phytoplankton. Mar. Biol. 122 (1), 1–11.
Kumar, P.S., Kumaraswami, M., Rao, G.D., Ezhilarasan, P., Sivasankar, R., Rao, V.R., Ramu, K., 2018. Influence of nutrient fluxes on phytoplankton community and harmful algal blooms along the coastal waters of southeastern Arabian Sea. Cont. Shelf Res. 161, 20–28.
Kurekin, A.A., Miller, P.I., Van der Woerd, H.J., 2014. Satellite discrimination of *Karenia mikimotoi* and *Phaeocystis* harmful algal blooms in European coastal waters: merged classification of ocean colour data. Harmful Algae 31, 163–176.
Leahy, P., 1980. The effects of a dinoflagellate bloom in 1978 on the invertebrate fauna of the sea-shore in Dunmanus Bay, Co. Cork, Ireland. Journal of Sherkin Island 1, 119–125.
Lecorre, P., Lhelguen, S., Wafar, M., 1993. Nitrogen source for uptake by *Gyrodinium* cf *aureolum* in a tidal front. Limnol. Oceanogr. 38 (2), 446–451.
Lee, C.K., Park, T.G., Park, Y.T., Lim, W.A., 2013. Monitoring and trends in harmful algal blooms and red tides in Korean coastal waters, with emphasis on Cochlodinium polykrikoides. Harmful Algae 30, S3–S14.
Lei, Q.Y., Lu, S.H., 2011. Molecular ecological responses of the dinoflagellate *Karenia*

mikimotoi to phosphate stress. Harmful Algae 12, 39–45.
Lemley, D.A., Adams, J.B., Rishworth, G.M., 2018. Unwinding a tangled web: a fine-scale approach towards understanding the drivers of harmful algal bloom species in a eutrophic south African estuary. Estuaries Coasts 41 (5), 1356–1369.
Lesser, M.P., Shumway, S.E., 1993. Effects of toxic dinoflagellates on clearance rates and survival in juvenile bivalve mollusks. J. Shellfish Res. 12 (2), 377–381.
Li, C.W., Song, S.Q., Liu, Y., Chen, T.T., 2014. Occurrence of *Amoebophrya*spp. infection in planktonic dinoflagellates in Changjiang (Yangtze River) Estuary, China. Harmful Algae 37, 117–124.
Li, J., Glibert, P.M., Zhou, M.J., 2010. Temporal and spatial variability in nitrogen uptake kinetics during harmful dinoflagellate blooms in the East China Sea. Harmful Algae 9 (6), 531–539.
Li, J., Glibert, P.M., Zhou, M.J., Lu, S.H., Lu, D.D., 2009. Relationships between nitrogen and phosphorus forms and ratios and the development of dinoflagellate blooms in the East China Sea. Mar. Ecol. Prog. Ser. 383, 11–26.
Li, X.D., Yan, T., Lin, J.N., Yu, R.C., Zhou, M.J., 2017. Detrimental impacts of the dinoflagellate *Karenia mikimotoi* in Fujian coastal waters on typical marine organisms. Harmful Algae 61, 1–12.
Li, Y.Y., Yu, J.F., Sun, T.L., Liu, C.C., Sun, Y., Wang, Y., 2018. Using the marine rotifer *Brachionus plicatilis* as an endpoint to evaluate whether ROS-dependent hemolytic toxicity is involved in the allelopathy induced by *Karenia mikimotoi*. Toxins 10 (11).
Liang, Y., Liu, C.Q., Tian, C.Y., Sun, M.H., 2013. Effects of nutrient concentrations on community succession in six marine microalga species. Fisheries Sci 32 (11), 627–635.
Liang, Y., Sun, M.H., Liu, C.Q., Tian, C.Y., 2015. Effects of nitrogen sources on the growth and interspecific competition of *Phaeodactylum tricornutum*,*Dunaliella salina* and *Karenia mikinotoi*. Marine Environmental Science 24 (1), 29–35.
Liang, Y.B., 2012. Investigation and Evaluationn of Red Tide in China Ocean. China Ocean Press.
Lin, J., Yan, T., Zhang, Q., Zhou, M., 2015. Impact of several harmful algal bloom (HAB) causing species, on life history characteristics of rotifer *Brachionus plicatilis* Müller. Chin. J. Oceanol. Limnol. 34 (4), 642–653.
Lin, J.N., 2015. The field and experimental research of detrimental effects of HABs in the East China Sea, Institute of Oceanology. Proc. Chin. Acad. Med. Sci. Peking Union Med. Coll.
Lin, J.N., Yan, T., Zhang, Q.C., Wang, Y.F., Liu, Q., Zhou, M.J., 2016. Effects of *Karenia mikimotoi* blooms on antioxidant enzymes in gastropod abalone, *Haliotis discus hannai*. Mar. Sci. 40 (6), 17–22.
Lindahl, O., 1983. On the development of a *Gyrodinium aureolum* occurrence on the Swedish west-coast in 1982. Mar. Biol. 77 (2), 143–150.
Lindahl, O., 1986. Offshore growth of *Gyrodinium aureolum* (Dinophyceae) - the cause of coastal blooms in the Skagerrak area. Sarsia 71 (1), 27–33.
Liu, Q., Yan, T., Yu, R.C., Zhang, Q.C., Zhou, M.J., 2018. Interactions between selected microalgae and microscopic propagules of Ulva prolifera. J. Mar. Biol. Assoc. U.K. 98 (7), 1571–1580.
Liu, T., Shi, Z., Li, H., Liu, J., Yang, W., 2012. Cytotoxicity of *Karenia mikimotoi* extracts. Journal of hygiene research 41 (3), 405–409.
Long, M.A., Wang, P.G., Zhu, B.H., Pan, K.H., 2013. Inter-specific competition of *Karenia mikimotoi* and Platymonas subcordiformis under different level of nutrients. Marine Environmental Science.
Lou, X.L., Huang, W.G., Mao, X.M., Shi, A.Q., Zhang, H.G., Chen, P., 2006. Satellite observation of a red tide in the East China Sea during 2005. P Soc Photo-Opt Ins 6406 M4061-M4061.
Lu, S.H., Hodgkiss, I.J., 2004. Harmful algal bloom causative collected from Hong Kong waters. Hydrobiologia 512 (1-3), 231–238.
Lu, X., Zhou, B., Xu, L., Liu, L., Wang, G., Liu, X., Tang, X., 2016. A marine algicidal *Thalassospira* and its active substance against the harmful algal bloom species *Karenia mikimotoi*. Appl. Microbiol. Biotechnol. 100 (11), 5131–5139.
Lv, S.H., Huang, K.X., 2007. The growth of *Karenia mikimotoi* Hansen in three different types of inorganic nitrogen sources. Ecology & Environment 16 (5), 1337–1341.
Ma, Z., Wu, M., Lin, L., Thring, R.W., Yu, H., Zhang, X., Zhao, M., 2017. Allelopathic interactions between the macroalga *Hizikia fusiformis* (Harvey) and the harmful blooms-forming dinoflagellate *Karenia mikimotoi*. Harmful Algae 65, 19–26.
Madhu, N.V., Reny, P.D., Paul, M., Ullas, N., Resmi, P., 2011. Occurrence of red tide caused by *Karenia mikimotoi* (toxic dinoflagellate) in the southwest coast of India. Indian J Geo-Mar Sci 40 (6), 821–825.
Mahoney, J.B., Olsen, P., Cohn, M., 1990. Blooms of a dinoflagellate *Gyrodinium* cf *aureolum* in New-Jersey coastal waters and their occurrence and effects worldwide. J Coastal Res 6 (1), 121–135.
Marshall, H.G., 1980. Seasonal phytoplankton composition in the lower Chesapeake Bay and old plantation Creek, Cape Charles, Virginia. Estuaries 3 (3), 207–216.
Marshall, J.-A., de Salas, M., Oda, T., Hallegraeff, G., 2005a. Superoxide production by marine microalgae I. Survey of 37 species from 6 classes. Marine Biolology 147 (2), 533–540.
Marshall, J.A., Nichols, P.D., Hamilton, B., Lewis, R.J., Hallegraeff, G.M., 2003. Ichthyotoxicity of *Chattonella marina* (Raphidophyceae) to damselfish (*Acanthochromis polycanthus*): the synergistic role of reactive oxygen species and free fatty acids. Harmful Algae 2 (4), 273–281.
Marshall, J.A., Ross, T., Pyecroft, S., Hallegraeff, G., 2005b. Superoxide production by marine microalgae II. Towards understanding ecological consequences and possible functions. Mar. Biol. 147 (2), 541–549.
Matsuyama, Y., Uchida, T., Honjo, T., 1999. Effects of harmful dinoflagellates, *Gymnodinium mikimotoi* and *Heterocapsa circularisquama*, red tide on filtering rate of bivalve molluscs. Fisheries Sci 65 (2), 248–253.
Mitchell, S., Rodger, H., 2007. Pathology of wild and cultured fish affected by a *Karenia mikimotoi* bloom in Ireland, 2005. Bull. Eur. Assoc. Fish Pathol. 27 (1), 39–42.
Mochizuki, M., Takenaga, F., Itoh, S., Tsuyuki, H., 1999. Lipid and fatty acid compositions of marine phytoplanktons. J. Jpn. Soc. Food Sci. 46 (1), 29–33.
Mooney, B.D., De Salas, M., Hallegraeff, G.M., Place, A.R., 2009. Survey for karlotoxin production in 15 species of gymnodinioid dinoflagellates (Kareniaceae, Dinophyta). J. Phycol. 45 (1), 164–175.
Mooney, B.D., Nichols, P.D., de Salas, M.F., Hallegraeff, G.M., 2007. Lipid, fatty acid, and sterol composition of eight species of *Kareniaceae* (Dinophyta): chemotaxonomy and putative lipid phycotoxins. J. Phycol. 43 (1), 101–111.
Morrison, J.A., Gamble, J.C., Napier, I.R., 1991. Mass mortality of herring eggs associated with a sedimenting diatom bloom. ICES J. Mar. Sci. 48 (2), 237–245.
Munir, S., Siddiqui, P.J.A., Naz, T., Burhan, Z.U., Morton, S.L., 2015. Growth rates of dinoflagellates along the Karachi coast assessed by the size fractionation method. Oceanol Hydrobiol. St 44 (3), 326–334.
Nagayama, K., Shibata, T., Fujimoto, K., Honjo, T., Nakamura, T., 2003. Algicidal effect of phlorotannins from the brown alga Ecklonia kurome on red tide microalgae. Aquaculture 218 (1-4), 601–611.
Naito, K., Imai, I., Nakahara, H., 2008. Complexation of iron by microbial siderophores and effects of iron chelates on the growth of marine microalgae causing red tides. Phycol. Res. 56 (1), 58–67.
Naito, K., Matsui, M., Imai, I., 2005. Ability of marine eukaryotic red tide microalgae to utilize insoluble iron. Harmful Algae 4 (6), 1021–1032.
Nakamura, Y., Suzuki, S., Hiromi, J., 1996. Development and collapse of a *Gymnodinium mikimotoi* red tide in the Seto Inland Sea. Aquat. Microb. Ecol. 10 (2), 131–137.
Nakamura, Y., Suzuki, S.Y., Hiromi, J., 1995. Population dynamics of heterotrophic dinoflagellates during a *Gymnodinium mikimotoi* red tide in the Seto Inland Sea. Mar. Ecol. Prog. Ser. 125 (1-3), 269–277.
Neely, T., Campbell, L., 2006. A modified assay to determine hemolytic toxin variability among *Karenia* clones isolated from the Gulf of Mexico. Harmful Algae 5 (5), 592–598.
Neely, T.E., 2006. Differences in Growth and Toxicity of Karenia. Texas A&M University.
Negri, R.M., Carreto, J.I., Benavides, H.R., Akselman, R., Lutz, V.A., 1992. An unusual bloom of *Gyrodinium* cf. *Aureolum* in the Argentine sea: community structure and conditioning factors. J. Plankton Res. 14 (2), 261–269.
Nielsen, G., Kaas, H., Ravn, H., 1993. Vertical migration of *Gyrodinium aureolum* in an artificial water column. Dev. Mar. Bio. 3, 789–794.
Nielsen, M.V., Stromgren, T., 1991. Shell growth-response of mussels (*Mytilus edulis*) exposed to toxic microalgae. Mar. Biol. 108 (2), 263–267.
Nielsen, M.V., Tonseth, C.P., 1991. Temperature and salinity effect on growth and chemical composition of *Gyrodinium aureolum* Hulburt in culture. J. Plankton Res. 13 (2), 389–398.
Nielsen, T., Bjorn, L.O., Ekelund, N.G.A., 1995. Impact of natural and artificial UVB radiation on motility and growth rate of marine dinoflagellates. J. Photochem. Photobiol. B, Biol. 27 (1), 73–79.
Nielsen, T., Ekelund, N.G.A., 1993. Effect of UV-B radiation and humic substances on growth and motility of Gyrodinium aureolum. Limnol. Oceanogr. 38 (7), 1570–1575.
Nishiguchi, T., Cho, K., Yasutomi, M., Ueno, M., Yamaguchi, K., Basti, L., Yamasaki, Y., Takeshita, S., Kim, D., Oda, T., 2016. Intracellular haemolytic agents of *Heterocapsa circularisquama* exhibit toxic effects on *H. Circularisquama* cells themselves and suppress both cell-mediated haemolytic activity and toxicity to rotifers (*Brachionus plicatilis*). Aquat. Toxicol. 179, 95–102.
Nishiyama, K., Kawaguchi, M., Yoshida, Y., Noguchi, K., Terada, M., Aketagawa, T., Eguchi, T., 2013. A red tide of *Karenia mikimotoi* in the Saga imari Bay in summer, 2012. Bulletin of Saga Prefectural Genkai Fisheries Research and Development Center 6, 31–62.
O'Boyle, S., McDermott, G., Silke, J., Cusack, C., 2016. Potential impact of an exceptional bloom of *Karenia mikimotoi* on dissolved oxygen levels in waters off western Ireland. Harmful Algae 53, 77–85.
Oda, M., 1935. *Gymnodinium mikimotoi*Miyake et Kominami n. sp. (MS.) no akashiwo to ryusando no koka. (The red tide of*Gymnodinium mikimotoi* Miyake et Kominami n. sp. (MS) and the influence of copper sulfate on the red tide). Doubutsugaku Zasshi (Zoology magazine) 47, 35–48.
Oda, T., Ishimatsu, A., Shimada, M., Takeshita, S., Muramatsu, T., 1992. Oxygen radical mediated toxic effects of the red tide flagellate *Chattonella marina* on Vibrio alginolyticus. Mar. Biol. 112 (3), 505–509.
Oda, T., Sato, Y., Kim, D., Muramatsu, T., Matsuyama, Y., Honjo, T., 2001. Hemolytic activity of *Heterocapsa circularisquama* (Dinophyceae) and its possible involvement in shellfish toxicity. J. Phycol. 37 (4), 509–516.
Ohkubo, N., Tomaru, Y., Yamaguchi, H., Kitatsuji, S., Mochida, K., 2017. Development of a method to assess the ichthyotoxicity of the harmful marine microalgae *Karenia* spp. Using gill cell cultures from red sea bream (*Pagrus major*). Fish Physiol. Biochem. 43 (6), 1603–1612.
Onji, M., Nakano, S., Suzuki, S., 2003. Virus-like particles suppress growth of the red-tide-forming marine dinoflagellate Gymnodinium mikimotoi. Mar Biotechnol (NY) 5 (5), 435–442.
Ottway, B., 1979. Observations on a bloom of *Gyrodinium aureolum* Hulburt on the south coast of Ireland, summer 1976, associated with mortalities of littoral and sub-littoral organisms. Ir. Fish. Invest. Ser. B. 18, 3–9.
Ou, X.Y., 2006. Histopathological Effect of *Karenia Mikimotoi* Bloom on Gills of Common Farmed Fishes in the East China Sea. Ji Nan University.
Ouchi, A., Aida, S., Uchida, T., Honjo, T., 1994. Sexual reproduction of a red tide dinoflagellate Gymnodinium mikimotoi. Fisheries Sci 60 (1), 125–126.
Paasche, E., Bryceson, I., Tangen, K., 1984. Interspecific variation in dark nitrogen uptake by Dinoflagellates. J. Phycol. 20 (3), 394–401.
Palenik, B., Zafiriou, O.C., Morel, F.M.M., 1987. Hydrogen peroxide production by a marine phytoplankter. Limnol. Oceanogr. 32 (6), 1365–1369.
Pang, Y., Nie, R., Lv, S.H., 2016. Effects of the different kinds of phosphorus sources on

growth and alkaline phosphatase activity (APA) of *Karenia mikimotoi* Hansen. Marine Sciences 40 (4), 59–64.
Park, J., Jeong, H.J., Du Yoo, Y., Yoon, E.Y., 2013. Mixotrophic dinoflagellate red tides in Korean waters: distribution and ecophysiology. Harmful Algae 30, S28–S40.
Park, J.H., Yoshinaga, I., Nishikawa, T., Imai, I., 2010. Algicidal bacteria in particle-associated form and in free-living form during a diatom bloom in the Seto Inland Sea, Japan. Aquat. Microb. Ecol. 60 (2), 151–161.
Park, J.K., 2013. Purification and characterisation of a novel alkalophilic alpha-D-mannosidase from Pseudomonas fluorescens. Biocontrol Sci Techn 23 (11), 1324–1335.
Parrish, C.C., Bodennec, G., Gentien, P., 1994. Time courses of intracellular and extracellular lipid classes in batch cultures of the toxic dinoflagellate, *Gymnodinium* cf. *Nagasakiense*. Mar. Chem. 48 (1), 71–82.
Parrish, C.C., Bodennec, G., Gentien, P., 1998. Haemolytic Glycoglycerolipids From *Gymnodinium* species. Phytochemistry 47 (5), 783–787.
Parrish, C.C., Bodennec, G., Sebedio, J.L., Gentien, P., 1993. Intracellular and extracellular lipids in cultures of the toxic dinoflagellate, Gyrodinium aureolum. Phytochemistry 32 (2), 291–295.
Partensky, F., Leboterff, J., Verbist, J.F., 1989. Does the fish killing dinoflagellate *Gymnodinium* cf. *Nagasakiense* produce cytotoxins. J. Mar. Biol. Assoc. U.K. 69 (3), 501–509.
Partensky, F., Vaulot, D., 1989. Cell size differentiation in the bloom-forming dinoflagellate *Gymnodinium* cf. *Nagasakiense*. J. Phycol. 25 (4), 741–750.
Pingree, R.D., Pugh, P.R., Holligan, P.M., Forster, G.R., 1975. Summer phytoplankton blooms and red tides along tidal fronts in the approaches to the English Channel. Nature 258 (5537), 672–677.
Pitcher, G., Cembella, A., Glibert, P., Research., I.C.o.S.U.S.C.o.O, Commission., I.O, 2003. Global Ecology and Oceanography of Harmful Algal Blooms: Implementation Plan; an International Programme Sponsored by the Scientific Committee on Oceanic Research (Scor) and the Intergovernmental Oceanographic Commission (Unesco) Scientific Committee on Oceanic Research; Intergovernmental Oceanographic Commission Baltimore, MD Paris.
Pitcher, G.C., Calder, D., 2000. Harmful algal blooms of the southern Benguela Current: a review and appraisal of monitoring from 1989 to 1997. S Afr J Marine Sci 22, 255–271.
Potts, G.W., Edwards, J.M., 1987. The impact of a *Gyrodinium aureolum* bloom on inshore young fish populations. J. Mar. Biol. Assoc. U.K. 67 (2), 293–297.
Prtensky, F., Vaulot, D., Couté, A., Sournia, A., 1988. Morphological and nuclear analysis of the bloom-forming dinoflagellates *Gyrodinium* cf. *Aureolum* and *Gymnodinium nagasakiense*. J. Phycol. 24 (3), 408–415.
Pybus, C., 1980. Observations on a *Gyrodinium aureolum* (Dinophyta) bloom off the south coast of Ireland. J. Mar. Biol. Assoc. U.K. 60 (3), 661–674.
Qi, Y.Z., Chen, J.F., Wang, Z.H., Xu, N., Wang, Y., Shen, P.P., Lu, S.H., Hodgkiss, I.J., 2004. Some observations on harmful algal bloom (HAB) events along the coast of Guangdong, southern China in 1998. Hydrobiologia 512 (1-3), 209–214.
Raine, R., Joyce, B., Richard, J., Pazos, Y., Moloney, M., Jones, K.J., Patching, J.W., 1993. The development of a bloom of the dinoflagellate [*Gyrodinium aureolum* (Hulbert)] on the south-west Irish coast. ICES J. Mar. Sci. 50 (4), 461–469.
Raine, R., O'Boyle, S., O'Higgins, T., White, M., Patching, J., Cahill, B., McMahon, T., 2001. A satellite and field portrait of a *Karenia mikimotoi* bloom off the south coast of Ireland, August 1998. Hydrobiologia 465 (1-3), 187–193.
Reddy-Lopata, K., Auerswald, L., Cook, P., 2006. Ammonia toxicity and its effect on the growth of the South African abalone Haliotis midae Linnaeus. Aquaculture 261 (2), 678–687.
Richardson, B., Corcoran, A.A., 2015. Use of dissolved inorganic and organic phosphorus by axenic and nonaxenic clones of *Karenia brevis* and *Karenia mikimotoi*. Harmful Algae 48, 30–36.
Riegman, R., deBoer, M., Domis, L.D., 1996. Growth of harmful marine algae in multispecies cultures. J. Plankton Res. 18 (10), 1851–1866.
Roberts, R.J., Bullock, A.M., Turner, M., Jones, K., Tett, P., 1983. Mortalities of *Salmo gairdneri* exposed to cultures of *Gyrodinium aureolum*. J. Mar. Biol. Assoc. U.K. 63 (4), 741–743.
Roden, C.M., Lennon, H.J., Mooney, E., Leahy, P., Lart, W., 1981. Red tides, water stratification and phytoplankton species succession around Sherkin Island, south west Ireland, in 1979. Journal of Sherkin Island 1 (2), 50.
Rodriguez, F., Fernandez, E., Head, R.N., Harbour, D.S., Bratbak, G., Heldal, M., Harris, R.P., 2000. Temporal variability of viruses, bacteria, phytoplankton and zooplankton in the western English Channel off Plymouth. J. Mar. Biol. Assoc. U.K. 80 (4), 575–586.
Saldarriaga, J.F., Taylor, F.J., Keeling, P.J., Cavalier-Smith, T., 2001. Dinoflagellate nuclear SSU rRNA phylogeny suggests multiple plastid losses and replacements. J. Mol. Evol. 53 (3), 204–213.
Sandric Leong, S.C.Y., Lim, L.P., Chew, S.M., Jerome Kok, J.W.K., Teo, S.L.M., 2015. Three new records of dinoflagellates in Singapore's coastal waters, with observations on environmental conditions associated with microalgal growth in the Johor Straits. Raffles B Zool 24–36.
Sasaki, M., Tsukano, C., Tachibana, K., 2002. Studies toward the total synthesis of gymnocin A, a cytotoxic polyether: a highly convergent entry to the F-N ring fragment. Org. Lett. 4 (10), 1747–1750.
Satake, M., Shoji, M., Oshima, Y., Naoki, H., Fujita, T., Yasumoto, T., 2002. Gymnocin-A, a cytotoxic polyether from the notorious red tide dinoflagellate, Gymnodinium mikimotoi. Tetrahedron Lett. 43 (33), 5829–5832.
Satake, M., Tanaka, Y., Ishikura, Y., Oshima, Y., Naoki, H., Yasumoto, T., 2005. Gymnocin-B with the largest contiguous polyether rings from the red tide dinotlagellate, *Karenia* (formerly *Gymnodinium*) *mikimotoi*. Tetrahedron Lett. 46 (20), 3537–3540.
Schultz, M., Kiorboe, T., 2009. Active prey selection in two pelagic copepods feeding on potentially toxic and non-toxic dinoflagellates. J. Plankton Res. 31 (5), 553–561.
Seki, T., Satake, M., Mackenzie, L., Kaspar, H.F., Yasumoto, T., 1995. Gymnodimine, a new marine toxin of unprecedented structure isolated from New Zealand oysters and the dinoflagellate, *Gymnodinium* sp. Tetrahedron Lett. 36 (39), 7093–7096.
Sellem, F., Pesando, D., Bodennec, G., El Abed, A., Girard, J.P., 2000. Toxic effects of *Gymnodinium* cf. *Mikimotoi* unsaturated fatty acids to gametes and embryos of the sea urchin *Paracentrotus lividus*. Water Res. 34 (2), 550–556.
Shen, A., Ma, Z., Jiang, K., Li, D., 2016. Effects of temperature on growth, photophysiology, Rubisco gene expression in *Prorocentrum donghaiense* and *Karenia mikimotoi*. Ocean Sci. J. 51 (4), 581–589.
Shen, A.L., Li, D.J., 2016. Effects of different nutrients levels on the growth of *Prorocentrum donghaiense* and *Karenia mikimotoi*. Marine Fisheries 38 (4), 415–423.
Shen, A.L., Xing, X.L., Li, D.J., 2015. Allelopathic effects of *Prorocentrum donghaiense* and *Karenia mikimotoi* on each other under different temperature. Thalassas 31 (1), 33–49.
Shen, A.L., Yuan, X.W., Liu, G.P., Li, D.J., 2014. Growth interactions between the bloom-forming dinoflagellates *Prorocentrum donghaiense* and *Karenia mikimotoi* under different temperature. Thalassas 30 (2), 33–45.
Shi, F., McNabb, P., Rhodes, L., Holland, P., Webb, S., Adamson, J., Immers, A., Gooneratne, R., Holland, J., 2012. The toxic effects of three dinoflagellate species from the genus *Karenia* on invertebrate larvae and finfish. N. Z. J. Mar. Freshwater Res. 46 (2), 149–165.
Shi, Z., Liu, J., Hongye, L.I., Cui, W., 2011. Effects of some membrane lipids on the hemolysis induced by hemolytic toxin from Karenia mikimotoi. Journal of Hygiene Research 40 (3), 308–311.
Shikata, T., Matsunaga, S., Nishide, H., Sakamoto, S., Onistuka, G., Yamaguchi, M., 2015. Diurnal vertical migration rhythms and their photoresponse in four phytoflagellates causing harmful algal blooms. Limnol. Oceanogr. 60 (4), 1251–1264.
Shikata, T., Onitsuka, G., Abe, K., Kitatsuji, S., Yufu, K., Yoshikawa, Y., Honjo, T., Miyamura, K., 2017. Relationships between light environment and subsurface accumulation during the daytime in the red-tide dinoflagellate Karenia mikimotoi. Mar. Biol. 164 (1).
Shikata, T., Sakamoto, S., Onitsuka, G., Aoki, K., Yamaguichi, M., 2014. Effects of salinity on diel vertical migration behavior in two red-tide algae. *Chattonella antiqua* and *Karenia mikimotoi* Plankton and Benthos Research 9 (1), 42–50.
Shikata, T., Takahashi, F., Nishide, H., Shigenobu, S., Kamei, Y., Sakamoto, S., Yuasa, K., Nishiyama, Y., Yamasaki, Y., Uchiyama, I., 2019. RNA-Seq analysis reveals genes related to photoreception, nutrient uptake, and toxicity in a noxious red-tide raphidophyte Chattonella antiqua. Fronties in Microbiolology 10 (1764), 1764.
Shimada, H., Kanamori, M., Yoshida, H., Imai, I., 2016. First record of red tide due to the harmful dinoflagellate *Karenia mikimotoi* in Hakodate Bay, southern Hokkaido, in autumn 2015. Nippon Suisan Gakkai Shi 82 (6), 934–938.
Shutler, J.D., Warren, M.A., Miller, P.I., Barciela, R., Mahdon, R., Land, P.E., Edwards, K., Wither, A., Jonas, P., Murdoch, N., Roast, S.D., Clements, O., Kurekin, A., 2015. Operational monitoring and forecasting of bathing water quality through exploiting satellite Earth observation and models: the AlgaRisk demonstration service. Comput Geosci-Uk 77, 87–96.
Silke, J., F., O.B, Cronin, M., 2005. *Karenia Mikimotoi*: an Exceptional Dinoflagellate Bloom in Western Irish Waters, Summer 2005.
Silva, E.S., Faust, M.A., 1995. Small cells in the life history of dinoflagellates (Dinophyceae) - a review. Phycologia 34 (5), 396–408.
Siswanto, E., Ishizaka, J., Tripathy, S.C., Miyamura, K., 2013. Detection of harmful algal blooms of *Karenia mikimotoi* using MODIS measurements: A case study of Seto-Inland Sea, Japan. Remote Sens. Environ. 129, 185–196.
Smayda, T.J., Reynolds, C.S., 2001. Community assembly in marine phytoplankton: application of recent models to harmful dinoflagellate blooms. J. Plankton Res. 23 (5), 447–461.
Smolowitz, R., Shumway, S.E., 1997. Possible cytotoxic effects of the dinoflagellate, *Gyrodinium aureolum*, on juvenile *Bivalve molluscs*. Aquac. Int. 5 (4), 291–300.
Smyth, M.J., Cretney, E., Kelly, J.M., Westwood, J.A., Street, S.E.A., Yagita, H., Takeda, K., van Dommelen, S.L.H., Degli-Espostic, M.A., Hayakawa, Y., 2005. Activation of NK cell cytotoxicity. Mol. Immunol. 42 (4), 501–510.
SOAC, 1990. In: China, S.O.A.o (Ed.), Report of Marine Environment Quality in 1989.
SOAC, 2015. In: China, S.O.A.o (Ed.), Report of Marine Environment Quality in 2014.
SOAC, 2016. In: China, S.O.A.o (Ed.), Report of Marine Environment Quality in 2015.
Sola, F., Masoni, A., Fossat, B., Porthe-Nibelle, J., Gentien, P., Bodennec, G., 1999. Toxicity of fatty acid 18:5n3 from *Gymnodinium cf. mikimotoi*: I. Morphological and biochemical aspects on *Dicentrarchus labrax* gills and intestine. J. Appl. Toxicol. 19 (4), 279–284.
Song, J.J., 2014. Research of the mechanisms of HABs in the East China Sea affecting material energy utilization of zooplankton and mussel, Institute of Oceanology. Proc. Chin. Acad. Med. Sci. Peking Union Med. Coll.
Sophie, 2001. Modelling of Gymnodinium mikimotoï Blooms along the French Atlantic Coast: Geographical and Vertical Distributions.
Sournia, A., 1995. Red tide and toxic marine phytoplankton of the world ocean: an inquiry into biodiversity. Harmful Marine Alagal Blooms 103–112.
Southgate, T., Wilson, K., Cross, T.F., Myers, A.A., 1984. Recolonization of a rocky shore in S. W. Ireland following a toxic bloom of the dinoflagellate, Gyrodinium aureolum. J. Mar. Biol. Assoc. U.K. 64 (2) 485-&.
Sun, K., Yan, T., Zhou, M.J., Ho, K.C., 2010. Effect of *Karenia mikimotoi* on the survival of rotifer *Brachionus plicatilis*, brine shrimp *Artemia salina*, and *Neomysis awatschensis*. Mar. Sci. 34 (9), 76–81.
Takayama, H., Adachi, R., 1984. *Gymnodinium nagasakiens*e sp.nov., a red-tide forming dinophyte in the adjacent waters of Japan. Bulletin of Plankton Society of Japan 31.
Takayama, H., Matsuoka, K., 1991. A reassessment of the specific characters of *Gymnodinium mikimotoi* Miyake et KominamI ex Oda and *Gymnodinium nagasakiense*

Takayama et Adachi. Bulletin of Plankton Society of Japan 38 (1), 53–68.
Takeuchi, T., Kokubo, T., Tsuji, Y., Honjo, T., 1995. Growth of *Gymnodinium mikimotoi* population in tanabe bay and change of distribution pattern of red tide by current. Nippon Suisan Gakkai Shi 61 (4), 494–498.
Tanaka, Y., Satake, M., Yotsu-Yamashita, M., Oshima, Y., 2013. Gymnocin-a carboxylic acid and gymnocin-a2, cytotoxic polyethers from the red tide dinoflagellate Karenia mikimotoi. Heterocycles 87 (10), 2037–2046.
Tang, J.Y., Wong, C.K., Au, D.W., 2007. The ichthyotoxic alga *Chattonella marina* induces Na^+, K^+ -ATPase, and CFTR proteins expression in fish gill chloride cells in vivo. Biochem. Biophys. Res. Commun. 353 (1), 98–103.
Tang, J.Y.M., Anderson, D.M., Au, D.W.T., 2005. Hydrogen peroxide is not the cause of fish kills associated with *Chattonella marina*: cytological and physiological evidence. Aquat. Toxicol. 72 (4), 351–360.
Tangen, K., 1977. Blooms of *Gyrodinium aureolum* (Dinophyceae) in north European waters, accompanied by mortality in marine organisms. Sarsia 63 (2), 123–133.
Tangen, K., BjÖrnland, T., 1981. Observations on pigments and morphology of *Gyrodinium aureolum* Hulburt, a marine dinoflagellate containing 19′ -hexanoyloxyfucoxanthin as the main carotenoid. J. Plankton Res. 3 (3), 389–401.
Taylor, J.D., Berzano, M., Percy, L., Lewis, J., 2013. Evaluation of the MIDTAL microarray chip for monitoring toxic microalgae in the Orkney Islands, U.K. Environ. Sci. Pollut. Res. Int. 20 (10), 6765–6777.
Tsukano, C., Sasaki, M., 2006. Total synthesis and structure-activity relationship of a cytotoxic polycyclic ether gymnocin-A. J. Syn. Org. Chem. Jpn. 64 (8), 808–818.
Uchida, T., Toda, S., Matsuyama, Y., Yamaguchi, M., Kotani, Y., Honjo, T., 1999. Interactions between the red tide dinoflagellates *Heterocapsa circularisquama* and *Gymnodinium mikimotoi* in laboratory culture. J. Exp. Mar. Biol. Ecol. 241 (2), 285–299.
Vanhoutte-Brunier, A., Fernand, L., Menesguen, A., Lyons, S., Gohin, F., Cugier, P., 2008. Modelling the *Karenia mikimotoi* bloom that occurred in the western English Channel during summer 2003. Ecol Model 210 (4), 351–376.
Wang, A.J., Wang, X.L., Han, X.R., Yan-Bin, L.I., Zhu, C.J., 2008. Effects of solar radiation on the growth and succession of harmful algae in the East China Sea in spring. Marine Environmental Science 27 (2), 144–148.
Wang, C., Lin, X., Li, L., Lin, S., 2016. Differential growth responses of marine phytoplankton to Herbicide glyphosate. PLoS One 11 (3), e0151633.
Wang, D., Xie, L.L., Zhu, X.B., Bi, X., Zheng, Y.Z., Zhu, Y.K., 2018. Study on the metabolites of DH-e, a Halomonas marine bacterium, against three toxic dinoflagellate species. Water Sci. Technol. 78 (7), 1535–1544.
Wang, H., Hu, Z.X., Tang, Y.Z., 2017. Preliminary investigation on the allelopathic effects of four common harmful algal bloom (HAB)-forming dinoflagellates on Akashiwo sanguinea. Mar. Sci. 41 (9), 94–101.
Wang, H.B., Cheng, M., Yang, Y.Y., Shi-Hu, L.I., Yan, B.L., 2012. The responses of algae pavlova viridis and *Karenia mikimotoi* to three conventional antibiotics stress. Fisheries Sci 31 (6), 329–332.
Wang, X.J., Feng, X.Q., Zhuang, Y., Lu, J.H., Wang, Y., Goncalves, R.J., Li, X., Lou, Y.L., Guan, W.C., 2019a. Effects of ocean acidification and solar ultraviolet radiation on physiology and toxicity of dinoflagellate Karenia mikimotoi. Harmful Algae 81, 1–9.
Wang, X.J., Niu, X.Q., Chen, Y.J., Sun, Z.W., Han, A.X., Lou, X.Y., Ge, J.K., Li, X.W., Yang, Y.Q., Jian, J.B., Gonçalves, R.J., Guan, W.C., 2019b. Transcriptome sequencing of a toxic dinoflagellate, *Karenia mikimotoi* subjected to stress from solar ultraviolet radiation. Harmful Algae 88, 101640.
Wang, Z.H., Yin, Y.W., Qi, Y.Z., Xie, L.C., Jiang, T.J., 2001. Histopathological changes in fish gills during *Gymnodinium mikimotoi* red tide in Guishan Island area, the South China Sea. Acta Oceanolog. Sin. 23 (1), 133–138.
Wen, S.Y., Liu, X.Z., Wang, Z.Z., Yu, J., Zhang, F.S., Liu, Y.J., Song, L.L., 2018. Temperature-ecological amplitude of *Karenia mikimotoi* and *Prorocentrum donghaiense* at different light intensities in laboratory culture. Acta Ecol. Sin. 38 (14), 268–275.
Whittington, R.J., Jones, J.B., Hine, P.M., Hyatt, A.D., 1997. Epizootic mortality in the pilchard *Sardinops sagax neopilchardus* in Australia and New Zealand in 1995 .1. Pathology and epizootiology. Dis Aquat Organ 28 (1), 1–16.
Widdows, J., Moore, M.N., Lowe, D.M., Salkeld, P.N., 1979. Some effects of a dinoflagellate bloom (*Gyrodinium aureolum*) on the mussel, *Mytilus edulis*. J. Mar. Biol. Assoc. U.K. 59 (2), 522–524.
Xu, J.Y., Kiorboe, T., 2018. Toxic dinoflagellates produce true grazer deterrents. Ecology 99 (10), 2240–2249.
Xu, N., Liu, J.Y., Lai, H.Y., Hu, Z.X., Duan, S.S., 2013. Uptake and utilization characteristics of *Prorocentrum donghaiense*, *Phaeocystis globosa*, *Karenia mikimotoi* and *Skeletonema costatum* for dissolved free amino acids. Acta Scientiae Circumstantiae 33 (4), 1058–1065.
Yamaguchi, H., Nishijima, T., Nishitani, H., Fukami, K., Adach, M., 2004. Organic phosphorus utilization and alkaline phosphatase production of 3 red tide phytoplankton. Nippon Suisan Gakkai Shi 70 (2), 123–130.
Yamaguchi, M., 1992. DNA-synthesis and the cell cycle in the noxious red-tide dinoflagellate Gymnodinium nagasakiense. Mar. Biol. 112 (2), 191–198.
Yamaguchi, M., Honjo, T., 1989. Effects of temperature, salinity and irradiance on the growth of the noxious red tide Flagellate *Gymnodinium nagasakiense* (Dinophyceae). Nippon Suisan Gakkai Shi 55 (11), 2029–2036.
Yamasaki, Y., Kim, D.I., Matsuyama, Y., Oda, T., Honjo, T., 2004. Production of superoxide anion and hydrogen peroxide by the red tide dinoflagellate Karenia mikimotoi. J. Biosci. Bioeng. 97 (3), 212–215.
Yamatogi, T., Ishida, N., Hirae, S., Sugihara, Y., Kamada, M., Nishiyama, K., Aoki, K., 2016. Environmental features and mass mortality of cultured fish during *Karenia mikimotoi* bloom in the Imari Bay. Japan. Jpn. J. Phycol. 64, 94–101.
Yanagi, T., Yamamoto, T., Koizumi, Y., Ikeda, T., Kamizono, M., Tamori, H., 1995. A numerical simulation of red tide formation. J. Mar. Syst. 6 (3), 269–285.
Yang, Q.L., Cai, L.H., Gao, Y.H., Su, Z., Chen, C.P., Li, B.Q., Xu, C.Y., Lin, G.M., Zheng, H.D., Xiang, P., 2009. Study on distributional characteristics of organisms in ballast water of exotic ships entering major ports of Fujian and its potential invasion threat. Transact ions of Oceanolo gy and Limnolog y 4, 25–38.
Yang, Q.L., Cai, L.H., Gao, Y.H., Zhan, S.U., Chen, C.P., Lin, G.M., Huang, M.Z., Bing-Qian, L.I., Xiang, P., Cui-Ya, X.U., 2011a. Plankton found in ballast waters of foreign ships harboring in ports of Southeast China. Marine Sciences.
Yang, W.D., Zhang, N.S., Cui, W.M., Xu, Y.Y., Li, H.Y., Liu, J.S., 2011b. Effects of co-existing microalgae and grazers on the production of hemolytic toxins in Karenia mikimotoi. Chin. J. Oceanol. Limnol. 29 (6), 1155–1163.
Yasumoto, T., Underdal, B., Aune, T., Hormazabal, V., Skulberg, O.M., Oshima, Y., 1990. Screening for hemolytic and ichthyotoxic components of *Chrysochromulina polylepis* and *Gyrodinium aureolum* from Norwegian coastal waters. Toxic marine phytoplankton 436–440.
Yoshinaga, I., Kawai, T., Ishida, Y., 1997. Analysis of algicidal ranges of the bacteria killing the marine dinoflagellate *Gymnodinium mikimotoi* isolated from Tanabe Bay, Wakayama Pref, Japan. Fisheries Sci 63 (1), 94–98.
Young, J.S., 1973. A marine kill in New Jersey coastal waters. Mar. Pollut. Bull. 4 (5), 70.
Yuasa, K., Shikata, T., Kuwahara, Y., Nishiyama, Y., 2018. Adverse effects of strong light and nitrogen deficiency on cell viability, photosynthesis, and motility of the red-tide dinoflagellate Karenia mikimotoi. Phycologia 57 (5), 525–533.
Zapata, M., Fraga, S., Rodriguez, F., Garrido, J.L., 2012. Pigment-based chloroplast types in dinoflagellates. Mar. Ecol. Prog. Ser. 465 33-+.
Zevenboom, W., Rademaker, M., Colijn, F., 1991. Exceptional algal blooms in Dutch north-sea waters. Water Sci. Technol. 24 (10), 251–260.
Zhang, H.X., Wang, Z.H., Zhang, Z., Wang, R.J., Tang, X.X., 2014. Population relationship between two marine algaes *Platymonas helgolandica* and *Karenia mikimotoi* affected by anthracene. Marine Environmental Science 33 (6), 37–42.
Zhang, Q.C., Song, J.J., Yu, R.C., Yan, T., Wang, Y.F., Kong, F.Z., Zhou, M.J., 2013a. Roles of mixotrophy in blooms of different dinoflagellates: implications from the growth experiment. Harmful Algae 30, 10–26.
Zhang, Q.C., Yu, R.C., Song, J.J., Yan, T., Wang, Y.F., Zhou, M.J., 2011a. Will harmful dinoflagellate *Karenia mikimotoi* grow phagotrophically? Chin. J. Oceanol. Limnol. 29 (4), 849–859.
Zhang, S.W., Ou, J.L., Lv, S.H., Chen, J.F., 2011b. Effects of light and nutrients on the phagotrophic behaviors of three harmful dinoflagellates. Marine Sciences 35 (4), 94–99.
Zhang, T.F., Yan, T., Zhang, Q.C., Li, X.D., Zhou, M.J., 2018. Acute effect of four typical bloom forming algae on abalone *Haliotis discus hannai* and its antioxidant enzymes system. Marine Environmental Science 37 (2), 207–214.
Zhang, X., Tang, X., Zhou, B., Wang, Y., 2013b. Effects of decabromodiphenyl ether (BDE-209) on inter-specific competition between two species of marine bloom-forming microalgae. PLoS One 8 (3), e56084.
Zhang, X.X., Tang, X.X., Jiang, S., Yuan, M.Q., Liu, Y.F., Zhou, B., 2013c. Toxic effect of 2,2′,4,4′-Tetrabromodiphenyl Ether (BDE-47) on *Karenia mikimotoi* in the different levels of biological organizations. Marine Environmental Science.
Zhao, Y., Tang, X., Zhao, X., Wang, Y., 2017. Effect of various nitrogen conditions on population growth, temporary cysts and cellular biochemical compositions of Karenia mikimotoi. PLoS One 12 (2), e0171996.
Zheng, N., Ding, N., Gao, P., Han, M., Liu, X., Wang, J., Sun, L., Fu, B., Wang, R., Zhou, J., 2018. Diverse algicidal bacteria associated with harmful bloom-forming *Karenia mikimotoi* in estuarine soil and seawater. Sci. Total Environ. 631-632 (2018), 1415–1420.
Zhou, S., Wu, J., Meng, Q., Ma, W., Qin, Y., Gu, X., Huang, Y., Cao, G., Chen, J., 2012. The investigation and risk analysis of the red tide species in ballast waters of foreign ships harboring in Shanghai port. Plant Pathol. Quar. J. Fungal Biolog. 3, 40–43.
Zhou, Z.X., 2017. Simulating the seasonal succession and long-term changes of harmful algal blooms in the coastal waters adjacent to the Changjiang River estuary, Institute of Oceanology. Proc. Chin. Acad. Med. Sci. Peking Union Med. Coll.
Zhou, Z.X., Yu, R.C., Zhou, M.J., 2017. Seasonal succession of microalgal blooms from diatoms to dinoflagellates in the East China Sea: a numerical simulation study. Ecol Model 360, 150–162.
Zou, Y., Kim, D., Yagi, M., Yamasaki, Y., Kurita, J., Iida, T., Matsuyama, Y., Yamaguchi, K., Oda, T., 2013. Application of LDH-release assay to cellular-level evaluation of the toxic potential of harmful algal species. Biosci. Biotechnol. Biochem. 77 (2), 345–352.
Zou, Y.N., Yamasaki, Y., Matsuyama, Y., Yamaguchi, K., Honjo, T., Oda, T., 2010. Possible involvement of hemolytic activity in the contact-dependent lethal effects of the dinoflagellate *Karenia mikimotoi* on the rotifer *Brachionus plicatilis*. Harmful Algae 9 (4), 367–373.

Farley, Lisa (PIRSA)

From: Ledgard, Aaron (PIRSA)
Sent: Saturday, 10 May 2025 9:16 AM
To: Rodgers, Giverny (PIRSA)
Cc: Macnamara, Charley (PIRSA)
Subject: FW: karin Mikimotoi Water sample results

UNOFFICIAL

Yumba water quality results

Aaron LEDGARD | Senior Fisheries Officer – Kangaroo Island
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | Shop 7, 56 Dauncey Street Kingscote SA 5223
PO Box 115, Kingscote SA 5223
M: Clause 6(1)
www.pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Clause 6(1) <Clause 6(1)>
Sent: Friday, 9 May 2025 9:18 AM
To: Ledgard, Aaron (PIRSA) <Aaron.Ledgard@sa.gov.au>
Cc: Clause 6(1) <Clause 6(1)>
Subject: RE: karin Mikimotoi Water sample results

UNOFFICIAL

Hi Aaron,

These are our counts taken on the 7Th of May

Counts for KI Ab farm

SP 8 Row 10	1,085,000 cells/L
East outlet	240,882 Cells/L

B0401	345,714 cells/L
West outlet	447,273 cells/L

Kind Regards

Clause 6(1)
Operations Manager
Yumbah AQUACULTURE
Yumbah Kangaroo Island
1884 North Coast Road
WISANGER (Smith Bay) SA 5223
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com
ausab

From: Ledgard, Aaron (PIRSA) <Aaron.Ledgard@sa.gov.au>
Sent: Wednesday, 16 April 2025 2:42 PM
To: Clause 6(1) <Clause 6(1)>
Cc: Clause 6(1) <Clause 6(1)>
Subject: RE: karin Mikimotoi Water sample results

UNOFFICIAL

Thank you for the report.

Aaron LEDGARD | Senior Fisheries Officer – Kangaroo Island
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | Shop 7, 56 Dauncey Street Kingscote SA 5223
PO Box 115, Kingscote SA 5223
M: Clause 6(1)
www.pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Clause 6(1) <Clause 6(1)>
Sent: Wednesday, 16 April 2025 2:39 PM
To: Ledgard, Aaron (PIRSA) <Aaron.Ledgard@sa.gov.au>
Cc: Clause 6(1) <Clause 6(1)>
Subject: RE: karin Mikimotoi Water sample results

You don't often get email from Clause 6(1) Learn why this is important

UNOFFICIAL

Hi Aaron,

These are our water sample results from Monday the 14th of April.

14/04/2025	KI Ab Farm Shore Line Westline	500
14/04/2025	KI Ab Farm Nursery Unclean	3600
14/04/2025	Ki Ab Farm Nursery Cleaned	6000
14/04/2025	KI Ab Farm East Shoreline	2100
14/04/2025	KI Ab Farm B0304	8000

Kind Regards.

Clause 6(1)
Operations Manager
Yumbah AQUACULTURE
Yumbah Kangaroo Island
1884 North Coast Road
WISANGER (Smith Bay) SA 5223
M: +61 455779891
E: Clause 6(1)
W: www.yumbah.com
ausab

From: Ledgard, Aaron (PIRSA) <Aaron.Ledgard@sa.gov.au>
Sent: Tuesday, 15 April 2025 3:13 PM
To: Clause 6(1) <Clause 6(1)>
Cc: Clause 6(1) <Clause 6(1)>
Subject: RE: karin Mikimotoi Water sample results

UNOFFICIAL

Thanks Clause 6(1)

Aaron LEDGARD | Senior Fisheries Officer – Kangaroo Island
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | Shop 7, 56 Dauncey Street Kingscote SA 5223
PO Box 115, Kingscote SA 5223
M: Clause 6(1)

www.pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Clause 6(1) <Clause 6(1)>
Sent: Tuesday, 15 April 2025 8:10 AM
To: Ledgard, Aaron (PIRSA) <Aaron.Ledgard@sa.gov.au>
Cc: Clause 6(1) <Clause 6(1)>
Subject: karin Mikimotoi Water sample results

You don't often get email from Clause 6(1). Learn why this is important

Hi Aaron,

These are the samples we have taken since we first discovered the Abs having unusual behaviour.

1st of April	
W Farm Outlet	3,096 cells/L
W2-1	175 cells/L
A4-6	756 cells/L
7th of April	
B0304	61,380 cells/L
East Shoreline	40,920 cells/L
Nursery Section 8	270,500 cells/L
K0201	65,920 cells/L
West Shoreline	154,880 cells/L

I am sending off more samples this morning, which I will send to you once results have come through.

Kind Regards

Clause 6(1)
Operations Manager

yumbah AQUACULTURE

Yumbah Kangaroo Island
1884 North Coast Road
WISANGER (Smith Bay) SA 5223
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com

Farley, Lisa (PIRSA)

From:	Lear, Jordan (PIRSA)
Sent:	Wednesday, 14 May 2025 1:19 PM
To:	Executive Officer; Begg, Gavin (PIRSA); Barry Brown; Andrew Harris
Cc:	Porter, Karen (PIRSA)
Subject:	RE: PIRSA - RecFish SA meeting
Attachments:	Meeting Agenda - RecFish SA and PIRSA Meeting 15 May 2025.docx

OFFICIAL

Thanks Asher,

Please see attached agenda.

Kind regards,
Jordan

Jordan Lear | Fisheries Manager
Fisheries & Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Ave, West Beach 5024
GPO Box 1671 Adelaide SA 5001
T: +61 8 8429 0931 | **M:** Clause 6(1) | **E:** Jordan.lear@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Executive Officer
Sent: Wednesday, 14 May 2025 1:10 PM
To: Lear, Jordan (PIRSA)
Cc: Porter, Karen (PIRSA) ; Barry Brown ; Andrew Harris
Subject: RE: PIRSA - RecFish SA meeting

OFFICIAL

Hey Jordan,

agenda items attached,

- Out of scope
- Algae species update and SASQAP results
- Out of scope

kind regards

ASHER DEZSERY
Executive Officer

0400 774 447
Clause 6(1)

RECFISH SA
recfishsa.org.au

This email message is intended only for the Addressee(s) and contains information which may be confidential and/or copyright. If you are not the intended recipient please do not read, save, forward, disclose or copy the contents of this email. If the email has been sent to you in error, please notify the sender by reply email and delete this email and any copies or links to this email completely and immediately from your system. No representation is made that this email is free of viruses. Virus scanning is recommended and is the responsibility of the recipient.

From: Executive Officer
Sent: Wednesday, 14 May 2025 1:01 PM
To: Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Cc: Porter, Karen (PIRSA) <Karen.Porter@sa.gov.au>; Barry Brown <Clause 6(1)>; Andrew Harris <Clause 6(1)>
Subject: RE: PIRSA - RecFish SA meeting

hey Jordan, just touching on them now! ETA 10mins

ASHER DEZSERY
Executive Officer

0400 774 447
Clause 6(1)

RECFISH SA

recfishsa.org.au

This email message is intended only for the Addressee(s) and contains information which may be confidential and/or copyright. If you are not the intended recipient please do not read, save, forward, disclose or copy the contents of this email. If the email has been sent to you in error, please notify the sender by reply email and delete this email and any copies or links to this email completely and immediately from your system. No representation is made that this email is free of viruses. Virus scanning is recommended and is the responsibility of the recipient.

From: Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Sent: Wednesday, 14 May 2025 1:01 PM
To: Executive Officer <Clause 6(1)>
Cc: Porter, Karen (PIRSA) <Karen.Porter@sa.gov.au>; Barry Brown <Clause 6(1)>; Andrew Harris <Clause 6(1)>
Subject: RE: PIRSA - RecFish SA meeting

OFFICIAL

Hi Asher
Just following up on any agenda items.

Kind regards,
Jordan

Jordan Lear | Fisheries Manager
Fisheries & Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Ave, West Beach 5024
GPO Box 1671 Adelaide SA 5001
T: +61 8 8429 0931 | **M:** Clause 6(1) | **E:** Jordan.lear@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Lear, Jordan (PIRSA)
Sent: Friday, 9 May 2025 10:51 AM
To: Executive Officer <Clause 6(1)>
Cc: Porter, Karen (PIRSA) <Karen.Porter@sa.gov.au>; Barry Brown <Clause 6(1)>; Andrew Harris <Clause 6(1)>
Subject: PIRSA - RecFish SA meeting

Hi Asher,

Do you have an specific agenda items ahead of next Thursdays meeting?

Kind regards,
Jordan

Jordan Lear | Fisheries Manager
Fisheries & Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Ave, West Beach 5024
GPO Box 1671 Adelaide SA 5001
T: +61 8 8429 0931 | **M:** Clause 6(1) | **E:** Jordan.lear@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Agenda

PIRSA

Doc 4a

RecFish SA | PIRSA

Date & Time	1pm, Thursday 15 May 2025
Venue	PIRSA-SARDI West Beach/ Microsoft Teams
Participants	Prof Gavin Begg – Executive Director, PIRSA Asher Dezsery – Executive Officer, RecFish SA Andrew Harris – Chairperson, RecFish SA Jordan Lear – Fisheries Manager, PIRSA Barry Brown – Deputy Chairperson, RecFish SA
Apologies	

Agenda Items

Last meeting minutes

- Confirmation of action items

General

- Algal bloom update / SASQUAP results
- Out of scope

PIRSA

- Algal bloom update
- Out of scope
-
-
-
-

RecFish SA

Out of scope

- Pipi die off update, Goolwa to Kingston
- Drone fishing ban over Murray Mouth for all secotrs

Other Business

Government of South Australia
Department of Primary Industries and Regions

Farley, Lisa (PIRSA)

From: PIRSA:SASQAP
Sent: Wednesday, 16 April 2025 11:28 AM
To: [redacted] (Health); Carr, Andrew (PIRSA); Angel Oysters - [redacted] Barclay, Ann (PIRSA); Begg, Gavin (PIRSA); BST Oysters Supplies; BST Oysters Supplies - [redacted]; Burman, Lisa (PIRSA); Palomino, Alessandra (PIRSA); Wilkinson, Clinton (PIRSA); Cornish, Georgie (PIRSA); [redacted] Dept of Ag (DoA); DoA Exports; Doroudi, Mehdi (PIRSA); Dougherty, Tom (PIRSA); Dowsett, Paul (PIRSA); Hanchant, Janiece (PIRSA); Jeremy Walton; Buss, Jessica (PIRSA); Mellor, Emily (PIRSA); PIRSA:Minister Scriven; Hill, John (PIRSA); Bansemer, Matthew (PIRSA); Cronin, Michael (PIRSA); Spurling, Sarah (PIRSA); PIRSA Fisheries - Yolande Markey; Markey, Yolande (PIRSA); PIRSA:Media; O'Connor, Michelle (PIRSA); Poulos, Con (PIRSA); Puckridge, Trevor (PIRSA); Rodrigues, Sam (PIRSA); [redacted] (Health); SA Lobster Co - [redacted] Executive Officer; Shelly Alderman; Erik Poole; Theil, Mandee (PIRSA-SARDI); Therasa
Subject: Extension of exclusion zone 10km 16/04/2025
Attachments: Coorong Exclusion Zone 10km 20250416.pdf

OFFICIAL: Sensitive

Extension of exclusion zone 10km 16/04/2025 – see email for documentation regards SASQAP

Michelle O'Connor| Business Support Officer,
South Australia Shellfish Quality Assurance Program (SASQAP)
Department of Primary Industries and Regions
Government of South Australia | 1 Hindmarsh St,
PO Box 5 PORT LINCOLN SA 5606
P: +61 8 8688 3411 | **F:** +61 8 8688 3438 | **E:** michelle.o'connor@sa.gov.au
TEAMS NUMBER +618 82146071
pir.sa.gov.au
Work Days: Monday Tuesday Wednesday Thursday

Government of South Australia
Department of Primary Industries and Regions

Service l Professionalism l Trust l Respect l Collaboration & Engagement l Honesty & Integrity l Courage & Tenacity l Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Government of South Australia
Department of Primary Industries and Regions

South Australia Shellfish Quality Assurance Program (SASQAP)
Lincoln Marine Science Centre
PO Box 5
1 Hindmarsh St
PORT LINCOLN SA 5606
T: 08 8688 3409
E: PIRSA.SASQAP@sa.gov.au
ABN: 53 763 159 658
pir.sa.gov.au

16/04/2025

Subject: Extension of the Exclusion Zone to 10km

Dear Harvesters

As you are aware there is a toxic algal bloom happening at Goolwa. As per discussions with harvesters there has been observations of a pipi die off on the commercial side.

SASQAP has decided to extend the exclusion zone to the 10km station.

Below represents the new exclusion boundary expressed in degrees minutes, seconds.

Sand dune high water mark :	**138 58. 185 E** **35 36 12.704 S**
Low water mark:	**138 58 2.989** **35 36 51.100S**

SASQAP will continue to monitor and further investigations are being carried out.

Any queries please contact me on Clause 6(1) to discuss

Clinton Wilkinson
Program Leader
South Australian Shellfish Quality Assurance Program
(Delegate of the Minister)

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Wednesday, 16 April 2025 8:02 AM
To: Read, Matt (PIRSA); Jones, Annabel (PIRSA); Lopez, Lambertus (PIRSA); Mellor, Emily (PIRSA); Bansemer, Matthew (PIRSA); Najjar, Feeras (PIRSA); Darter, Gary (PIRSA)
Cc: Mayfield, Stephen (PIRSA-SARDI)
Subject: Streaky Bay - Port Lincoln port visit 14-16 April 2025
Attachments: West Coast Port Lincoln port visit April 2025.docx

Hi All
FYI - Please see actions from recent port visit that Matt and I undertook.

Karen – can you please add action list to our manager's meeting

Out of scope

Thanks
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

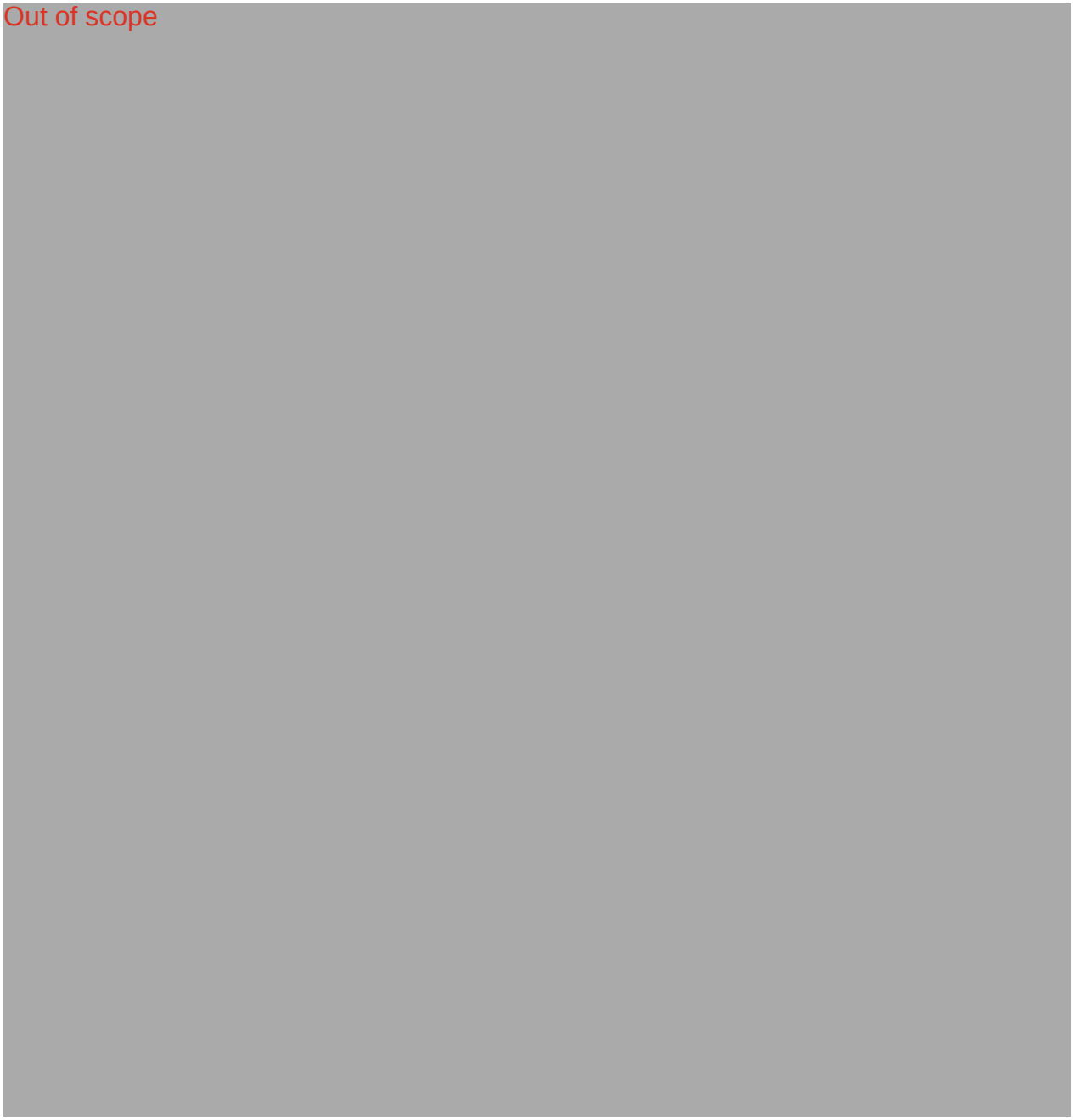
West Coast – Port Lincoln Port Visit 14-16 April 2025

Streaky Bay (14 April 2025)

Out of scope

Port Lincoln (15 April 2025)

Out of scope



Out of scope

Clause 6(1) (Sardine Fishery)

- Out of scope
- Algal bloom – considering options to move cages, if needed
- ACTION: NEED TO ENSURE PIRSA STEPS UNDERTAKEN TO ENABLE EMERGENCY MOVEMENT OF CAGES (EMILY)
- Out of scope

Out of scope

Farley, Lisa (PIRSA)

From: Porter, Karen (PIRSA)
Sent: Friday, 11 April 2025 3:00 PM
To: Begg, Gavin (PIRSA); Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; ceo@asbtia.org; executiveofficer@oysterssa.com.au; Mark Andrews; rob.gratton@cleanseas.com.au; eo@prawnassociation.com.au; neil@nmac.com.au; nathan@kimberconsulting.com.au; Clause 6(1) Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) eo@mfasa.org.au; Keith Rowling; sapfafishers@gmail.com
Subject: Draft Meeting Minutes - Fisheries and Aquaculture + Industry EO Meeting - 27 March 2025
Attachments: DRAFT Meeting Minutes - Fisheries Aquaculture Industry EO meeting 27 March 2025.docx

Hi everyone,

Attached for your consideration are the draft Minutes from the Fisheries & Aquaculture Industry EO meeting held Thursday 27 March 2025.

With kind regards,

Karen

Karen Porter | Executive Support Officer to Executive Director & Director Operations
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0131 | **E:** karen.porter@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Meeting Minutes

Doc 7a

Thursday 27 March 2025 – 10am to 12.30pm
2 Hamra Avenue, West Beach & MS Teams

Fisheries & Aquaculture Industry EO Quarterly Meeting

PIRSA Attendees: Gavin Begg (Chair), Gretchen Grammer, Matt Read, Feeras Najjar, Emily Mellor, Stephen Mayfield, Annabel Jones, Karen Porter (Executive Support Officer)

Industry Attendees: Kyri Toumazos, Nicole Hancox, Thomas McNab, Dan Casement, Lynlee Lowe, Mark Andrews, Rob Gratton, Tim Ferrell, Neil MacDonald, Nathan Kimber, Arthur Martel, Ray Henderson, Claire Webber, Tom Robinson, Adam Main, Tony Custance, Keith Rowling,

Apologies:
Merilyn Nobes, Tom Hyde, Ben Barnes, Michael Tokley, Pat Tripodi, Tom Cosentino

Guests:
Bianca Priest – Director, Marine Park Grants – Parks Australia, Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Deklyn Townsend – A/G Assistant Director, Fishing Business Assistance Grants, DCCEEW

Brian Jeffriess – Chair, Cost Recovery Implementation Committee (CRIC)

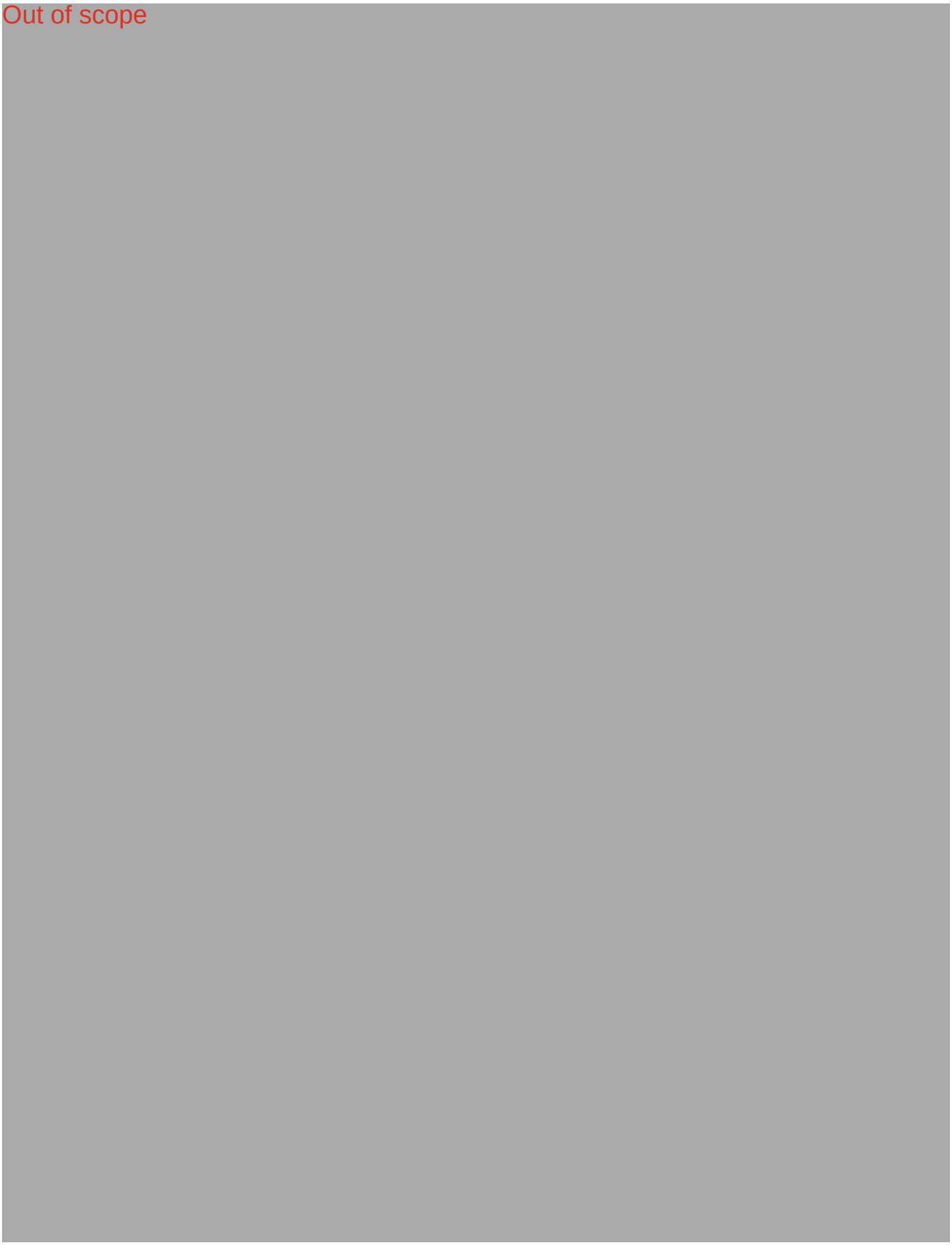
Lisien Loan, Director Conservation and Wildlife – DEW

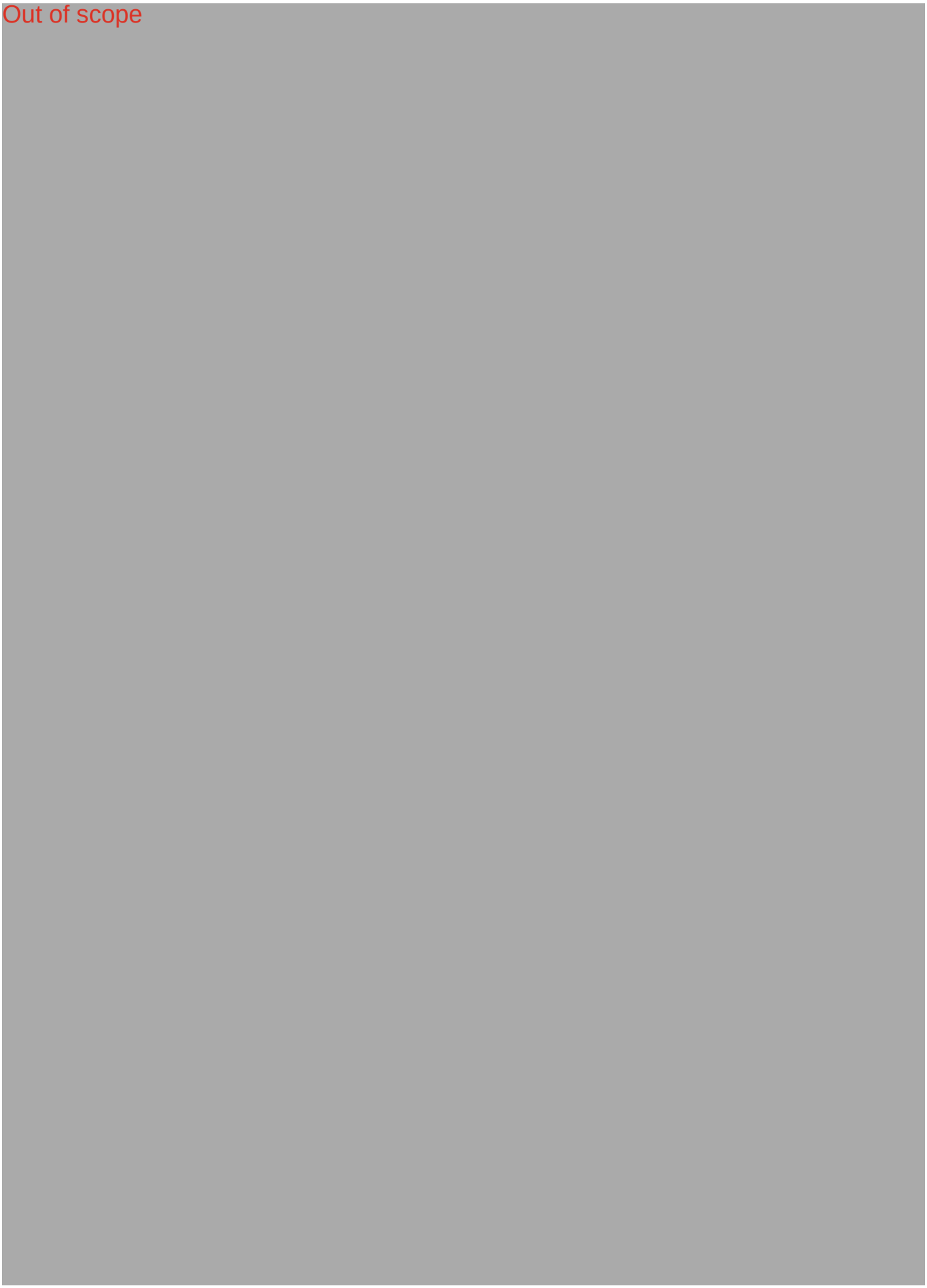
Nathan Bicknell – Extension Officer SA, FRDC

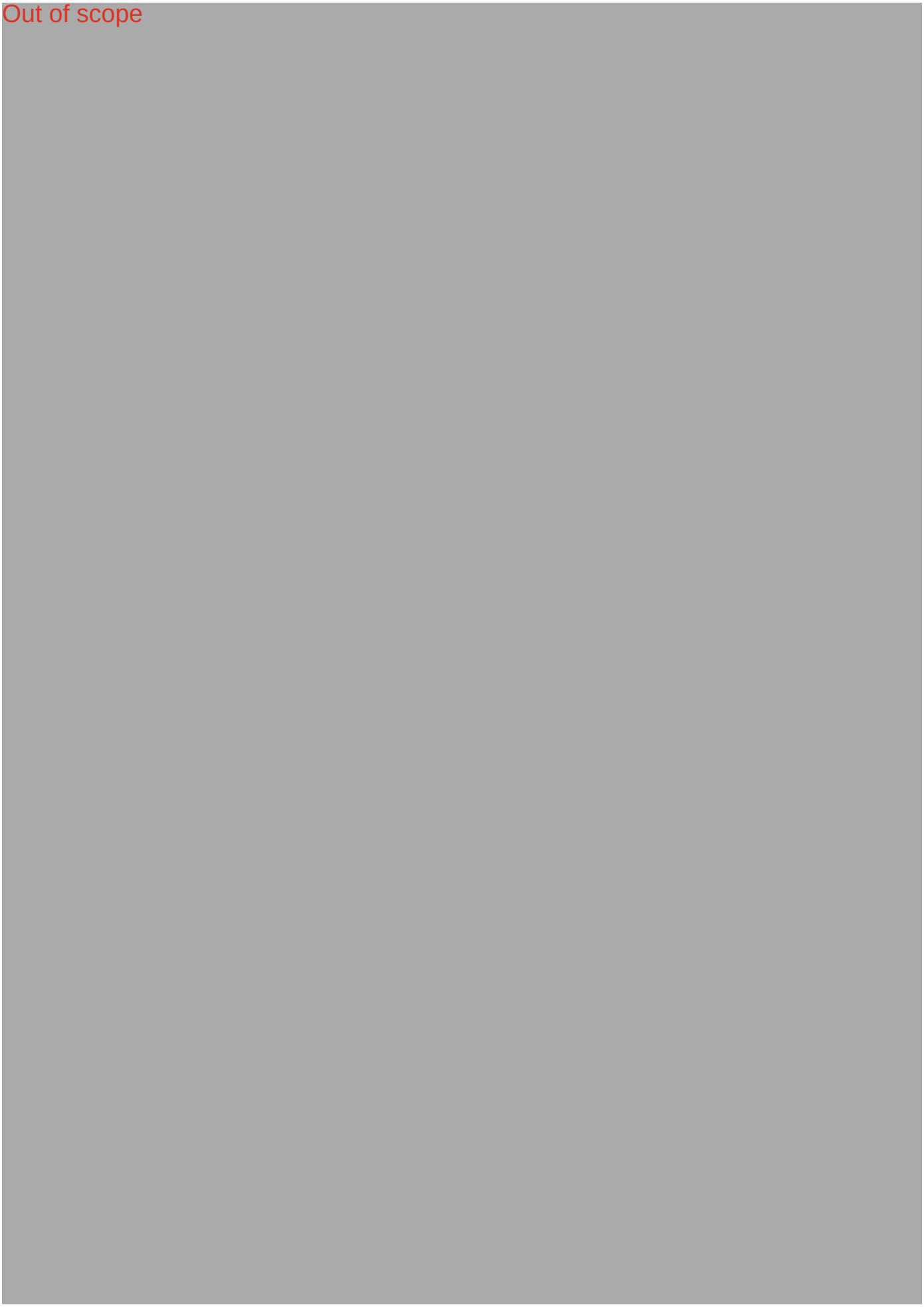
Out of scope

DRAFT

Out of scope




Out of scope


Out of scope

Out of scope

9. Other Business

Algae update

Clause 6(1) - PIRSA Principal Biosecurity Officer, Weeds and Pests provided an update on the micro algae bloom situation that has unfolded over the last few weeks.

PIRSA, Department of Health - notifiable diseases, EPA and DEW (for marine mammals and birds impacted) were part of the response following a call received through Fishwatch.

PIRSA investigated the fish kill at Parsons Beach.

A report was received last Sunday, and samples were collected by PIRSA and EPA Monday. Elevated temperature, discolouration of water and foam pointed to an algae event.

Toxic bloom micro algae produce a toxin affecting marine life (gills). SA Health provided

advice it does not impact humans however is an irritant if it gets in eyes or is breathed in.

Consumption of fish if caught alive have no human life impact. Dead fish found on the beach however should not be consumed.

There has also been discoloured water in Robe. At this stage it is understood this is not linked. Samples did not come back with micro algae however people are still encouraged to report anything unusual to the Emergency Animal Disease hotline – 1800 675 888.

The next meeting will be held Thursday 3 July 2025.

Meeting closed 12.00pm

Out of scope

DRAFT

Farley, Lisa (PIRSA)

From: Jones, Annabel (PIRSA)
Sent: Monday, 19 May 2025 3:32 PM
To: Clause 6(1) @sasardines.com.au
Subject: FW: A6901338 20250516_SARDI Advice Note_Sardine Fishery - Risks to the Sardine Stock of Proposed Transfer of Uncaught Quote From the Gulf St Vincent Zone to the Spencer Gulf Zone for the 2025 Season_Earl - Workflow Task: Approval Required
Attachments: 20250516_SARDI Advice Note_Sardine Fishery quota transfer algal bloom.pdf

Clause 6(1)

OFFICIAL

Dear Clause 6(1)
Please find attached advice note from SARDI to inform consideration of second quota allocation for Spencer Gulf Zone

I will give you a call tomorrow if that is OK to discuss in a bit more detail.

Regards

Annabel

Dr Annabel Jones | General Manager Fisheries Management
Fisheries and Aquaculture | **Department of Primary Industries and Regions - PIRSA**
Government of South Australia | 2 Hamra Ave, West Beach SA 5024
GPO Box 1671 Adelaide SA 5001
P: +61 08 8429 0165 | **M:** Clause 6(1)
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Government of South Australia
Department of Primary Industries and Regions

Service l Professionalism l Trust l Respect l Collaboration & Engagement l Honesty & Integrity l Courage & Tenacity l Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 8a

TO: **PIRSA FISHERIES AND AQUACULTURE (PROF. GAVIN BEGG – EXECUTIVE DIRECTOR)**

FROM: **DR JASON EARL (SARDI AQUATIC AND LIVESTOCK SCIENCES)**

SUBJECT: **SARDINE FISHERY – RISKS TO THE SARDINE STOCK OF PROPOSED TRANSFER OF UNCAUGHT QUOTA FROM THE GULF ST VINCENT ZONE TO THE SPENCER GULF ZONE FOR THE 2025 SEASON**

DATE: **16 MAY 2025**

KEY ISSUES

- The South Australian Sardine Fishery (SASF) is managed through an annual Total Allowable Commercial Catch (TACC) that is allocated across three spatial zones. The TACC for the 2025 fishing season is 50,000 tonnes (t), comprising up to 30,000 t from Spencer Gulf Zone (SGZ), 6,000 t from Gulf St Vincent Zone (GSVZ) and 14,000 t from Outside Zone (OZ).
- According to the South Australian Sardine Industry Association (SASIA), the harmful algal bloom (HAB) currently present in Investigator Strait and adjacent waters off southern Yorke Peninsula has substantially altered the distribution of sardines in GSVZ, significantly reducing catch rates and the viability of fishing operations within the zone.
- The SASIA have requested PIRSA Fisheries and Aquaculture consider the transfer of the remaining uncaught quota from the GSVZ to the SGZ for the 2025 season to avoid disruptions to the supply of Sardine as feed for South Australia's Southern Bluefin Tuna ranching sector.
- This Advice Note provides requested information on the risk to the sustainable classification for the Sardine stock of transferring uncaught quota from the GSVZ of approximately 4,800 t to the SGZ for the 2025 season.

BACKGROUND

The South Australian Sardine Fishery (SASF) is Australia's largest fishery by catch weight. It is a purse-seine fishery that targets Australian Sardine (*Sardinops sagax*) in waters off South Australia. Most of the catch is supplied as feed for the State's Southern Bluefin Tuna ranching sector in southern Spencer Gulf from February to June each year (Appendix 1). The primary management tool is the Total Allowable Commercial Catch (TACC), which is determined annually by applying exploitation rates of 12.5 to 27.5% based on the size of the spawning biomass and the level of research and monitoring undertaken (i.e., the frequency of the Daily Egg Production Method (DEPM), population modelling and ecosystem assessment) (PIRSA 2023).

Fishing effort of the SASF is concentrated in a relatively small proportion of the total area where the managed population of Sardine is distributed in South Australia. Spatial management arrangements involve three zones to limit the catch in the Spencer Gulf Zone (SGZ) and the Gulf St Vincent Zone (GSVZ), reduce the capture of small fish from these Zones, and increase catch from the Outside Zone (OZ) (Fig. 1). Annual catch limits for the SGZ and GSVZ are determined based on the mean size of Sardine (MSS) in the catch, and spread the spatial extent of fishing and reduce the likelihood

of growth overfishing occurring. This management approach has been successful in increasing the MSS taken from the Gulf zones and distributing effort and catch across the region (Grammer et al. 2024a).

The Southern Australian biological stock of Sardine that supports the SASF was last assessed in 2024 using the DEPM (Grammer et al. 2024b). The estimate of spawning biomass obtained using the 2024 DEPM was ~290,000 t (248,230–335,232, 95%CI). The TACC of 50,000 t for the 2025 fishing season represents a maximum exploitation rate of 17%, which is below the 33% level considered safe for this stock by Smith et al. (2015). The TACC is allocated across zones, and comprises up to 30,000 t from the SGZ, 6,000 t from the GSVZ, and 14,000 t from the OZ.

According to the South Australian Sardine Industry Association (SASIA), the harmful algal bloom (HAB) of the species *Karenia mikimotoi* currently present in Investigator Strait between Kangaroo Island, the southern coast of Yorke Peninsula and the southern tip of the Fleurieu Peninsula, has substantially altered the distribution of sardines in the GSVZ, significantly reducing catch rates and the commercial viability of fishing operations in the zone. Given the current high demand for sardine to support tuna feeding, the SASIA have requested PIRSA Fisheries and Aquaculture consider the transfer of the remaining uncaught quota from GSVZ to SGZ for the 2025 season to ensure Sardine supply continuity during this critical time.

PIRSA has requested advice on the potential risks to the Sardine stock of transferring the remaining uncaught quota of approximately 4,800 t from GSVZ to SGZ for the 2025 season.

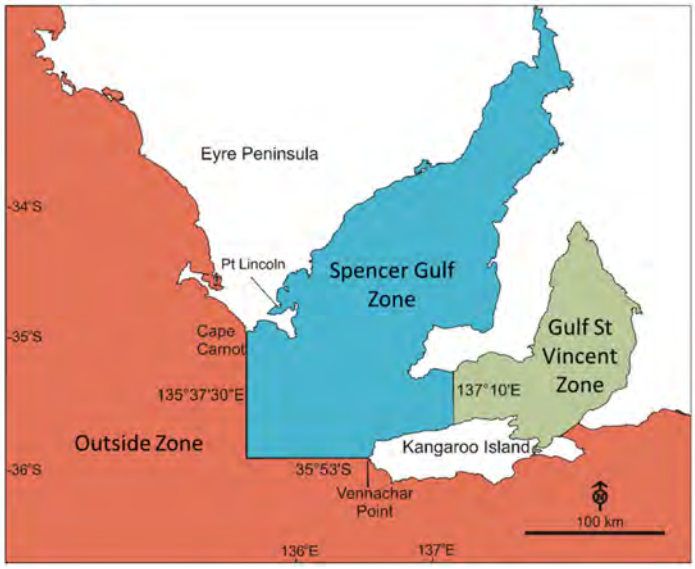


Figure 1. The three spatial management zones of the South Australian Sardine Fishery.

RESULTS / DISCUSSION

Transfer of the remaining uncaught quota of approximately 4,800 t from the GSVZ to the SGZ for the 2025 season will increase the allocated catch for the SGZ to approximately 34,800 t, which is above the maximum catch limit prescribed for SGZ of 30,000 t in the Management Plan (PIRSA 2023). Since 1999, the total catch of Sardine from SGZ has exceeded 30,000 t in three years – 2004 (32,320 t), 2005 (35,895 t) and 2012 (30,499 t) (Fig. 2). On each occasion, annual catch from the GSVZ was ≤ 3,000 t. The total catch in the GSVZ in the 2025 fishing season to date is approximately 1,200 t.

Egg sampling in the GSVZ for the 2025 spawning biomass survey occurred during February 2025, prior to the start of the HAB event in March 2025. Samples collected during the 2025 spawning biomass survey that contain Sardine eggs appear to be widely distributed over the entire survey area. This suggests that the estimate of spawning biomass for 2025 will likely exceed 200,000 t (SARDI unpublished data).

Given the high spawning biomass of Sardine in waters off South Australia in 2024 (~290,000 t; Grammer et al. 2024b), the assumption that the estimate of spawning biomass for 2025 will likely exceed 200,000 t, and the TACC of 50,000 t for 2025 being an exploitation rate < 17% (well below the 33% level considered safe for this stock), the potential risk to the sustainable status of the southern Australian stock of Sardine of transferring the remaining uncaught quota of approximately 4,800 t from GSVZ to SGZ for the 2025 season is considered low.

Despite the low risk, there are two key considerations that should be taken into account. First, there are no data on the potential impacts that the HAB, currently present in southern Spencer Gulf and Investigator Strait, has had on Sardine eggs, larvae, juveniles and adults in this area, which has historically been a consistent spawning area for Sardine (Grammer et al. 2024b). Large numbers of eggs regularly also occur to the south and east of Kangaroo Island, including in 2024 (Fig. 3). While the SASIA has reported that the HAB has significantly impacted the distribution of target-sized Sardines and dispersed schools out of the GSVZ, no information currently exists on the fate of these schools, or the impact the HAB has had on the early life stages of Sardine.

Second, allowing the catch of Sardine from the SGZ to exceed the maximum catch limit of 30,000 t prescribed for the 2025 fishing season, reduces the level of protection for the portion of the stock in the SGZ from depletion of target-sized fish, and increases the risk of growth overfishing. The MSSs of the catch from the SGZ in the past two years have been marginally above 142 mm fork length (FL), which is the size at 50% maturity for Sardine (Grammer et al. 2024a). If the MSS for the SGZ falls to ≤ 142 mm FL in 2025, the Management Plan prescribes a reduction in allocated catch for 2026 (PIRSA 2023). One possible approach to mitigate the risk of growth overfishing in the SGZ, and the likelihood that the MSS falls to ≤ 142 mm FL in 2025, is to restrict harvest of the transferred quota from the GSVZ to the southern areas of the SGZ, which typically supports larger Sardine compared to northern areas (Grammer et al. 2024a).

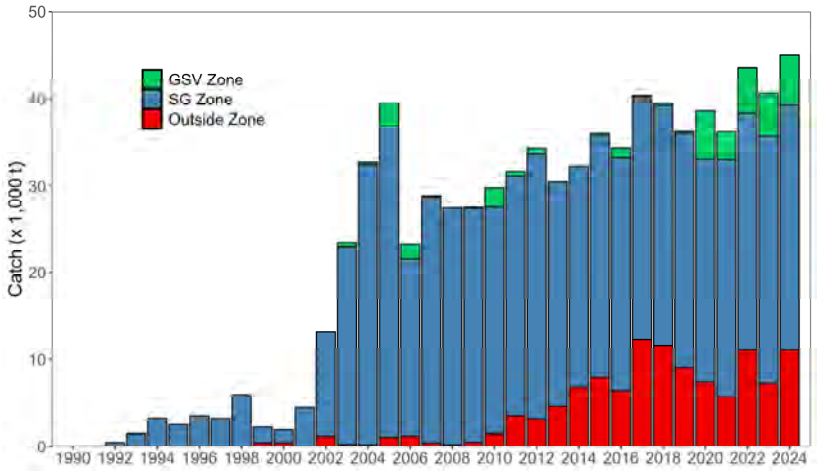


Figure 2. Annual Sardine catch (tonnes, logbook data) by zone between 1992 and 2024. Data for 2024 are provisional.

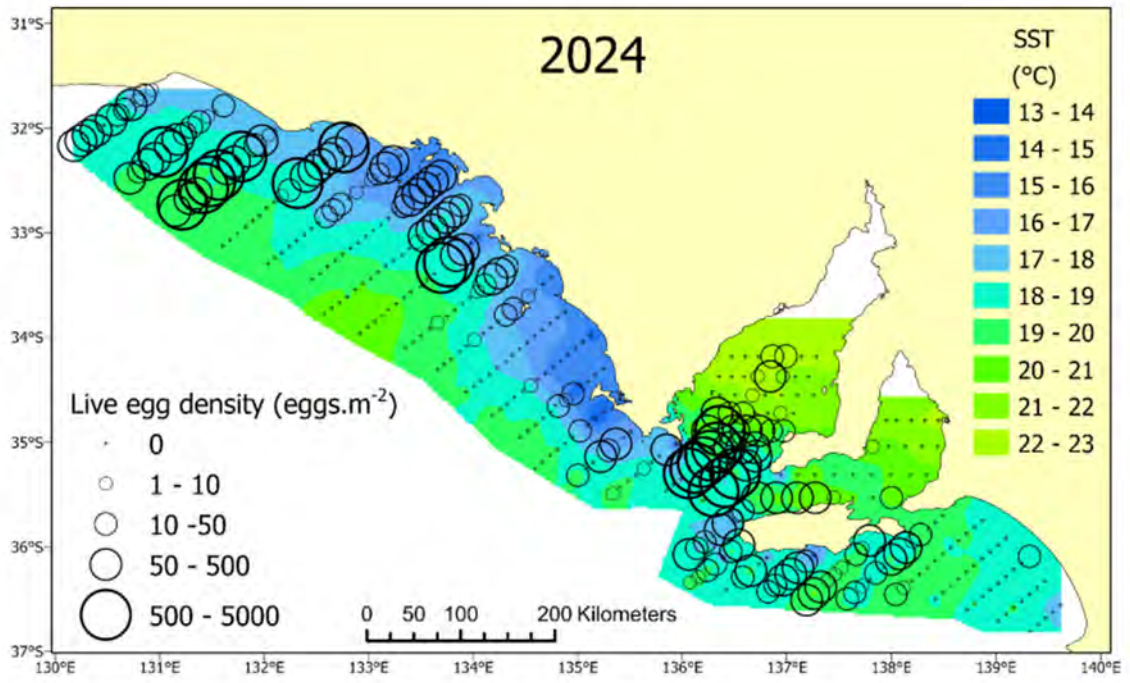


Figure 3. Densities of live Sardine eggs at sites sampled off South Australia from February to April 2024.

Assoc. Prof Gretchen Grammer
A/Research Director, SARDI Aquatic and Livestock Sciences

Disclaimer

PIRSA and its employees do not warrant or make any representation regarding the use, or results of the use, of the information contained herein as regards to its correctness, accuracy, reliability, and currency or otherwise. PIRSA and its employees expressly disclaim all liability or responsibility to any person using the information or advice. Use of the information and data contained in this Note is at the user's sole risk. If users rely on the information, they are responsible for ensuring by independent verification its accuracy, currency, or completeness.

References

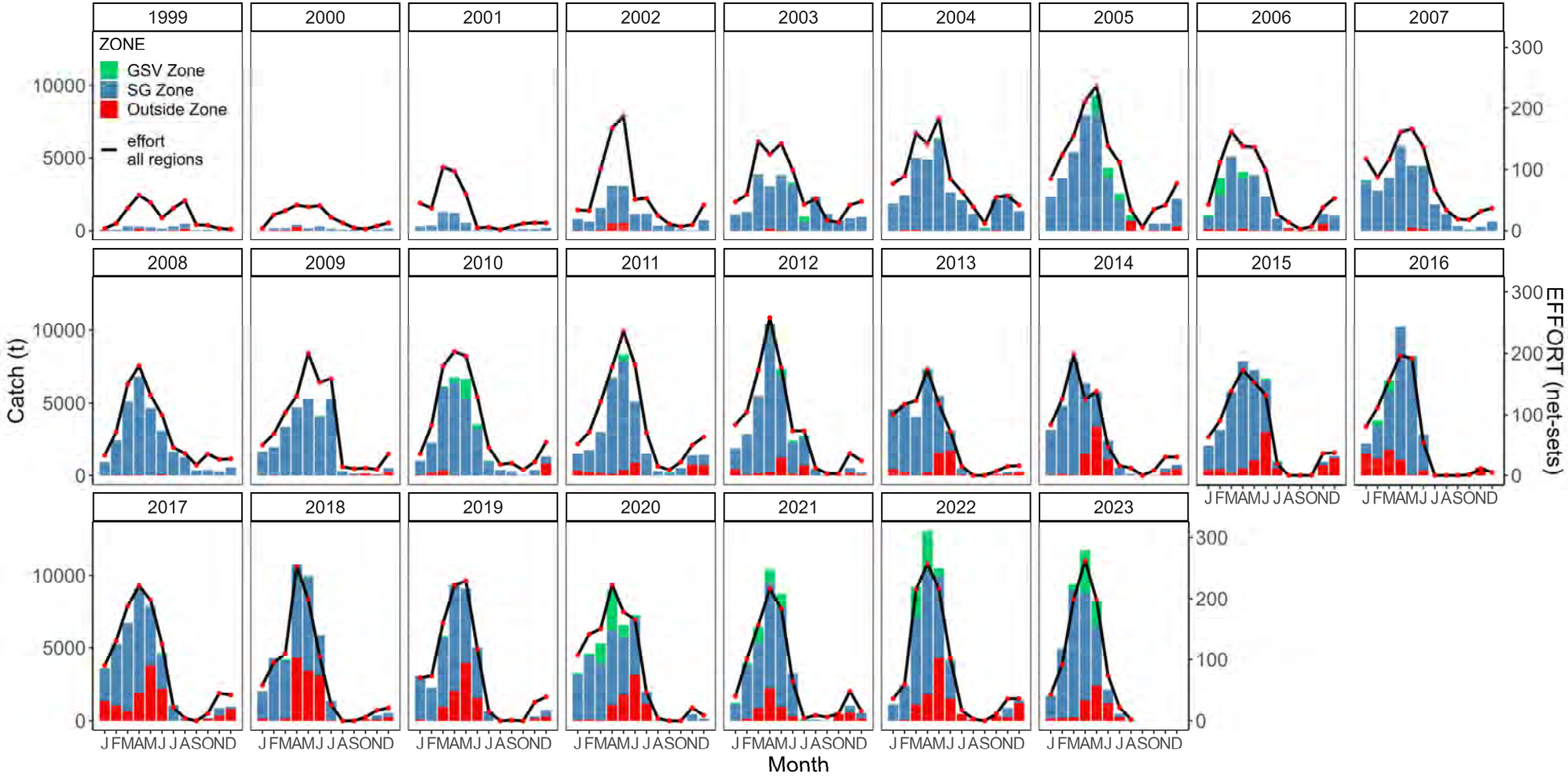
Grammer, G.L., Bailleul, F. and Ivey, A. 2024a. Stock assessment of Australian Sardine (*Sardinops sagax*) off South Australia 2023. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000765-9. SARDI Research Report Series No. 1208. 105pp.

Grammer, G.L., Ivey, A. and Cheeseman, C. 2024b. Spawning biomass of Sardine, *Sardinops sagax*, in waters off South Australia in 2024. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000566-14. SARDI Research Report Series No. 1232. 38pp.

PIRSA 2023. Management Plan for the South Australian Commercial Sardine Fishery. Fisheries Management Series paper number 87. The South Australian Fisheries Management Series. Department of Primary Industries and Regions. Government of South Australia. 49 pp.

Smith, A.D., Ward, T.M., Hurtado, F., Fulton, E. and Punt, A.E. 2015. Review and update of harvest strategy settings for the Commonwealth Small Pelagic Fishery – single species and ecosystem considerations. Hobart. Final Report of FRDC Project No. 2013/028.

Appendix 1. Intra-annual patterns in Sardine catch (tonnes, bars) by region and effort (net-sets, red points with black lines, all regions) in SASF between 1999 and 2022, from Grammer et al. (2024a).



Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Monday, 31 March 2025 3:14 PM
To: Jones, Annabel (PIRSA)
Cc: Shanks, Steve (PIRSA); Bansemer, Matthew (PIRSA)
Subject: RE: Inquiry Regarding Algae Bloom and Abalone Mortality

Thanks Annabel – approved; happy for you to let her know

From: Jones, Annabel (PIRSA)
Sent: Monday, 31 March 2025 2:50 PM
To: Begg, Gavin (PIRSA)
Cc: Shanks, Steve (PIRSA)
Subject: FW: Inquiry Regarding Algae Bloom and Abalone Mortality

OFFICIAL

Hi Gavin
We have received an email from Nicole regarding Abalone mortalities and the Algae bloom in the Fleurieu
Are you OK to send through a short email to her indicating that 1 Abalone mortality had been reported and this fish was tested for AVG with a negative result provided.

Annabel?

From: Bansemer, Matthew (PIRSA) <Matthew.Bansemer@sa.gov.au>
Sent: Monday, 31 March 2025 1:20 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>
Cc: Shanks, Steve (PIRSA) <Steve.Shanks@sa.gov.au>
Subject: RE: Inquiry Regarding Algae Bloom and Abalone Mortality

OFFICIAL

I don't see any issues, but I would normally run releasing results past Gavin or the CVO to confirm there are no issues.
Matt

Dr Matthew Bansemer | Manager, Aquatic Animal Health Program
Fisheries and Aquaculture | **Department of Primary Industries and Regions - PIRSA**
Government of South Australia | 2 Hamra Avenue, West Beach, 5024, SA
GPO Box 1625 Adelaide SA 5001 | Internal PIRSA DX 210
P: (08) 8429 2100 **M:** Clause 6(1) **E:** Matthew.Bansemer@sa.gov.au
pir.sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

Service I Professionalism I Trust I Respect I Collaboration & Engagement I Honesty & Integrity I Courage & Tenacity I Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Jones, Annabel (PIRSA) <annabel.jones@sa.gov.au>
Sent: Monday, 31 March 2025 12:25 PM
To: Bansemer, Matthew (PIRSA) <Matthew.Bansemer@sa.gov.au>
Cc: Shanks, Steve (PIRSA) <Steve.Shanks@sa.gov.au>
Subject: FW: Inquiry Regarding Algae Bloom and Abalone Mortality

OFFICIAL

Hi Matt
Are we OK to let Nicole know there has been 1 Abalone mortality reported and this fish was tested for AVG with a negative result provided.

Thanks
Annabel

Dr Annabel Jones | General Manager Fisheries Management
Fisheries and Aquaculture | **Department of Primary Industries and Regions - PIRSA**
Government of South Australia | 2 Hamra Ave, West Beach SA 5024
GPO Box 1671 Adelaide SA 5001
P: +61 08 8429 0165 | **M:** Clause 6(1)
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Government of South Australia
Department of Primary Industries and Regions

Service I Professionalism I Trust I Respect I Collaboration & Engagement I Honesty & Integrity I Courage & Tenacity I Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Dr Nicole Hancox <eo@abalonesa.com.au>
Sent: Monday, 31 March 2025 11:36 AM
To: Shanks, Steve (PIRSA) <Steve.Shanks@sa.gov.au>; Jones, Annabel (PIRSA) <annabel.jones@sa.gov.au>
Cc: pres@abalonesa.com.au
Subject: Inquiry Regarding Algae Bloom and Abalone Mortality

Hi Steve and Annabel,
We are concerned about the algae bloom around the Fleurieu Peninsula and Kangaroo Island. Could you confirm whether any abalone mortalities have been detected in the area?
Additionally, if abalone mortalities were identified, would they be tested for AVG, given that this region is at the forefront of the containment area for the outbreak?
Structured monitoring or surveillance of abalone habitats ahead of the outbreak area may possibly arise for discussion at the upcoming AVG workshop.
We appreciate your insights on this issue.
Kind Regards
Nicole

Dr Nicole Hancox

Executive Officer
Abalone Industry Association of South Australia Inc

ABN 27 148 436 421
PO Box 763, Port Lincoln, SA, 5606
AUSTRALIA
T +61 428 630 211
E eo@abalonesa.com.au

This message is intended for the addressee and may contain privileged information or confidential information or both. If you are not the intended recipient please delete it and notify the sender.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Wednesday, 14 May 2025 1:09 PM
To: Pat Tripodi
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Wilkinson, Clinton (PIRSA)
Subject: RE: Algal bloom update - 13 May 2025

Hi Pat
Thanks for the info – further testing is being undertaken by SASQAP, waiting on results.
Regards
Gavin

From: Pat Tripodi
Sent: Tuesday, 13 May 2025 7:15 PM
To: Begg, Gavin (PIRSA)
Subject: RE: Algal bloom update - 13 May 2025

Thanks Gavin.

Is there any word yet on the further testing of the second species of algae?

Also, is any testing of water being conducted outside of the bloom areas to monitor rises and falls? I was fishing yesterday off of Grange. When I started fishing on the slack tide I had excellent water visibility easily seeing the bottom (and KGW) in 8m of water. As the tide pushed in, the water got murkier and green, to the point where I couldn't even tell the difference between sand and weed. I have never before observed the water becoming murky on the rising tide and the colour of the water. My observed water temp was 18.8oC. It was a bit concerning.

It didn't effect the KGW (they were still biting and schooled up), but it had me pretty concerned. I had a MSF fisher fishing alongside me and he hadn't seen anything like it too.

Regards

Pat Tripodi
Executive Officer
Marine Fishers Association Inc.
M 0429 000 282
eo@mfasa.org.au
www.marinefishersa.com.au
PO Box 546, Port Adelaide SA 5015

mfa Marine Fishers Association Inc

MAIL DISCLAIMER
The information in this email is privileged information for and on behalf of MFA Members only and may be protected by copyright law. Any unauthorized use, distribution, or disclosure of its contents to third parties is strictly prohibited. If you received this email in error, please delete it immediately from your device.

From: Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton

<rob.gratton@cleanseas.com.au> [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted] @bigpond.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @sasardines.com.au' [redacted] @sasardines.com.au>; [redacted] @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted] @CH4global.com' [redacted] @CH4global.com>; [redacted] @bigpond.com' [redacted] @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted] @asbtia.org>; ' [redacted] @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (EPA) <[redacted] @sa.gov.au>; [redacted] (EPA) [redacted] @sa.gov.au>; [redacted] (EPA) <[redacted] @sa.gov.au>

Subject: RE: Algal bloom update - 13 May 2025

OFFICIAL

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted] @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted] @bigpond.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @sasardines.com.au' [redacted] @sasardines.com.au> [redacted] @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted] @CH4global.com [redacted] @CH4global.com>; [redacted] @bigpond.com' [redacted] @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted] @asbtia.org>; [redacted] @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (DEW) <[redacted] @sa.gov.au>; [redacted] (EPA) <[redacted] @sa.gov.au> [redacted] (EPA) <[redacted] @sa.gov.au>; [redacted] (EPA) <[redacted] @sa.gov.au>

Subject: RE: Algal bloom update - 13 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted] @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald

<neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>

Subject: RE: Algal bloom update - 9 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>

Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling

<keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>; Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) :ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.

Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) :eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) :eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com Clause 6(1) @CH4global.com Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

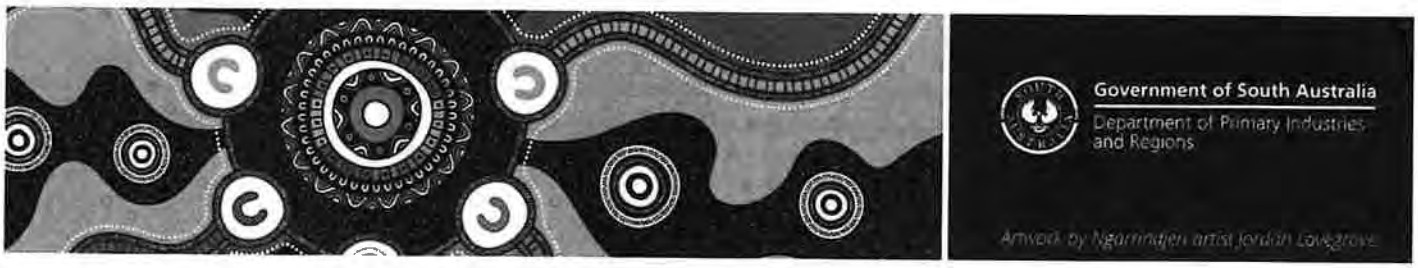
Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 22 April 2025 6:02 PM
To: Asher Dezsery (Clause 6(1) @recfishsa.org.au)
Subject: RecFish samples
Attachments: PATH RESULTS: REEF FISH MORTALITY, [25-30522952]; PATH RESULTS: ROCK CRAB MORTALITY, [25-30522953]; PATH RESULTS: REEF FISH MORTALITY, [25-30522952]; PATH RESULTS: ROCK CRAB MORTALITY, [25-30522953]

OFFICIAL

Hi Asher

As discussed, please see attached test results from RecFish samples submitted to Gribbles vet pathology.

Below are results from the water samples.

Karenia
Mikiomotoi
Results

Date	Location	Cells/L	Comment
11/04/2025	RecFish Rosetta Head (algal scum)	800	Recfish
11/04/2025	Recfish Bluff VH	0	Recfish
11/04/2025	Oliver's Reef Surface	0	Recfish

In short, there was moderate autolysis of the tissue from all specimens submitted, and other tissues demonstrated unremarkable findings, so no cause of death can be identified.

Regards
Gavin

Farley, Lisa (PIRSA)

From: vets@clinicallabs.com.au
Sent: Saturday, 19 April 2025 4:00 PM
To: Macnamara, Charley (PIRSA)
Subject: PATH RESULTS: REEF FISH MORTALITY, [25-30522952]

GRIBBLES VETERINARY PATHOLOGY
LABORATORY 3427-15736
Clause 6(1)
33 FLEMINGTON STREET
GLENSIDE 5065
RESULTS PH: 1300 307 190

Report Addressee:
MADDISON GAUT

Tested on 12/04/25
Reported on 19/04/25 16:30
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
REEF FISH MORTALITY

VICTOR HARBOR 5211

Animal/s:
Fish - fin

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522952 Lab No.: 25-30522952

Samples tested as received

HISTOPATHOLOGY FROM NECROPSY

REF: 2025/V HI 669
INTERIM REPORT 19/4/2025

CLINICAL HISTORY
Please refer to the clinical history on the request form and the clinical notes sent with the request form. A brief summary of the clinical history;
April 10, 2025 RecFish SA informed purser of a mortality event from Victor Harbor (suspected due to ongoing L Bloom) and the collection of 2 reef fish and 2 rock crabs had occurred.

MACROSCOPY
Fish are allocated numbers 1 and 2 at the laboratory
1A-E and 2A-F correlate to F1-2; tissues for each fish include gill, skin, kidney, eye, liver, heart, brain, alimentary tract

Sections of cranium are being decalcified.

MICROSCOPY
F1-2
There is moderate autolysis of the alimentary sections, kidney, gills, heart, spleen, brain.

All other tissues including eye, skin, heart are histologically unremarkable.

DIAGNOSIS
F1-2
Unremarkable histological findings

COMMENTS
There are no findings consistent with:
Viral Nervous Necrosis, Viral Encephalopathy and Retinopathy in the eyes of both fish (Disease due to Barramundi Betanodavirus). The brain was too autolyzed to look for histological changes.

Findings consistent with Epizootic Ulcerative Syndrome (Aphanomyces invadens infection) are not evident in the skin of both fish.

GRIBBLES VETERINARY PATHOLOGY
LABORATORY 3427-15736
Clause 6(1)
33 FLEMINGTON STREET
GLENSIDE 5065
RESULTS PH: 1300 307 190

Report Addressee:
MADDISON GAUT

Tested on 12/04/25
Reported on 19/04/25 16:30
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
REEF FISH MORTALITY

VICTOR HARBOR 5211

Animal/s:
Fish - fin

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522952 Lab No.: 25-30522952

Samples tested as received
Cranium for both fish are being decalcified for examination of Myxobolus cerebralis.

Autolysis has limited examination for other diseases due to South Australian notifiable listed pathogens in finfish (Livestock Act 1997, Livestock Regulations 2013).

Clause 6(1)
Clause 6(1)
Clause 6(1)
Specialist Veterinary Anatomic Pathologist
Clause 6(1)@gribbles.com.au

Validated by Clause 6(1)

Farley, Lisa (PIRSA)

From: vets@clinicallabs.com.au
Sent: Saturday, 19 April 2025 4:00 PM
To: Macnamara, Charley (PIRSA)
Subject: PATH RESULTS: ROCK CRAB MORTALITY, [25-30522953]

GRIBBLES VETERINARY PATHOLOGY
LABORATORY 3427-15736
Clause 6(1)
33 FLEMINGTON STREET
GLENSIDE 5065
RESULTS PH: 1300 307 190

Report Addressee:
CHARLEY MACNAMARA

Tested on 12/04/25
Reported on 19/04/25 16:30
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
ROCK CRAB MORTALITY

VICTOR HARBOR 5211

Animal/s:
Crustacean

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522953 Lab No.: 25-30522953

Samples tested as received

HISTOPATHOLOGY FROM NECROPSY

REF: 2025/V HI 668
INTERIM FINDINGS 19/4/2025

CLINICAL HISTORY
Please refer to the clinical history on the request form and the clinical notes sent with the request form. A brief summary of the clinical history: April 10, 2025 RecFish SA informed purser of a mortality event from Victor Harbor (suspected due to ongoing L Bloom) and the collection of 2 reef fish and 2 rock crabs had occurred.

SAMPLES SUBMITTED
2 x rock crabs

MACROSCOPY
Slides 1A-E and 2A-E correspond to crabs 1-2
The organs for each crab include gills, digestive gland, stomach, heart, skeletal muscle
Please note the antennal gland and ganglia were too autolyzed to recover for histology.

carapace is being decalcified

MICROSCOPY
Crabs 1-2
There is moderate autolysis of all tissues. There are no other remarkable findings

DIAGNOSIS
There are no remarkable histological findings

COMMENTS
There are no gross findings consistent with Aphanomyces astaci. Further sections of carapace / cuticle are pending. Autolysis has limited investigation for other diseases due to other
South Australian notifiable pathogens for crustaceans (Livestock Act 1997, Livestock Regulations 2013).

Clause 6(1)
Clause 6(1)
Clause 6(1)

GRIBBLES VETERINARY PATHOLOGY
LABORATORY 3427-15736
Clause 6(1)
33 FLEMINGTON STREET
GLENSIDE 5065
RESULTS PH: 1300 307 190

Report Addressee:
CHARLEY MACNAMARA

Tested on 12/04/25
Reported on 19/04/25 16:30
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
ROCK CRAB MORTALITY

VICTOR HARBOR 5211

Animal/s:
Crustacean

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522953 Lab No.: 25-30522953

Samples tested as received
Specialist Veterinary Anatomic Pathologist
Clause 6(1)@gribbles.com.au

Validated by Clause 6(1)

Farley, Lisa (PIRSA)

From: vets@clinicallabs.com.au
Sent: Saturday, 12 April 2025 12:55 PM
To: Macnamara, Charley (PIRSA)
Subject: PATH RESULTS: REEF FISH MORTALITY, [25-30522952]

You don't often get email from vets@clinicallabs.com.au. Learn why this is important

GRIBBLES VETERINARY PATHOLOGY

Clause 6(1)

RESULTS PH: 1300 307 190

Report Addressee:
CHARLEY MACNAMARA

Tested on 12/04/25
Reported on 12/04/25 13:25
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
REEF FISH MORTALITY

VICTOR HARBOR 5211

Animal/s:
Fish - fin

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522952 Lab No.: 25-30522952

Samples tested as received

NECROPSY REPORT

CLINICAL HISTORY
Please refer to the clinical history on the request form and the clinical notes sent with the request form. A brief summary of the clinical history;
April 10, 2025 RecFish SA informed purser of a mortality event from Victor Harbor (suspected due to ongoing L Bloom) and the collection of 2 reef fish and 2 rock crabs had occurred.

SAMPLES SUBMITTED
2 x reef fish

NECROPSY FINDINGS
Both animals are in good body condition and there are moderate autolytic changes. One fish is 190mm and the other 90mm long.

GROSS SUMMARY
Unremarkable gross findings

SAMPLES COLLECTED & TESTING
Fixed tissues will be processed for histopathology.

Gill, kidney, liver, spleen, brain are stored frozen from F1-2 and kidney swab is also stored from F1-2.

COMMENTS
The gross findings are unremarkable.

Clause 6(1)
Clause 6(1)
Clause 6(1)
Specialist Veterinary Anatomic Pathologist
Clause 6(1) @gribbles.com.au

Validated by Clause 6(1)

Clause 6(1)

Farley, Lisa (PIRSA)

From: vets@clinicallabs.com.au
Sent: Saturday, 12 April 2025 12:55 PM
To: Macnamara, Charley (PIRSA)
Subject: PATH RESULTS: ROCK CRAB MORTALITY, [25-30522953]

You don't often get email from vets@clinicallabs.com.au. Learn why this is important

GRIBBLES VETERINARY PATHOLOGY
LABORATORY 3427-15736
Clause 6(1)
33 FLEMINGTON STREET
GLENSIDE 5065
RESULTS PH: 1300 307 190

Report Addressee:
CHARLEY MACNAMARA

Tested on 12/04/25
Reported on 12/04/25 13:25
Referred on 10/04/25 by:
DR MATTHEW BANSEMER
33 FLEMINGTON STREET

GLENSIDE SA 5065

Owner:
ROCK CRAB MORTALITY

VICTOR HARBOR 5211

Animal/s:
Crustacean

DOB: N/A

Collected: 10/04/25 00:25 Subm.No: 2530522953 Lab No.: 25-30522953

Samples tested as received

NECROPSY REPORT

CLINICAL HISTORY
Please refer to the clinical history on the request form and the clinical notes sent with the request form. A brief summary of the clinical history;
April 10, 2025 RecFish SA informed purser of a mortality event from Victor Harbor (suspected due to ongoing L Bloom) and the collection of 2 reef fish and 2 rock crabs had occurred.

SAMPLES SUBMITTED
2 x rock crabs

NECROPSY FINDINGS
Both animals are in good body condition and there are moderate autolytic changes. Each has a carapace approximately 90mm across.

GROSS SUMMARY
Unremarkable gross findings

SAMPLES COLLECTED & TESTING
Fixed tissues will be processed for histopathology.

Gill is stored frozen from F1-2 and haemolymph swab is also stored from F1-2.

COMMENTS
Unremarkable gross findings

Clause 6(1)
Clause 6(1)
Clause 6(1)
Specialist Veterinary Anatomic Pathologist
Clause 6(1)@gribbles.com.au

Validated by Clause 6(1)

Farley, Lisa (PIRSA)

From: Mellor, Emily (PIRSA)
Sent: Thursday, 17 April 2025 5:02 PM
To: Brian Jeffriess; Executive Officer; Mark Andrews; Rob Gratton; Clause 6(1) @yumbah.com; Daniel Casement
Cc: Donald McIntyre; Clause 6(1) @saringroup.com.au; Begg, Gavin (PIRSA)
Subject: re: Emergency Lease information
Attachments: Aquaculture emergency leases - Factsheet for aquaculture lease and licence holders.docx

Importance: High

Dear all

PIRSA is monitoring the current *Karenia mikimotoi* situation closely and will continue to distribute SARDI updates as they become available.

To assist and provide guidance during these difficult times please find attached a fact sheet summarising steps and considerations for emergency leases in the event these need to be implemented.

Kind regards and have a safe Easter all.

Emily

Emily Mellor | General Manager, Aquaculture
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0360 | Clause 6(1)
E: emily.mellor@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 12a

Aquaculture emergency leases

Instructions for aquaculture lease and licence holders

Background

Pursuant to Section 40 of the *Aquaculture Act 2001*, the Minister for Primary Industries and Regional Development (the Minister) may grant an emergency lease (to an existing aquaculture lease holder) for a pilot lease, production lease or research lease.

Definition: An emergency event is one that poses immediate or impending risk of stock loss for an aquaculture licence holder. Emergency event examples include (but are not limited to) an oil or chemical spill; known harmful algae bloom; exceptional weather (for example, cyclonic, as determined by the Minister); declared state emergency (under the *South Australian Emergency Management Act 2004*), an outbreak or imminent outbreak of an infectious or notifiable disease (declared by the Chief Veterinary Officer under the *Livestock Act 1997*); control of a disease or exotic organism (under the *Fisheries Management Act 2007*); or an unforeseen circumstance as determined by the Minister.

To assist aquaculture lease and licence holders better understand requirements regarding aquaculture emergency leases, this factsheet aims to summarise steps and considerations.

What do to

Only if the situation is deemed an emergency (see definition above) and there are no other feasible mitigation options (for example emergency harvest, translocation of stock, treatment of stock or otherwise), aquaculture stock and related infrastructure may be relocated out of harm's way immediately and temporarily (based on a term determined by the Minister) – and the following steps apply:

1. Install navigation marks in accordance with clause 26 of the *Aquaculture (Standard Lease and Licence Conditions) Policy 2022* before any structures are placed in the emergency leased area.
2. Contact the Fisheries and Aquaculture Division of the Department of Primary Industries and Regions (PIRSA) via email (pirsa.aquaculture@sa.gov.au) or by phone [(08) 8207 5332] within six (6) hours of the emergency relocation and:
    a. Provide a description of why the situation is an emergency (include mitigation options considered).
    b. Provide GPS coordinates (latitude [ddd° mm.mmm'] and longitude [ddd° mm.mmm'], including geodetic datum) for all corners of the aquaculture emergency lease area/s (including hectares).
    c. Request an aquaculture emergency lease application form.
3. Contact the Department for Infrastructure Transport (DIT) by phoning the Flinders Ports

Emily Mellor (General Manager, Aquaculture)
Email: Emily.Mellor@sa.gov.au
Phone: 08 8429 0360
pir.sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

Outer Harbour Vessel Traffic Services (formerly Signal Station) on 08 8248 3505 (24 hour hotline) or via VHF radio channel 12 (at all hours) and:

   a. Advise of the emergency lease (stock and infrastructure) relocation.
   b. Provide GPS coordinates (latitude [ddd° mm.mmm'] and longitude [ddd° mm.mmm'], including geodetic datum) for all corners of the aquaculture emergency lease area/s (including hectares).

4. Fill in an aquaculture emergency lease application form as soon as possible and submit to PIRSA Fisheries and Aquaculture via email (pirsa.aquaculture@sa.gov.au).
   a. PIRSA will confirm appropriateness of the emergency lease location and commence emergency lease assessment.
   b. Note – PIRSA may take up to five (5) business days to assess and grant an emergency lease and corresponding licence.

Considerations

Aquaculture emergency lease site selection considerations

- An emergency lease can be granted in state waters inside or outside an aquaculture zone.
- An emergency lease cannot be granted in the following locations:
  - Aquaculture exclusion zones
  - National Parks and Reserves (inclusive of a one (1) kilometre buffer area)
  - Marine Park restricted access zones
  - Marine Park sanctuary zones
  - Aquatic reserves
  - Ports[1]
- The public register can be used to help identify potential locations for aquaculture emergency leases, prior to discussion with PIRSA.

Environmental considerations

- Licensees should avoid sensitive benthic environments (for example seagrass meadows).
- Licensees conducting aquaculture in aquaculture emergency lease areas must take all reasonable and practical measures to:
  - prevent the escape of the licensed species and adverse impacts on, and adverse interactions with, seabirds and large marine invertebrates; and
    - If a sector-based strategy or individual aquaculture strategy applies to the licensee, then strategies must be complied with.
  - ensure the activities on the emergency lease site do not pollute the environment in a way which causes or may cause environmental harm; and
  - ensure the activities on the emergency lease site do not cause an unacceptable level of degradation or damage to the seabed (for example accumulation of aquaculture waste) or the marine or coastal environment, environmental harm.
- To provide evidence that the activities on the emergency lease are not causing environmental harm, licensees may be required to prepare a report on the condition of the aquatic environment in or around the licence area at the discretion of PIRSA.
- Upon expiry of the emergency lease, licensees are required to rehabilitate the area no

[1] It should be noted that where an emergency lease is to be temporarily located within a port or harbor within the meaning of the *Harbors and Navigation Act 1993* the concurrence of the Minister for Transport will be required. This may cause processing delays.

longer being used for aquaculture (i.e. the temporary emergency lease area). Rehabilitation will include removal of all infrastructure, stock and debris from the area within 90 days post expiry.

- PIRSA may require benthic video monitoring to support evidence of site rehabilitation.

General considerations

- You are reminded of your obligations in relation to the requirements of all statutes, regulations, by-laws, ordinances, rules or other forms of statutory instruments or delegated legislation applicable to the licensed site or to the use of the licensed site. These include but are not limited to those of the *Aquaculture Act 2001*, *Fisheries Management Act 2007*, *Environment Protection Act 1993*, the *Livestock Act 1997*, the *Aboriginal Heritage Act 1988* and the *Marine Parks Act 2007* and standardised conditions within the *Aquaculture (Standard Lease and Licence Conditions) Policy 2022*, including those relating to a bank guarantee or an approved scheme (Clause 24 of the *Aquaculture (Standard Lease and Licence Conditions) Policy 2022*).
- You should contact your banking institution and/or insurance provider to determine your individual requirements under an emergency lease.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess; Executive Officer; Mark Andrews; Rob Gratton; Tim Ferrell; Neil MacDonald; Nathan Kimber; Fay Martel; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) eo@mfasa.org.au; Keith Rowling; sapfafishers@gmail.com; Daniel Casement
Cc: Doubell, Mark (PIRSA)
Subject: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-11042025.pdf

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery (Clause 6(1))
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA)
Subject: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-11042025.pdf

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 11-April-2025

Context

SARDI is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation.

Note: presented daily increases/decreases in chlorophyll-a (chla) concentrations measured by satellite may not be associated with the presence of HAB species.

Update

- Moderate to extreme marine heatwave have persisted in SA waters since September 2024, with current water temperatures +1 to +3°C above the long-term 90th percentile conditions (Figure 1).

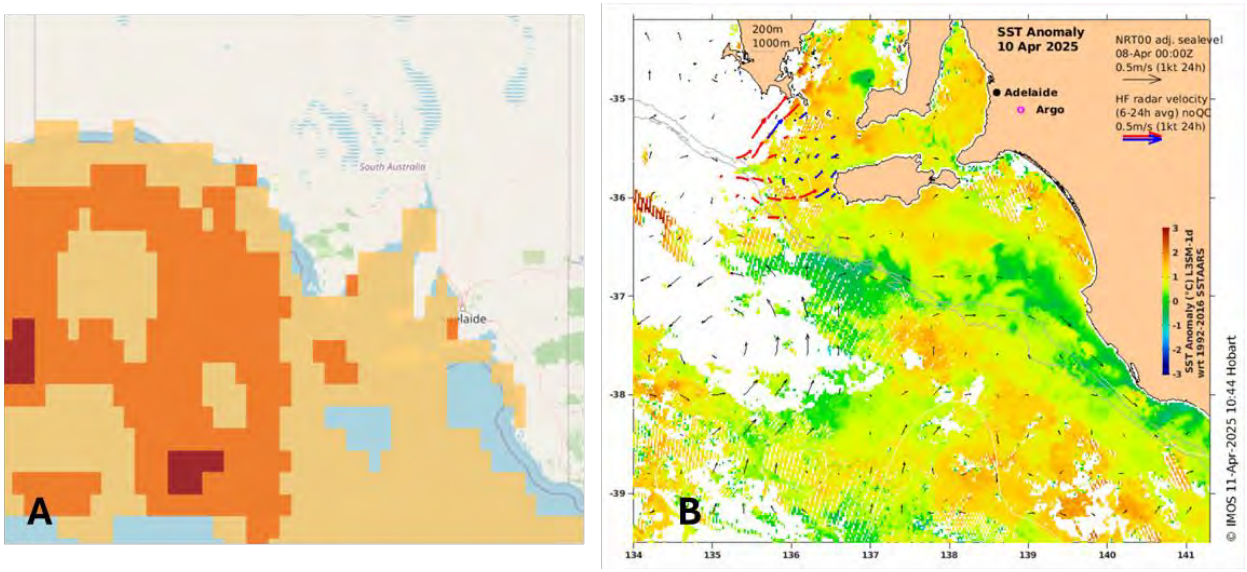


Figure 1. ***(A)*** *Snapshot of the current marine heatwave conditions in SA on the 11th of April 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.* ***(B)*** *Current sea surface temperature anomalies in the south Australian region. Source: https://oceancurrent.aodn.org.au/.*

Contact: Mark.Doubell@sa.gov.au

South Australian Harmful Algal Bloom (HAB) Situation Update: 11-April-2025

- Satellite images show elevated chla levels are persisting in Investigator Strait, along the north coast of Kangaroo Island, the eastern foot of Yorke Peninsula, and near Goolwa (Figure 2).

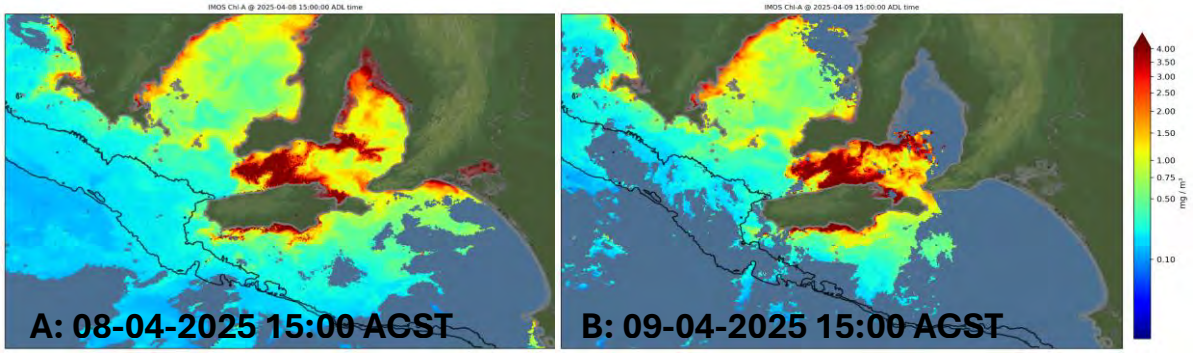


Figure 2. Latest sea surface chla maps taken on (A) 08-April and (B) 09-April 2025. Source: https://oceancurrent.aodn.org.au/. Grey-blue regions indicate areas where no data is available due to could cover.

- Corresponding daily images showing areas of sea surface chla increases and decreases (Figure 3) were determined by subtracting the median value of the previous 10-days sea surface chla maps from the latest sea surface chla maps shown in Figure 2.

- Comparison of the changes in concentrations observed on 9-April to those observed on 8-April indicate sea surface chla concentrations are increasing in Investigator Strait, along the western tip of Yorke Peninsula, in gulf waters to extending from the western tip of Yorke Peninsula towards Wedge Island, and along the western coast of Spencer Gulf from Boston Bay to Port Gibbon.

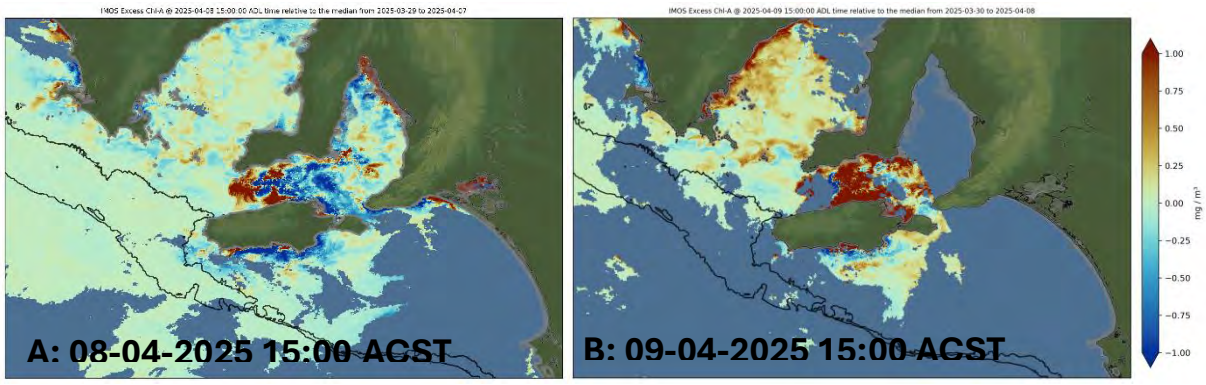


Figure 3. Daily images showing increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to could cover.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 11-April-2025

- Oceanographic forecast and particle modelling (Figure 4) Figure 1is used to predict the trajectory of water masses over a period of 5 days starting 10-April 2025 for a variety of source locations.

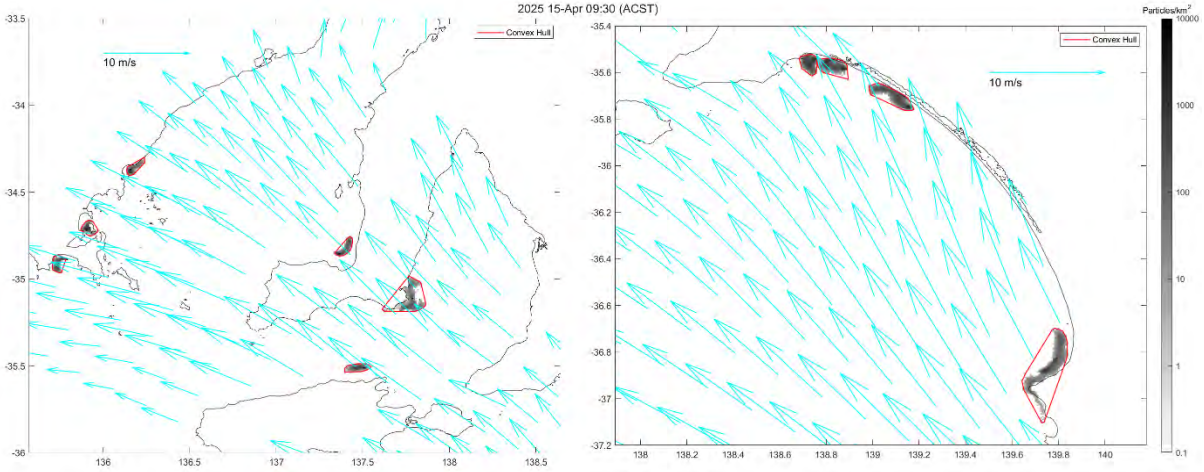


Figure 4. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 10-April and ending 15-April. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess; Executive Officer; Mark Andrews; Rob Gratton; Tim Ferrell; Neil MacDonald; Nathan Kimber; Fay Martel; Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; 'Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; 'Daniel Casement'
Cc: Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-15042025.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess ; Executive Officer ; Mark Andrews ; Rob Gratton ; Tim Ferrell ; Neil MacDonald ; Nathan Kimber ; Fay Martel ; ray.henderson@yumbah.com; tom.hyde@yumbah.com; Claire@sasardines.com.au; michael@strategicmc.com.au; tom@goolwapipico.com; adam.main@CH4global.com; mr_skin@bigpond.com; eo@mfasa.org.au; Keith Rowling ; sapfafishers@gmail.com; Daniel Casement
Cc: Doubell, Mark (PIRSA)
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001

T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery ([redacted])
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-15042025.pdf

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery (executiveofficer@recfishsa.org.au)
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA)
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 15-April-2025

Context

SARDI is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation.

Note: presented daily increases/decreases in chlorophyll-a (chla) concentrations measured by satellite may not be associated with the presence of HAB species.

Update

- Moderate to extreme marine heatwave have persisted in SA waters since September 2024, with current water temperatures +1 to +3°C above the long-term 90th percentile conditions (Figure 1).

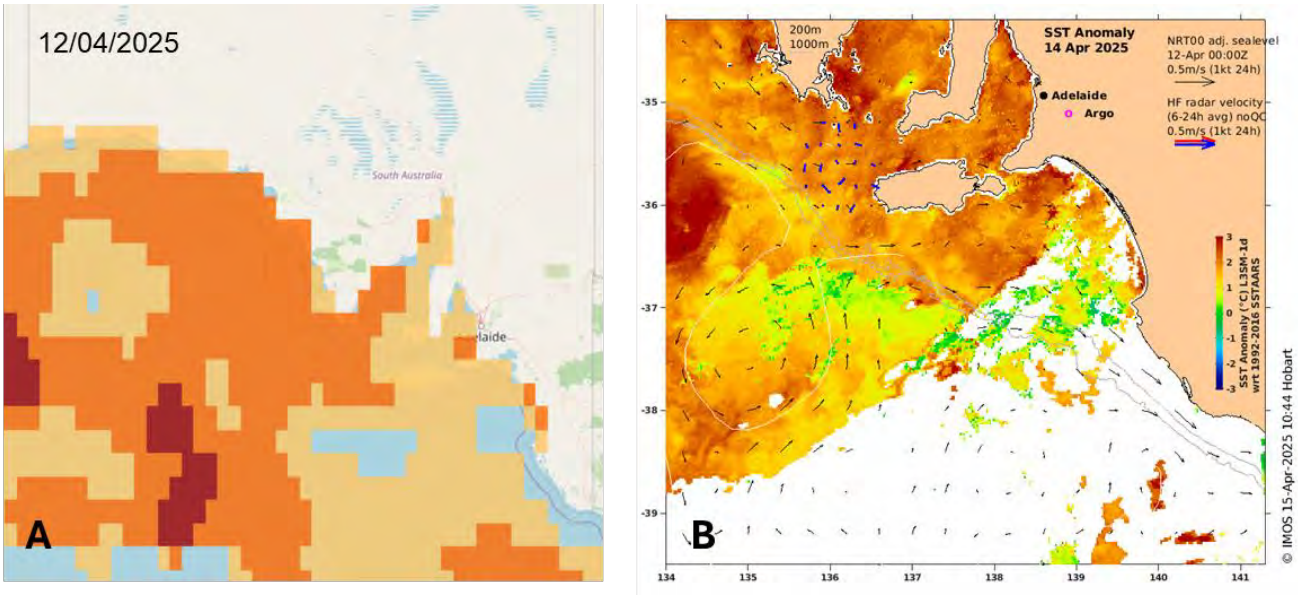


Figure 1. ***(A)*** *Latest available snapshot of the current marine heatwave conditions in SA on the 12th of April 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.* ***(B)*** *Current sea surface temperature anomalies in the south Australian region. Source: https://oceancurrent.aodn.org.au/.*

Contact: Mark.Doubell@sa.gov.au

South Australian Harmful Algal Bloom (HAB) Situation Update: 15-April-2025

- Satellite images show elevated chla levels are persisting in Investigator Strait, along the north coast of Kangaroo Island, the eastern foot of Yorke Peninsula, and near Goolwa (Figure 2).

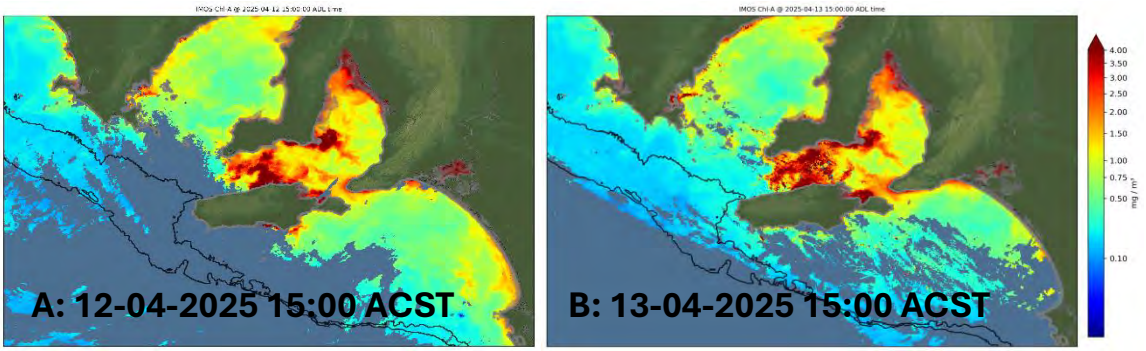


Figure 2. Latest sea surface chla maps taken on (A) 12-April and (B) 13-April 2025. Source: https://oceancurrent.aodn.org.au/. Grey-blue regions indicate areas where no data is available due to could cover.

- Corresponding daily images showing areas of sea surface chla increases and decreases (Figure 3) were determined by subtracting the median value of the previous 10-days sea surface chla maps from the latest sea surface chla maps shown in Figure 2.

- Comparison of the changes in concentrations observed on the 12-13 of April (below) to those provided previously in the situation update on 11-April (which showed surface chla images taken on 8-9 April) indicate sea surface chla concentrations are generally decreasing in Investigator Strait, in the waters surrounding Goolwa and Port Lincoln, and along the southwestern coast of Spencer Gulf and bays along the north coast of Kangaroo Island.

- Localised hotspots of increasing of sea surface chla are observed around the southern tip of the Fleurieu Peninsula extending across to Penneshaw on Kangaroo Island, around the southern tip of the Yorke Peninsula, and along the central western coast of Kangaroo Island near Stokes Bay.

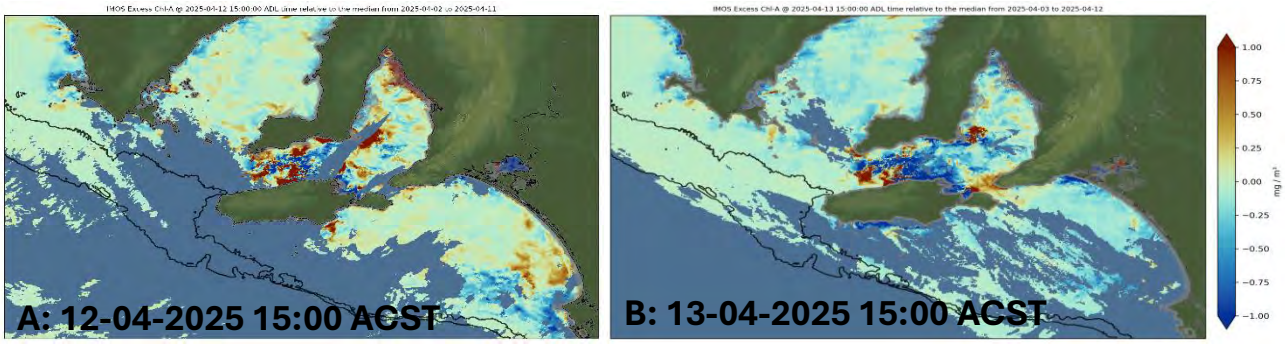


Figure 3. Daily images showing increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to could cover.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 15-April-2025

- Oceanographic forecast and particle modelling (Figure 4) Figure 1is used to predict the trajectory of water masses over a period of 5 days starting 15-April and ending 20-April 2025 for a variety of source locations.

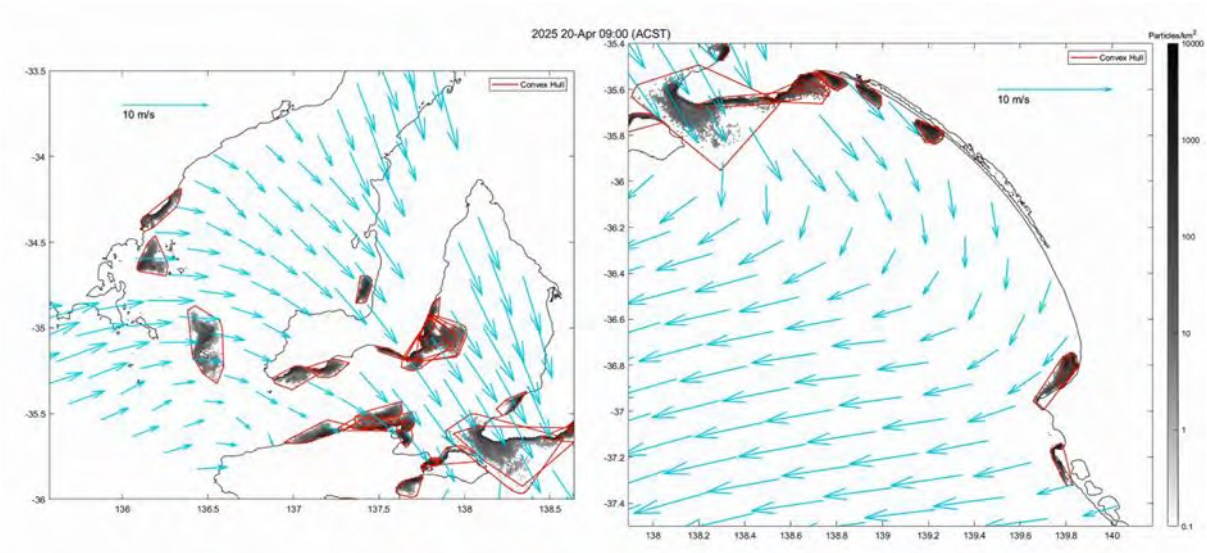


Figure 4. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 15-April and ending 20-April. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farley, Lisa (PIRSA)

From: Mellor, Emily (PIRSA)
Sent: Tuesday, 15 April 2025 6:40 PM
To: Donald McIntyre
Subject: FW: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-15042025.pdf

Hi Don
Rob would have received this from Gavin this afternoon but shooting it to you as well post our discussion this afternoon.

Thanks
Emily

From: Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>
Sent: Tuesday, 15 April 2025 5:22 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; 'Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; 'Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

OFFICIAL

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling

<keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess; Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) '; Clause 6(1) @yumbah.com'; 'Clause 6(1) @yumbah.com'; 'Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; 'Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; Clause 6(1)
Cc: Doubell, Mark (PIRSA)
Subject: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-18042025.pdf

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-18042025.pdf

Clause 6(1)

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update

Clause 6(1)

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Clause 6(1)

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024

GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 18-April-2025

Context

SARDI is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation.

Note: presented daily increases/decreases in chlorophyll-a (chla) concentrations measured by satellite may not be associated with the presence of HAB species.

Update

- As of the 15th of April, sea surface temperatures (SST) remain +2 to +3°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 1).

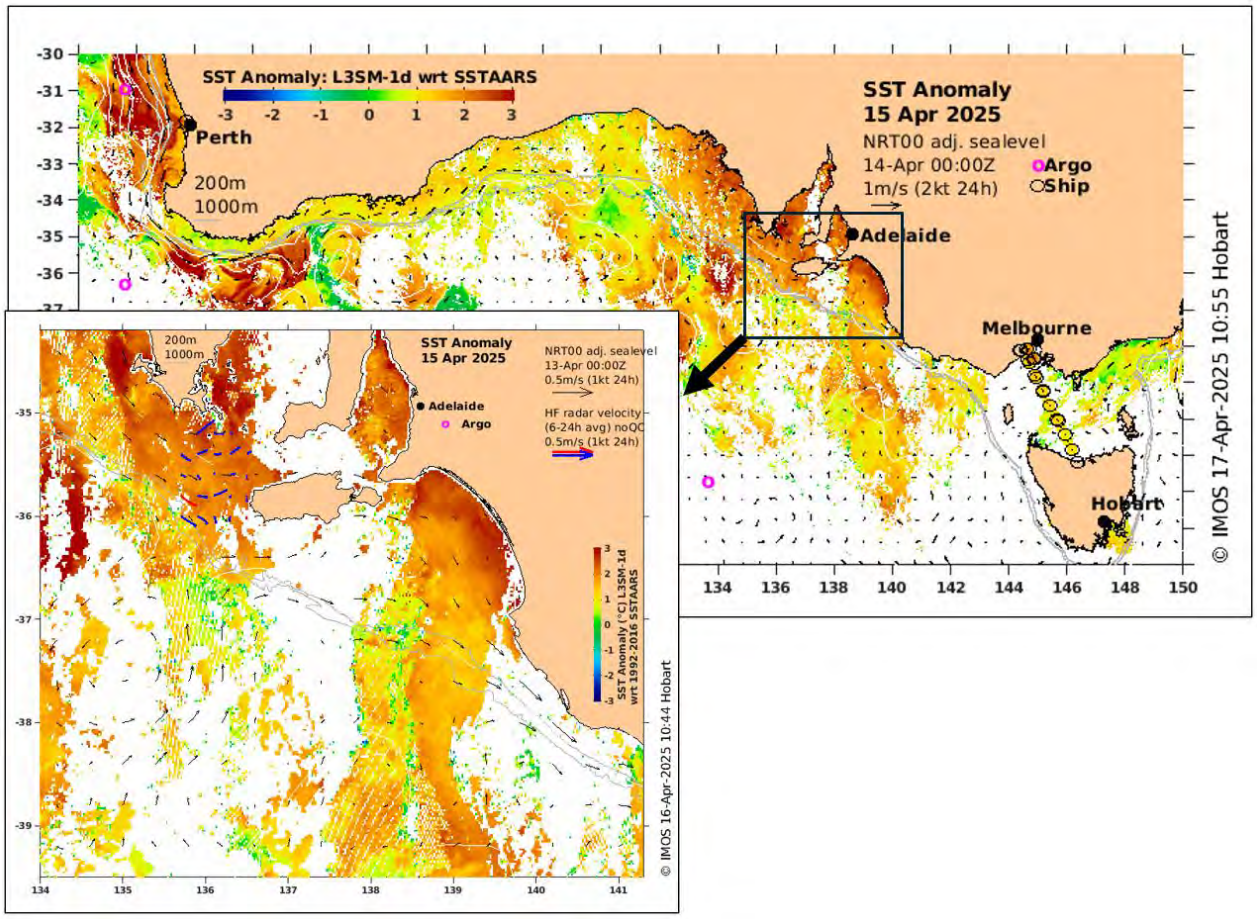


Figure 1. Latest sea surface temperature anomalies in the south Australian region. Source: https://oceancurrent.aodn.org.au/.

Contact: Mark.Doubell@sa.gov.au

South Australian Harmful Algal Bloom (HAB) Situation Update: 18-April-2025

- Satellite images show elevated chla levels are persisting in Investigator Strait, along the north coast of Kangaroo Island, and extend along the eastern side of Yorke Peninsula and near Goolwa and Robe (Figure 2).

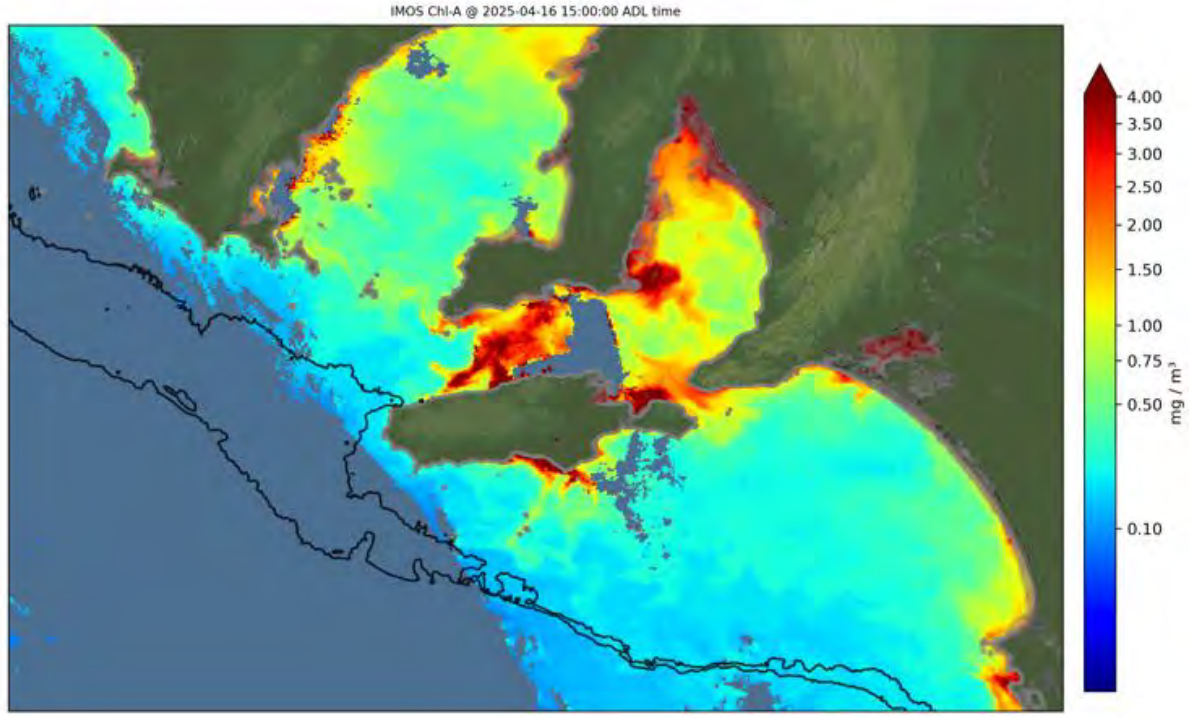


Figure 2. Latest sea surface chla maps taken on 16-April. Source: https://oceancurrent.aodn.org.au/. Regions where no data is available due to cloud cover are shaded in grey-blue.

- The corresponding daily image showing areas of sea surface chla increases and decreases (Figure 3) was determined by subtracting the median value of the previous 10-days sea surface chla maps from the latest sea surface chla maps shown in Figure 2.

- Comparison of the changes in concentrations observed on 16-April 2025 (Figure 3) to those provided previously in the situation update on 15-April, indicate sea surface chla concentrations are generally decreasing in the coastal waters near Goolwa and Waitpinga, and Edithburgh.

- Localised hotspots of increasing of sea surface chla are observed around the southern tip of the Fleurieu Peninsula extending across to Penneshaw on Kangaroo Island, around the southern tip of the Yorke Peninsula, along the central western coast of Kangaroo Island from Stokes Bay to Western River, along the western coastline of Gulf St Vincent from Wool Bay to Stansbury and near the coast between Tumby Bay and Port Neill in Spencer Gulf.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 18-April-2025

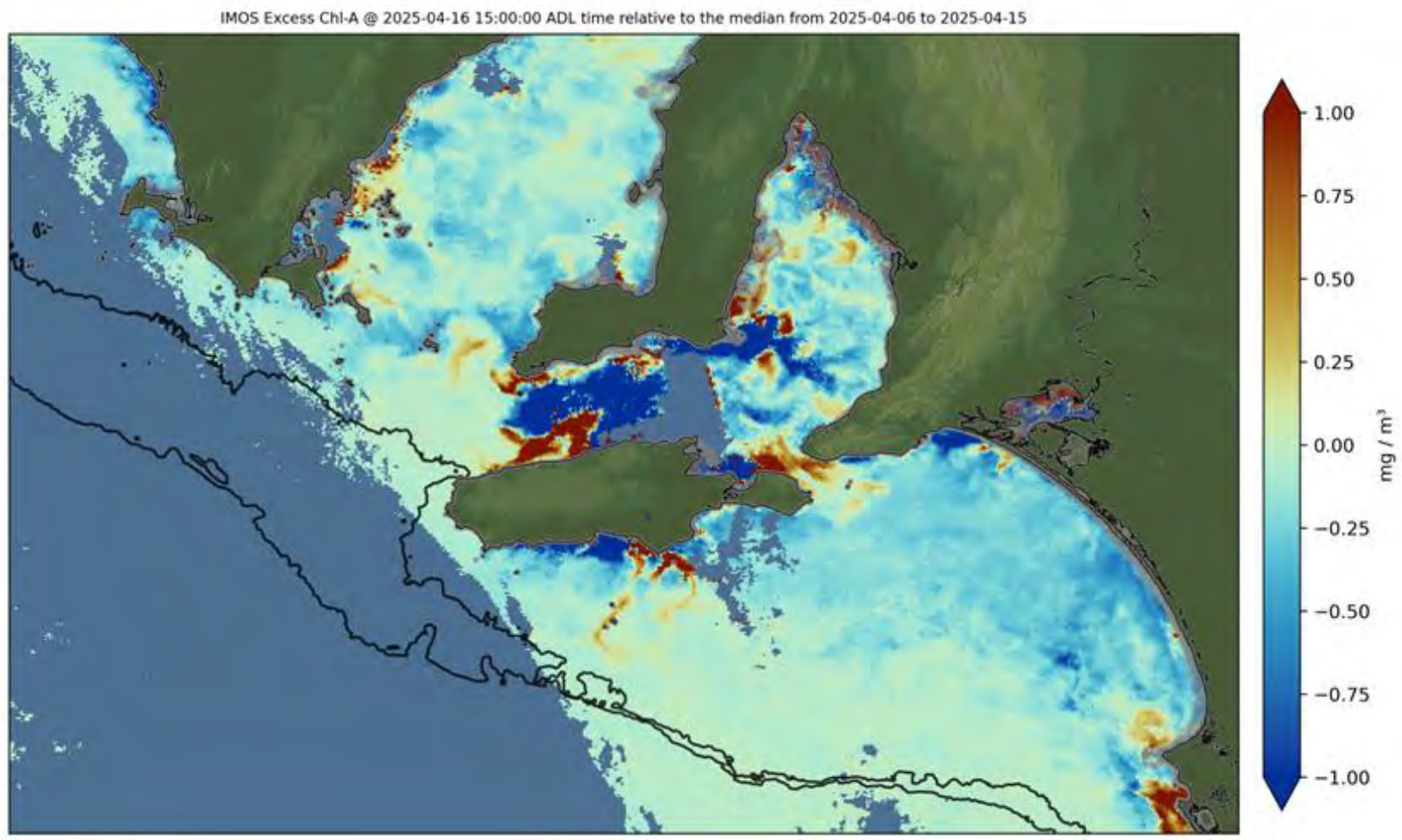


Figure 3. Latest daily image for 16-April showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 18-April-2025

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figure 4) was used to predict the trajectory of water masses over a period of 5 days, starting 17-April and ending 22-April 2025. The model simulation includes the passage of a cold front that is predicted to pass through Adelaide during Sunday and Monday (20-21 April), which is expected to bring strong southwesterly to southerly winds between 25-35 km/h (7-10 m/s). These winds are predicted to transport water masses containing phytoplankton (chla) northward along the coast of both gulfs.

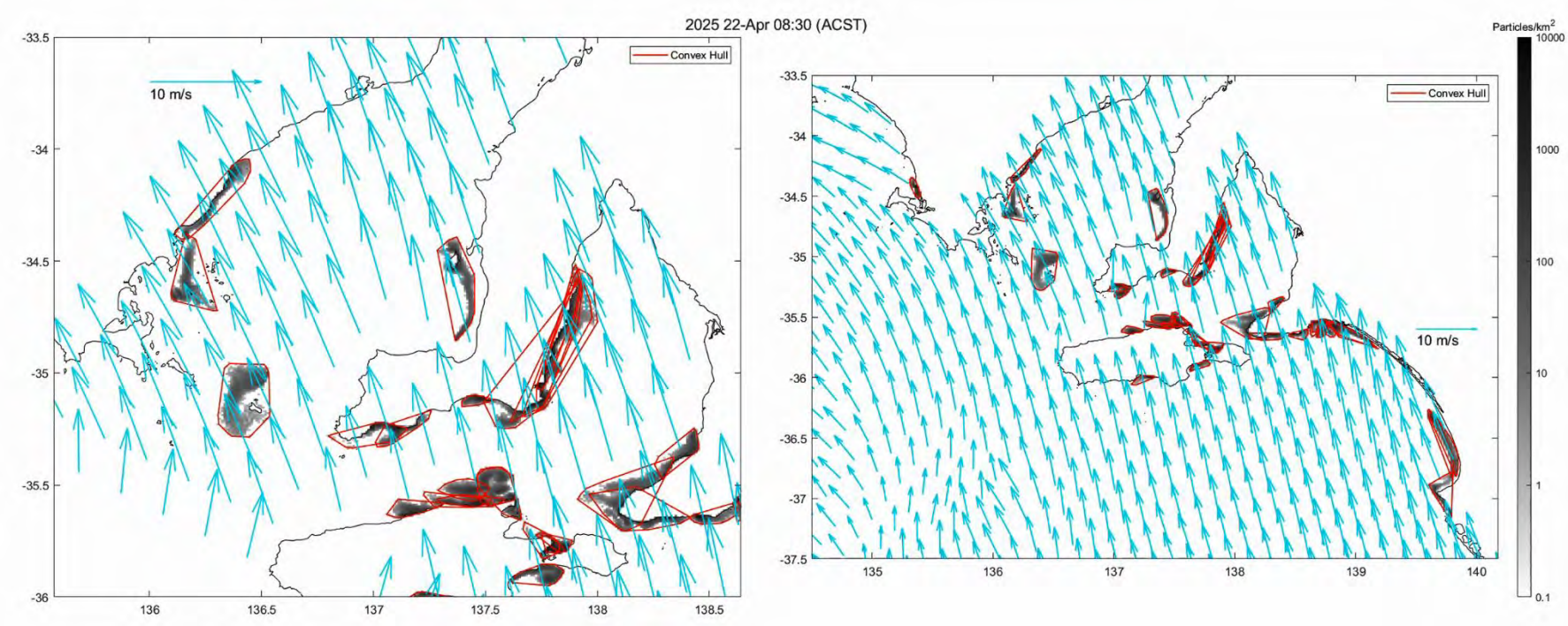


Figure 4. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 17-April and ending 22-April. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess; Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; 'Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; Clause 6(1)
Cc: Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-24042025.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess ; Executive Officer ; Clause 6(1) ; Rob Gratton ; Clause 6(1) Neil MacDonald ; Nathan Kimber ; Clause 6(1) Clause 6(1) @yumbah.com' ; Clause 6(1) @yumbah.com' ; Clause 6(1) @sasardines.com.au' ; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' ; Clause 6(1) @CH4global.com' ; Clause 6(1) @bigpond.com' ; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com' ; Clause 6(1)
Cc: Doubell, Mark (PIRSA)
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@dea nseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yum bah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling

<keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

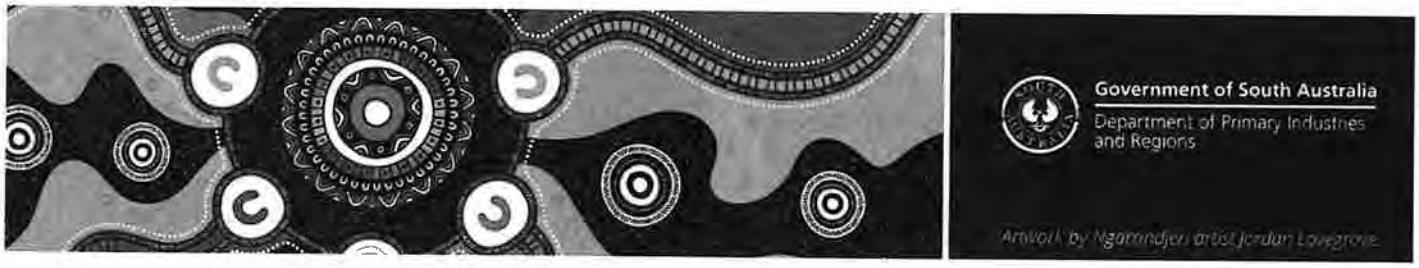
Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-24042025.pdf

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery ([redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) < Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) < Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information :

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

Context

SARDI is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation.

Note: presented daily increases/decreases in chlorophyll-a (chla) concentrations measured by satellite may not be associated with the presence of HAB species.

Update

- Moderate to extreme marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024, with latest conditions on 21-April 2025 indicating moderate to strong MHW conditions continue to persist across South Australia (Figure).

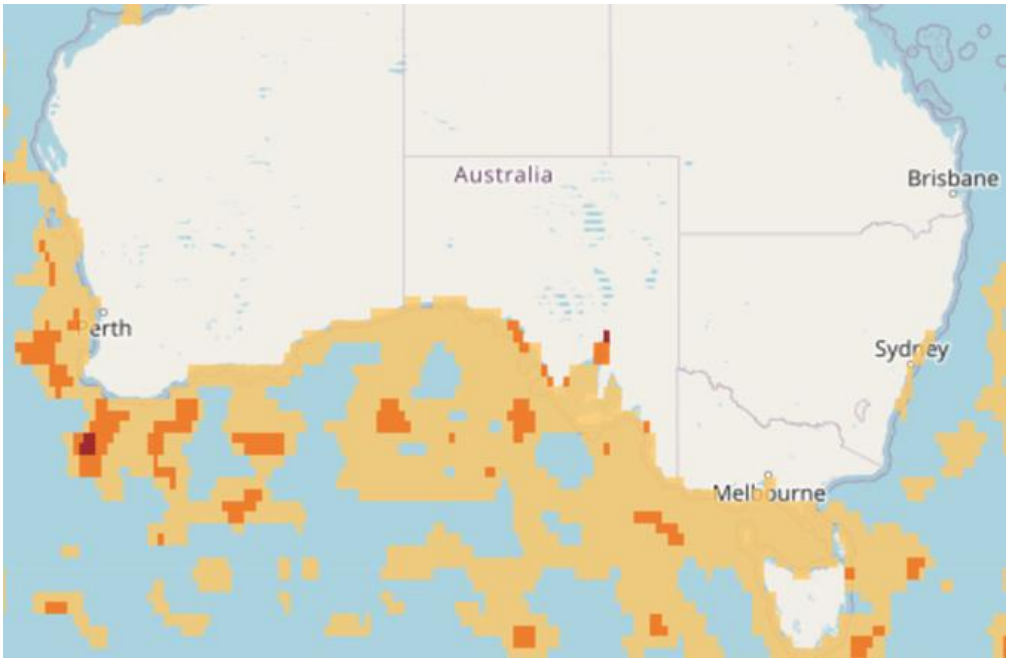


Figure 1. Latest available snapshot of the current marine heatwave conditions in Australia on the 21-April 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

- As of 22-April 2025, sea surface temperature (SST) anomalies remain +1 to +2°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update provided on 18-April, SST anomlaies have reduced by approaximately 1°C across much of the state's coastal waters.

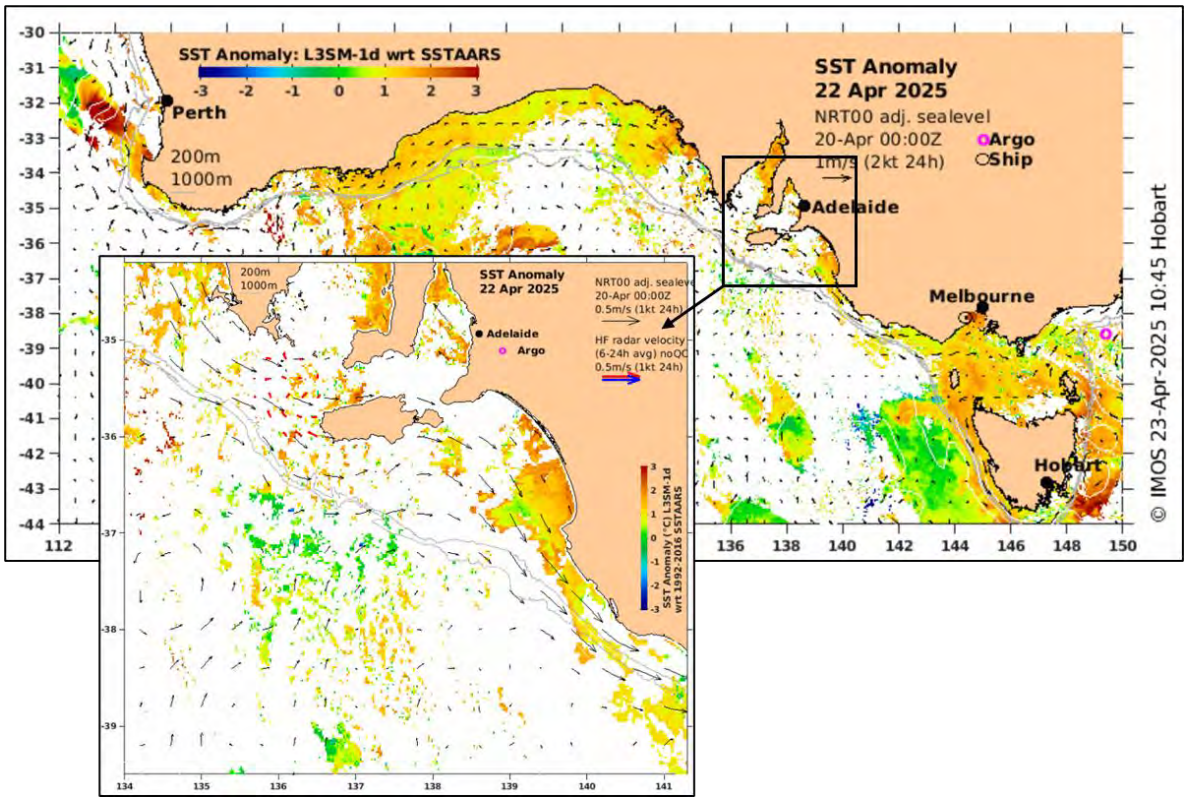


Figure 2. Latest sea surface temperature anomalies in the south Australian region. Source: https://oceancurrent.aodn.org.au/.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

- SST data collected by the IMOS and SAWAVES wave-buoy network (sawaves.org) shows sea surface temperatures decreased in coastal waters across the state by approximately 1 to 2°C during the period 17-April to 24-April 2025 (to present; Figure 3). The largest decreases coincided with the passing of a cold front between 19-22 April, which was associated with increases in significant wave height.

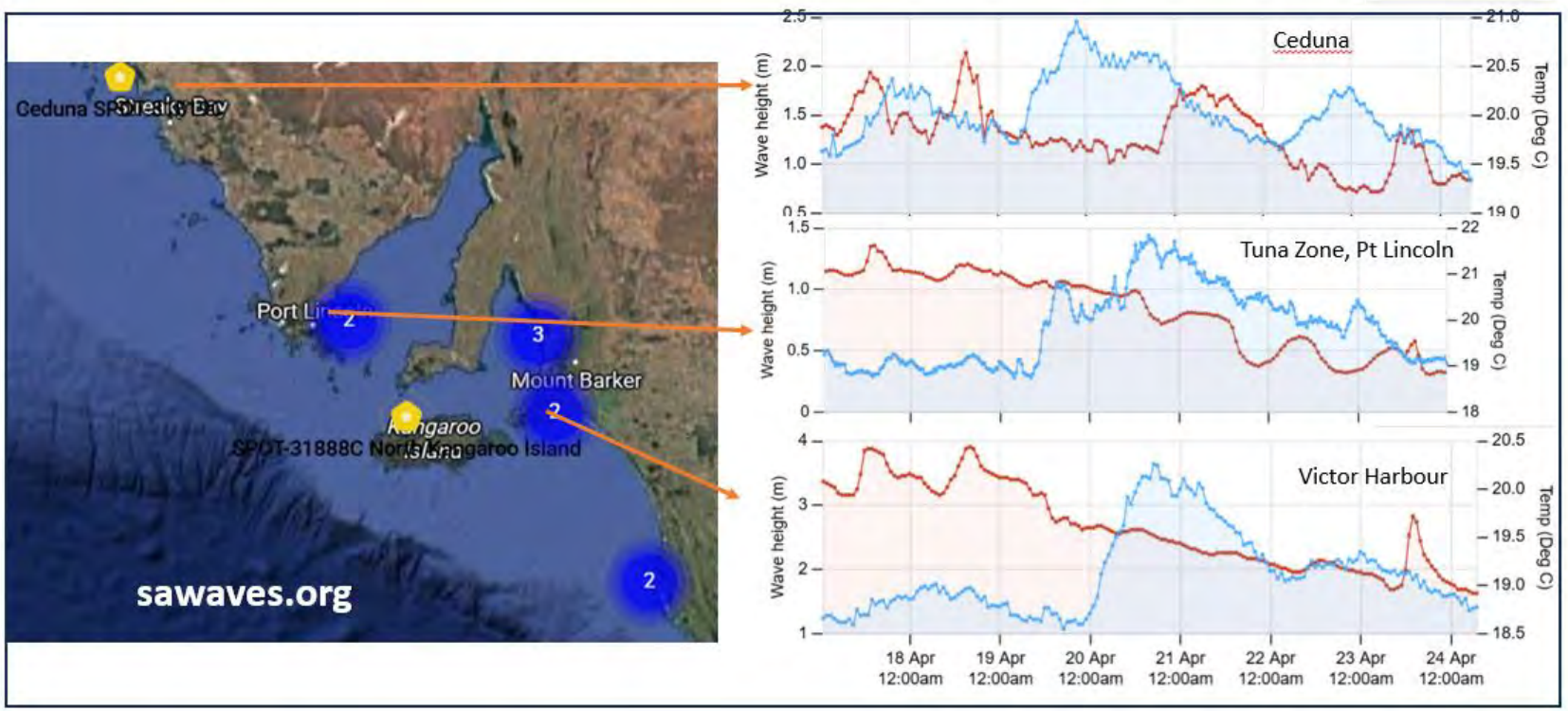


Figure 3. Latest sea surface temperature (red) and significant wave height (blue) data from wave-buoys located in coastal South Australian regions. Source: sawaves.org

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

SARDI
South Australian Research and Development Institute

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

TO NOTE: Cloud cover restricted the availability of satellite images of SST and surface chla concentrations between 19-April and 21-April 2025.

- Figure 4 shows the latest satellite chla image taken on 22-April. Elevated chla levels are persisting in Investigator Strait, in upper Gulf Saint Vincent and along the Coorong coast east of Goolwa.

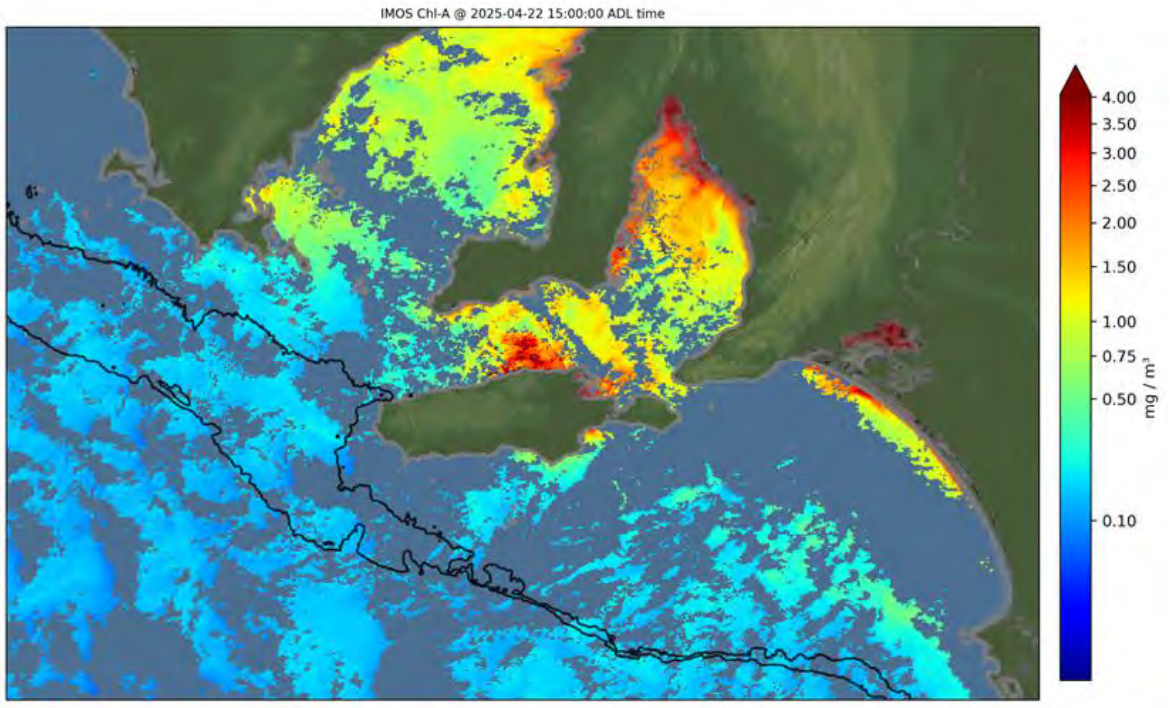


Figure 4. Latest sea surface chla map taken on 22-April 2025. Source: https://oceancurrent.aodn.org.au/. Regions where no data is available due to could cover are shaded in grey-blue.

- The corresponding daily image showing areas of sea surface chla increases and decreases (Figure 5) was determined by subtracting the median value of the previous 10-days sea surface chla maps from the latest sea surface chla maps shown in Figure 4.

- Comparison of the changes in concentrations observed on the 22-April (Figure 5) to those provided previously in the situation update on 18-April, indicate sea surface chla concentrations are generally decreasing in the coastal waters in Investigator Strait, southern Gulf Saint Vincent, and on the western side of southern Spencer Gulf.

- Areas of increasing sea surface chla are observed along the Coorong, in the central and eastern sides of upper Gulf Saint Vincent (including Adelaide metropolitan waters), in central and southern Spencer Gulf, and around D'Estrees Bay on Kangaroo Island.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

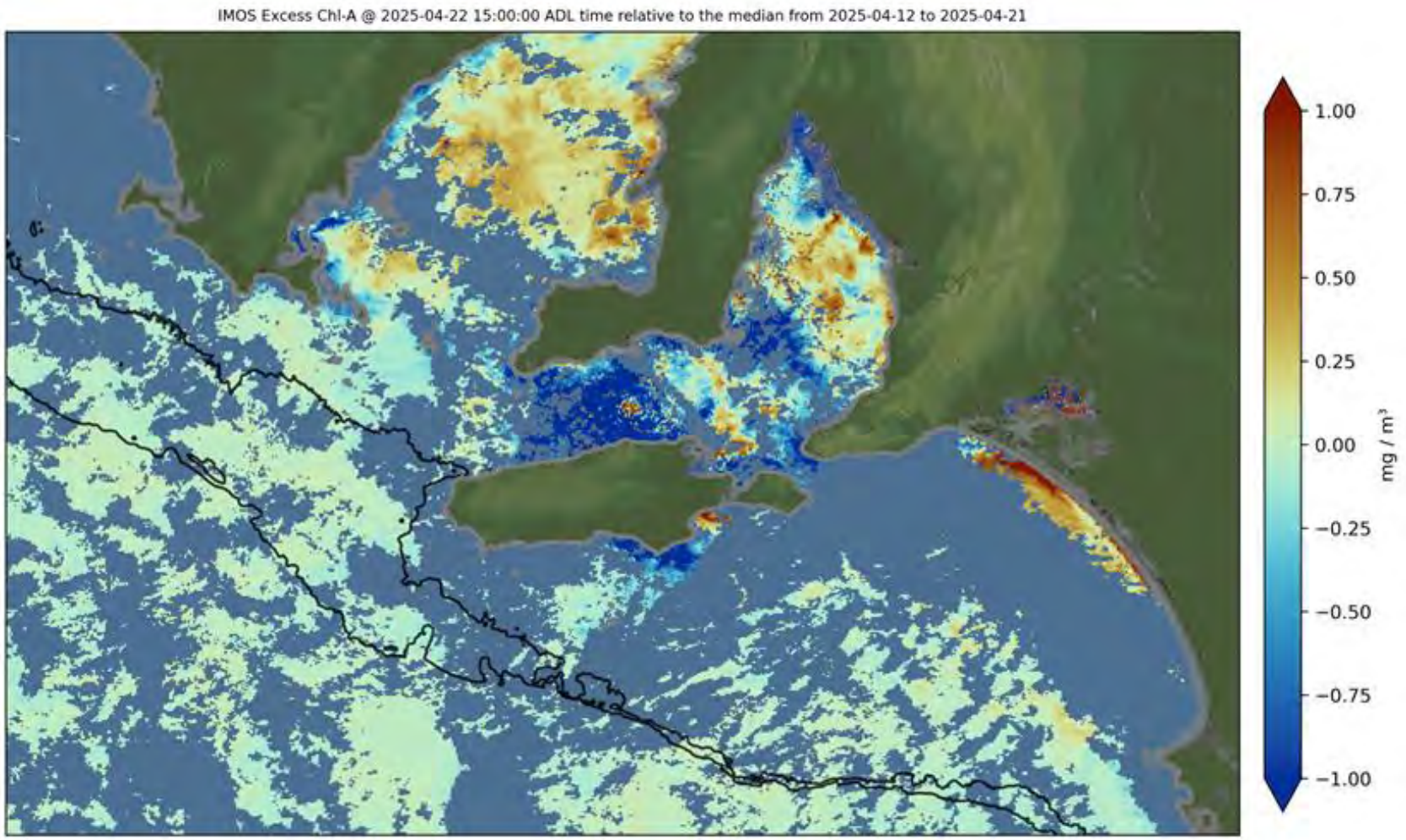


Figure 5. Latest daily image for 22-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to could cover.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 24-April-2025

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figure 6) was used to predict the trajectory of water masses over a period of 5 days, starting 22-April and ending 27-April 2025. The end of model simulation includes the passage of a cold front which is predicted to pass through Adelaide during Saturday and Sunday (26-27 April 2025). The front which is expected to bring moderate southerly to southwesterly winds is predicted to transport water masses containing phytoplankton (chla) northward along the coast of both gulfs.

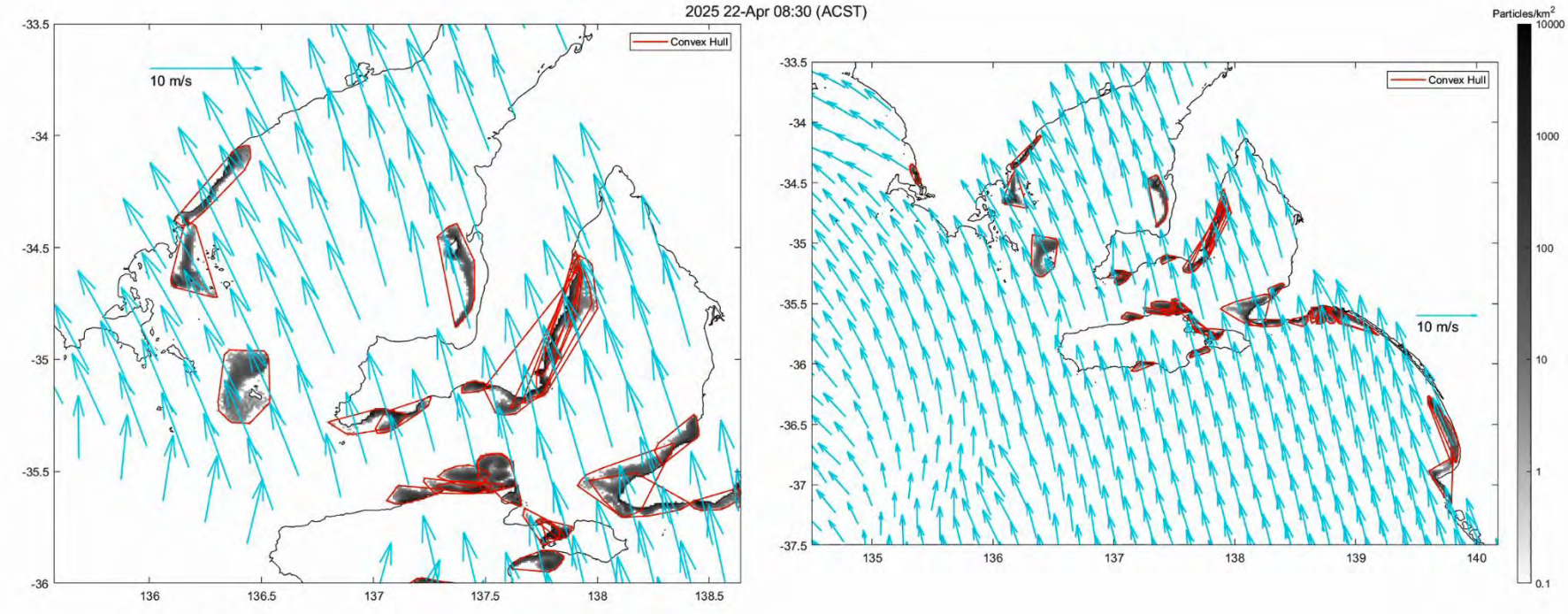


Figure 6. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 22-April and ending 27-April 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Contact: Mark.Doubell@sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farley, Lisa (PIRSA)

From: Clause 6(1) <Clause 6(1)>
Sent: Thursday, 1 May 2025 5:08 PM
To: Begg, Gavin (PIRSA)
Subject: FW: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-28042025.pdf

You don't often get email from Clause 6(1). Learn why this is important

OFFICIAL

Hi Gavin,

I hope you're doing well. Can you please add me to the email alerts below? I'll be taking over from Clause 6(1) in this regard going forward. These updates are great by the way- thanks.

Kind regards,

Clause 6(1)
Manager- Farm Operations
Yumbah Aquaculture
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com

From: Ray Henderson
Sent: Tuesday, 29 April 2025 9:32 AM
To: Clause 6(1); Clause 6(1); Clause 6(1); Clause 6(1); Clause 6(1); Clause 6(1)
Subject: FW: Algal bloom update

FYI Update

Kind regards
Clause 6(1)

Clause 6(1)
Yumbah Aquaculture
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com

From: Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1)@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) <Clause 6(1)@yumbah.com>; Clause 6(1) <Clause 6(1)@yumbah.com>; 'Clause 6(1)@sasardines.com.au' <Clause 6(1)@sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

OFFICIAL

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1)@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1)@sasardines.com.au' <Clause 6(1)@sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; 'Clause 6(1) Clause 6(1)@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; 'Clause 6(1) <Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula, particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in South Australia was in 2014 in Coffin Bay.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons the current HAB is dynamic and can travel depending on weather, ocean circulation and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions (PIRSA) eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals, or extensive fish kills, to contact their local National Parks and Wildlife Service office.

Important Notes

- The presented daily increases/decreases in chlorophyll-a (chla) concentrations determined form satellite chla imagery do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Sea temperatures currently remain 1–2°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of increasing chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, are found off the southern tip of Yorke Peninsula near Pondalowie, along the western side of Gulf Saint Vincent between Edithburgh and Port Vincent and along the Coorong near Salt Creek. Decreasing chla levels are found in Investigator Strait between the northwest coast of Kangaroo Island and Yorke Peninsula and the northwestern region of the Coorong near Goolwa.

Ocean circulation forecasts covering a five-day period ending 3-May 2025, provide an indication of where water masses and any algae contained within them may move

from multiple source locations. These forecasts help anticipate potential shifts in bloom distribution based on prevailing ocean currents and environmental drivers.

Detailed Update

- Moderate to extreme marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024, with latest conditions on 23April 2025 indicating moderate MHW conditions persist across South Australia's coastal regions (Figure 1).

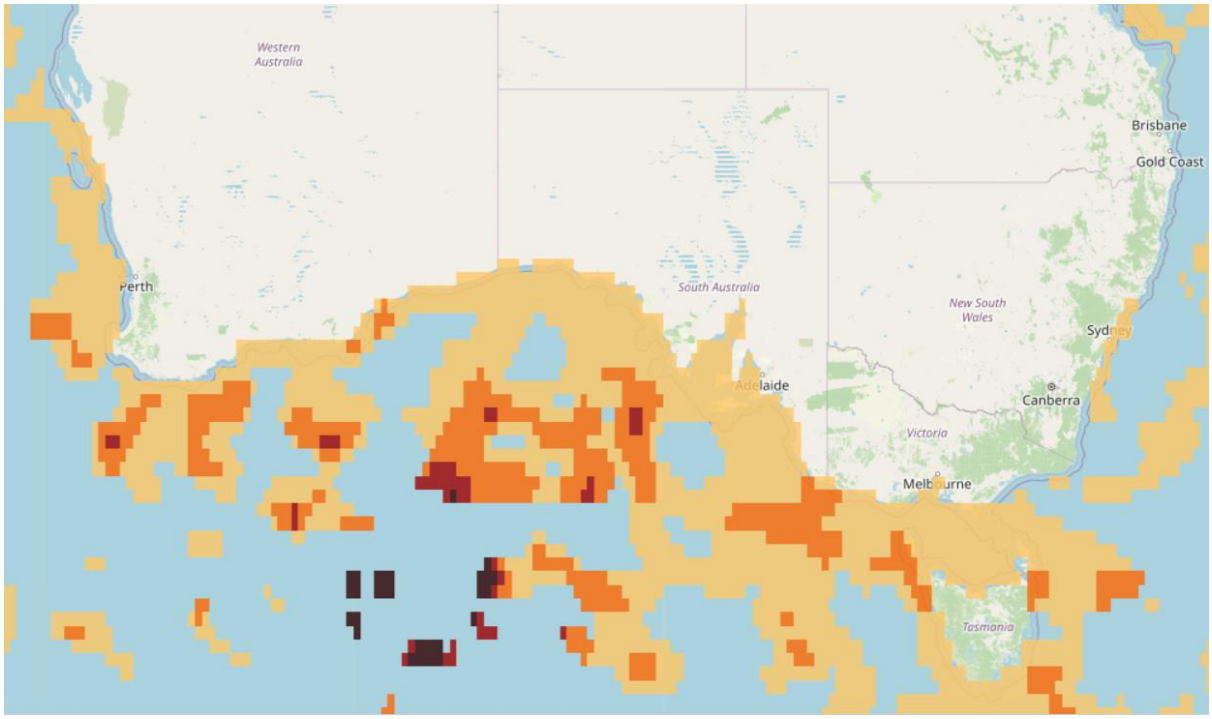


Figure 1. Latest available snapshot of the current marine heatwave conditions in Australia on the 23-April 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

- As of 25-April 2025, sea surface temperature (SST) anomalies remain +1 to +2°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update provided on 24-April, SST anomlaies have remained relatively stable.

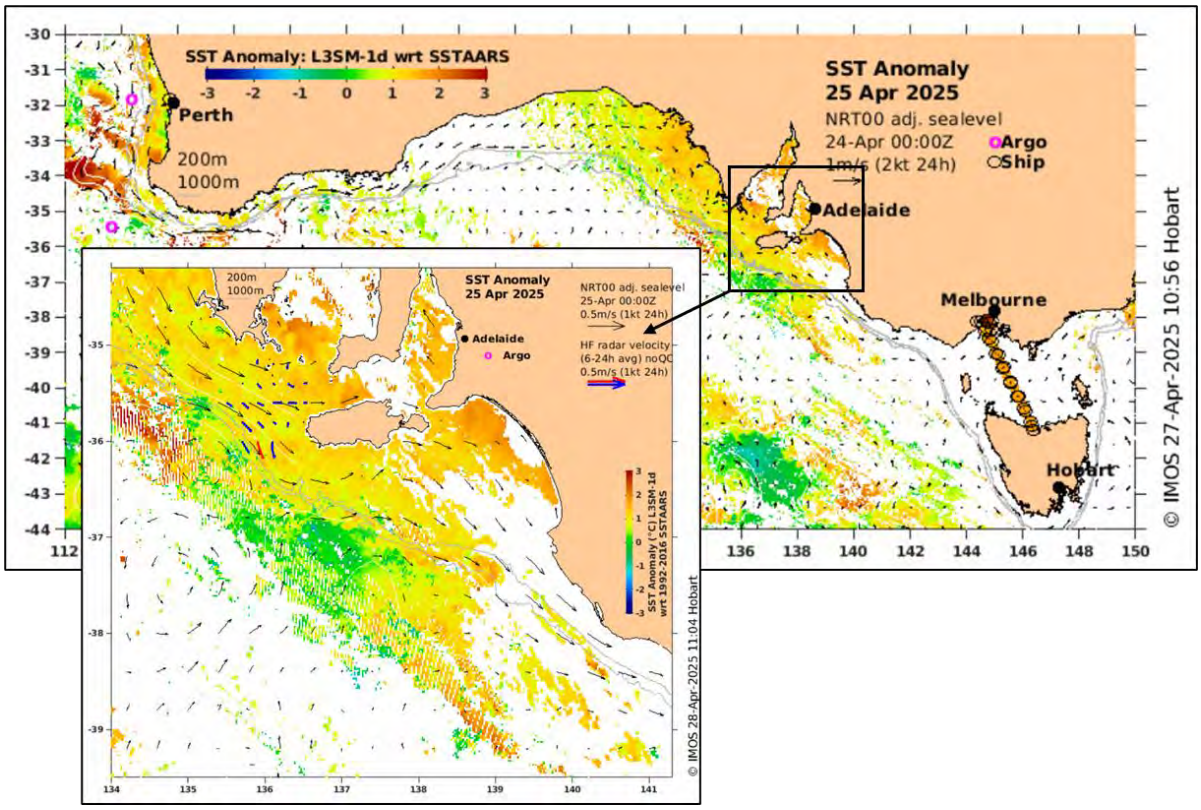


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

Government of South Australia
Department of Primary Industries and Regions

SARDI
South Australian Research and Development Institute

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

- SST data collected by the IMOS and SAWAVES wave buoy network show surface temperatures decreases stabilised across South Australia during the period 25-April to 28-April 2025, with current temperatures ranging from ranging from approximately 19°C in Victor Harbour and Port Lincoln to 19.5 °C in Ceduna.

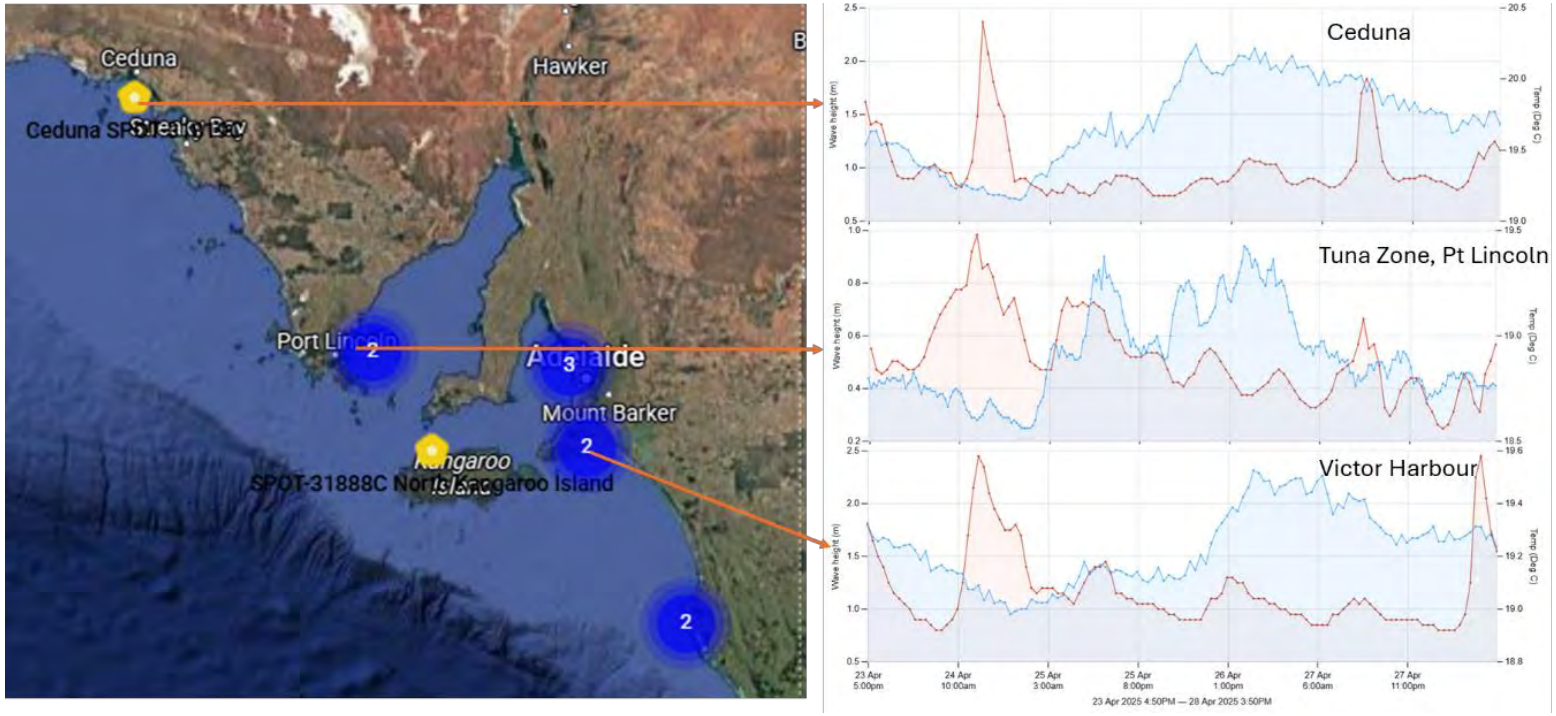


Figure 3. Latest sea surface temperature and significant wave height data from wave-buoys located in coastal South Australian regions. Source: sawaves.org

Government of South Australia
Department of Primary Industries and Regions

SARDI
South Australian Research and Development Institute

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

- Figure 4 shows the latest satellite chla image taken on 26-April 2025. Elevated chla levels are persisting off the southern tip of Yorke Peninsula, the western side of upper Gulf Saint Vincent and along Coorong east coast of Goolwa to Kingston in the southeast.

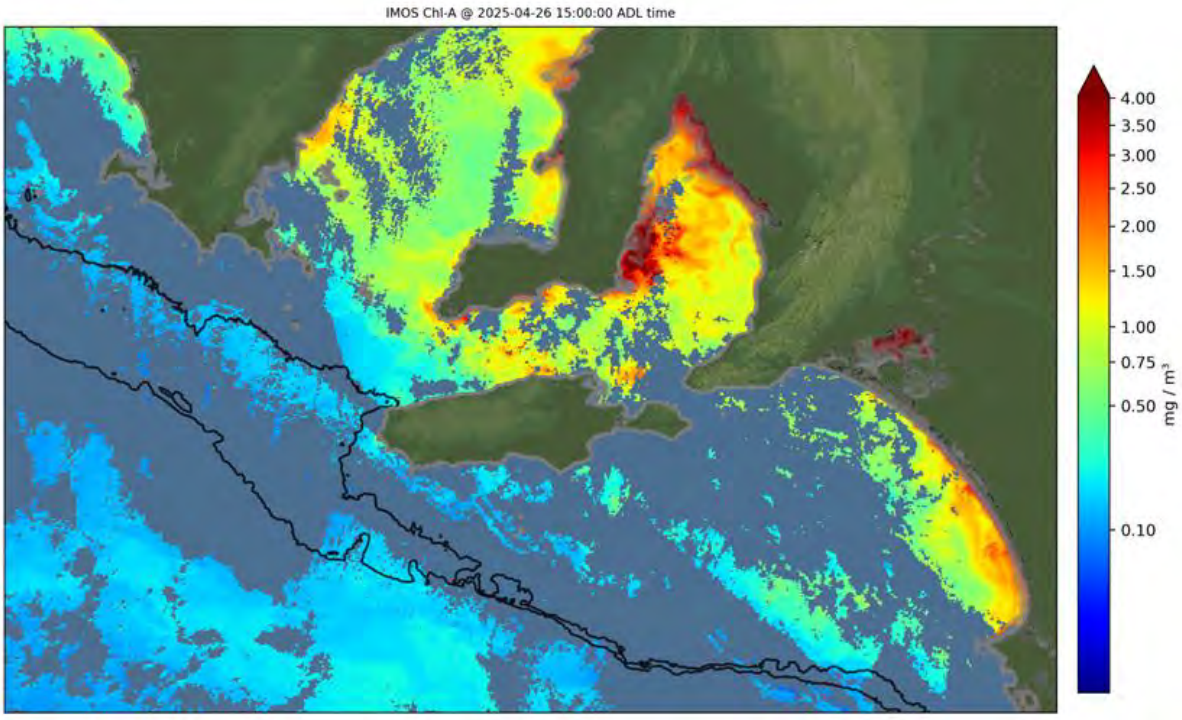


Figure 4. Latest sea surface chla map taken on 26-April 2025. Source: https://oceancurrent.aodn.org.au/. Regions where no data is available due to cloud cover are shaded in grey-blue.

- The corresponding daily image for 26-April 2025 showing areas of sea surface chla increases and decreases (Figure 5) was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the changes in concentrations observed on the 26-April 2025 (Figure 5) to that from 22-April 2025 (Figure 6), indicate sea surface chla concentrations are generally decreasing in Investigator Strait, northern Gulf Saint Vincent, and the northwestern region of the Coorong near Goolwa.

- Areas of increasing sea surface chla are observed along the southeastern region of the Coorong, on western side of central Gulf Saint Vincent, and the southern and western tip of Yorke Peninsula.

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

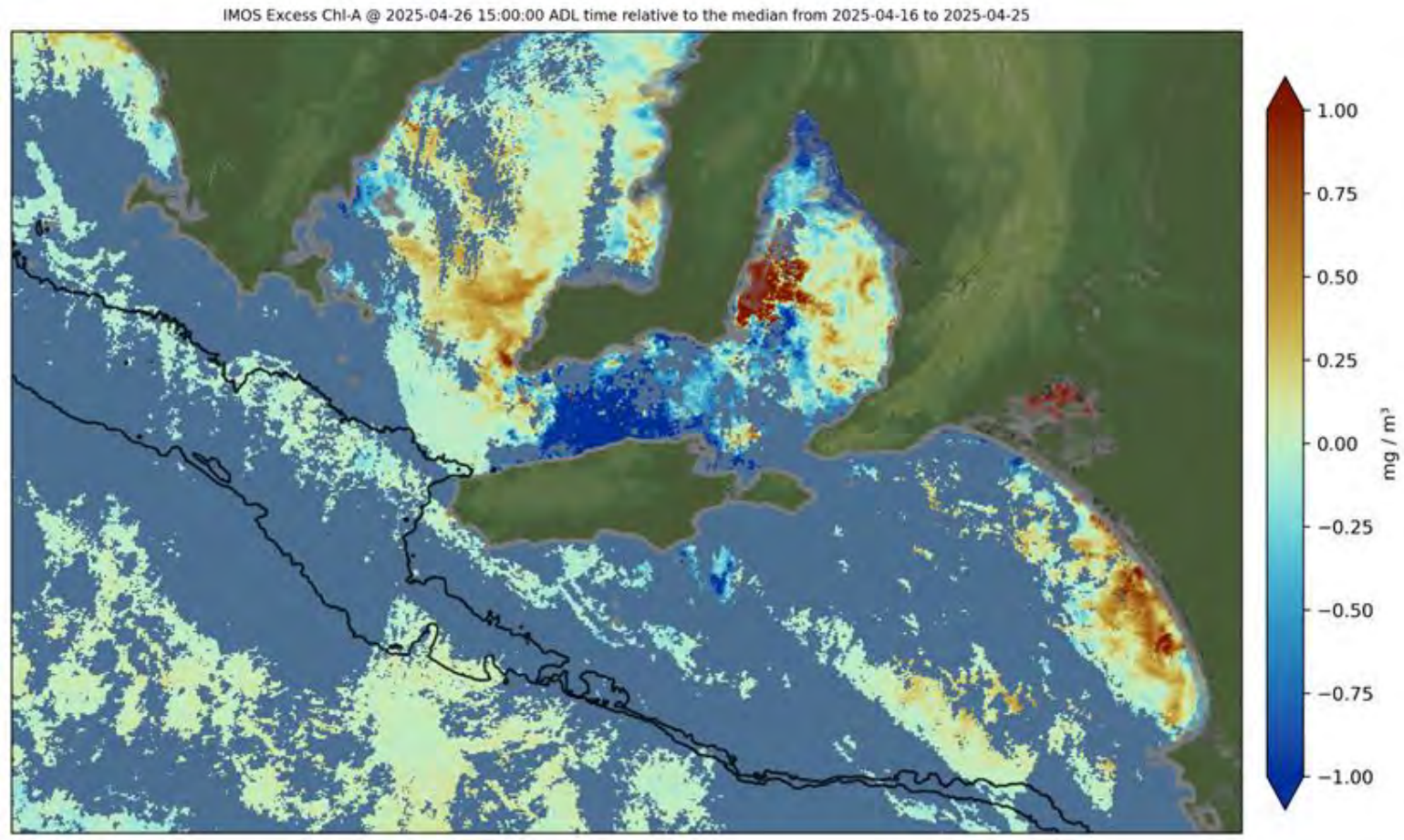


Figure 5. Latest daily image for 26-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

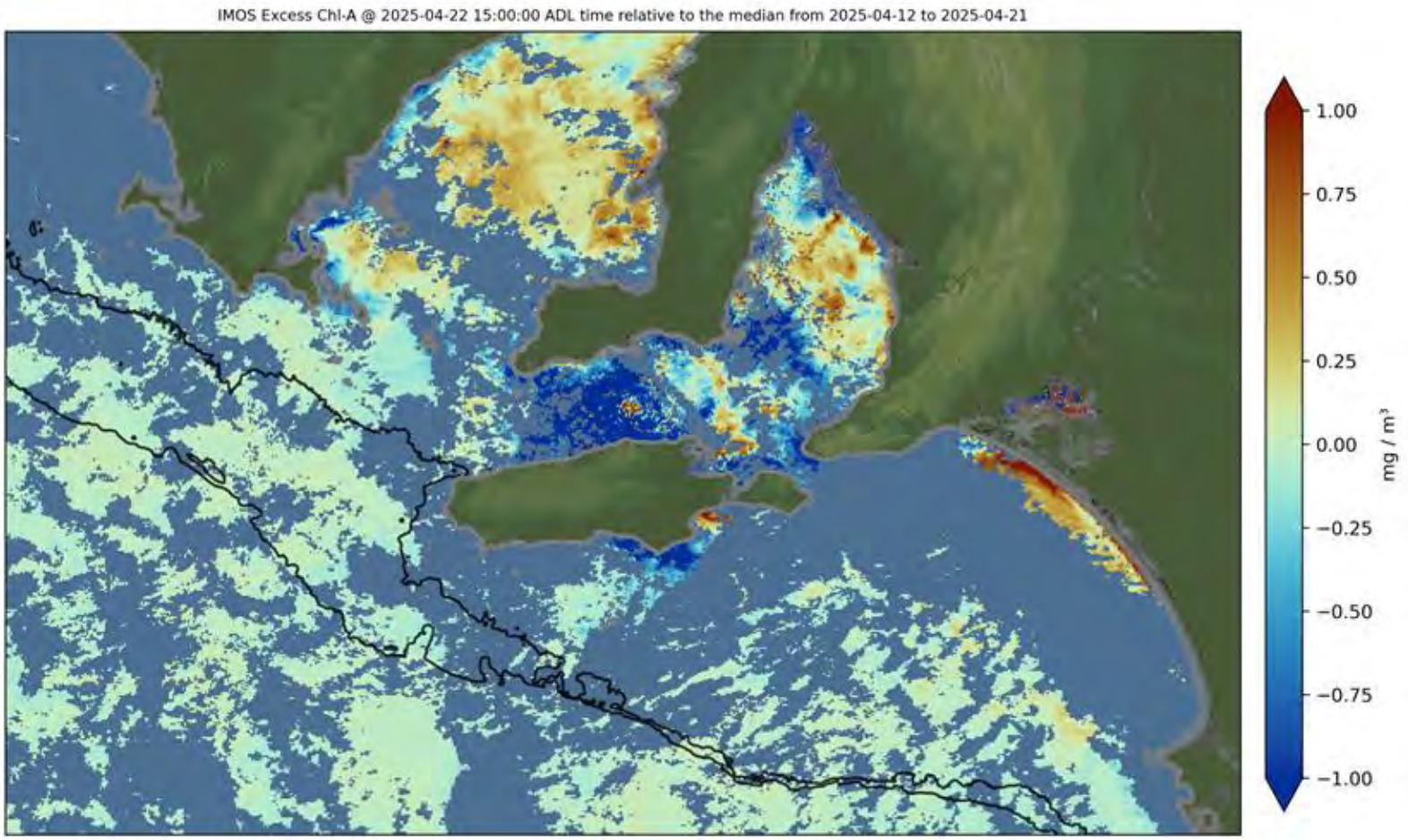


Figure 6. Daily image for 22-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figures 7 and 8) was used to predict the trajectory of water masses over a period of 5 days, starting 28-April and ending 03-May 2025. Moderate southeasterly winds dominate the beginning of the forecasted period before transitioning to light to moderate easterlies on 2-May and northerlies on 3-May 2025.

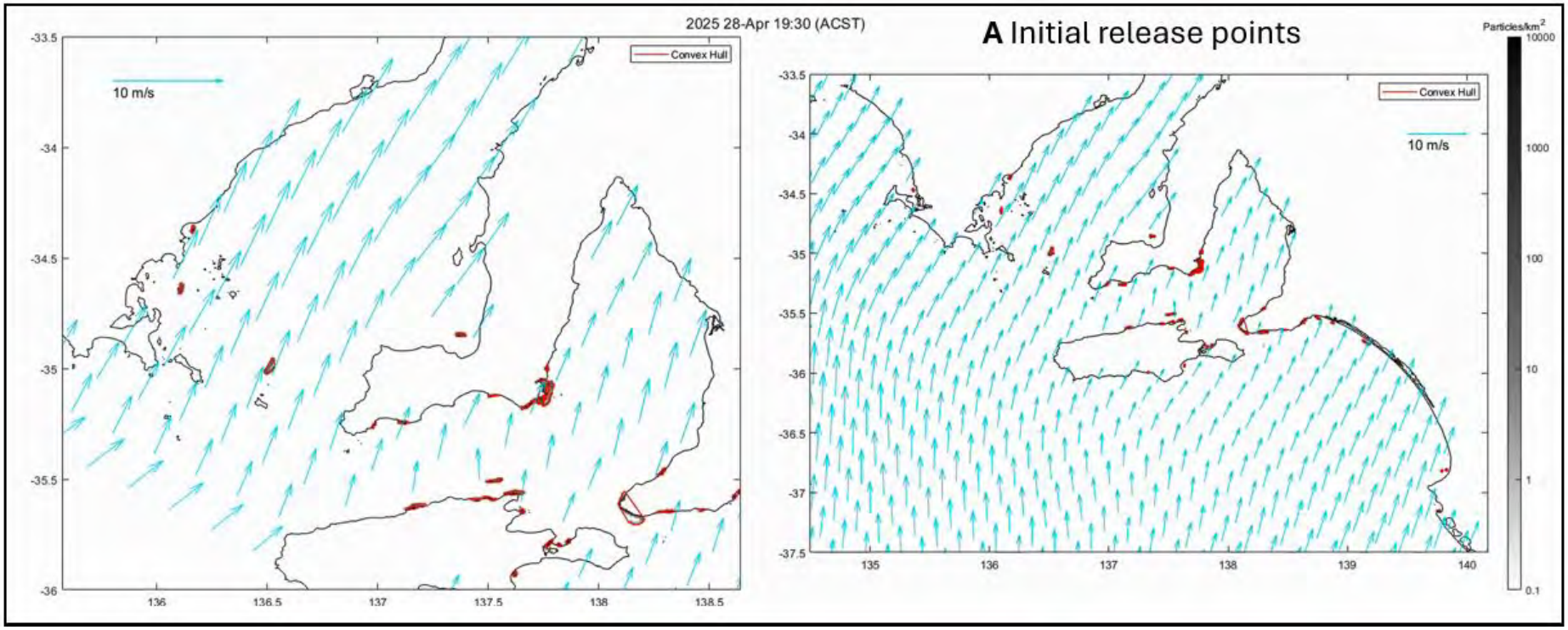


Figure 7. Initial results of oceanographic forecast modelling of particle trajectories for different source locations 20.5 hours following release on 28-April 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

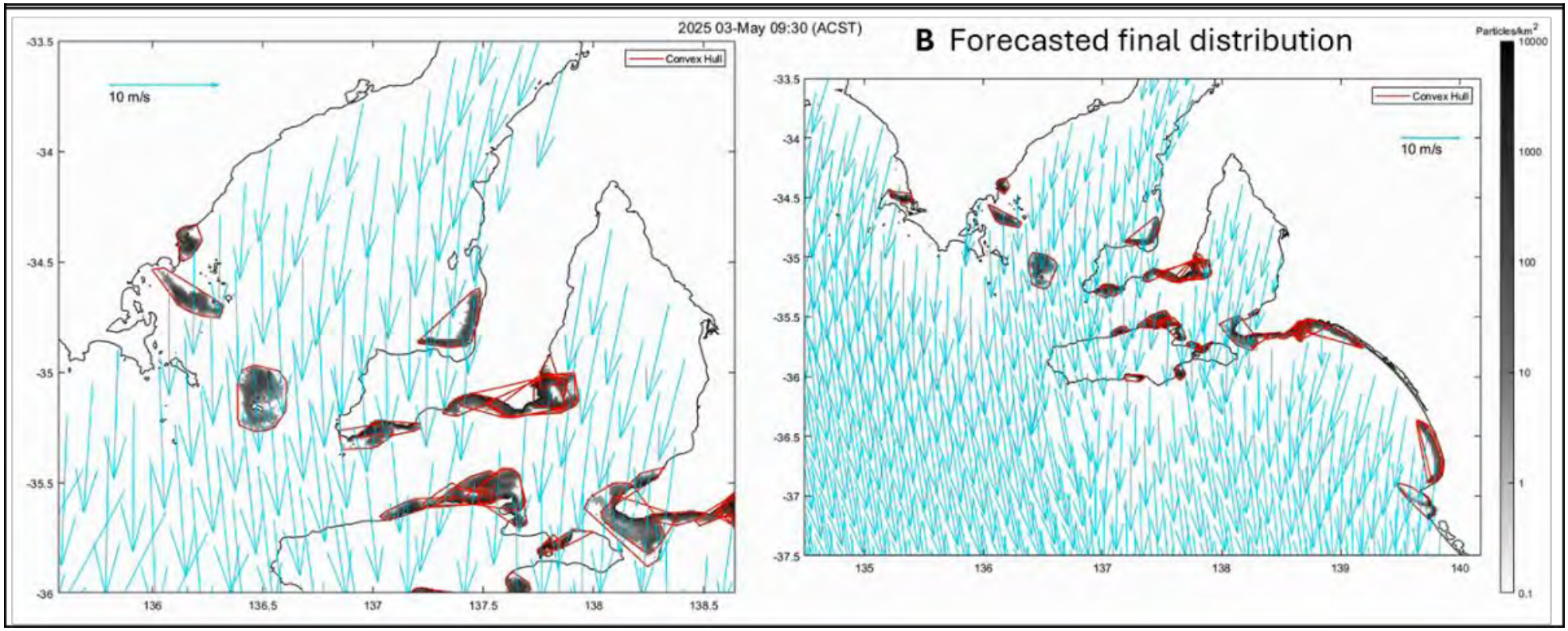


Figure 8. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 28-April and ending 03-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location.

Government of South Australia
Department of Primary Industries and Regions

SARDI
South Australian Research and Development Institute

South Australian Harmful Algal Bloom (HAB) Situation Update: 28-April-2025

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess; Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling; sapfafishers@gmail.com; Clause 6(1) Clause 6(1)
Cc: Doubell, Mark (PIRSA); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 2 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-02052025_Media.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Brian Jeffriess ; Executive Officer ; Clause 6(1) Rob Gratton ; Clause 6(1) ; Neil MacDonald ; Nathan Kimber ; Clause 6(1) Clause 6(1) @yumbah.com' ; Clause 6(1) @yumbah.com' ; ' Clause 6(1) @sasardines.com.au' ; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' ; Clause 6(1) @CH4global.com' ; ' Clause 6(1) @bigpond.com' ; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com' ; Clause 6(1)
Cc: Doubell, Mark (PIRSA)
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@dea nseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) yumbah.com' < Clause 6(1) @yumbah.com>; ' Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; ' Clause 6(1) @sasardines.com.au' < Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au;

'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted]<ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]<[redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted]<eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; '[redacted]@yumbah.com' <[redacted]@yumbah.com>; '[redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; '[redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com [redacted]<ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au> [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted]<eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com; [redacted]@yumbah.com; [redacted]@sasardines.com.au; [redacted]@strategicmc.com.au; tom@goolwapipico.com; [redacted]@CH4global.com; [redacted]@bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:27 PM
To: 'Asher Dezsery' Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update
Attachments: SARDI Oceanography-HAB Situation Update Support-02052025_Media.pdf

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:01 AM
To: 'Asher Dezsery' Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery (Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM

To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

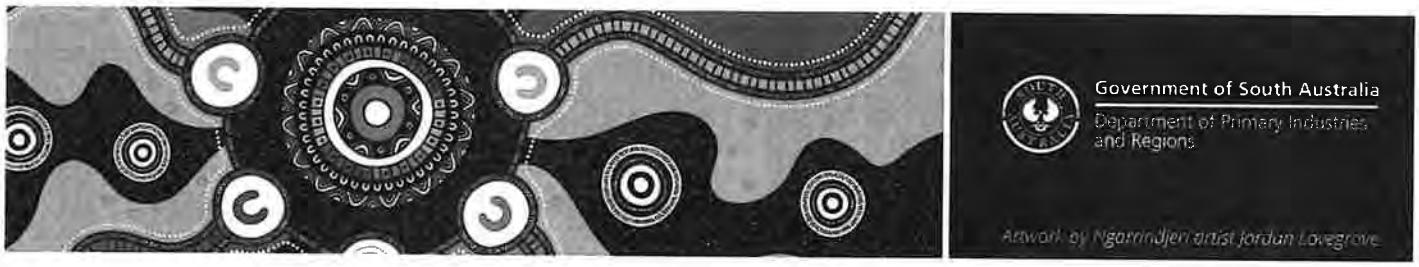
Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 18b

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula in South Australia (SA), particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in Coffin Bay, SA in 2014.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons, the current HAB is dynamic and can travel depending on weather, ocean circulation, and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions (PIRSA) eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates, refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals or extensive fish kills, to contact their local National Parks and Wildlife Service office.

Important Notes

- The daily increases/decreases in chlorophyll-a (chla) concentrations determined from satellite chla imagery presented in this document do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave (MHW) has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Sea temperatures currently remain 1–2°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of increasing chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, are found throughout Investigator Strait between Kangaroo Island and the foot of Yorke Peninsula, throughout upper Gulf Saint Vincent extending along the western from Edithburgh to Port Wakefield and back down along the eastern side as far south as the Adelaide Metropolitan coastline. Decreasing chla levels are found along the southeastern region of the Coorong and in waters to the west of the southern tip of Yorke Peninsula.

Ocean circulation forecasts covering a five-day period ending 7-May 2025, provide an indication of where water masses, and any algae contained within them, may move from multiple source

locations. These forecasts help anticipate potential shifts in bloom distribution based on prevailing ocean currents and environmental drivers.

Detailed Update

- Moderate to extreme marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024, with latest conditions on 29-April 2025 indicating moderate to strong MHW conditions persist across South Australia's coastal regions (Figure 1).

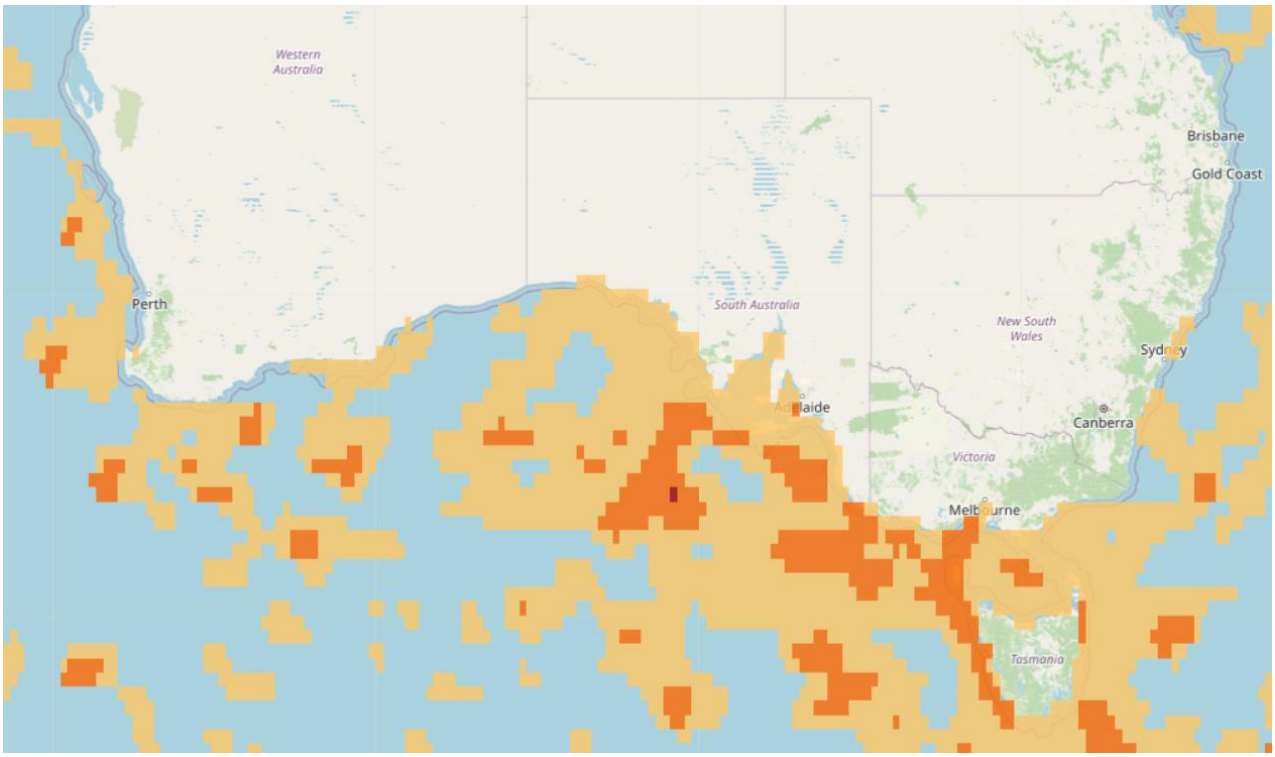


Figure 1. Latest available snapshot of the current marine heatwave conditions in Australia on 29-April 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

- As of 01-May 2025, sea surface temperature (SST) anomalies remain +1 to +2°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update provided on 28-April, SST anomlaies have remained relatively stable.

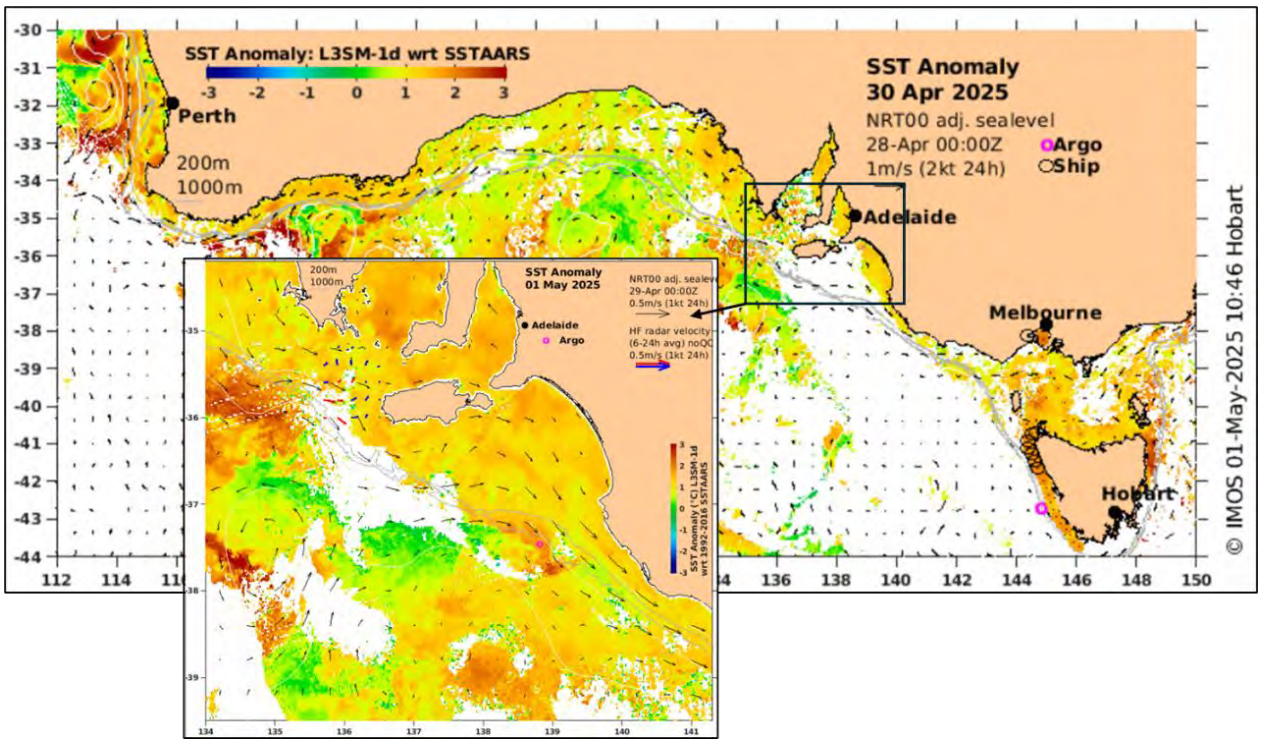


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

- SST data collected by the IMOS and SAWAVES wave buoy network show that decreases of surface temperatures due to seasonal cooling of approximately 0.25 to 1°C occurred across South Australia during the period of 23-April to 02-May 2025, with current temperatures ranging from approximately 18.5°C in Victor Harbour and Port Lincoln to 19.0 °C in Ceduna.

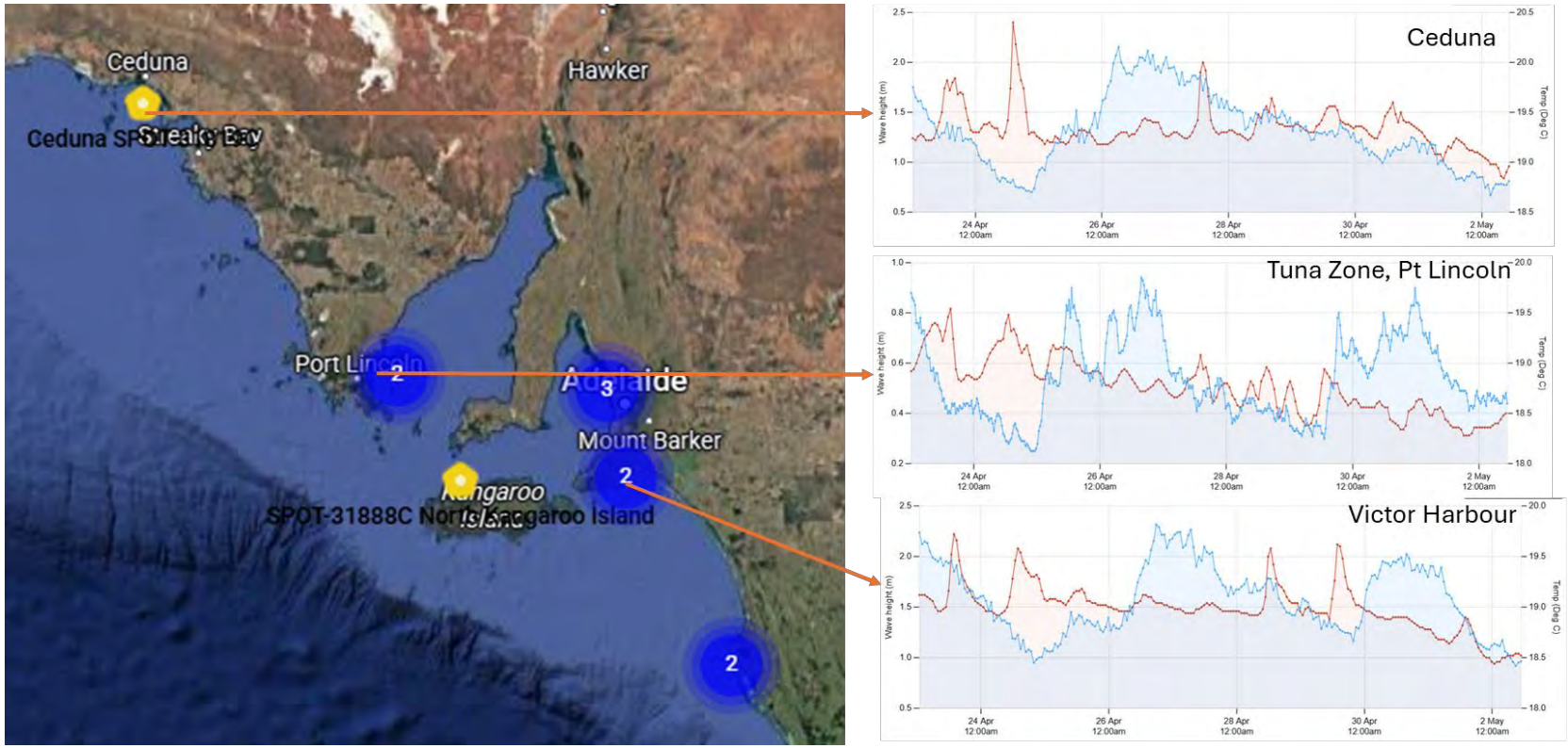


Figure 3. Latest sea surface temperature and significant wave height data from wave-buoys located in coastal South Australian regions. Source: sawaves.org

- Figure 4 shows the latest satellite chla image taken on 30-April 2025. Elevated chla levels are found off the southern foot of Yorke Peninsula, the western and northern regions of Gulf Saint Vincent, in the embayment's surrounding Port Lincoln, and along the Coorong region east coast of Goolwa to Kingston in the southeast.

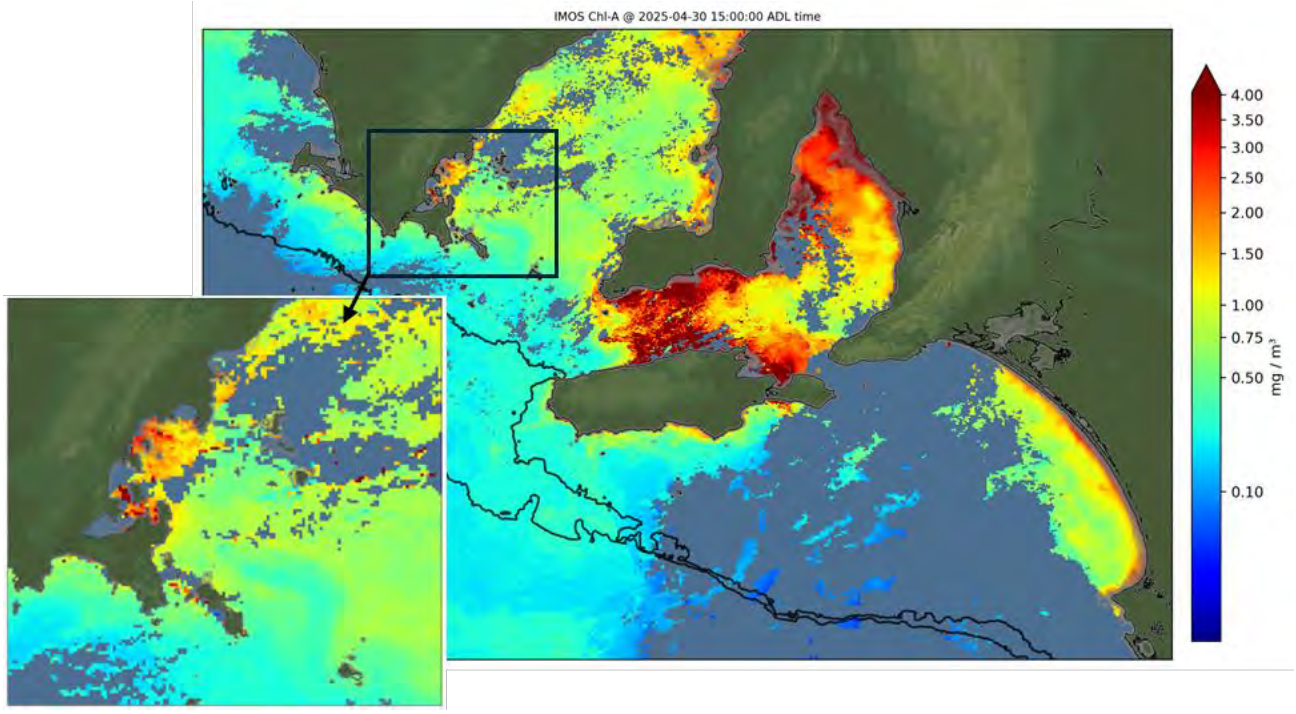


Figure 4. Latest sea surface chla map taken on 30-April 2025. Regions where no data is available due to cloud cover are shaded in grey-blue. Source: https://oceancurrent.aodn.org.au/

- The corresponding daily image for 30-April 2025, showing areas of sea surface chla increases and decreases (Figure 5), was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the changes in concentrations observed on the 30-April 2025 (Figure 5) to that from 26-April 2025 (Figure 6), suggest sea surface chla concentrations are generally increasing in Investigator Strait, northern Gulf Saint Vincent including along the Adelaide Metropolitan coastline, the north coast of Kangaroo Island, and in Boston Bay, Port Lincoln.

- Areas of decreasing sea surface chla are observed along the southeastern region of the Coorong and in waters to the west of the southern tip of Yorke Peninsula.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

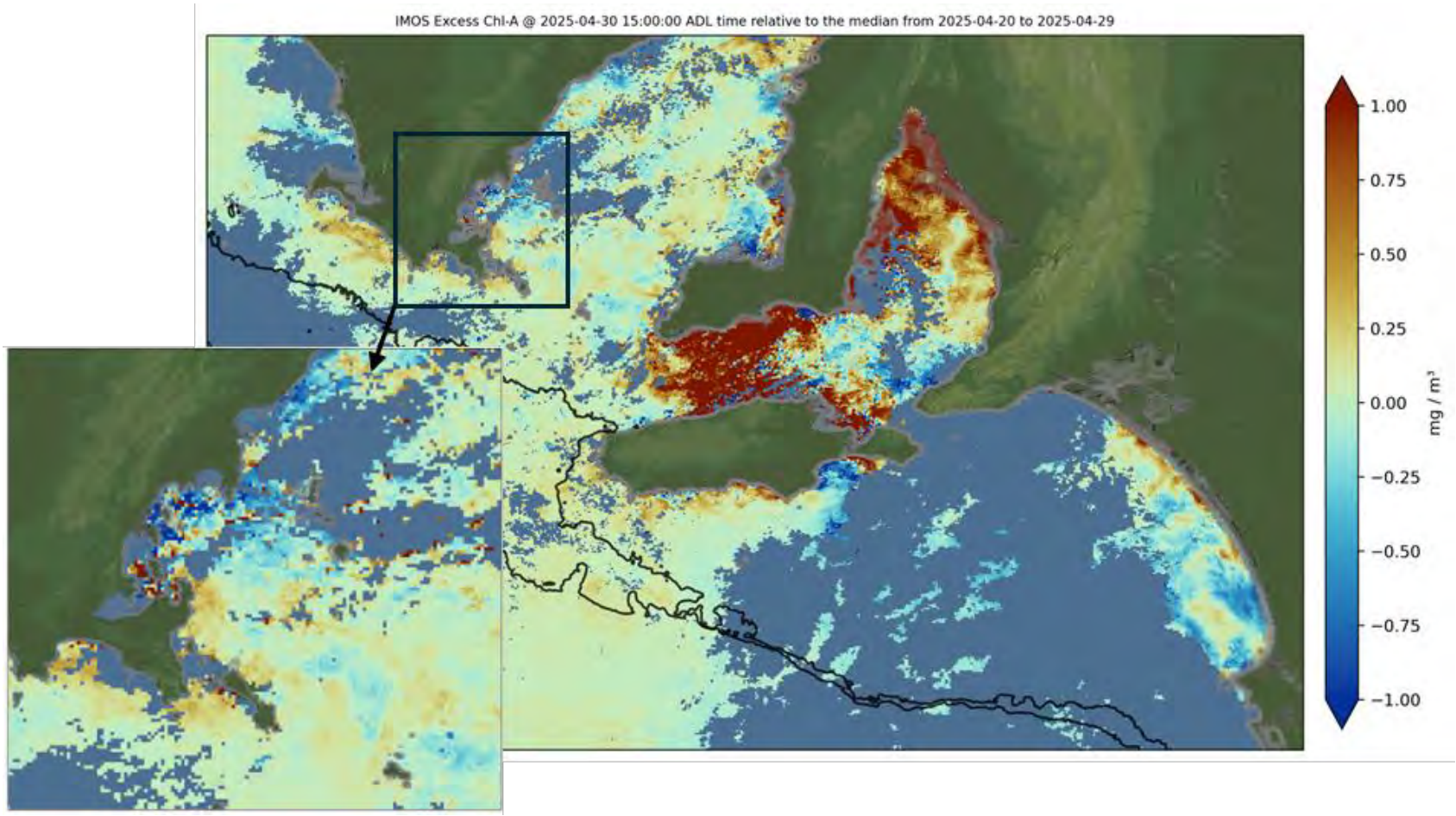


Figure 5. Latest daily image for 30-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

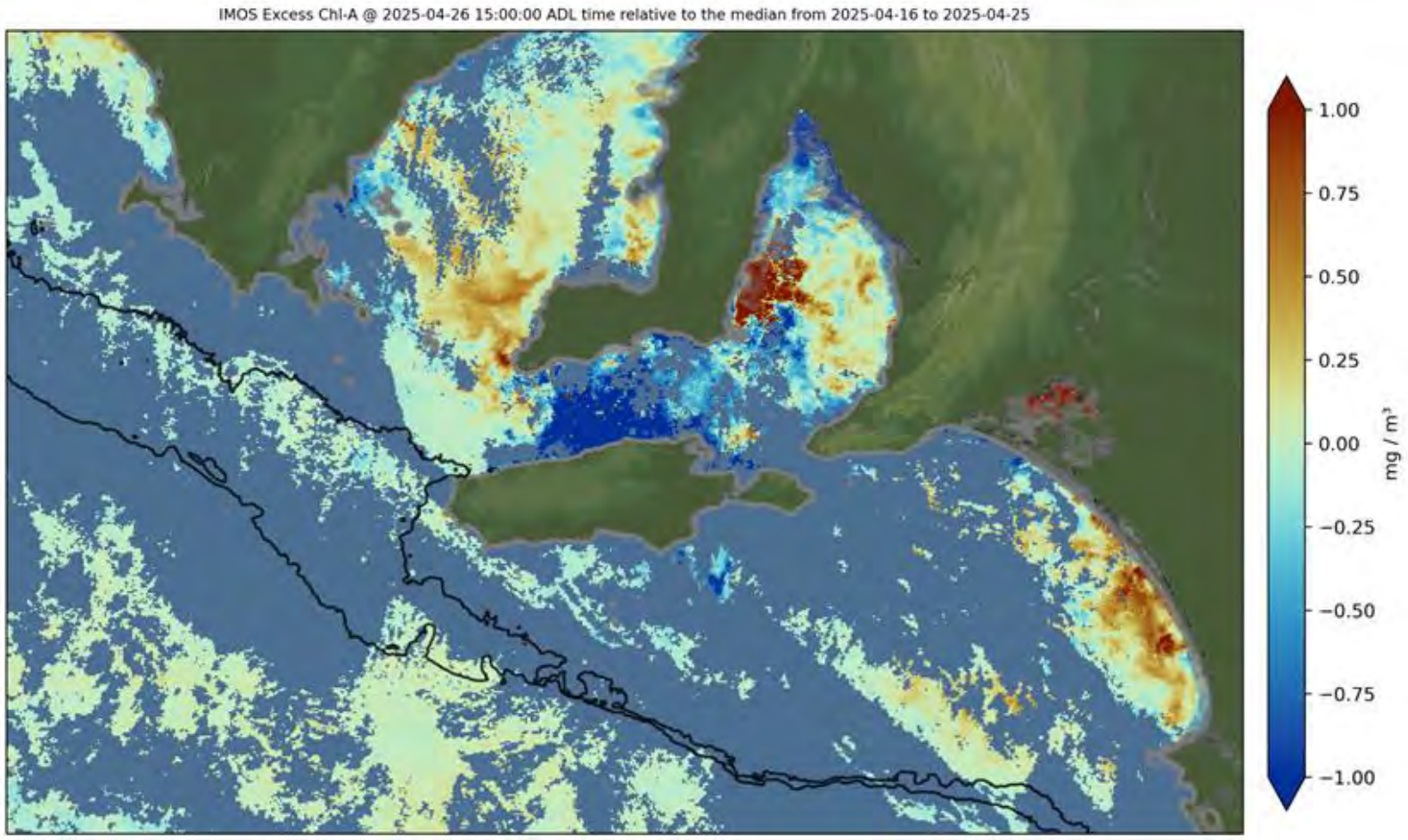


Figure 6. Daily image for 30-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figures 7 and 8) was used to predict the trajectory of water masses over a period of 5 days, starting 02-May and ending 07-May 2025. Moderate north to northeasterly winds dominate the beginning of the forecasted period before a front passes through, and a transition occurs to moderate to strong west to south-westerly winds over the period of 5-May to 7-May 2025.

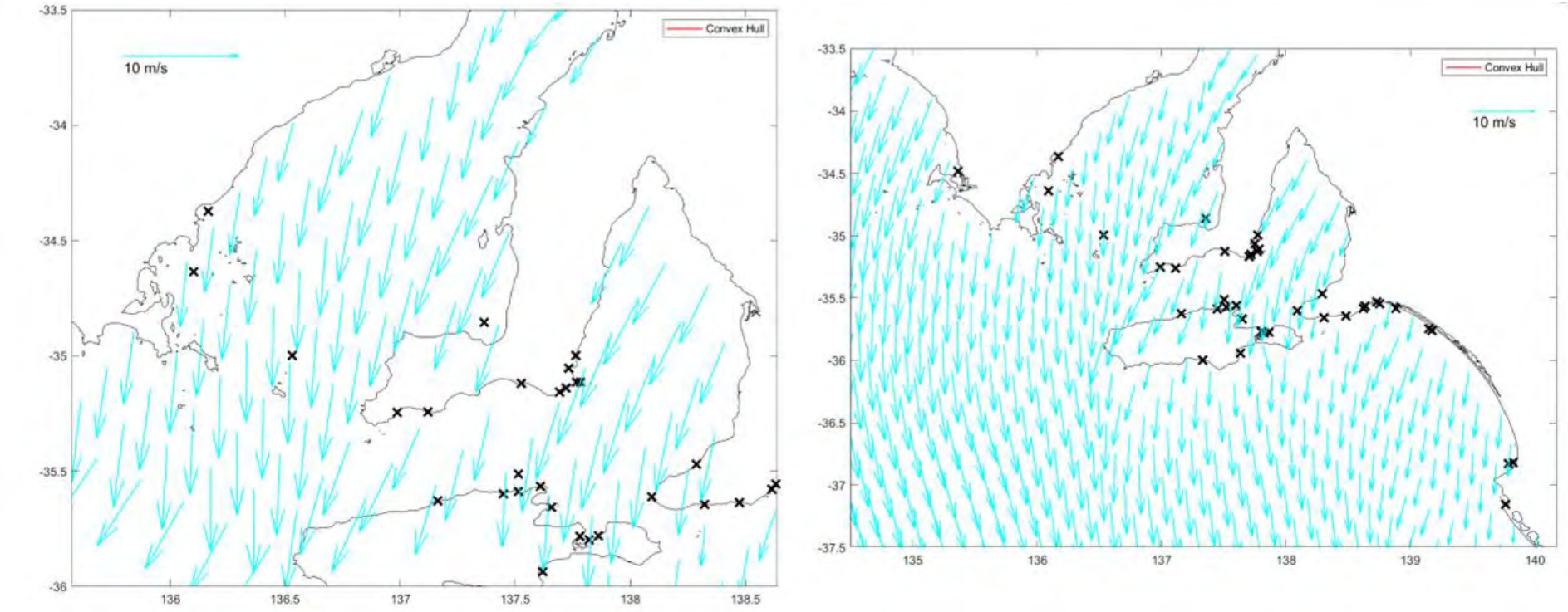


Figure 7. Initial release locations for the oceanographic forecast modelling of water mass movements using particles representative of microscopic algae. Blue arrows indicate the model wind speed and direction.

South Australian Harmful Algal Bloom (HAB) Situation Update: 02-05-2025

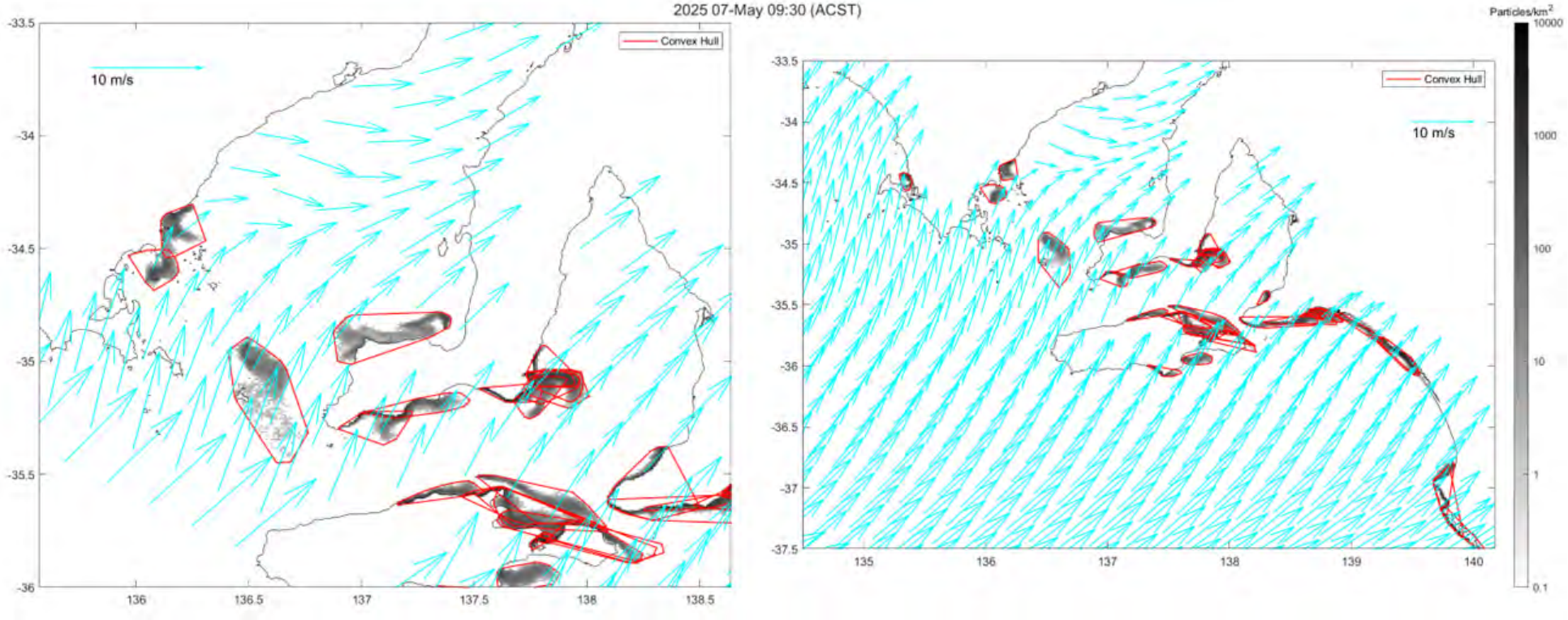


Figure 8. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 02-May and ending 07-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location across the simulation period.

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer; Clause 6(1) Rob Gratton Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; Clause 6(1)
Cc: Doubell, Mark (PIRSA); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 6 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-06052025_Media.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) ; Executive Officer ; Clause 6(1) ; Rob Gratton ; Clause 6(1) ; Neil MacDonald ; Nathan Kimber ; Clause 6(1) Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling ; sapfafishers@gmail.com; Clause 6(1)
Cc: Doubell, Mark (PIRSA) ; Clause 6(1) (DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com'

[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted]<ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted]<eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; '[redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted]<ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted]<eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; 'mr_skin@bigpond.com' <mr_skin@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-06052025_Media.pdf

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:27 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:01 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA)

<Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula in South Australia (SA), particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in Coffin Bay, SA in 2014.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons, the current HAB is dynamic and can travel depending on weather, ocean circulation, and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions (PIRSA) eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates, refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals or extensive fish kills, to contact their local National Parks and Wildlife Service office.

Important Notes

- The daily increases/decreases in chlorophyll-a (chla) concentrations determined from satellite chla imagery presented in this document do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave (MHW) has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Since the last update on 02-May 2025, there has been a slight reduction in sea surface temperatures across the state's coastal waters, but temperatures currently remain up to 2°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of increasing chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, are found throughout Investigator Strait between Kangaroo Island and Yorke Peninsula and extend around the tip of Yorke Peninsula from Port Moorowie to Daly Head, and in the coastal waters from Point Turton to Port Victoria in Spencer Gulf. Decreasing chla levels are found along the southeastern region of the Coorong and in waters to the west of the southern tip of Yorke Peninsula.

Separate to the bloom identified off the Fleurieu Peninsula in mid-March, chla increases are also observed in the Coffin Bay region and in Boston and Louth Bay's near Port Lincoln.

Ocean circulation forecasts covering a five-day period ending 9-May 2025, provide an indication of where water masses, and any algae contained within them, may move from multiple source locations. These forecasts help anticipate potential shifts in bloom distribution based on prevailing ocean currents and environmental drivers.

Detailed Update

- Moderate marine heatwave (MHW) conditions continue to persist across most of southern Australia since September 2024, with latest conditions on 03-May 2025 indicating moderate MHW conditions persist across South Australia's coastal regions (Figure 1). Compared to the last update provided on 02 May 2025, the MHW conditions have reduced in the upper (northernmost) regions of both Gulfs, along the Coorong and Bonney Coast in the Southeast and off the western tip of the lower Eyre Peninsula.

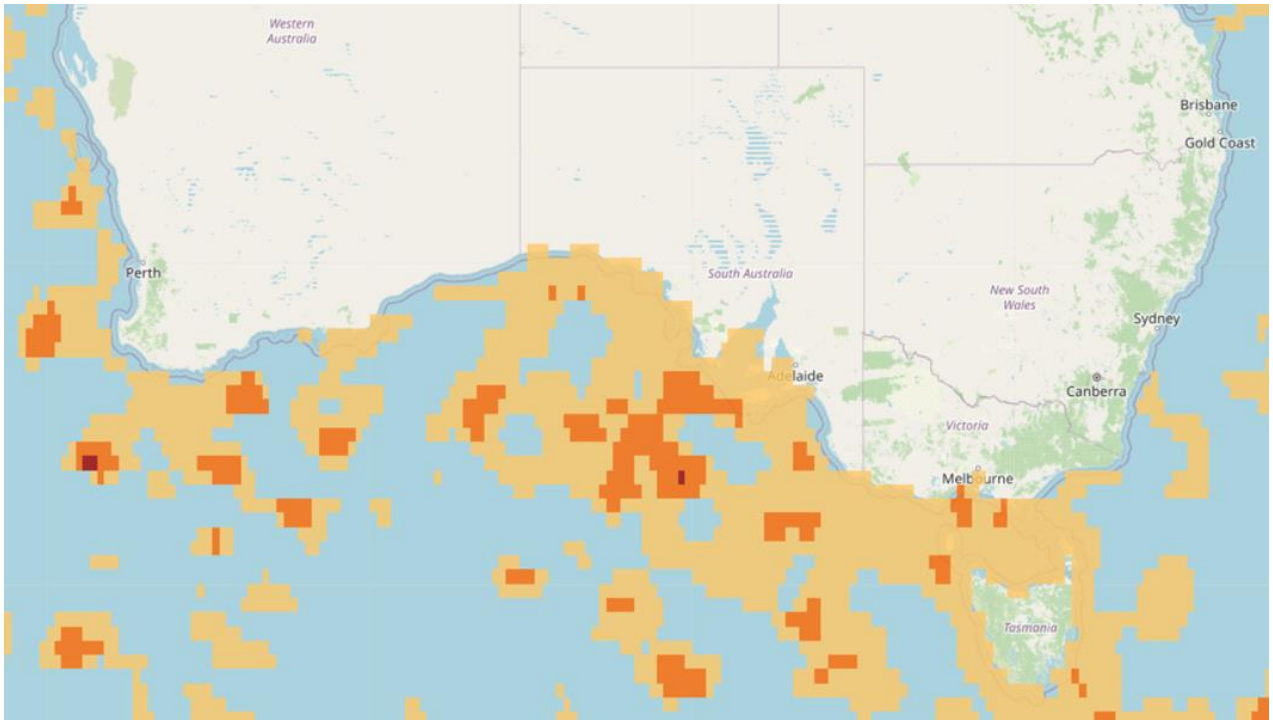


Figure 1. Latest available snapshot of the current marine heatwave conditions in Australia on 03-May 2025. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

- As of 04-05 May 2025, sea surface temperature (SST) anomalies remain up to +2°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update provided on 02-May, SST anomlaies have slightly reduced across much of the states coastal and gulf waters.

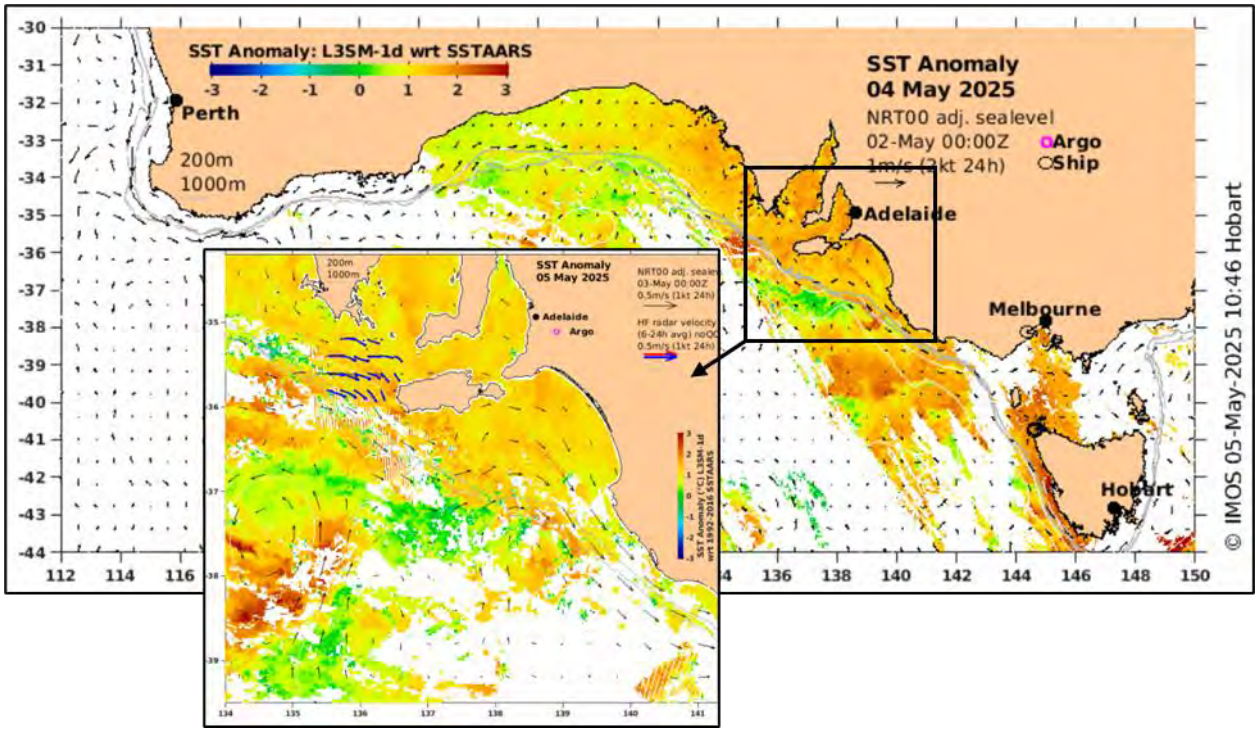


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

- SST data collected by the Integrated Marine Observing System (IMOS) and SAWAVES wave buoy network show that decreases in sea surface temperatures due to seasonal cooling of approximately 0.5 to 1.5°C occurred across South Australia during the period of 28-April to 06-May 2025, with current temperatures ranging from approximately 18.2°C in Victor Harbour to 18.9 °C in Ceduna.

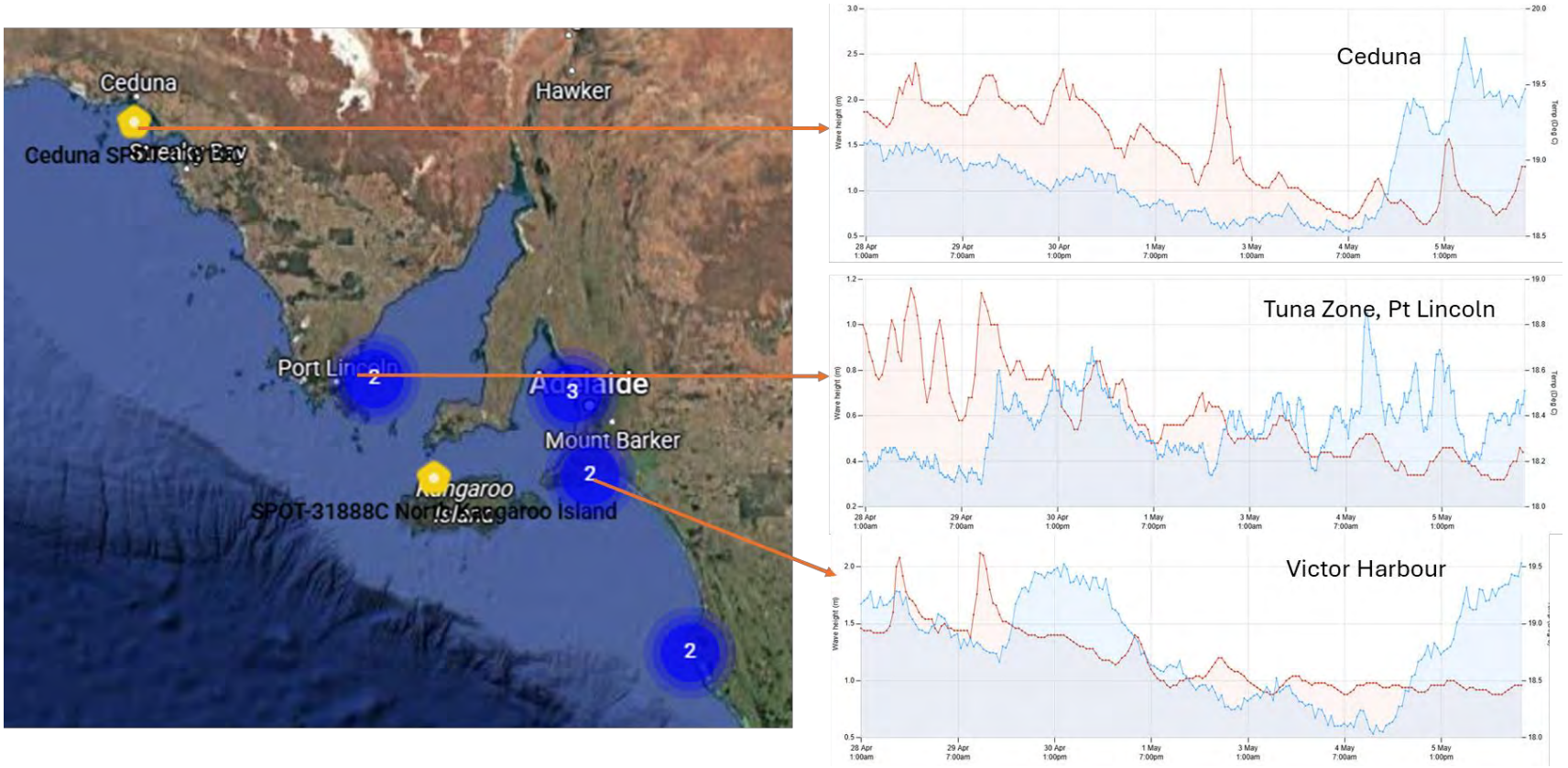


Figure 3. Latest sea surface temperature (red line) and significant wave height data (blue line) from wave-buoys located in coastal South Australian regions. Source: sawaves.org

- Figure 4 shows the latest satellite chla image taken on 04-May 2025. Elevated chla levels are found off the southern foot of Yorke Peninsula, the western and northern regions of Gulf Saint Vincent, in the embayment's surrounding Port Lincoln, and along the Coorong region east coast of Goolwa to Kingston in the southeast.

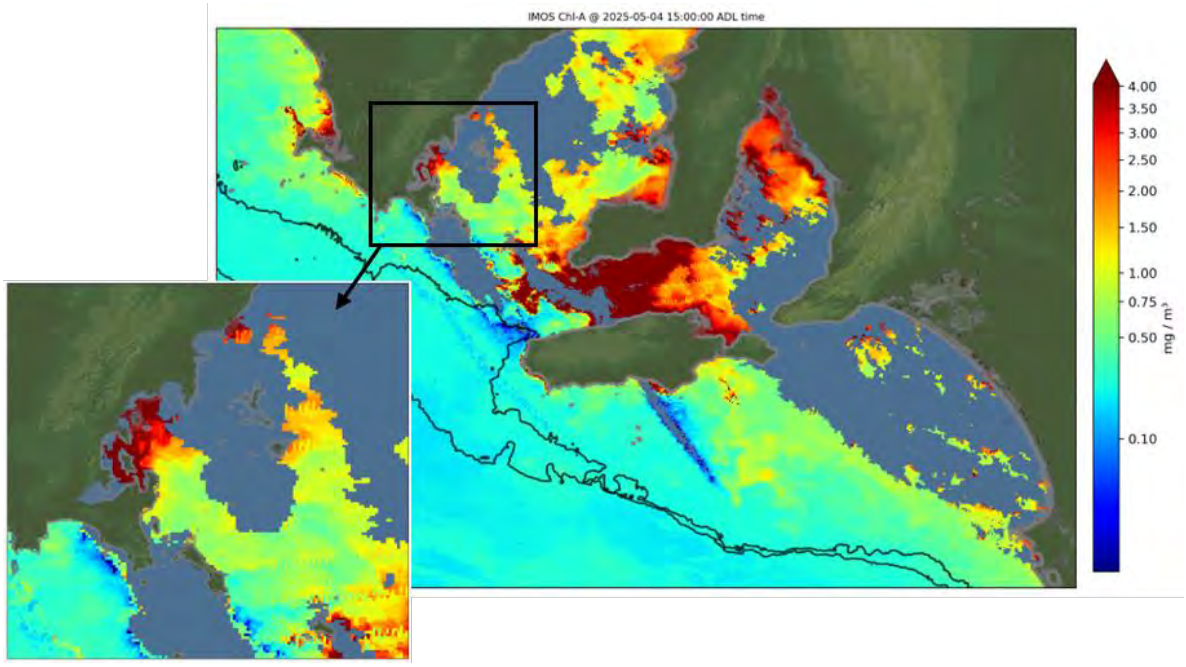


Figure 4. Latest sea surface chla map taken on 04-May 2025. Regions where no data is available due to cloud cover are shaded in grey-blue. Source: https://oceancurrent.aodn.org.au/

- The corresponding daily image for 04-May 2025, showing areas of sea surface chla increases and decreases (Figure 5), was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the changes in concentrations observed on the 04-May 2025 (Figure 5) to that from 30-April 2025 (Figure 6), suggests sea surface chla concentrations are generally increasing in Investigator Strait, northern Gulf Saint Vincent, around the foot of Yorke Peninsula from Port Moorowie to Daly Head, from Point Turton to Port Victoria in southeastern Spencer Gulf, and in the Coffin Bay region and Boston and Louth Bay's near Port Lincoln.

- Areas of decreasing sea surface chla are observed surrounding the America River region on Kangaroo Island.

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

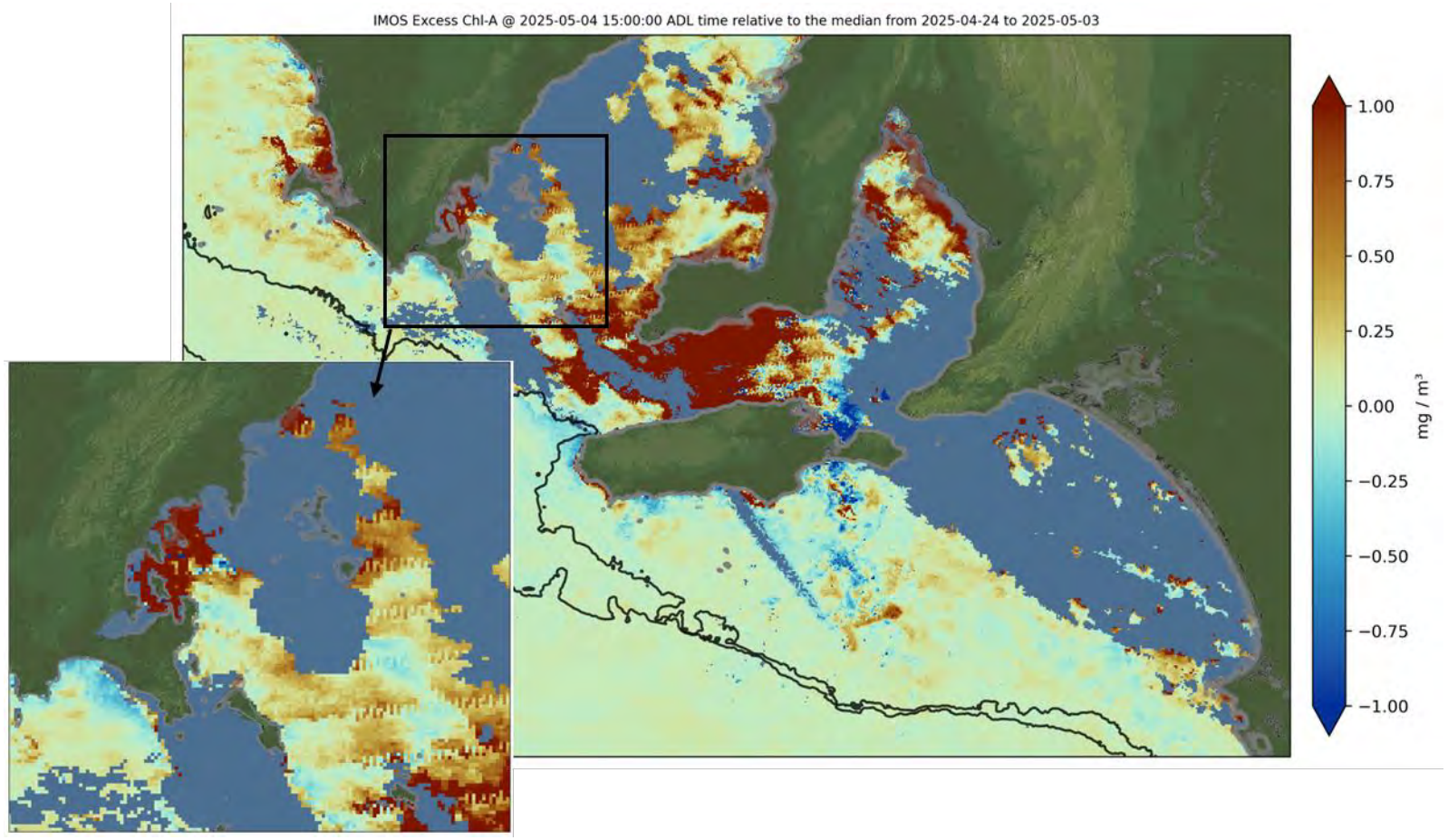


Figure 5. Latest daily image for 04-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

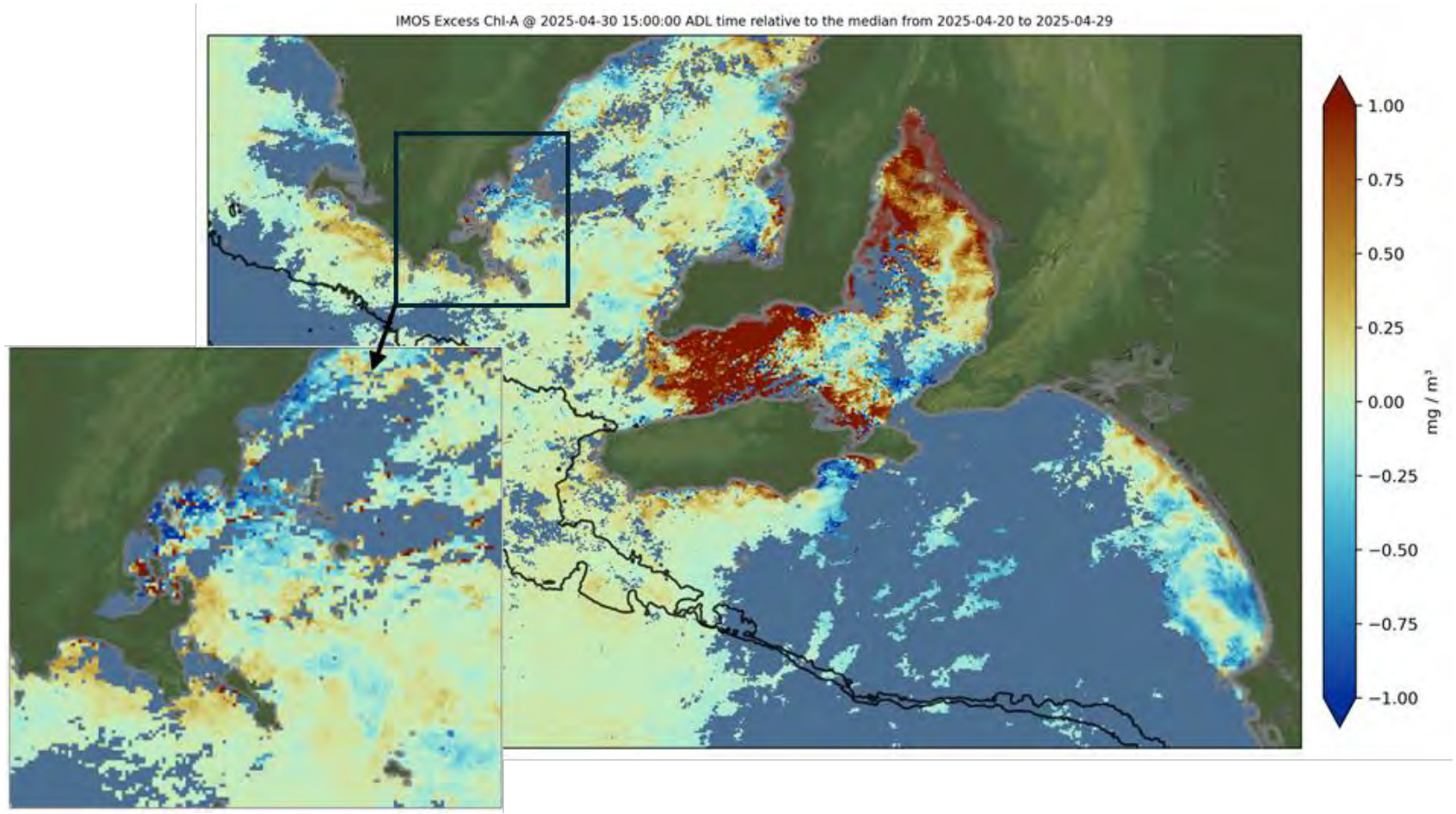


Figure 6. Daily image for 30-April 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figures 7 and 8) was used to predict the trajectory of water masses over a period of 5 days, starting 04-May and ending 09-May 2025. Moderate north to northeasterly winds dominated the beginning of the forecasted period before changing to moderate to strong west to south-westerly winds over the period of 05-May to 07-May. Winds transition to moderate southerlies over 07-May to 08-May, and then become lighter east to northeasterlies over 08-May and 09-May.

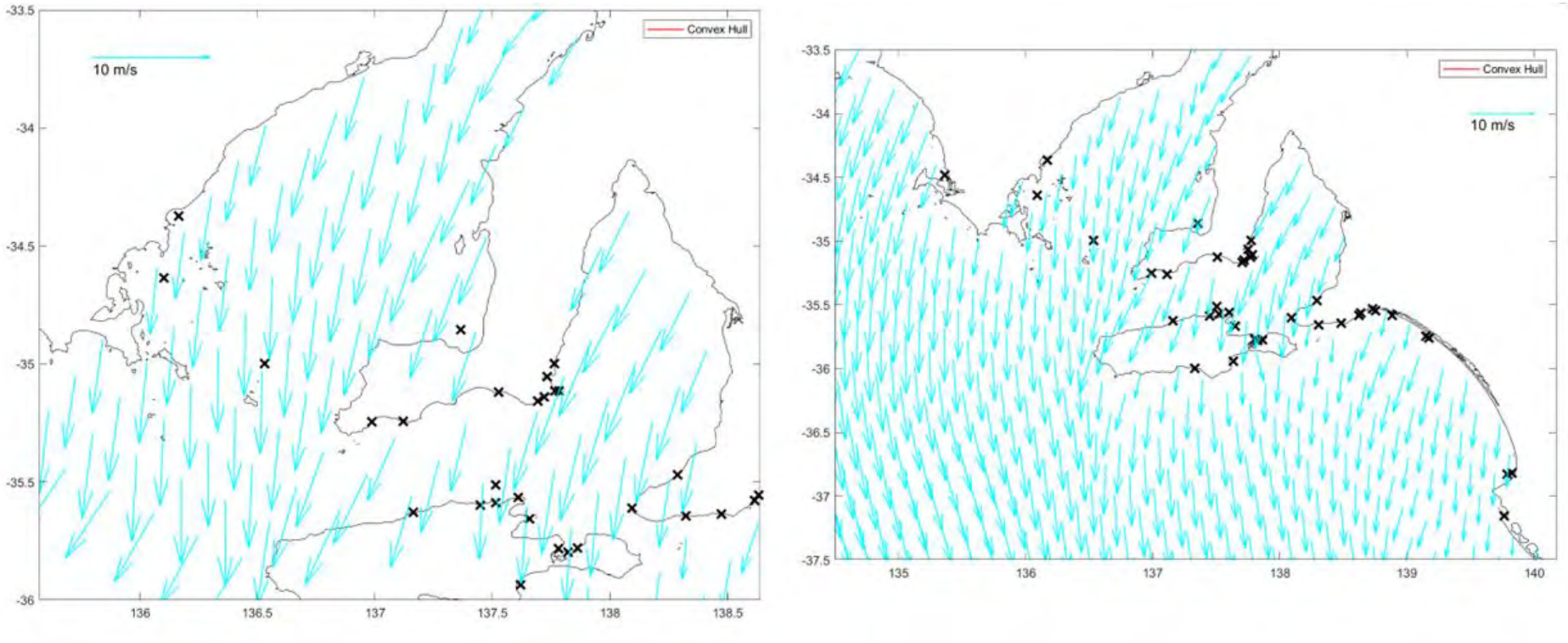


Figure 7. Initial release locations (black x) for the oceanographic forecast modelling of water mass movements using particles representative of microscopic algae. Blue arrows indicate the model wind speed and direction.

South Australian Harmful Algal Bloom (HAB) Situation Update: 06-05-2025

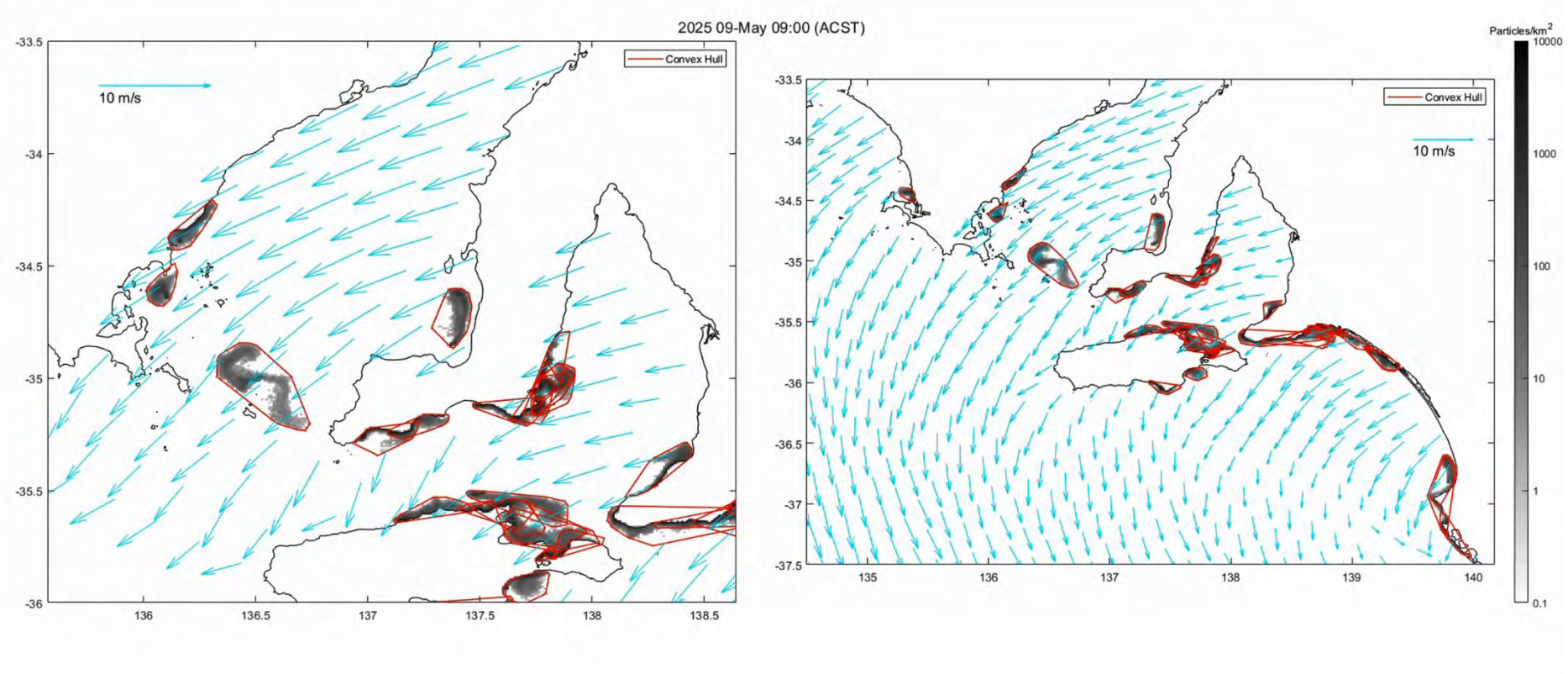


Figure 8. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 04-May and ending 09-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location across the simulation period.

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Wednesday, 7 May 2025 8:57 PM
To: eo@mfasa.org.au
Cc: Read, Matt (PIRSA); Bansemer, Matthew (PIRSA)
Subject: Re: Algal bloom update - 6 May 2025

Thanks Pat

Get Outlook for iOS

From: Pat Tripodi
Sent: Wednesday, May 7, 2025 8:56:42 PM
To: Begg, Gavin (PIRSA)
Cc: Read, Matt (PIRSA) ; Bansemer, Matthew (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025

No problem.
I sent out an email to all my Members today to report any sightings to Fishwatch.

Regards
Pat Tripodi
Executive Officer
Marine Fishers Association Inc.
M 0429 000 282
eo@mfasa.org.au
www.marinefishersa.com.au
PO Box 546, Port Adelaide SA 5015

MAIL DISCLAIMER
The information in this email is privileged information for and on behalf of MFA Members only and may be protected by copyright law. Any unauthorized use, distribution, or disclosure of its contents to third parties is strictly prohibited. If you received this email in error, please delete it immediately from your device.

From: Begg, Gavin (PIRSA)
Sent: Wednesday, 7 May 2025 4:51 AM
To: eo@mfasa.org.au
Cc: Read, Matt (PIRSA) ; Bansemer, Matthew (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025

OFFICIAL

Thanks Pat – if you can please let the guys know to provide reports through Fishwatch

From: Pat Tripodi <eo@mfasa.org.au>
Sent: Tuesday, 6 May 2025 9:01 PM
To: Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>
Subject: RE: Algal bloom update - 6 May 2025

Thanks Gavin
I'm starting to get more reports from my guys about the impacts of this algae bloom. In GSV the area effected now extends up to Pt. Vincent on the Western side and up to Aldinga on the Eastern side.

Regards
Pat Tripodi
Executive Officer
Marine Fishers Association Inc.
M 0429 000 282
eo@mfasa.org.au

www.marinefishersa.com.au
PO Box 546, Port Adelaide SA 5015

MAIL DISCLAIMER
The information in this email is privileged information for and on behalf of MFA Members only and may be protected by copyright law. Any unauthorized use, distribution, or disclosure of its contents to third parties is strictly prohibited. If you received this email in error, please delete it immediately from your device.

From: Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 6 May 2025

OFFICIAL

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au> Clause 6(1) DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025
Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted] @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted] @bigpond.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @sasardines.com.au' [redacted] @sasardines.com.au> [redacted] @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted] @CH4global.com' [redacted] @CH4global.com>; [redacted] @bigpond.com' [redacted] @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted] @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update
Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted] @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted] @bigpond.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @yumbah.com' [redacted] @yumbah.com>; [redacted] @sasardines.com.au' [redacted] @sasardines.com.au>; [redacted] @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted] @CH4global.com' [redacted] @CH4global.com>; [redacted] @bigpond.com' [redacted] @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted] @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update
Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted] @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au> [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted] @bigpond.com>; [redacted] @yumbah.com'

[redacted]@yumbah.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@sasardines.com.au' [redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' [redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update
Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com; [redacted]@yumbah.com; [redacted]@sasardines.com.au; [redacted]@strategicmc.com.au; tom@goolwapipico.com; [redacted]@CH4global.com; [redacted]@bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update
Hi All
Please see latest information from SARDI re. algal bloom.
Also, below other information:
Department for Environment and Water - SA Karenia mikimotoi algal...
Water quality alerts | SA Health
SA Karenia mikimotoi algal bloom update - PIRSA
Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.
Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; Clause 6(1) Clause 6(1)
Cc: Doubell, Mark (PIRSA); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 9 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-09052025_Media.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer ; Clause 6(1) ; Rob Gratton ; Clause 6(1) ; Neil MacDonald ; Nathan Kimber ; Clause 6(1) Clause 6(1) @yumbah.com' ; Clause 6(1) @yumbah.com' ; Clause 6(1) @sasardines.com.au' ; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' ; Clause 6(1) @CH4global.com' ; Clause 6(1) @bigpond.com' ; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com' ; Clause 6(1) ; Clause 6(1)
Cc: Doubell, Mark (PIRSA) ; Clause 6(1) (DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling

<keith@nmac.com.au>; sapfafishers@gmail.com; [redacted]@asbtia.org>; [redacted]@yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] DEW) [redacted]@sa.gov.au>; [redacted] DEW) <[redacted]@sa.gov.au>; [redacted] DEW) <[redacted]@sa.gov.au>; [redacted] (EPA) <[redacted]@sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.

Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au> Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

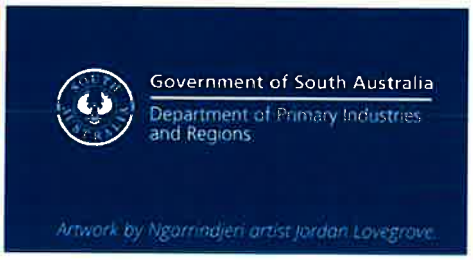
Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 9 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-09052025_Media.pdf

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:27 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:01 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery [redacted]

Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 20b

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula in South Australia (SA), particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in Coffin Bay, SA in 2014.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons, the current HAB is dynamic and can travel depending on weather, ocean circulation, and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions PIRSA eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates, refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals or extensive fish kills, to contact their local National Parks and Wildlife Service office. Extensive fish kills should be reported to Fishwatch on 1800 065 522.

Important Notes

- The daily increases/decreases in chlorophyll-a (chla) concentrations determined from satellite chla imagery presented in this document do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave (MHW) has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Since the last update on 06-May 2025, there has been a slight reduction in sea surface temperatures across the state's coastal waters, however current temperatures remain up to 1.5°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, indicate sea surface chla concentrations are currently decreasing in Investigator Strait, Gulf Saint Vincent, around the eastern foot region of Yorke Peninsula, and along the northern and western coastlines of Kangaroo Island. Areas of increasing sea surface chla are observed on the east coast of Kangaroo Island between Cape Willoughby and Mouth Flat Beach and along the Fleurieu Peninsula between Victor Harbour and Goolwa.

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

Ocean circulation forecasts covering a five-day period ending 14-May 2025, provide an indication of where water masses, and any microalgae contained within them, may move from multiple source locations. These forecasts help anticipate potential shifts in bloom distribution based on prevailing ocean currents and environmental drivers.

Detailed Update

- Marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024. The latest conditions on 06-May 2025 indicate that the current moderate MHW conditions experienced across South Australia's coastal regions may be reducing in intensity, particularly in the upper (northernmost) regions of both Gulfs and along the Coorong and Bonney Coast in the Southeast (Figure 1).

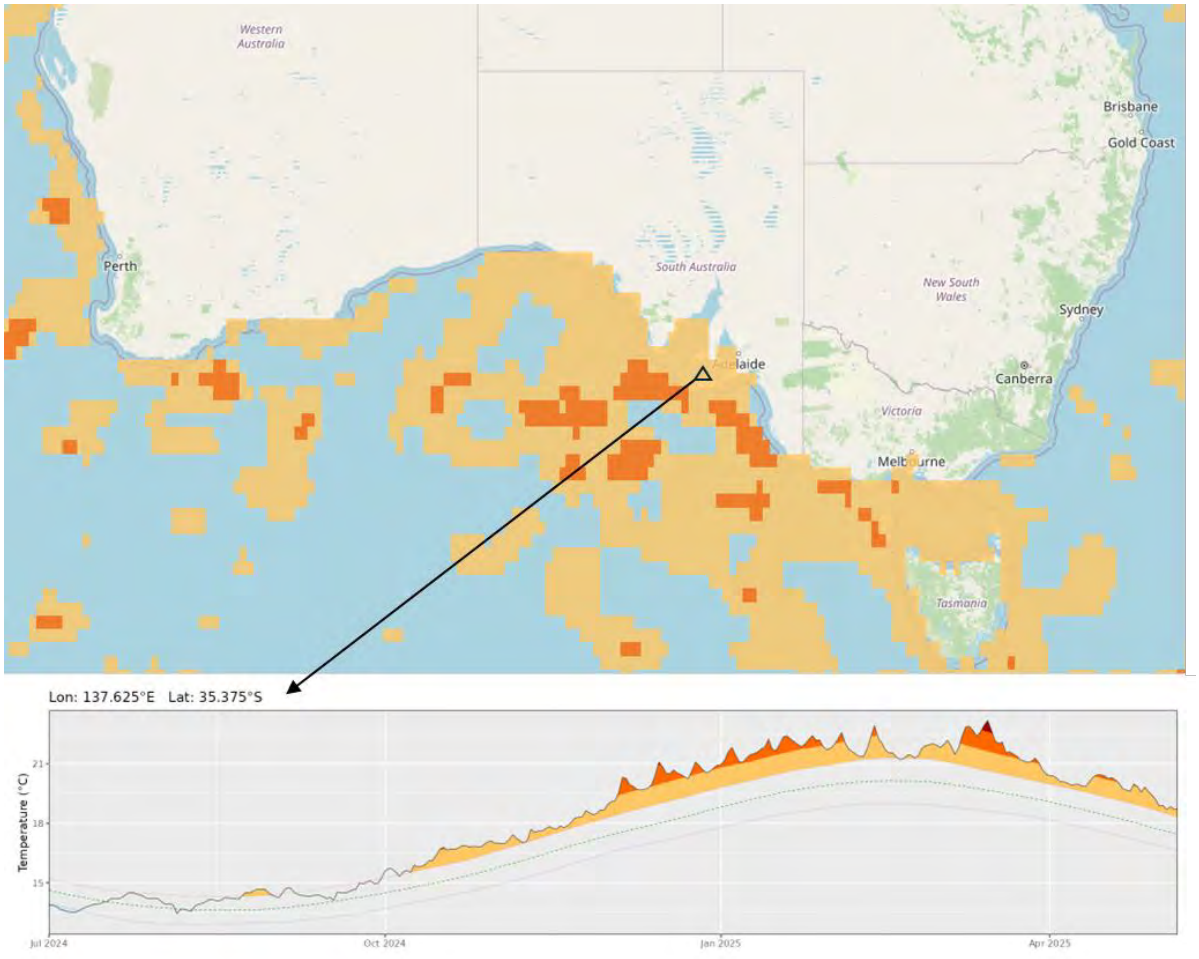


Figure 1. (Top) Latest available snapshot of the current marine heatwave conditions in Australia on 06-May 2025. (Bottom) Timeseries of seas surface temperature for a location in Investigator Strait showing the presence of MHW conditions since July 2024 to present. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

- As of 06-08 May 2025, sea surface temperature (SST) anomalies remain up to +1.5°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update provided on 06-May, SST anomlaies have slightly reduced across much of the states coastal and gulf waters.

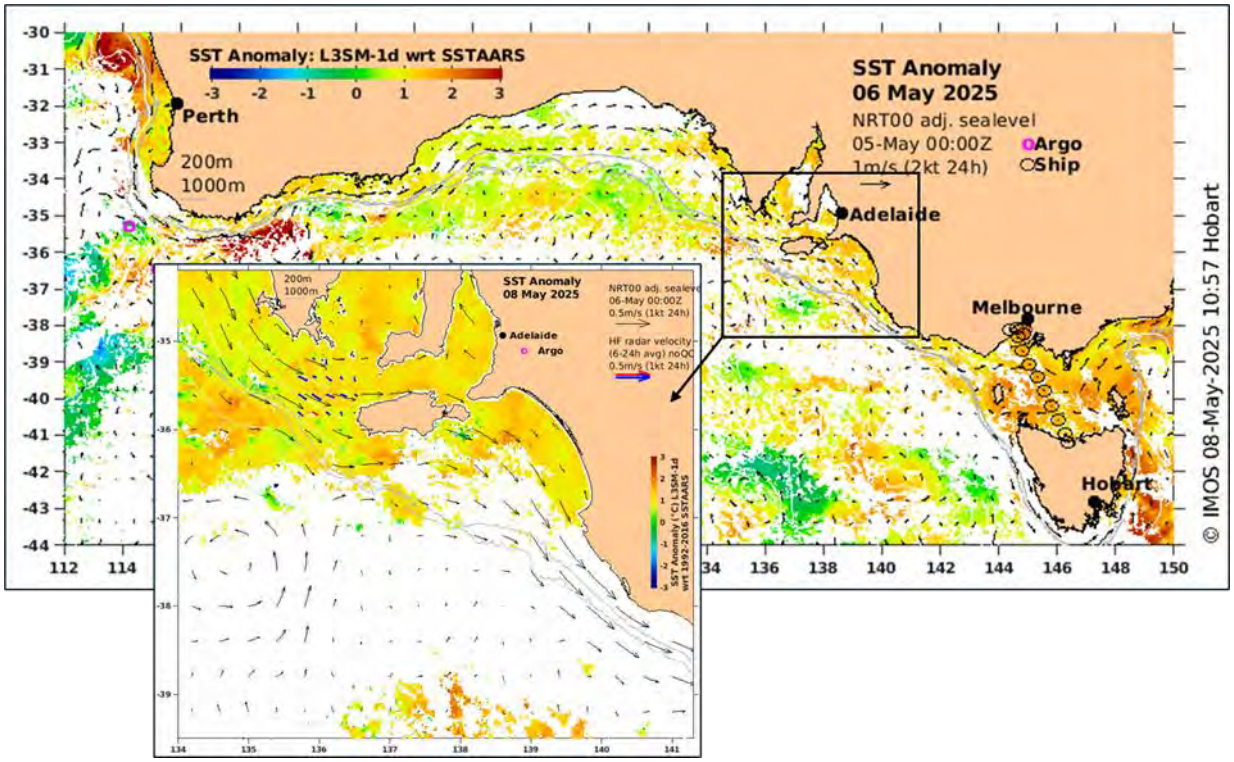


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

- SST data collected by the IMOS and SAWAVES wave buoy network show that decreases in sea surface temperatures due to seasonal cooling of approximately 0.5 to 1.0°C occurred across South Australia during the period of 01-May to 09-May 2025, with current temperatures ranging from approximately 18.0°C in Port Lincoln to 18.5 °C in Ceduna.

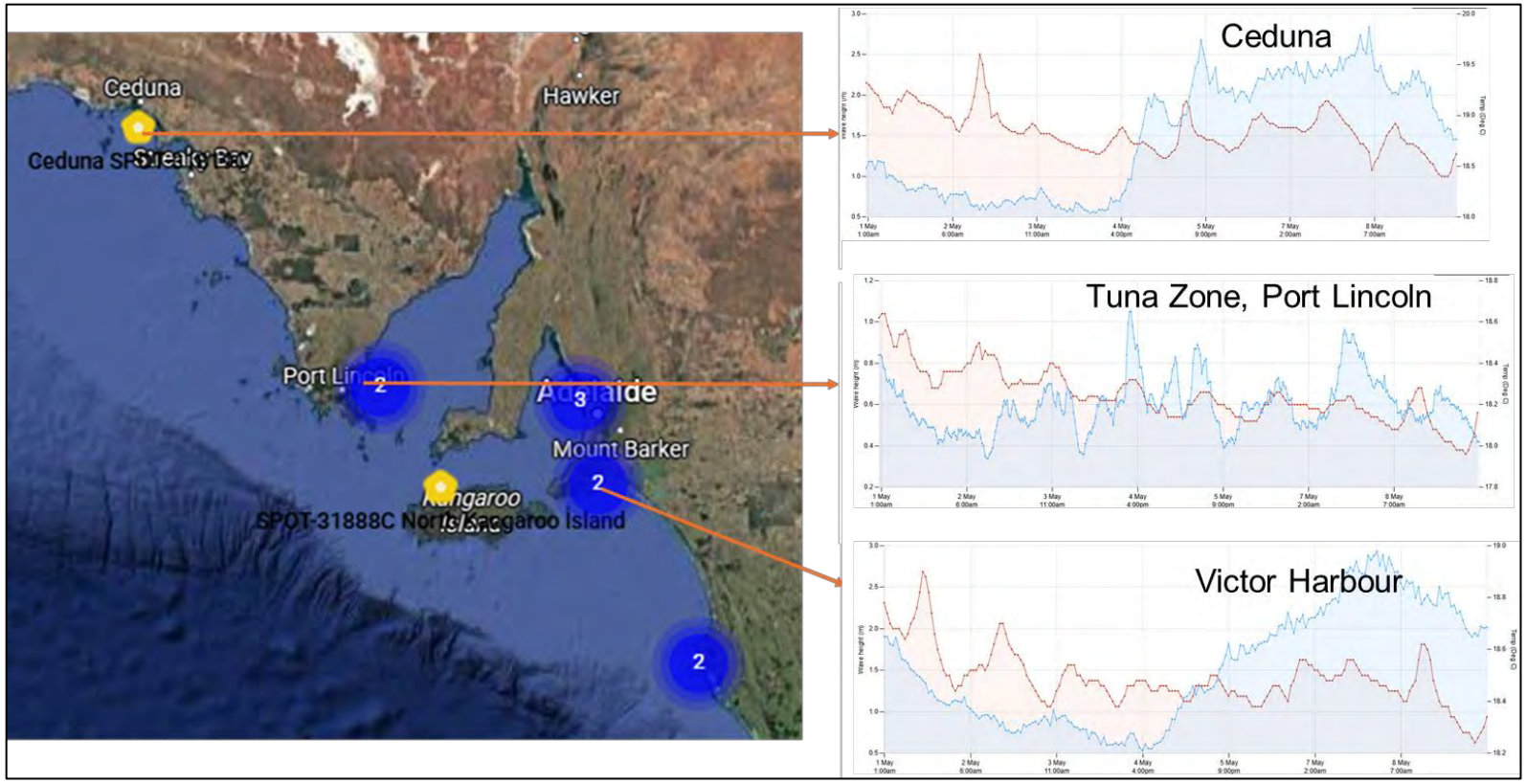


Figure 3. Latest sea surface temperature (red line) and significant wave height data (blue line) from wave-buoys located in coastal South Australian regions. Source: sawaves.org

- Figure 4 shows the latest satellite chla image taken on 07-May 2025. Cloud cover limited the data availability. Elevated chla levels are found off the southeastern foot of Yorke Peninsula, the western and northern regions of Gulf Saint Vincent, along the northern and western coast of Kangaroo Island, and in Coorong region near Victor Harbour, Goolwa and Kingston in the southeast.

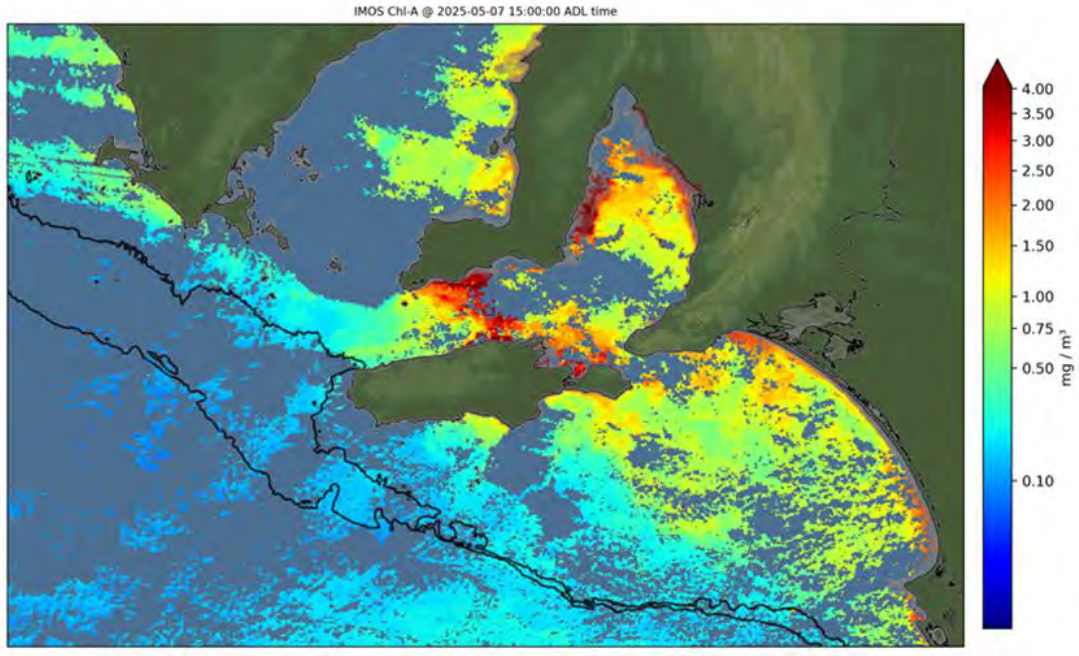


Figure 4. Latest sea surface chla map taken on 07-May 2025. Regions where no data is available due to cloud cover are shaded in grey-blue. Source: https://oceancurrent.aodn.org.au/

- The corresponding daily image for 07-May 2025, showing areas of sea surface chla increases and decreases (Figure 5), was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the changes in concentrations observed on the 07-May 2025 (Figure 5) to that from 04-May 2025 (Figure 6), suggest sea surface chla concentrations are generally decreasing in Investigator Strait, Gulf Saint Vincent, around the foot of Yorke Peninsula, and northern and western Kangaroo Island.

- Areas of increasing sea surface chla are observed on the east coast of Kangaroo Island between Cape Willoughby and Mouth Flat Beach and off the Fleurieu Peninsula between Victor Harbour and Goolwa.

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

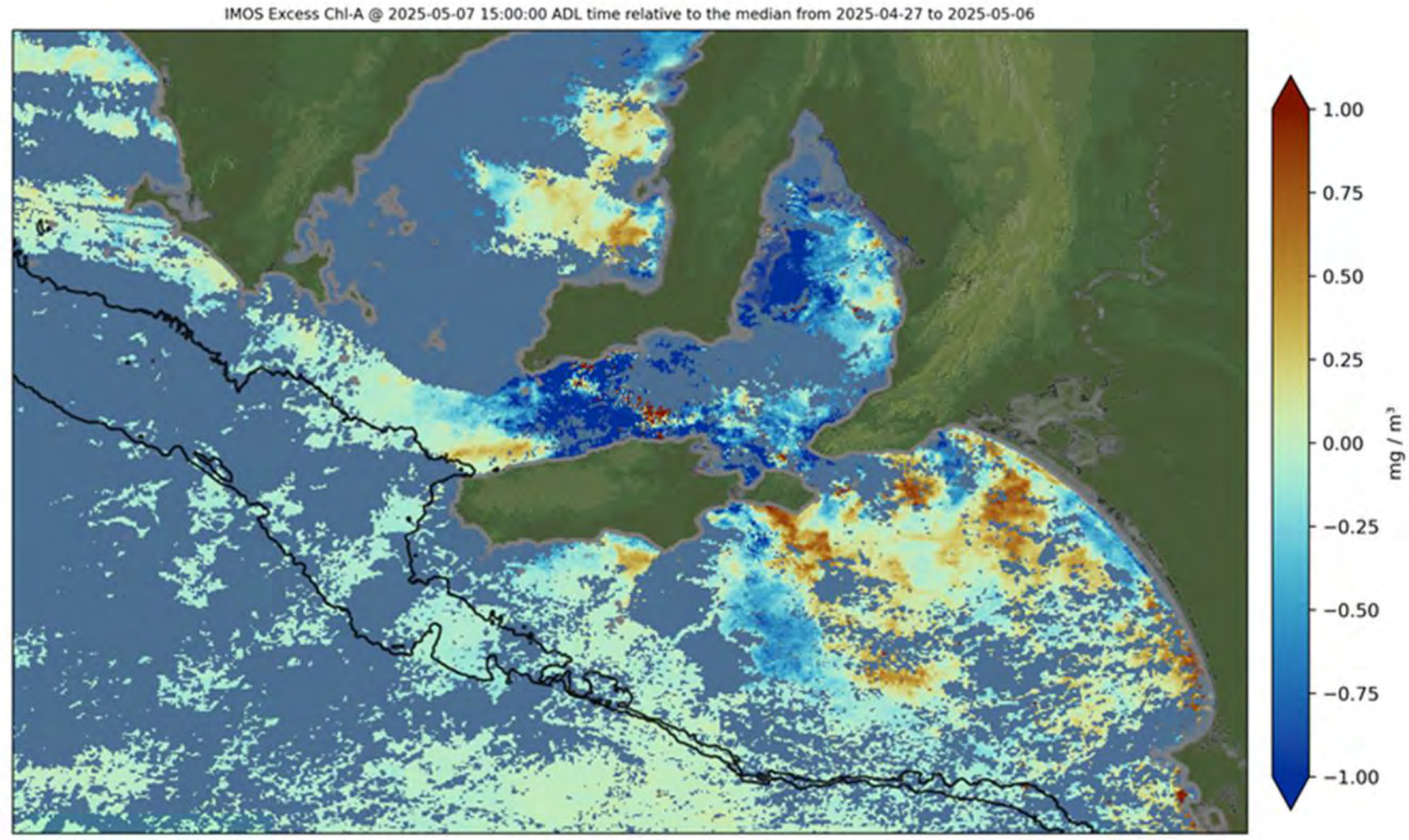


Figure 5. Latest daily image for 07-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

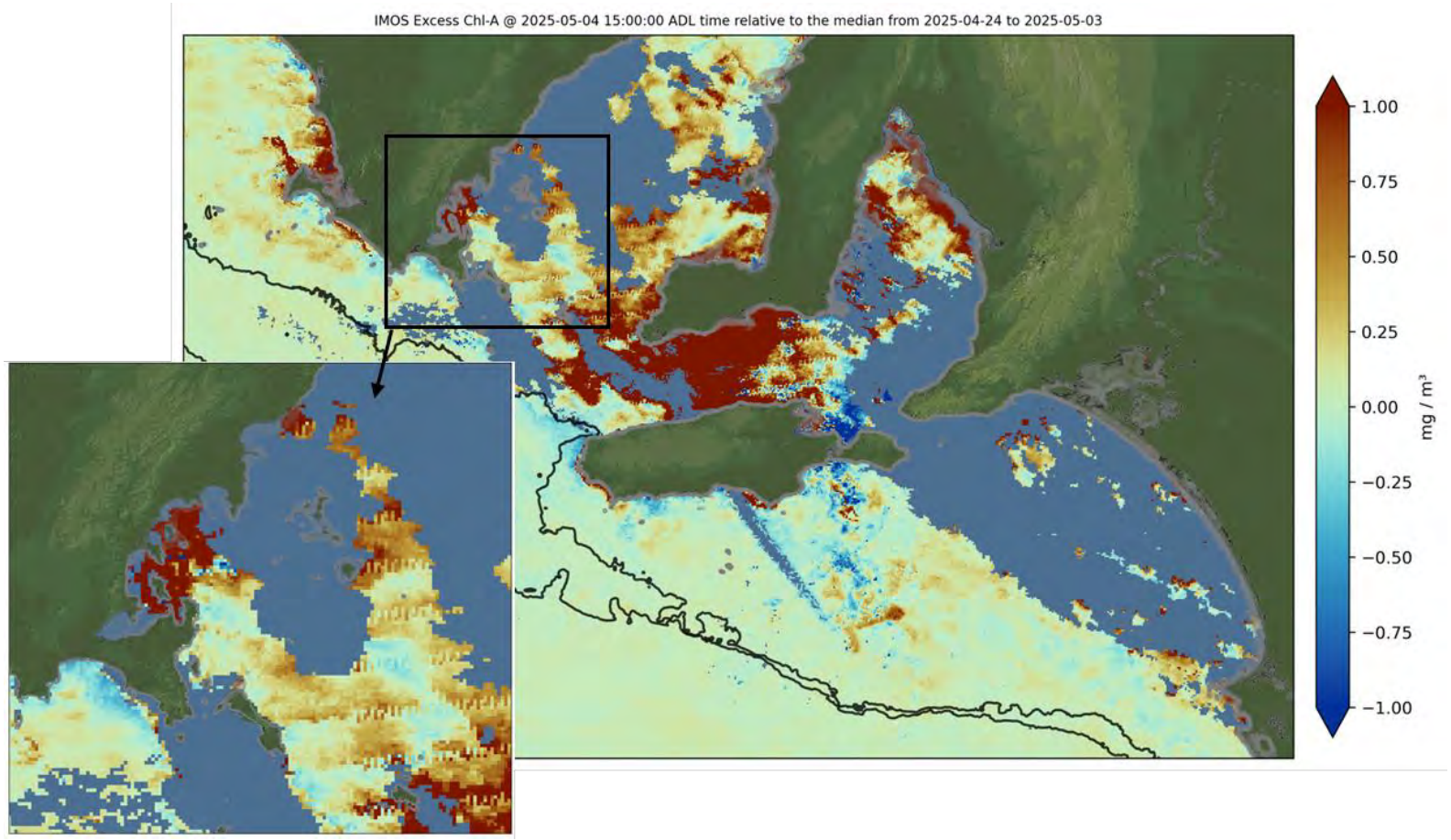


Figure 6. Daily image for 04-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figures 7 and 8) was used to predict the trajectory of water masses over a period of 5 days, starting 09-May and ending 14-May 2025. Light to moderate north-northeasterly to southeasterly winds dominate the forecast period.

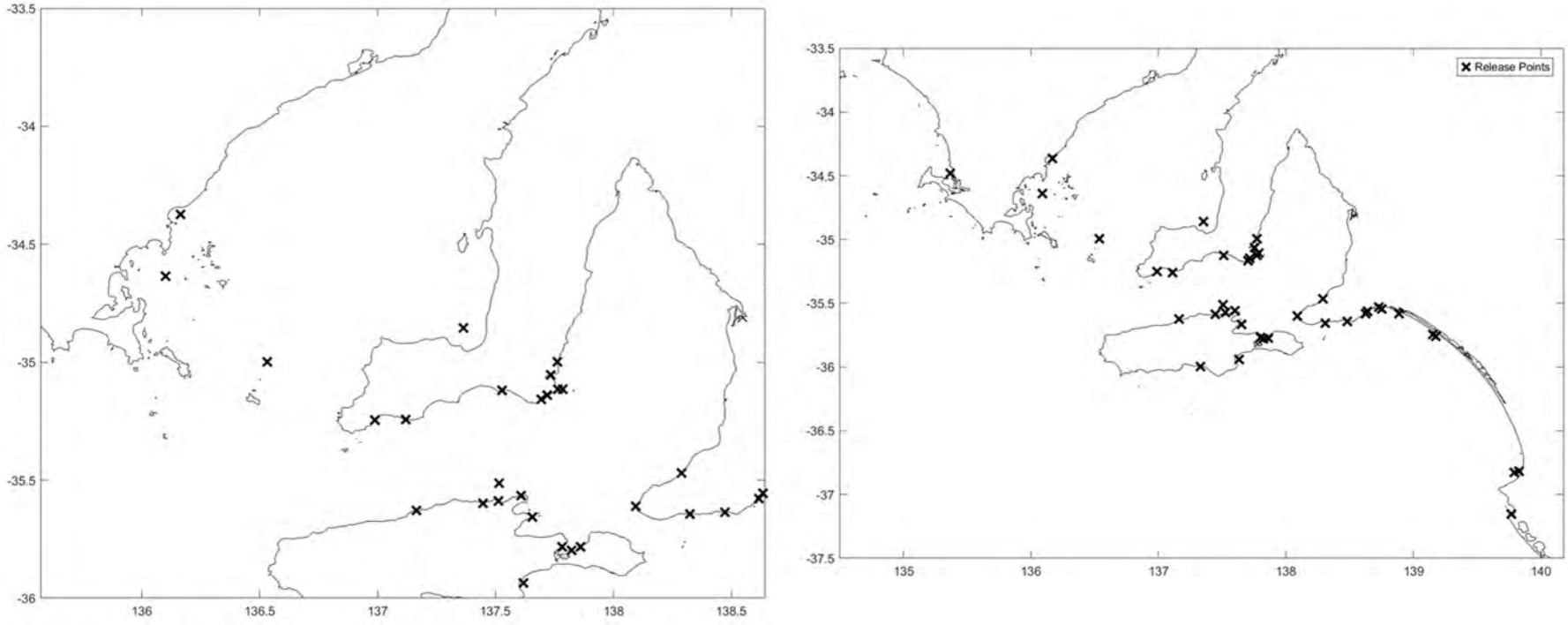


Figure 7. Initial release locations for the oceanographic forecast modelling of water mass movements using particles representative of microscopic algae.

South Australian Harmful Algal Bloom (HAB) Situation Update: 09-05-2025

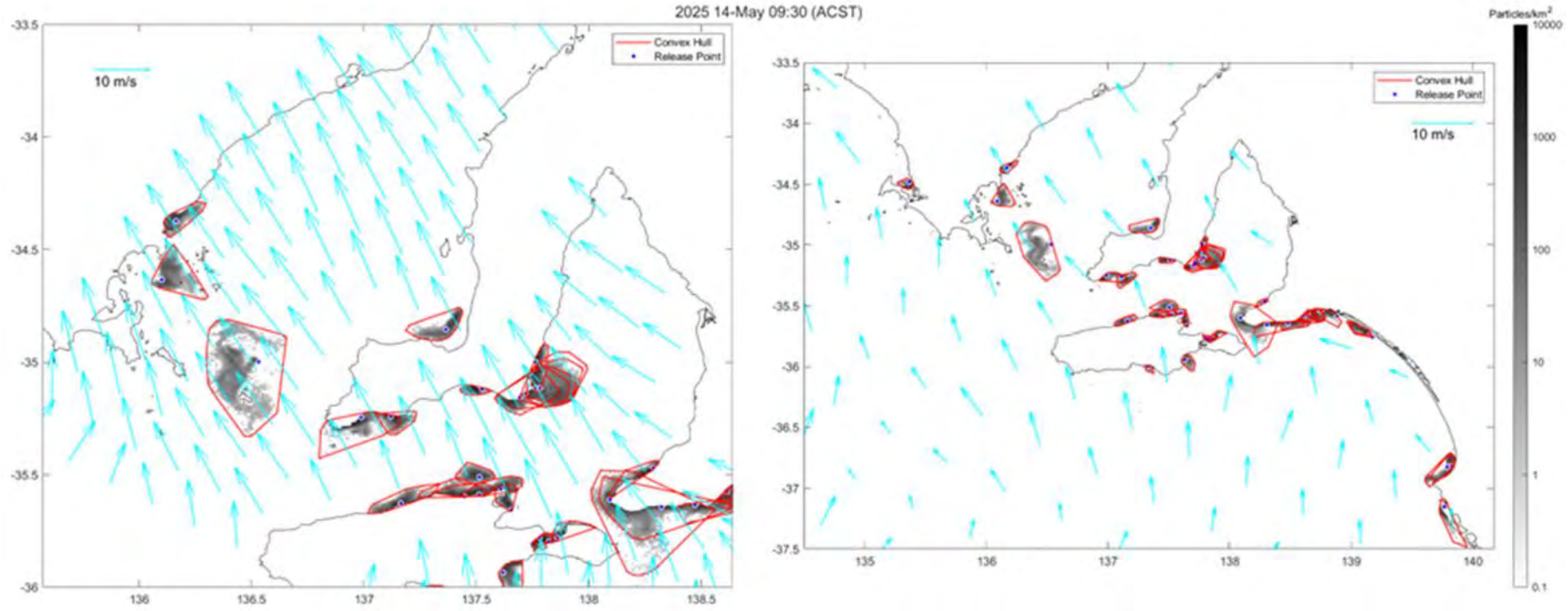


Figure 8. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 09-May and ending 14-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location across the simulation period.

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Farley, Lisa (PIRSA)

From: Pat Tripodi <eo@mfasa.org.au>
Sent: Monday, 12 May 2025 8:41 PM
To: Begg, Gavin (PIRSA); kyri.toumazos@hotmail.com; Keith Rowling; sapfafishers@gmail.com
Subject: RE: Algal bloom update - 9 May 2025

Hi Gavin

Yes, I have been passing this onto my Members. Last week I also sent them further info and asked them to report any fish deaths to Fishwatch.

Regards
Pat Tripodi
Executive Officer
Marine Fishers Association Inc.
M 0429 000 282
eo@mfasa.org.au
www.marinefishersa.com.au
PO Box 546, Port Adelaide SA 5015

MAIL DISCLAIMER
The information in this email is privileged information for and on behalf of MFA Members only and may be protected by copyright law. Any unauthorized use, distribution, or disclosure of its contents to third parties is strictly prohibited. If you received this email in error, please delete it immediately from your device.

From: Begg, Gavin (PIRSA)
Sent: Monday, 12 May 2025 6:54 PM
To: kyri.toumazos@hotmail.com; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com'
Subject: RE: Algal bloom update - 9 May 2025

OFFICIAL

Hi All – just checking if you are passing these updates on to your industry members?
Thanks
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith

Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>; Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 9 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>; Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>;

Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) <Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) <Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) <Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au> Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au> Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com> Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Kyriakos Toumazos <kyri.toumazos@hotmail.com>
Sent: Monday, 12 May 2025 8:33 PM
To: Begg, Gavin (PIRSA); Clause 6(1)
Cc: eo@mfasa.org.au; sapfafishers@gmail.com; Neil MacDonald
Subject: Re: Algal bloom update - 9 May 2025

OFFICIAL

Hello Gavin
Absolutely all updates are provided to industry
Kind Regards
Kyri

Get OutlookforAndroid

From: Begg, Gavin (PIRSA)
Sent: Monday, May 12, 2025 7:45:49 PM
To: Clause 6(1)
Cc: kyri.toumazos@hotmail.com; eo@mfasa.org.au; sapfafishers@gmail.com; Neil MacDonald
Subject: RE: Algal bloom update - 9 May 2025

OFFICIAL

Thanks Clause 6(1) - checking to see updates are being provided, and if we need to be providing more information.

From: Clause 6(1)
Sent: Monday, 12 May 2025 7:10PM
To: Begg, Gavin (PIRSA)
Cc: kyri.toumazos@hotmail.com; eo@mfasa.org.au; sapfafishers@gmail.com; Neil MacDonald
Subject: Re: Algal bloom update - 9 May 2025

Hi Gavin
Yes, updates are passed on to all the stakeholders Neil & I represent.
Why do you ask?
Regards
Clause 6(1)

Keith Rowling
NMAC (SA) P/L
Clause 6(1)

On Mon, 12 May 2025 at 18:54, Begg, Gavin (PIRSA) <Gavin.Begg@> wrote:

OFFICIAL

Hi All - just checking if you are passing these updates on to your industry members?
Thanks
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gQ..IL..fil!.>; Najjar, Feeras (PIRSA)

<Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au> Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>; Clause 6(1) @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>

Subject: RE: Algal bloom update - 9 May 2025

Hi All – please see latest SARDI update.

Regards

Gavin

From: Begg, Gavin (PIRSA)

Sent: Tuesday, 6 May 2025 7:45 PM

To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; 'adam.main@CH4global.com' <adam.main@CH4global.com>; Clause 6(1) @bigpond.com Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; 'Clause 6(1) Clause 6(1) @asbtia.org>; Clause 6(1) @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) EPA) <Clause 6(1) @sa.gov.au>

Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.

Regards

Gavin

From: Begg, Gavin (PIRSA)

Sent: Friday, 2 May 2025 3:26 PM

To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen

(PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) <Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>

Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.

Regards

Gavin

From: Begg, Gavin (PIRSA)

Sent: Tuesday, 29 April 2025 8:00 AM

To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) Clause 6(1) @asbtia.org>

Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>

Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.

Regards

Gavin

From: Begg, Gavin (PIRSA)

Sent: Thursday, 24 April 2025 12:53 PM

To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob

Gratton <rob.gratton@cleanseas.com.au> Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) <Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) <Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update
Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) <Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) <Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update
Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling

<keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update
Hi All
Please see latest information from SARDI re. algal bloom.
Also, below other information:
Department for Environment and Water - SA Karenia mikimotoi algal...
Water quality alerts | SA Health
SA Karenia mikimotoi algal bloom update - PIRSA
Regards
Gavin
Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com';
Cc: Doubell, Mark (PIRSA); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (EPA); Clause 6(1) (EPA); Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 13 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-13052025_Media.pdf

---

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) ; Executive Officer ; Clause 6(1) ; Rob Gratton ; Clause 6(1) ; Neil MacDonald ; Nathan Kimber ; Clause 6(1) Clause 6(1) @yumbah.com' ; Clause 6(1) @yumbah.com' ; Clause 6(1) @sasardines.com.au' ; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' ; Clause 6(1) @CH4global.com' ; Clause 6(1) @bigpond.com' ; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com' ;
Cc: Doubell, Mark (PIRSA) ; Clause 6(1) (DEW) ; Clause 6(1) DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (EPA) ; Clause 6(1) (EPA) ; Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 13 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au> Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' <Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>; Clause 6(1)

Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 9 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au> Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>; Clause 6(1) <Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>; Clause 6(1) Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@sasardines.com.au' [redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' [redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM

To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com; [redacted]@yumbah.com; [redacted]@sasardines.com.au; [redacted]@strategicmc.com.au; tom@goolwapipico.com; [redacted]@CH4global.com; [redacted]@bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director

Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:09 PM
To: 'Asher Dezsery Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 13 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-13052025_Media.pdf

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: 'Asher Dezsery Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 9 May 2025

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: 'Asher Dezsery Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:27 PM
To: 'Asher Dezsery Clause 6(1) [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:01 AM

To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula in South Australia (SA), particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in Coffin Bay, SA in 2014.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons, the current HAB is dynamic and can travel depending on weather, ocean circulation, and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions PIRSA eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates, refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals or extensive fish kills, to contact their local National Parks and Wildlife Service office. Extensive fish kills should be reported to Fishwatch on 1800 065 522.

Important Notes

- The daily increases/decreases in chlorophyll-a (chla) concentrations determined from satellite chla imagery presented in this document do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave (MHW) has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Since the last update on 09-May 2025, there has been a slight decrease in sea surface temperatures across the state's coastal waters, however current temperatures remain up to 2°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, indicate elevated sea surface chla concentrations are currently persisting in Investigator Strait between Kangaroo Island, the foot of Yorke Peninsula and the southern tip of the Fleurieu Peninsula, as well as in western and northern Gulf Saint Vincent. Areas of increasing sea surface chla are also observed in Spencer Gulf, including the embayments surrounding Port Lincon and coastal waters near Tumby Bay, Arno Bay and Point Turton.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

Ocean circulation forecasts covering a five-day period ending 18-May 2025, provide an indication of where water masses, and any microalgae contained within them, may move from multiple source locations. These forecasts help anticipate potential shifts in bloom distribution based on prevailing ocean currents and environmental drivers.

Detailed Update

- Marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024. The latest conditions on 10-May 2025 indicate that moderate MHW conditions continue across South Australia's coastal regions. Compared to the last update, MHW conditions in open waters along the continental shelf margin have slightly increased in intensity (Figure 1). These waters include the eastern lower Eyre Peninsula to Port MacDonnell, as well as waters near the entrance to Spencer Gulf and along the Coorong.

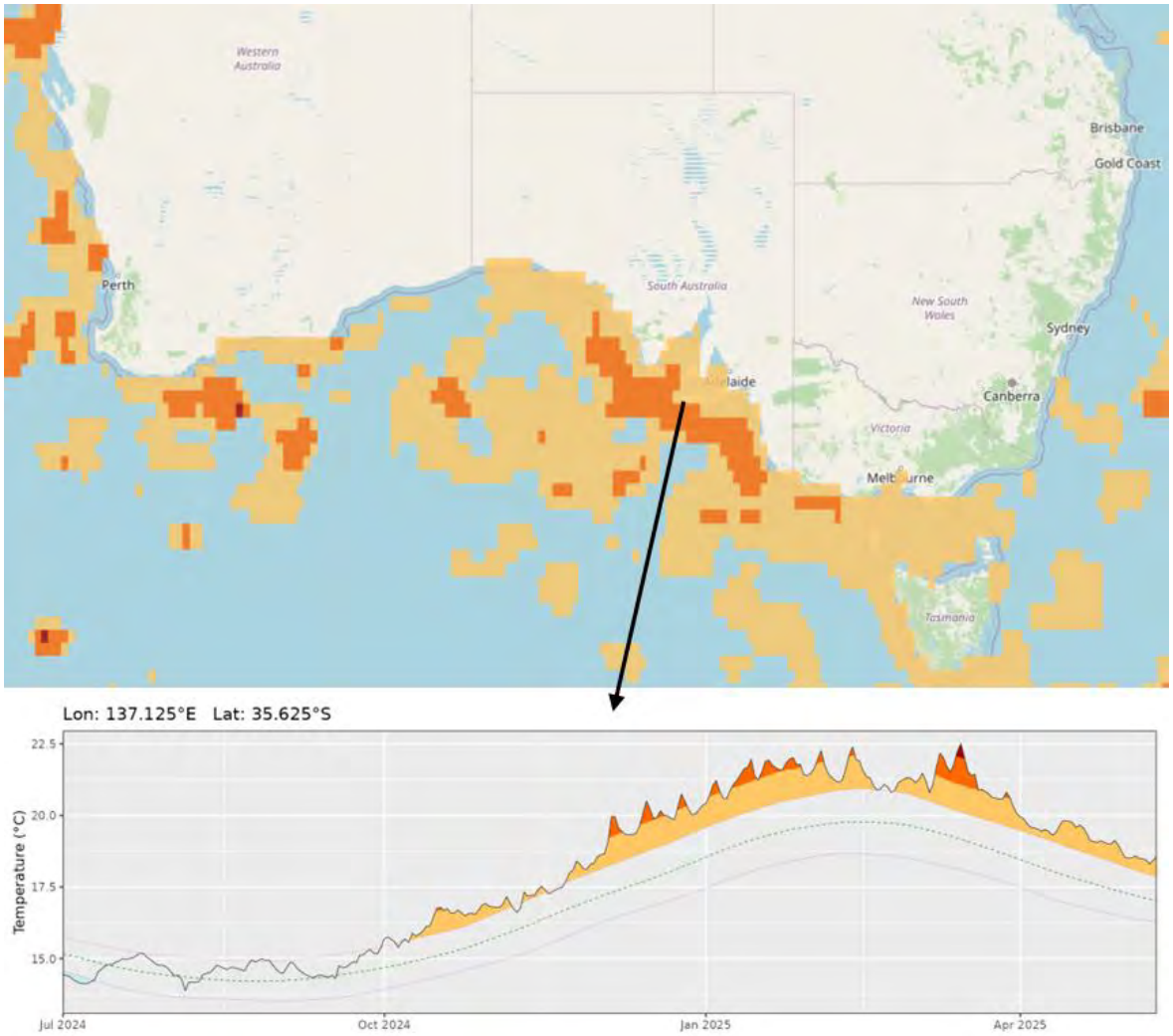


Figure 1. (Top) Latest available snapshot of the current marine heatwave conditions in Australia on 10-May 2025. (Bottom) Timeseries of seas surface temperature for a location in Investigator Strait showing the presence of MHW conditions since July 2024 to present. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

- As of 11-12 May 2025, sea surface temperature (SST) anomalies remain up to +2°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update, SST anomlaies have slightly increased by approximately 0.5°C across much of the state's coastal and gulf waters.

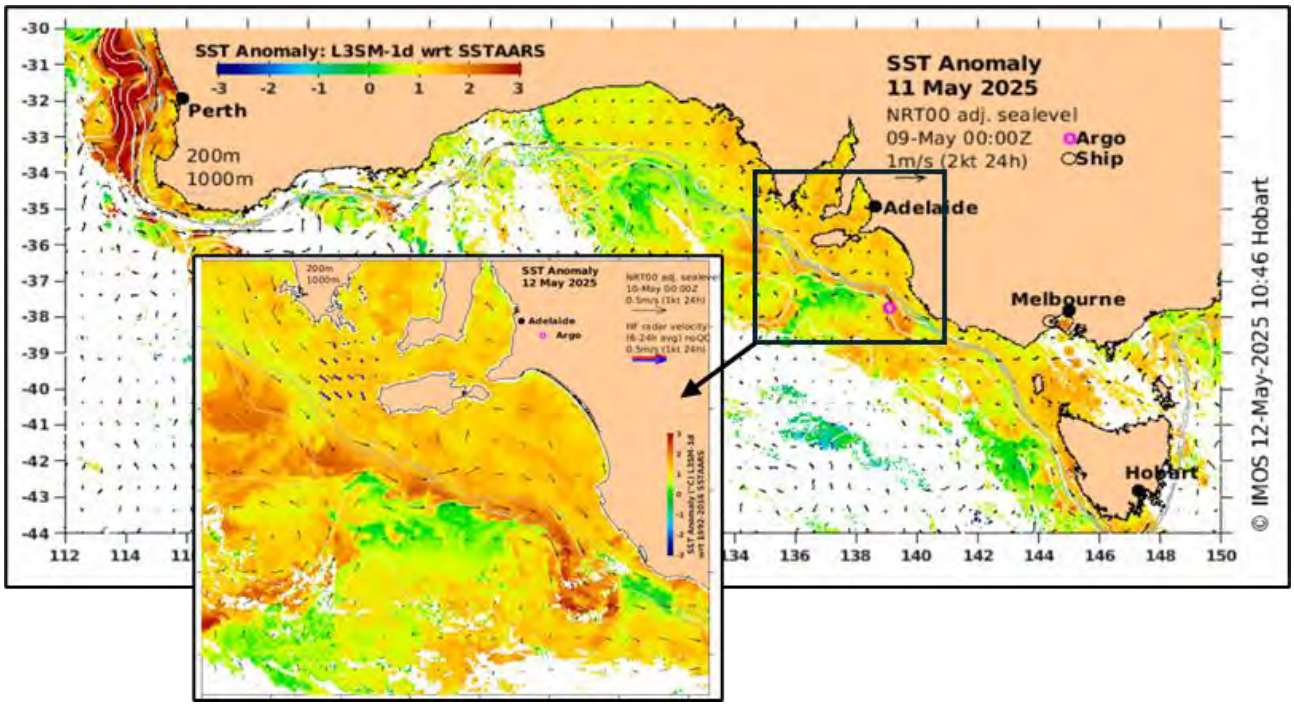


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

- SST data collected by the IMOS and SAWAVES wave buoy network show that decreases in sea surface temperatures due to seasonal cooling of approximately less than 0.5 °C occurred across South Australia during the period of 05-May to 13-May 2025. Warm daytime temperatures over the last few days have caused daily spikes in temperature up to approximately 1°C above the overnight minima. Current daily minimum temperatures range from approximately 17.4°C in Victor Harbour to 18.4 °C in Ceduna.

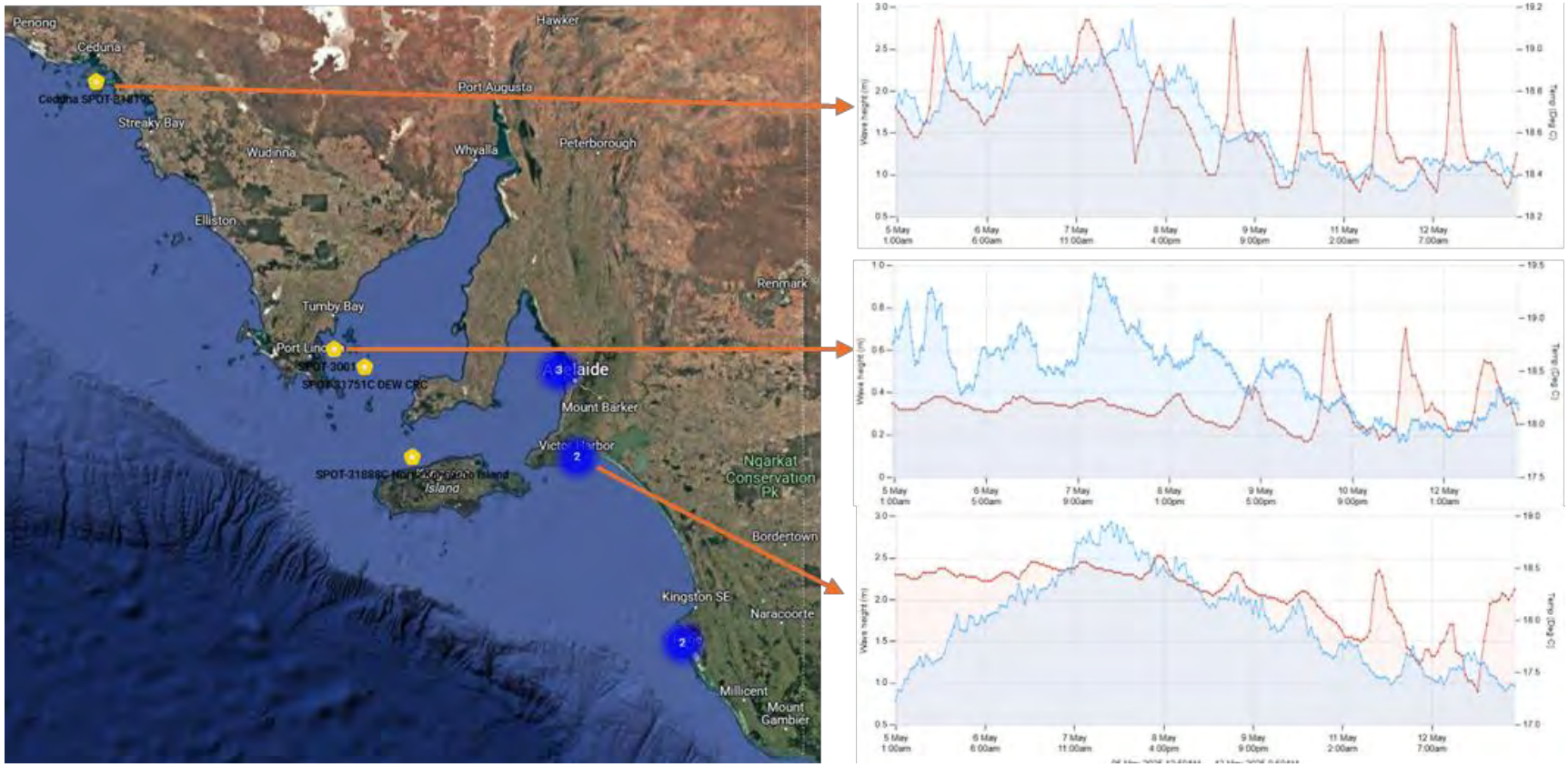


Figure 3. Latest sea surface temperature (red line) and significant wave height data (blue line) from wave-buoys located in coastal South Australian regions. Source: sawaves

- Figure 4 shows the latest satellite chla image taken on 11-May 2025. Persistent elevated chla levels are found in Investigator Strait between Kangaroo Island and Yorke Peninsula, including the coastlines along the southeastern foot of Yorke Peninsula, the northern and western coasts of Kangaroo Island, the western and northern regions of Gulf Saint Vincent, along the Fleurieu Peninsula from Myponga to Goolwa, along the southwestern coast of Spencer Gulf (including the embayments surrounding Port Lincoln and Tumby and Arno Bay), along the southwestern coast of Spencer Gulf from Point Turton to Port Victoria, and near Kingston in the southeast.

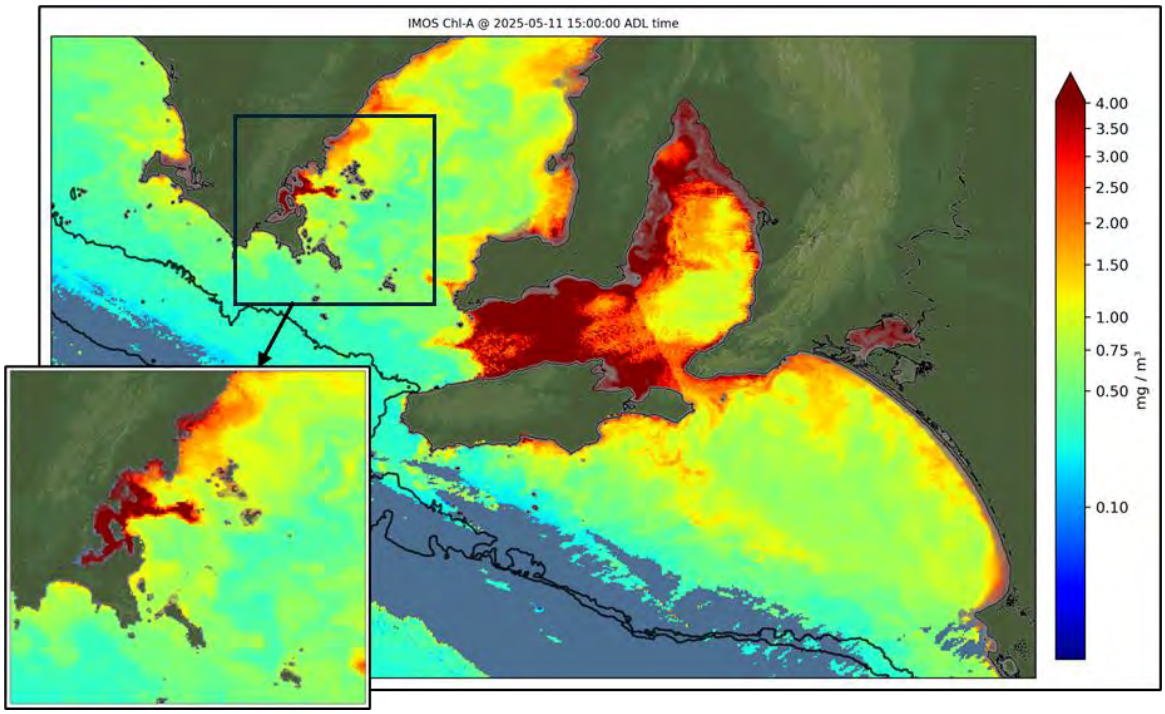


Figure 4. Latest sea surface chla map taken on 11-May 2025. Regions where no data is available due to cloud cover are shaded in grey-blue. Source: https://oceancurrent.aodn.org.au/

- The corresponding daily image for 11-May 2025, showing areas of sea surface chla increases and decreases (Figure 5), was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the daily changes in concentrations observed on 11-May 2025 (Figure 5) to that from 07-May 2025 (Figure 6), suggest sea surface chla concentrations are again generally increasing in Investigator Strait, in the western and northern regions of Gulf Saint Vincent, around the Fleurieu Peninsula, and in embayments from Port Lincoln to Arno Bay, and Point Turton in Spencer Gulf.

- Areas of decreasing sea surface chla are observed along the southern tip of Yorke Peninsula and off the Fleurieu Peninsula between Victor Harbour and Goolwa.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

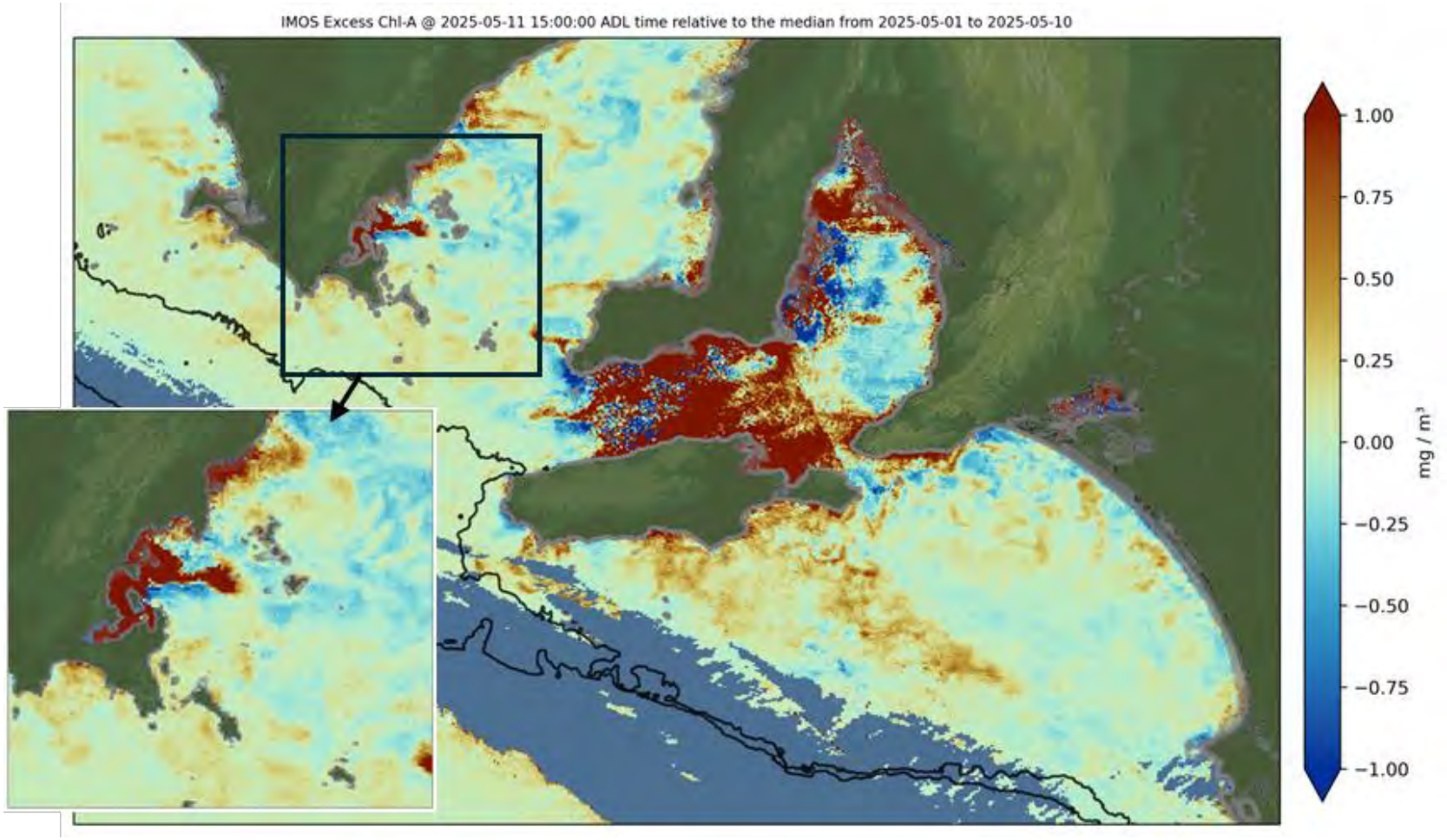


Figure 5. Latest daily image for 011-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

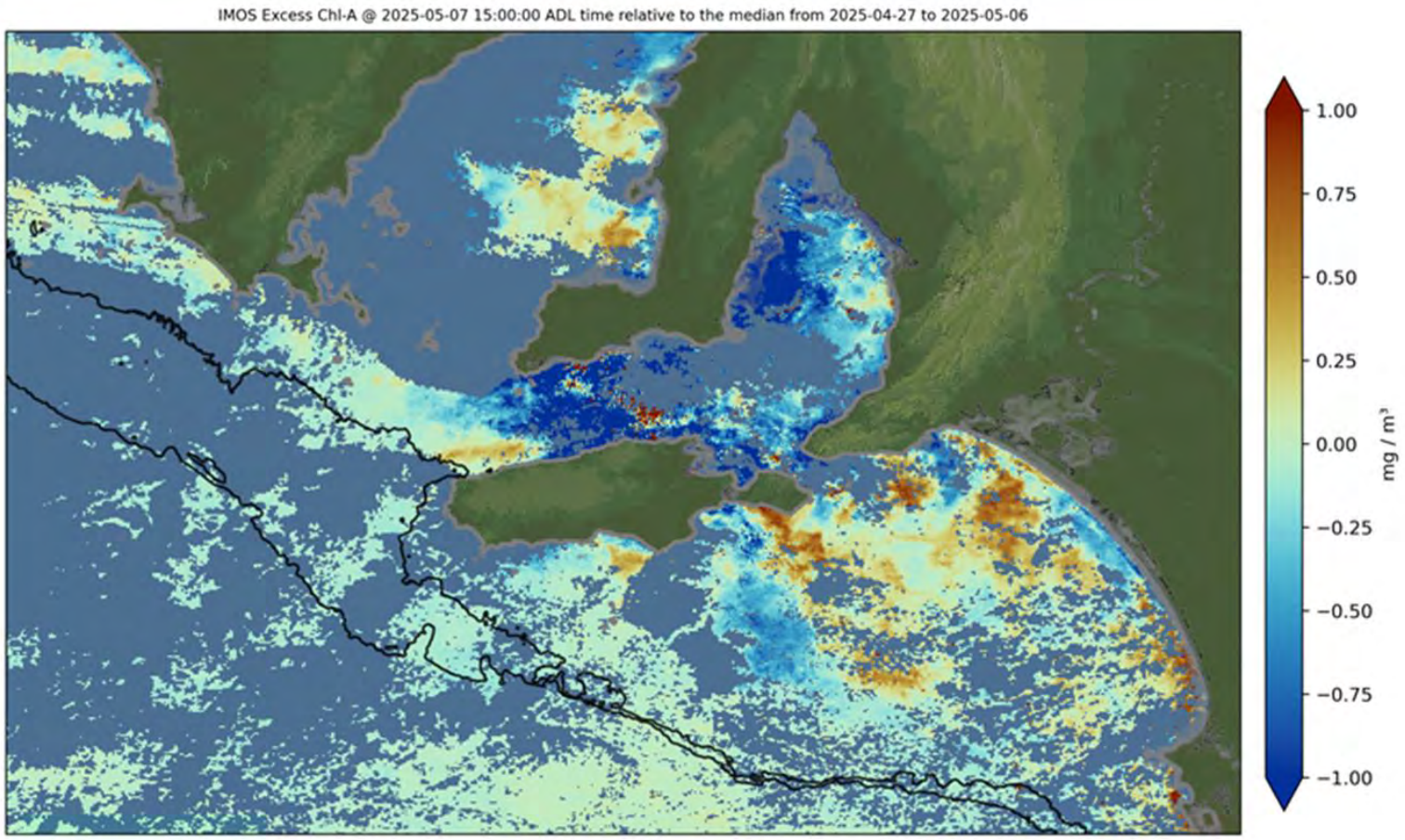


Figure 6. Daily image for 07-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figures 7 and 8) was used to predict the trajectory of water masses over a period of 5 days, starting 13-May and ending 18-May 2025. Light to moderate south to south-westerly winds dominate the forecast period up to 16-May before turning south to south-easterly over 17 to 18 May.

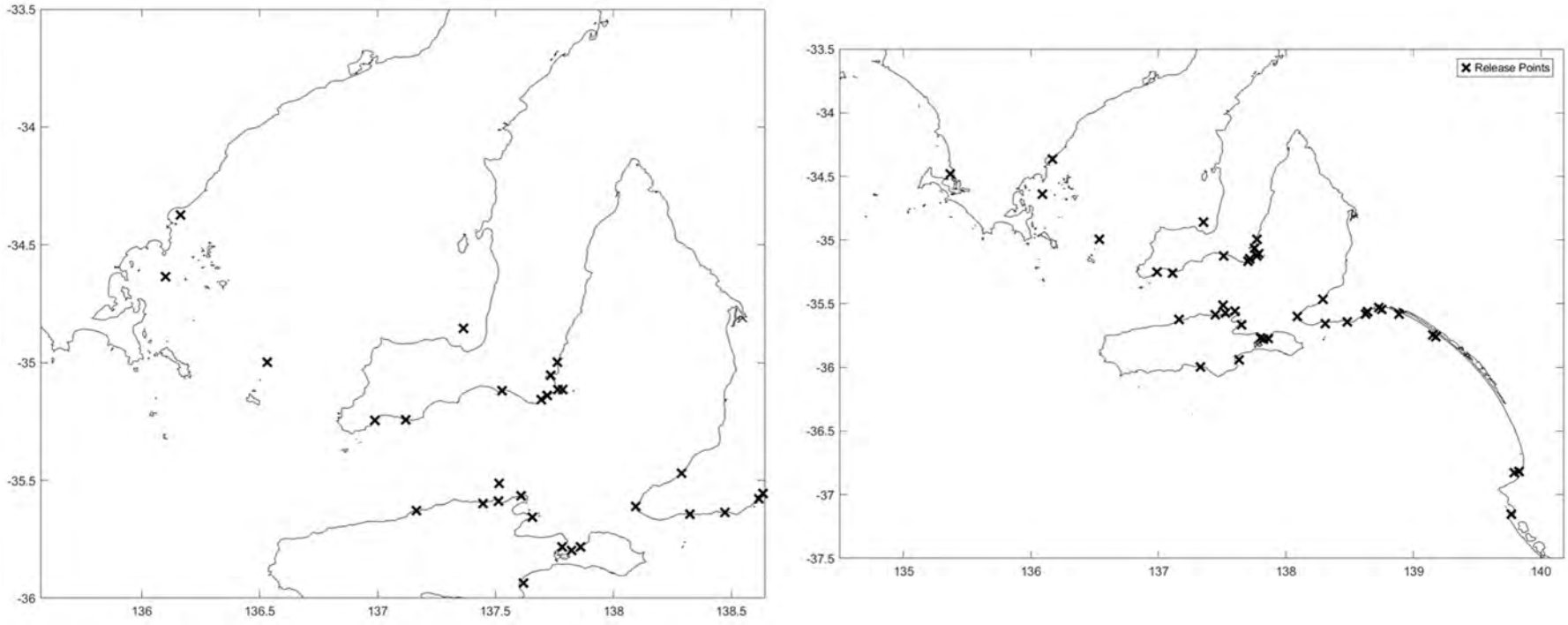


Figure 7. Initial release locations for the oceanographic forecast modelling of water mass movements using particles representative of microscopic algae.

South Australian Harmful Algal Bloom (HAB) Situation Update: 13-05-2025

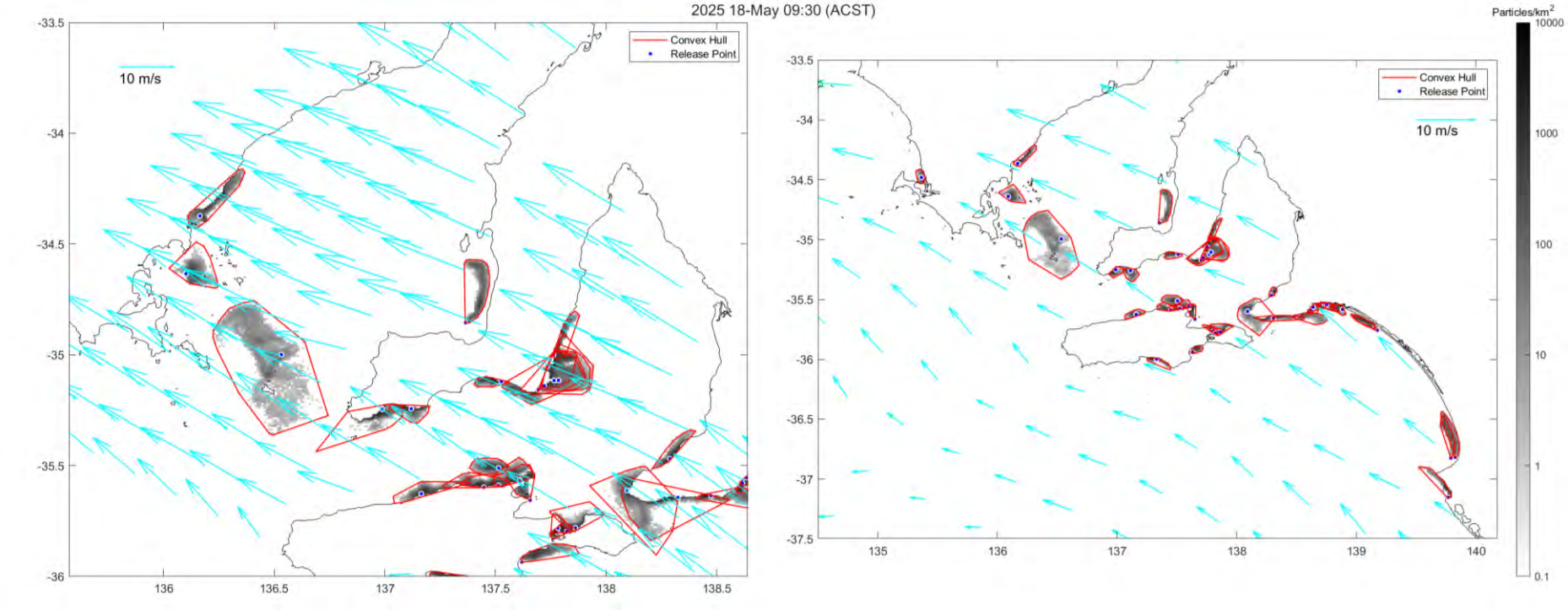


Figure 8. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 13-May and ending 18-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location across the simulation period.

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 17 May 2025 6:24 AM
To: Jones, Annabel (PIRSA); Najjar, Feeras (PIRSA); Mellor, Emily (PIRSA); Mayfield, Stephen (PIRSA-SARDI); Grammer, Gretchen (PIRSA-SARDI); Read, Matt (PIRSA); eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer; Clause 6(1) Rob Gratton; Clause 6(1) Neil MacDonald; Nathan Kimber; Clause 6(1) Clause 6(1) @yumbah.com'; Clause 6(1) @yumbah.com'; Clause 6(1) @sasardines.com.au'; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com'; Clause 6(1) @CH4global.com'; Clause 6(1) @bigpond.com'; eo@mfasa.org.au; Keith Rowling; 'sapfafishers@gmail.com'; Clause 6(1)
Cc: Doubell, Mark (PIRSA); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (DEW); Clause 6(1) (EPA) Clause 6(1) (EPA); Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 16 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-16052025_Media.pdf

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA) ; Najjar, Feeras (PIRSA) ; Mellor, Emily (PIRSA) ; Mayfield, Stephen (PIRSA-SARDI) ; Grammer, Gretchen (PIRSA-SARDI) ; Read, Matt (PIRSA) ; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) Executive Officer ; Clause 6(1) ; Rob Gratton ; Clause 6(1) Neil MacDonald ; Nathan Kimber ; Clause 6(1) ; Clause 6(1) @yumbah.com' ; ' Clause 6(1) @yumbah.com' ; ' Clause 6(1) @sasardines.com.au' ; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' ; Clause 6(1) @CH4global.com' ; Clause 6(1) @bigpond.com' ; eo@mfasa.org.au; Keith Rowling ; 'sapfafishers@gmail.com' ; Clause 6(1)
Cc: Doubell, Mark (PIRSA) Clause 6(1) (DEW) Clause 6(1) DEW) ; Clause 6(1) (DEW) ; Clause 6(1) (EPA) ; Clause 6(1) (EPA) ; Clause 6(1) (EPA)
Subject: RE: Algal bloom update - 13 May 2025

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:08 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; ' Clause 6(1) @sasardines.com.au' <Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>; Clause 6(1)

<[redacted]@yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (EPA) <[redacted]@sa.gov.au>; [redacted] (EPA) <[redacted]@sa.gov.au>; [redacted] (EPA) <[redacted]@sa.gov.au>
Subject: RE: Algal bloom update - 13 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' <[redacted]@CH4global.com>; [redacted]@bigpond.com' <[redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>; [redacted]@yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (DEW) <[redacted]@sa.gov.au>; [redacted] (EPA) <[redacted]@sa.gov.au>
Subject: RE: Algal bloom update - 9 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]@yumbah.com' <[redacted]@yumbah.com>; '[redacted]@yumbah.com' [redacted]@yumbah.com>; [redacted]@sasardines.com.au' <[redacted]@sasardines.com.au>; [redacted]@strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; [redacted]@CH4global.com' [redacted]@CH4global.com>; [redacted]@bigpond.com' [redacted]@bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; [redacted]@asbtia.org>; [redacted]@yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; [redacted] (DEW) [redacted]@sa.gov.au>[redacted]

Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 6 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:26 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com; Clause 6(1) @yumbah.com; Clause 6(1) @sasardines.com.au; Clause 6(1) @strategicmc.com.au; tom@goolwapipico.com; Clause 6(1) @CH4global.com; Clause 6(1) @bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; Clause 6(1) @asbtia.org>; Clause 6(1) <Clause 6(1) @yumbah.com>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (DEW) <Clause 6(1) @sa.gov.au>; Clause 6(1) (EPA) <Clause 6(1) @sa.gov.au>
Subject: RE: Algal bloom update - 2 May 2025

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:00 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' <Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' <Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi All – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>; eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; Clause 6(1) <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; Clause 6(1) @yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; Clause 6(1) <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; Clause 6(1) @bigpond.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @yumbah.com' Clause 6(1) @yumbah.com>; Clause 6(1) @sasardines.com.au' Clause 6(1) @sasardines.com.au>; Clause 6(1) @strategicmc.com.au; 'tom@goolwapipico.com' <tom@goolwapipico.com>; Clause 6(1) @CH4global.com' Clause 6(1) @CH4global.com>; Clause 6(1) @bigpond.com' Clause 6(1) @bigpond.com>; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; 'sapfafishers@gmail.com' <sapfafishers@gmail.com>; Clause 6(1) @asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:35 AM
To: Jones, Annabel (PIRSA) <Annabel.Jones@sa.gov.au>; Najjar, Feeras (PIRSA) <Feeras.Najjar2@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Mayfield, Stephen (PIRSA-SARDI) <Stephen.Mayfield@sa.gov.au>; Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Read, Matt (PIRSA) <Matt.Read@sa.gov.au>;

eo@abalonesa.com.au; pres@abalonesa.com.au; tom@margoconsulting.com.au; merilyn@nmac.com.au; kyri.toumazos@hotmail.com; [redacted] <ceo@asbtia.org>; Executive Officer <executiveofficer@oysterssa.com.au>; [redacted]@yumbah.com>; Rob Gratton <rob.gratton@cleanseas.com.au>; [redacted] <eo@prawnassociation.com.au>; Neil MacDonald <neil@nmac.com.au>; Nathan Kimber <nathan@kimberconsulting.com.au>; [redacted]@bigpond.com>; [redacted]yumbah.com; [redacted]@yumbah.com; [redacted]@sasardines.com.au [redacted]@strategicmc.com.au; tom@goolwapipico.com; [redacted]CH4global.com [redacted]@bigpond.com; eo@mfasa.org.au; Keith Rowling <keith@nmac.com.au>; sapfafishers@gmail.com; [redacted]@asbtia.org>
Cc: Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi All
Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Begg, Gavin (PIRSA)
Sent: Saturday, 17 May 2025 6:24 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI); Doubell, Mark (PIRSA); Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 16 May 2025
Attachments: SARDI Oceanography-HAB Situation Update Support-16052025_Media.pdf

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 13 May 2025 6:09 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 13 May 2025

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 10 May 2025 7:15 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 9 May 2025

Hi Asher
Please see latest SARDI update
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 6 May 2025 7:45 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) ; Doubell, Mark (PIRSA) ; Lear, Jordan (PIRSA)
Subject: RE: Algal bloom update - 6 May 2025

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 2 May 2025 3:27 PM
To: 'Asher Dezsery [redacted]

Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 29 April 2025 8:01 AM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Thursday, 24 April 2025 12:53 PM
To: 'Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Friday, 18 April 2025 1:18 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>; Lear, Jordan (PIRSA) <Jordan.Lear@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update. Thanks to Mark and SARDI team.
Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Tuesday, 15 April 2025 5:22 PM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Algal bloom update

Hi Asher – please see latest SARDI update

Regards
Gavin

From: Begg, Gavin (PIRSA)
Sent: Saturday, 12 April 2025 7:36 AM
To: Asher Dezsery [redacted]
Cc: Grammer, Gretchen (PIRSA-SARDI) <Gretchen.Grammer@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: Algal bloom update

Hi Asher

Please see latest information from SARDI re. algal bloom.

Also, below other information:

Department for Environment and Water - SA Karenia mikimotoi algal...

Water quality alerts | SA Health

SA Karenia mikimotoi algal bloom update - PIRSA

Regards
Gavin

Prof Gavin Begg | Executive Director
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0960 | **E:** gavin.begg@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 22b

South Australian Harmful Algal Bloom (HAB) Situation Update: 16-05-2025

Context

In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified in the waters around the Fleurieu Peninsula in South Australia (SA), particularly near Waitpinga and Parsons Beach. HABs are large growths of microscopic algae that can affect marine life, human health and water quality. The last notable bloom of this type of algae was recorded in Coffin Bay, SA in 2014.

It is difficult to predict the duration of HABs. Factors that can lead to the decline or end of the bloom include a change in environmental conditions such as cooler temperatures, increased mixing and water flow, decreased sunlight, and decreased nutrient availability. For these reasons, the current HAB is dynamic and can travel depending on weather, ocean circulation, and environmental conditions.

The South Australian Research and Development Institute (SARDI) is providing information about current environmental conditions specific to the evolution of the ongoing Harmful Algal Bloom (HAB) situation using publicly available data and ocean circulation forecasts provided by the Department of Primary Industries and Regions PIRSA eSA-Marine system.

Visitors to beaches are advised to avoid entering the water if it is discolored or foamy. For health related updates, refer to Water quality alerts on the SA Health website. We encourage anyone who discovers dead or sick marine mammals or extensive fish kills, to contact their local National Parks and Wildlife Service office. Extensive fish kills should be reported to Fishwatch on 1800 065 522.

Important Notes

- The daily increases/decreases in chlorophyll-a (chla) concentrations determined from satellite chla imagery presented in this document do not necessarily indicate the presence of HAB species. Water samples are required to confirm the presence and concentration of HAB species.
- Updates are provided as new data becomes available and are subject to data quality.

Update Summary

A marine heatwave (MHW) has been affecting southern Australia since September 2024. Like heatwaves on land, MHWs are periods of exceptionally warm ocean temperatures. Since the last update on 13-May, there has been a stabilization of sea surface temperature decreases due to seasonal cooling across the state's coastal waters. Current temperatures remain up to 2 to 3°C above average for this time of the year. These elevated temperatures are considered to be a contributing factor to the Harmful Algal Bloom (HAB).

Daily satellite measures of chlorophyll-a (chla) levels, an indicator of algae concentrations, with connectivity to the HAB bloom identified off the Fleurieu Peninsula in mid-March, indicate elevated sea surface chla concentrations are currently persisting in Investigator Strait between Kangaroo Island, the foot of Yorke Peninsula and the southern tip of the Fleurieu Peninsula, and along the western coast of Gulf Saint Vincent. However, since the last update, chla concentrations have decreased in Investigator Strait, along the northern and eastern coastlines of Kangaroo Island, along the south-eastern foot of Yorke Peninsula, around parts the Fleurieu Peninsula and in waters offshore from Port Lincoln, Arno Bay, Tumby Bay, Point Turton and Port Victoria in Spencer Gulf. Areas of increasing sea surface chla are observed along the western coastline of Gulf Saint

Vincent between Edithburgh and Ardrossan, Newland Head on the Fleurieu Peninsula, Boston and Louth Bays near Port Lincoln, and between Robe and Beachport in the southeast.

Ocean circulation forecasts covering a five-day period ending 21-May 2025, provide an indication of where water masses, and any microalgae contained within them, may move from multiple source locations based on prevailing ocean currents. These forecasts help anticipate potential shifts in bloom distribution where the presence of HAB species has been confirmed by water sampling.

Detailed Update

- Marine heatwave (MHW) conditions have persisted across most of southern Australia since September 2024. The latest conditions on 13-May 2025 indicate that moderate to strong MHW conditions continue across South Australia's coastal regions. Compared to the last update, MHW conditions have slightly increased in intensity in open waters along the continental shelf margin from the eastern lower Eyre Peninsula to Port MacDonnell, including waters near entrance to Spencer Gulf and along the Coorong (Figure 1).

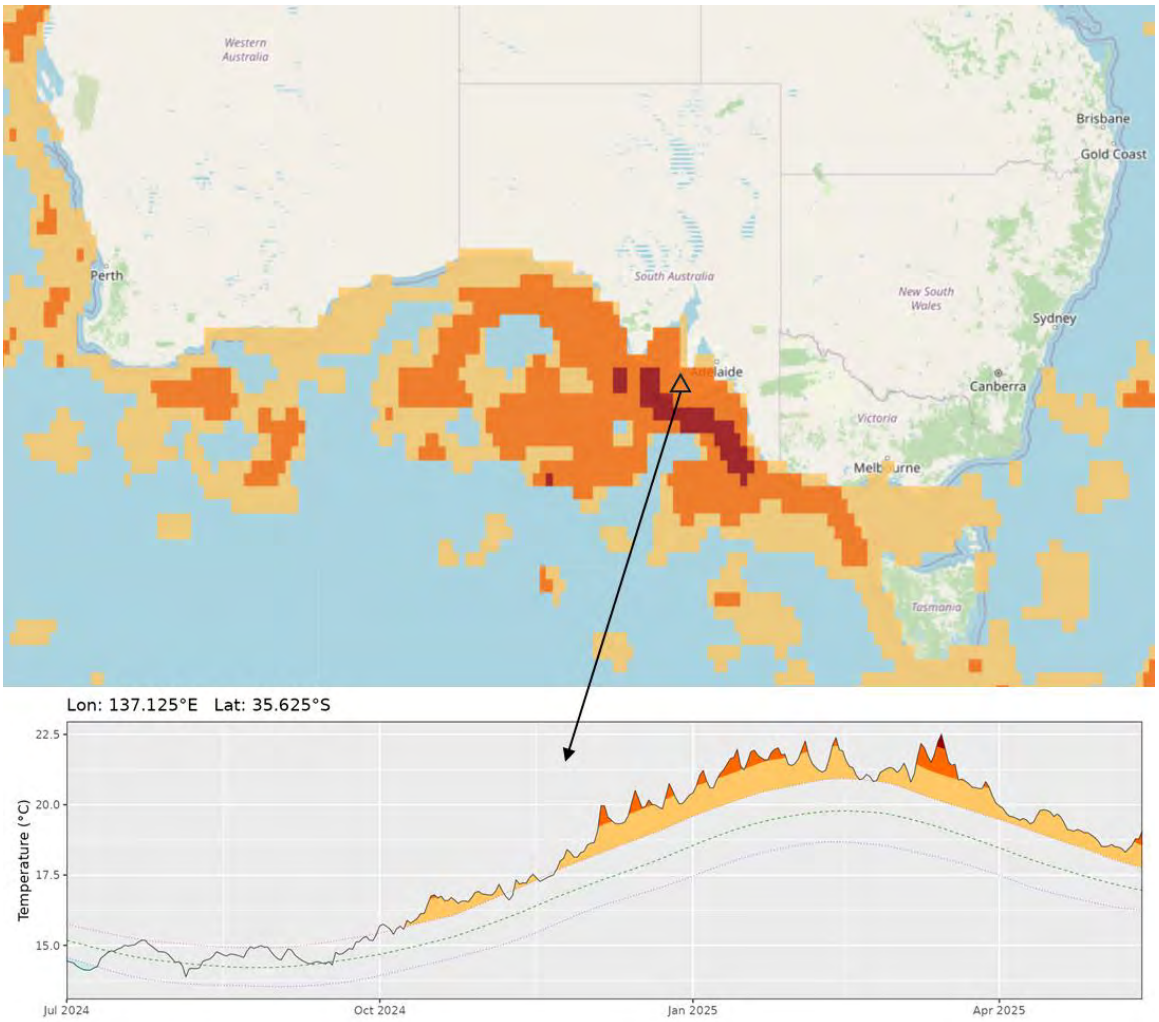


Figure 1. (Top) Latest available snapshot of the current marine heatwave conditions in Australia on 13-May 2025. (Bottom) Timeseries of seas surface temperature for a location in Investigator Strait showing the presence of MHW conditions since July 2024 to present. Light orange = moderate, orange = strong, dark orange = severe, dark red = extreme. Source: www.marineheatwaves.org.

South Australian Harmful Algal Bloom (HAB) Situation Update: 16-05-2025

- As of 13-May 2025, sea surface temperature (SST) anomalies remain up to +2 to 3°C above the long-term 90th percentile conditions for this time of the year across most of South Australia's shelf, gulf and coastal waters (Figure 2). Compared to the last update, SST anomlaies have slightly increased by up to 0.5°C across much of the states coastal and gulf waters.

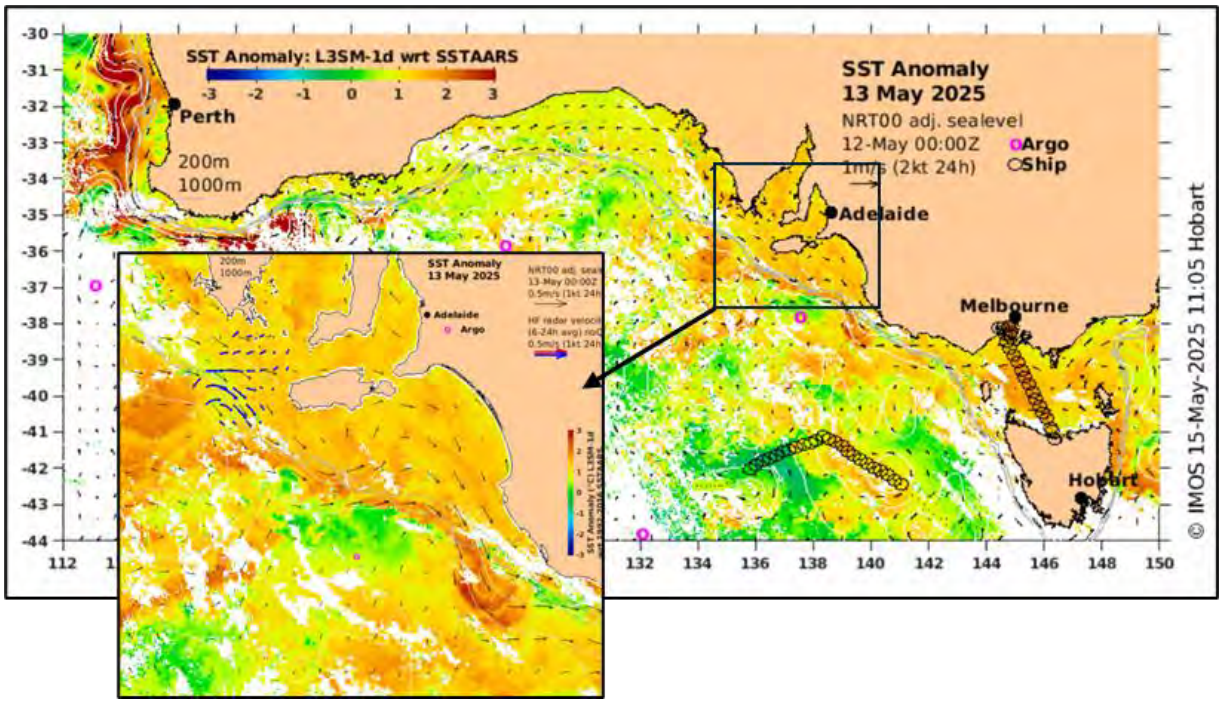


Figure 2. Latest sea surface temperature anomalies in the southern Australian region. Source: https://oceancurrent.aodn.org.au/.

South Australian Harmful Algal Bloom (HAB) Situation Update: 16-05-2025

- SST data collected by the IMOS and SAWAVES wave buoy network show that decreases in sea surface temperatures due to seasonal cooling stabilised or slightly increased across South Australia during the period of 08-May to 16-May 2025. Warm daytime temperatures over the last few days have caused daily spikes in temperature up to approximately 1°C above the overnight minima. Current daily minimum temperatures range from approximately 18.0°C in Victor Harbour to 18.4 °C in Ceduna.

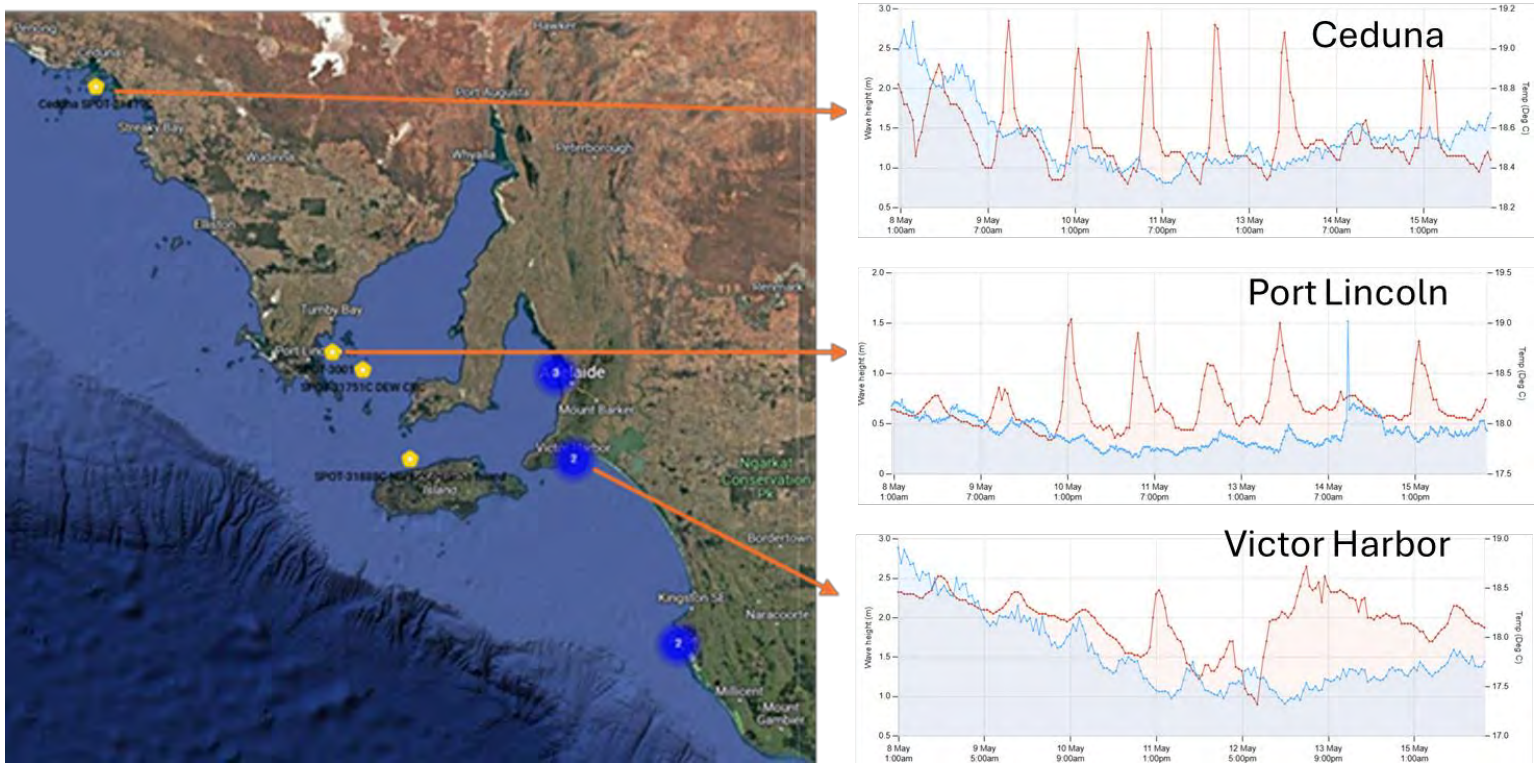


Figure 3. Latest sea surface temperature (red line) and significant wave height data (blue line) from wave-buoys located in coastal South Australian regions. Source: sawaves

- Figure 4 shows the latest cloud-free satellite chla image taken on 13-May 2025. Persistent elevated chla levels are found in Investigator Strait between Kangaroo Island and Yorke Peninsula, including the coastlines along the southeastern foot of Yorke Peninsula, the northern and eastern coasts of Kangaroo Island, the western and northern regions of Gulf Saint Vincent, along the Fleurieu Peninsula from Myponga to Goolwa, along the southwestern coast of Spencer Gulf including the embayments surrounding Port Lincoln, along the southwestern coast of Spencer Gulf from Point Turton to Port Victoria, and near Robe and Kingston in the southeast.

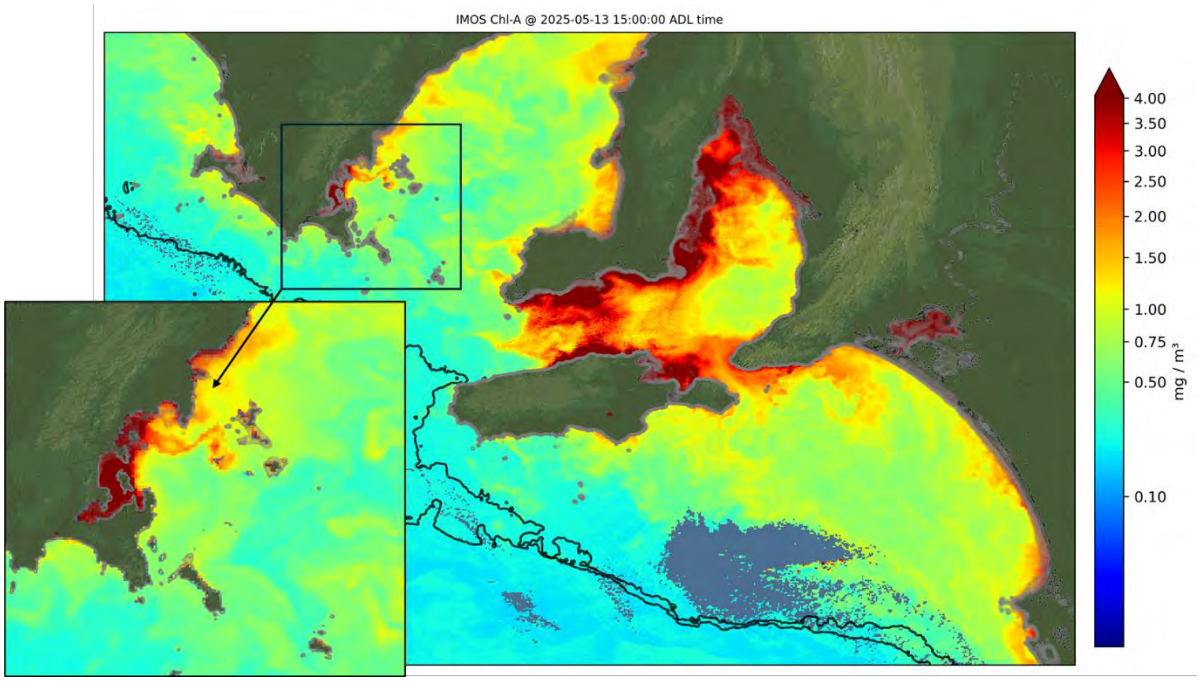


Figure 4. Latest sea surface chla map taken on 13-May 2025. Regions where no data is available due to cloud cover are shaded in grey-blue. Source: https://oceancurrent.aodn.org.au/

- The corresponding daily image for 13-May 2025, showing areas of sea surface chla increases and decreases (Figure 5), was determined by subtracting the median value of the previous 10-days of sea surface chla maps from the latest sea surface chla map shown in Figure 4.

- Comparison of the daily changes in concentrations observed on the 13-May 2025 (Figure 5) to that from 11-May 2025 (Figure 6), suggest sea surface chla concentrations are decreasing in Investigator Strait, along the northern and eastern coastlines of Kangaroo Island, along the south-eastern foot of Yorke Peninsula, around parts of the Fleurieu Peninsula and in embayment's around Port Lincoln, Arno Bay, Tumby Bay, Point Turton and Port Victoria in Spencer Gulf.

- Areas of increasing sea surface chla are observed along the western coastline of Gulf Saint Vincent between Edithburgh and Ardrossan, Newland Head on the Fleurieu Peninsula, Boston and Louth Bays near Port Lincoln and between Robe and Beachport in the southeast.

South Australian Harmful Algal Bloom (HAB) Situation Update: 16-05-2025

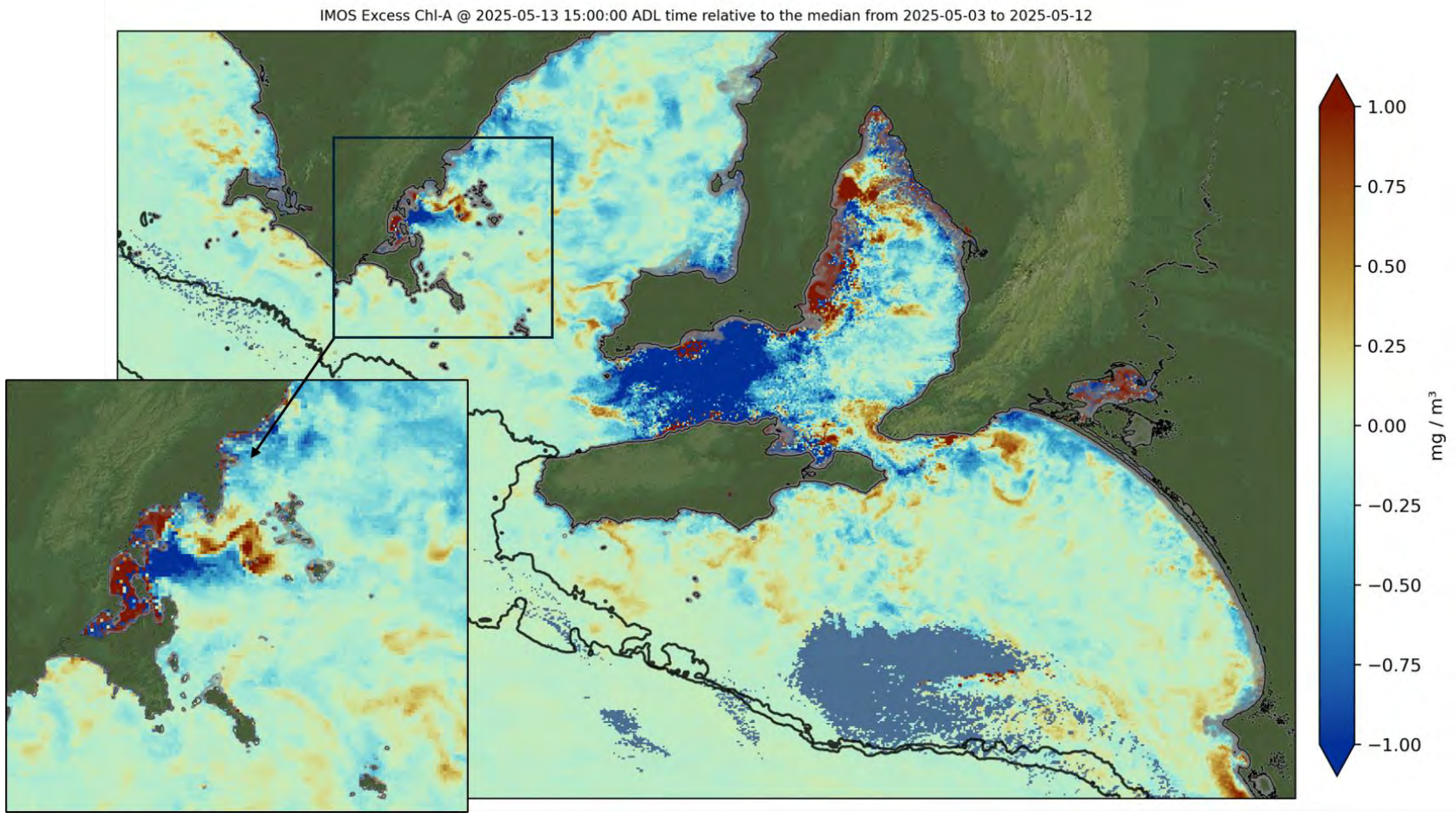


Figure 5. Latest daily image for 13-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

South Australian Harmful Algal Bloom (HAB) Situation Update: 16-05-2025

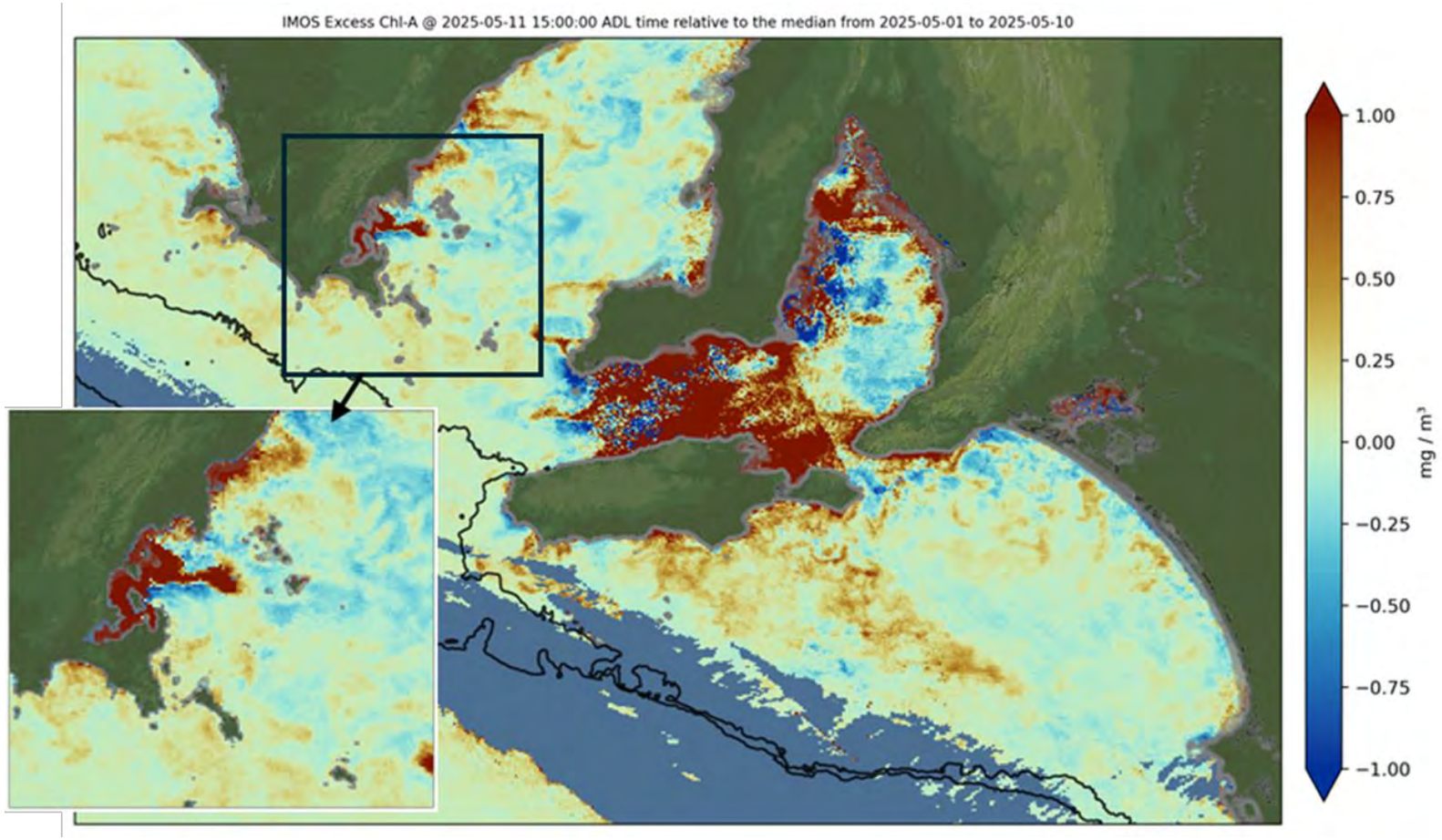


Figure 6. Daily image for 11-May 2025 showing areas of increases and decreases in sea surface chla concentrations. Grey-blue regions indicate areas where no data is available due to cloud cover.

- Oceanographic forecast modelling of particles released from multiple source regions across the state (Figure 7) was used to predict the trajectory of water masses over a period of 5 days, starting 16-May and ending 21-May 2025. The placement of these source regions are purely for predictive purposes and are not indicative of current locations where HAB species have been found. They show the predicted path of particles in a region based on the current modelled oceanographic and meteorological conditions. Light to moderate south-easterly winds dominate the forecast period up to 18-May before turning northerly on 19-May and westerly on 20-May 2025.

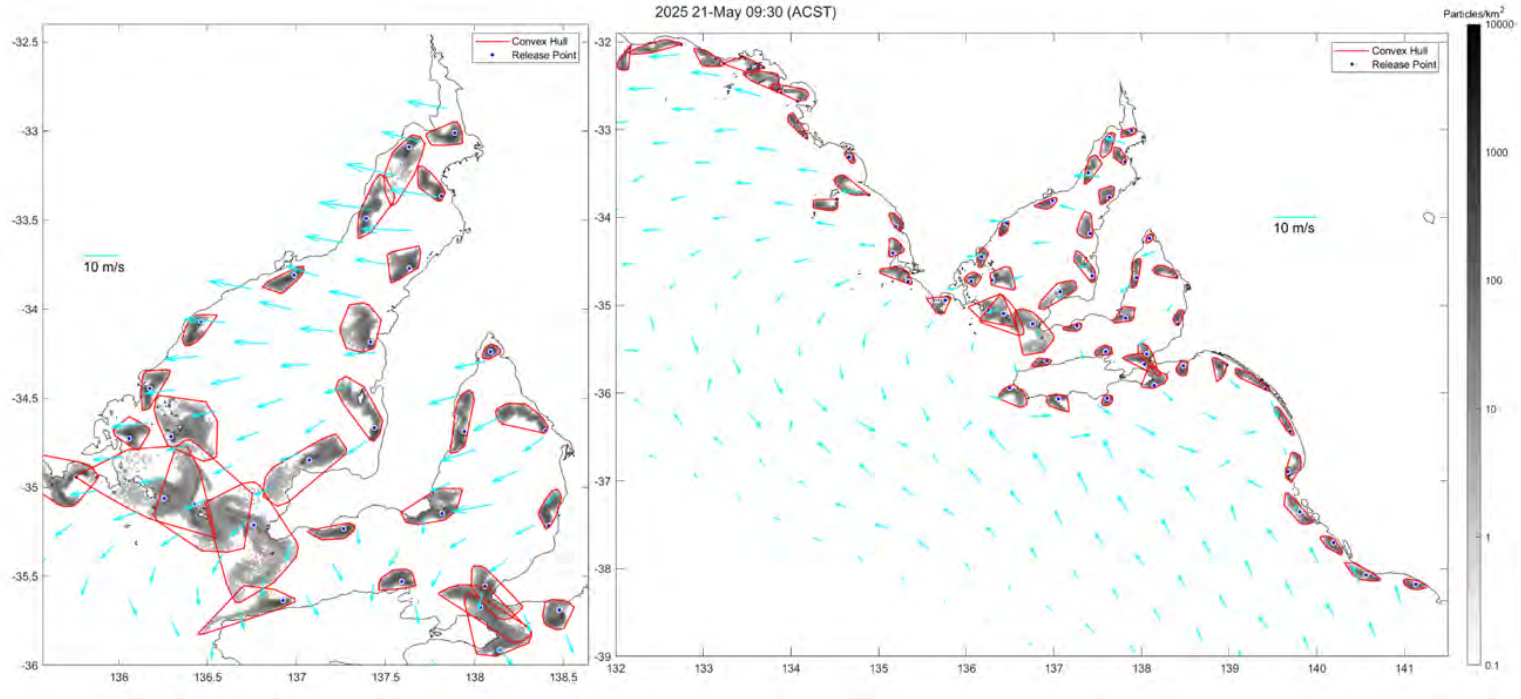


Figure 7. Final results of oceanographic forecast modelling of particle trajectories for different source locations for the period starting 16-May and ending 21-May 2025. Blue arrows indicate the model wind speed and direction. Red lines highlight the convex envelope, or polygon, with the shortest perimeter that encloses the particles tracked from each source location across the simulation period.

Acknowledgments

Data were sourced from Australia's Integrated Marine Observing System (IMOS) – IMOS is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS).

Disclaimer

- Use of the information and data contained within this site or these pages is at your sole risk.
- If you rely on the information provided in this update you are responsible for ensuring by independent verification its accuracy, currency or completeness.
- This site includes links to other websites operated by community, business and government. These linked websites will have their own terms and conditions of use and you should familiarise yourself with these.
- All linked websites are linked 'as is' and the Government of South Australia:
    - does not sponsor, endorse or necessarily approve of any material on websites linked from or to this site
    - does not make any warranties or representations regarding the quality, accuracy, merchantability or fitness for purpose of any material on websites linked from or to this site
    - does not make any warranties or representations that material on other websites to which this site is linked does not infringe the intellectual property rights of any person anywhere in the world
    - does not authorise the infringement of any intellectual property rights contained in material in other websites by linking this site to those other websites.
- If you use automatic language translation services in connection with this site (including Google Translate) you do so at your own risk.
- The information provided in this update is subject to change without notice.
- The Government of South Australia, its agents, instrumentalities, officers and employees:
    - make no representations, express or implied, as to the accuracy of the information and data contained on this site
    - make no representations, express or implied, as to the accuracy or usefulness of any translation of the information on this site or any linked website into another language
    - make no representations as to the availability of the site and the availability of websites linked from or to the site
    - accept no liability however arising for any loss resulting from the use of the site and any information and data or reliance placed on it (including translated information and data)
    - make no representations, either expressed or implied, as to the suitability of the said information and data for any particular purpose
    - accepts no liability for any interference with or damage to a user's computer, software or data occurring in connection with or relating to this site or its use or any website linked to this site

Farley, Lisa (PIRSA)

From: Mellor, Emily (PIRSA)
Sent: Thursday, 24 April 2025 2:25 PM
To: Lynlee Oysters SA
Subject: RE: Stansbury - algae intel

Are you happy to liaise with the growers in Stansbury and give them the info I am supplying or would you prefer I obtain their email addresses and send it to them directly?

Many thanks
Emily

From: Mellor, Emily (PIRSA)
Sent: Thursday, 24 April 2025 11:43 AM
To: 'Lynlee Oysters SA' <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

Also, there are currently no oyster sites operating within the Tickera and Port Broughton intertidal aquaculture zones in the Aquaculture (Zones - Eastern Spencer Gulf) Policy 2005.
There is currently 65ha in the Port Broughton Zone and 40ha in Tickera Zone. This would be a good bet given it is an approved aquaculture zone.

Happy to chat further at any time.

Kind regards
Emily

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Thursday, 24 April 2025 11:22 AM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

Also, might be worth considering whether there are any current empty sites with existing infrastructure on them where they could relocate quickly to. I am not sure how we determine this? Any thoughts?

Thanks
Emily

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Thursday, 24 April 2025 10:56 AM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Thanks Emily,

I'll pass this onto the Stansbury guys.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8.30 - 3.00, **Fri** 8.30 - 4.00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Thursday, 24 April 2025 10:53 AM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Hi Lynlee

If the Stansbury guys are potentially considering moving if there is mikimotoi detected in the area they could consider scoping out potential areas that may be suitable for an emergency lease and send these in to us to be proactive. We can then advise if there are any issues (i.e. nav channels, aquaculture exclusion zones, national park boundaries etc) which may prove problematic if we were to consider an emergency lease in the area – alternatively they can look at these layers on the Public Register themselves when considering areas.

Many thanks
Emily

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Thursday, 24 April 2025 8:31 AM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Thanks for all of this Emily, will do.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8.30 - 3.00, Fri 8.30 - 4.00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 5:36 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Also Lynlee, would you mind reminding growers to report any fish mortalities they observe to FishWatch and not assume they are already aware of the situation?

This helps to ensure we are collecting samples promptly etc.

Many thanks
Emily

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 4:59 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

Hi Lynlee,

I have done some fact checking and can confirm there are currently no restrictions on intra-state Pacific Oyster movements between growing regions in South Australia.

The movement of aquatic animals, including Pacific Oysters, between aquaculture licences in South Australia is currently not considered in the *Prohibition of Entry into and Movement within South Australia of Aquaculture Stock* 2020 Notice, pursuant to section 33 of the *Livestock Act 1997* (the Act).

Disease risks, however, associated with translocation of aquatic animals to aquaculture licences (including land-based aquaculture licences) require mitigation and translocation approval. Pursuant to section 30 of the Act, if livestock or livestock products are affected with a notifiable condition; or there is reason to suspect that livestock or livestock products are affected with a notifiable condition, the livestock or livestock products must not be brought into, removed from or moved within the State without the approval of the Chief Inspector.

This means – if for example Pacific Oyster Mortality Syndrome (POMS) were to be detected in oyster growing areas, then approval from the Chief Inspector of Stock would be required for every Pacific Oyster movement between aquaculture licences (including landbased and marine based). This is why ongoing POMS surveillance is very important.

In the current circumstances (Lester below) this is ok as there are currently no notifiable conditions, nor reason to suspect the oysters are affected with a notifiable condition.

If however, the area is subject to a SASQAP closure due to the mikimotoi bloom then there is no movement of stock allowed – but I think if producers did want to move stock out of harm's way (i.e. to an emergency lease or one of their other leases) then they would potentially need to apply through the PIRSA Food Safety team. I will confirm this with Sarah Spurling tomorrow and get back to you.

If you have any questions, please don't hesitate to contact me.

Kind regards,

Emily

Emily Mellor | General Manager, Aquaculture
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0360 | **E:** emily.mellor@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Wednesday, 23 April 2025 2:10 PM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Hi there,

I've just spoken to Clause 6(1) and Clause 6(1) (Southern Yorke Oysters), they have both confirmed they have sighted dead sea life today. Yesterday all was ok and the water was clear, this morning completely different story, very murky. They have seen dead cuttle fish, carpet sharks, blue rings (and a couple others that I didn't catch).

Clause 6(1) – He has the majority of sub 20mm stock as he is a ongrower. His oysters are looking ok at the moment but I told him that Clinton mentioned there can be a delay for oysters and also if he has any questions to give Clinton a call. Clause 6(1) asked about translocation rules. I didn't know and told him to contact you if he wants more info.

Clause 6(1) – Clause 6(1). He has moved 1.2million oysters to Coffin Bay. He still has 400,000 at Stansbury but has left the bigger ones there, Clinton has told him that the bigger oysters don't seem to be affected by this algae as much.

They both have the emergency lease info and will contact you if they have any questions. Give me a call if need be.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8.30 - 3.00, Fri 8.30 - 4.00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 12:39 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: re: Stansbury - algae intel

OFFICIAL

Hi Lynlee
Hope you had a nice Easter.

Just touching base to see if you have been receiving any intel on how the industry are feeling about the current *Karenia mikimotoi* bloom?
To date the oyster industry have been pretty quiet about it. I know some samples are coming to Clinton from Stanbury way tomorrow so will be good to get these results as I believe the water is pretty yuck over there.

Are any other bays concerned?

I know there was some social media from Coffin Bay claiming there were dead fish etc. around Gunyah Beach however I can report back that to date, reports of dead fish or birds at Coffin Bay National Park have **not been received** by the Department of Primary Industries and Regions (PIRSA). Fisheries Officers working in the area have also not sighted any dead fish or birds. DEW has also not received any reports of dead fish/birds either. Clinton has also confirmed no toxic species in the samples from this area.

You would have received my email around the emergency lease provisions of the Act. Please share with your members as you feel necessary. It is obviously just a precaution at this stage.

Many thanks
Emily

Emily Mellor | General Manager, Aquaculture
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0360 | **E:** emily.mellor@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Mellor, Emily (PIRSA)
Sent: Thursday, 24 April 2025 2:51 PM
To: Lynlee Oysters SA
Subject: RE: Stansbury - algae intel

Spoke to Clause 6(1):
I asked him what the situation was – mentioned he had a basket of dead oysters that he had pulled in and would be seeing if he had any more over the weekend.
I reminded him to call in any higher-than-normal mortalities. I asked whether he had received the SARDI updates and emergency lease info and he has.
Mentioned this was an option for him to consider and he said that they couldn't do it anyway as they would have to establish the infrastructure elsewhere. I said we recognise it is not ideal but is an option and if they need to be there for any length of time then it could be more feasible to have to establish the required infrastructure/markers etc.
Reminded him to send off some samples to SASQAP if he was still concerned – he said they sent some off earlier this week (maybe end of last week) and they had come back with low levels of mikimotoi.
Also reminded him to report to Fishwatch if he saw any change in the number of dead fish etc.

I will send him an email with Maddi Gaut and Matt Bansemer contact details (Aquatic Animal Health Team) and my details in case he has any follow up.
Thanks Lynlee

Kind regards
Emily

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Thursday, 24 April 2025 1:43 PM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Thanks Emily, I'll pass this on.

I have just received this text message from Clause 6(1) who has the leases at Clause 6(1). Can I hand ball this one to you or how would you like me to respond? Tell him to contact PIRSA? It makes it hard when he's away. I know his son Clause 6(1) is looking after the oysters Clause 6(1) (Clause 6(1) or phone Clause 6(1) Clause 6(1). I have added a few comments in Clause 6(1) message in red.

Msg from Clause 6(1):

Hi Lindlee.
Am currently Cl 6(1) however had a call from a concerned Clause 6(1) regarding algal bloom at Stansbury. They have just started seeing a few dead fish. As you know we have been seeing dead fish all around us for a couple of months now (I spoke with Clause 6(1) on 10th April who told me they had seen the coral die and a few fish) . Clinton at SASQAP is also aware. We have also expressed our concern (not sure who to, not me) of mortalities occurring in our stock. It is of great concern to us. Clause 7(1)(c)
Clause 7(1)(c)

Why is it suddenly a concern for Stansbury, who have just started seeing small fish kills in the area. This has been going on around us for a long time now. Can you please advise us on our options Clause 7(1)(c) Clause 7(1)(c) .

Please contact me regarding these concerns. Either by email, phone or WhatsApp. Clause 6(1) Clause 6(1) .

Thanks
Clause 6(1)

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8 30 - 3 00, **Fri** 8 30 - 4 00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Thursday, 24 April 2025 11:43 AM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Also, there are currently no oyster sites operating within the Tickera and Port Broughton intertidal aquaculture zones in the Aquaculture (Zones - Eastern Spencer Gulf) Policy 2005.
There is currently 65ha in the Port Broughton Zone and 40ha in Tickera Zone. This would be a good bet given it is an approved aquaculture zone.

Happy to chat further at any time.

Kind regards
Emily

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Thursday, 24 April 2025 11:22 AM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

Also, might be worth considering whether there are any current empty sites with existing infrastructure on them where they could relocate quickly to. I am not sure how we determine this? Any thoughts?

Thanks
Emily

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Thursday, 24 April 2025 10:56 AM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Thanks Emily,

I'll pass this onto the Stansbury guys.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8.30 - 3.00, Fri 8.30 - 4.00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Thursday, 24 April 2025 10:53 AM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Hi Lynlee

If the Stansbury guys are potentially considering moving if there is mikimotoi detected in the area they could consider scoping out potential areas that may be suitable for an emergency lease and send these in to us to be proactive. We can then advise if there are any issues (i.e. nav channels, aquaculture exclusion zones, national park boundaries etc) which may prove problematic if we were to consider an emergency lease in the area – alternatively they can look at these layers on the Public Register themselves when considering areas.

Many thanks
Emily

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Thursday, 24 April 2025 8:31 AM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Thanks for all of this Emily, will do.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8 30 - 3 00, **Fri** 8 30 - 4.00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 5:36 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Also Lynlee, would you mind reminding growers to report any fish mortalities they observe to FishWatch and not assume they are already aware of the situation?

This helps to ensure we are collecting samples promptly etc.

Many thanks
Emily

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 4:59 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: RE: Stansbury - algae intel

Hi Lynlee,

I have done some fact checking and can confirm there are currently no restrictions on intra-state Pacific Oyster movements between growing regions in South Australia.

The movement of aquatic animals, including Pacific Oysters, between aquaculture licences in South Australia is currently not considered in the *Prohibition of Entry into and Movement within South Australia of Aquaculture Stock* 2020 Notice, pursuant to section 33 of the *Livestock Act 1997* (the Act).

Disease risks, however, associated with translocation of aquatic animals to aquaculture licences (including land-based aquaculture licences) require mitigation and translocation approval. Pursuant to section 30 of the Act, if livestock or livestock products are affected with a notifiable condition; or there is reason to suspect that livestock or livestock products are affected with a notifiable condition, the livestock or livestock products must not be brought into, removed from or moved within the State without the approval of the Chief Inspector.

This means – if for example Pacific Oyster Mortality Syndrome (POMS) were to be detected in oyster growing areas, then approval from the Chief Inspector of Stock would be required for every Pacific Oyster movement

between aquaculture licences (including landbased and marine based). This is why ongoing POMS surveillance is very important.

In the current circumstances (Lester below) this is ok as there are currently no notifiable conditions, nor reason to suspect the oysters are affected with a notifiable condition.

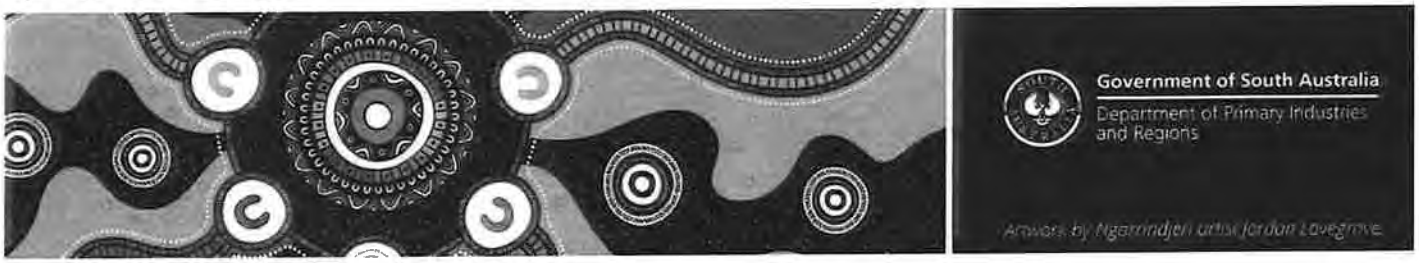
If however, the area is subject to a SASQAP closure due to the mikimotoi bloom then there is no movement of stock allowed – but I think if producers did want to move stock out of harm's way (i.e. to an emergency lease or one of their other leases) then they would potentially need to apply through the PIRSA Food Safety team. I will confirm this with Sarah Spurling tomorrow and get back to you.

If you have any questions, please don't hesitate to contact me.

Kind regards,

Emily

Emily Mellor | General Manager, Aquaculture
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0360 | **E:** emily.mellor@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Sent: Wednesday, 23 April 2025 2:10 PM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: RE: Stansbury - algae intel

OFFICIAL

Hi there,

I've just spoken to Clause 6(1) and Clause 6(1) (Southern Yorke Oysters), they have both confirmed they have sighted dead sea life today. Yesterday all was ok and the water was clear, this morning completely different story, very murky. They have seen dead cuttle fish, carpet sharks, blue rings (and a couple others that I didn't catch).

Clause 6(1) – He has the majority of sub 20mm stock as he is a ongrower. His oysters are looking ok at the moment but I told him that Clinton mentioned there can be a delay for oysters and also if he has any questions to give Clinton a call. Clause 6(1) asked about translocation rules. I didn't know and told him to contact you if he wants more info.

Clause 6(1) – Clause 6(1). He has moved 1.2million oysters to Coffin Bay. He still has 400,000 at Stansbury but has left the bigger ones there, Clinton has told him that the bigger oysters don't seem to be affected by this algae as much.

They both have the emergency lease info and will contact you if they have any questions. Give me a call if need be.

Kind Regards,

Lynlee Lowe
Executive Officer

OYSTERS SOUTH AUSTRALIA

T: 0427 003 346
E: executiveofficer@oysterssa.com.au
W: oysterssa.com.au

SA Oyster Growers Association
SA Oyster Research Council

Tues — Thurs 8 30 - 3 00, Fri 8 30 - 4 00

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Wednesday, 23 April 2025 12:39 PM
To: Lynlee Oysters SA <executiveofficer@oysterssa.com.au>
Subject: re: Stansbury - algae intel

OFFICIAL

Hi Lynlee
Hope you had a nice Easter.

Just touching base to see if you have been receiving any intel on how the industry are feeling about the current *Karenia mikimotoi* bloom?
To date the oyster industry have been pretty quiet about it. I know some samples are coming to Clinton from Stanbury way tomorrow so will be good to get these results as I believe the water is pretty yuck over there.

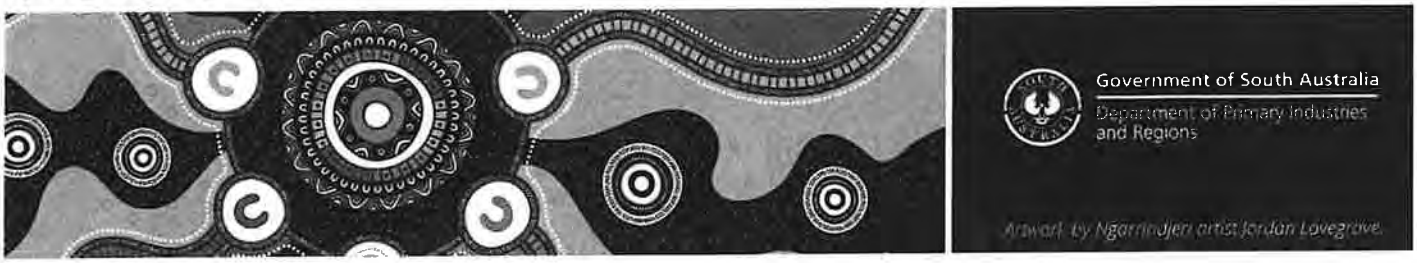
Are any other bays concerned?

I know there was some social media from Coffin Bay claiming there were dead fish etc. around Gunyah Beach however I can report back that to date, reports of dead fish or birds at Coffin Bay National Park have **not been received** by the Department of Primary Industries and Regions (PIRSA). Fisheries Officers working in the area have also not sighted any dead fish or birds. DEW has also not received any reports of dead fish/birds either. Clinton has also confirmed no toxic species in the samples from this area.

You would have received my email around the emergency lease provisions of the Act. Please share with your members as you feel necessary. It is obviously just a precaution at this stage.

Many thanks
Emily

Emily Mellor | General Manager, Aquaculture
Fisheries and Aquaculture | **Department of Primary Industries and Regions**
Government of South Australia | 2 Hamra Avenue, West Beach SA 5024
GPO Box 1625 Adelaide SA 5001
T: +61 8 8429 0360 | **E:** emily.mellor@sa.gov.au
pir.sa.gov.au



The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Wilkinson, Clinton (PIRSA)
Sent: Tuesday, 22 April 2025 11:18 AM
To: Macnamara, Charley (PIRSA); Mellor, Emily (PIRSA)
Cc: Gaut, Maddison (PIRSA); Begg, Gavin (PIRSA); Doubell, Mark (PIRSA)
Subject: RE: Gunyah beach report

OFFICIAL

Hi,

Looked at samples collected by Clause 6(1), reports of tired birds on the beach, no dead fish.

Moderate levels of diatoms, no toxic algae observed in two water samples.

Regards
Clinton

From: Macnamara, Charley (PIRSA) <Charley.Macnamara@sa.gov.au>
Sent: Tuesday, 22 April 2025 9:55 AM
To: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>
Cc: Gaut, Maddison (PIRSA) <Maddison.Gaut@sa.gov.au>; Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: RE: Gunyah beach report

OFFICIAL

Good morning Emily,

Apologies, I have been calling fishwatch callers back this morning. We have had no reports through fishwatch for Coffin Bay.

I know Clinton is getting water samples from the EP, but as this is the first I'm hearing of the reports, I have not been in touch with Fisheries to collect samples.

I shall investigate and I'll keep you updated.

Kind regards,
Charley

Dr. Charley Macnamara | A/g Principal Biosecurity Officer – Weeds and Aquatic Pests
Invasive Species Unit | Biosecurity Division | **Department of Primary Industries and Regions**
Government of South Australia | Building 1, Entry 4, Waite Road, Urrbrae
GPO Box 1671 Adelaide SA 5001
P: +61 8 8429 0791 **M:** Clause 6(1) **E:** charley.macnamara@sa.gov.au

pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations.
We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters.
We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Sent: Tuesday, 22 April 2025 8:42 AM
To: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>; Macnamara, Charley (PIRSA) <Charley.Macnamara@sa.gov.au>
Cc: Gaut, Maddison (PIRSA) <Maddison.Gaut@sa.gov.au>; Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>; Doubell, Mark (PIRSA) <Mark.Doubell@sa.gov.au>
Subject: FW: Gunyah beach report
Importance: High

OFFICIAL

Apologies
Realised the attachment wasn't there as I sent it on my phone.
Please see the attached as well as my email below.

Charley, just reread the post that there are fish mort as well. Not sure if any samples have been taken over there already?

Kind regards
Emily

From: Mellor, Emily (PIRSA) Emily.Mellor@sa.gov.au
Sent: Tuesday, 22 April 2025 8:25 AM
To: Wilkinson, Clinton (PIRSA) Clinton.Wilkinson@sa.gov.au; Macnamara, Charley (PIRSA) Charley.Macnamara@sa.gov.au
Cc: Begg, Gavin (PIRSA) Gavin.Begg@sa.gov.au; Doubell, Mark (PIRSA) Mark.Doubell@sa.gov.au; Gaut, Maddison (PIRSA) Maddison.Gaut@sa.gov.au
Subject: Fw: Gunyah beach report

Hi Clinton and Charley
Hoping you both had a nice Easter and a chance for some relaxation!

Please see attached message from Clause 6(1) (Clean Seas).
Do either of you have any updates or further reports that have come in over the weekend?

Clinton, potentially this is getting confused with the current closures in Coffin Bay?

Many thanks
Emily

From: Clause 6(1) <Clause 6(1) @cleanseas.com.au>
Sent: Monday, 21 April 2025 3:46 PM
To: Jakaitis, Kaine (PIRSA) <Kaine.Jakaitis@sa.gov.au>; Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>
Cc: Clause 6(1) <Clause 6(1) @cleanseas.com.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>
Subject: Gunyah beach report

Hi

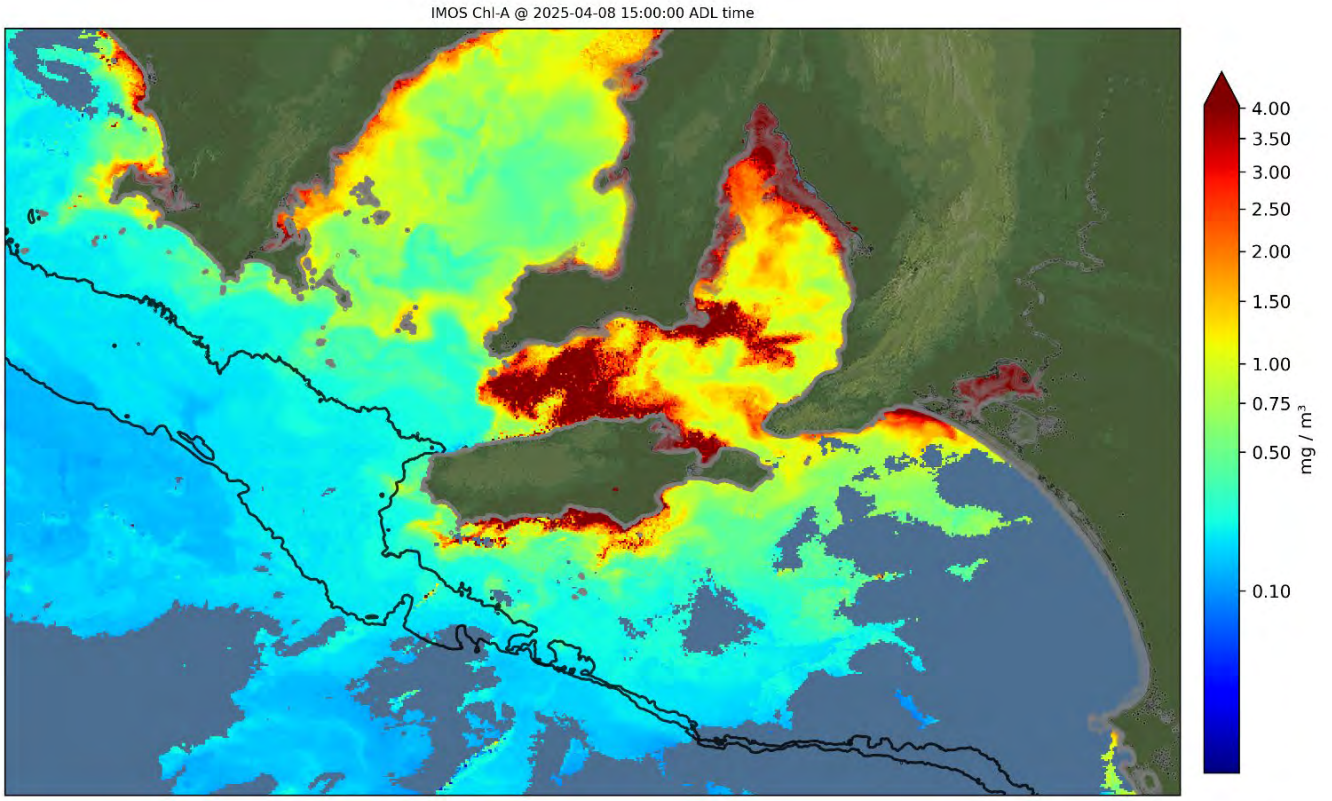
I had this sent to me just now. I know it's Easter but do you have any updates? Has the bloom expanded?

Thanks

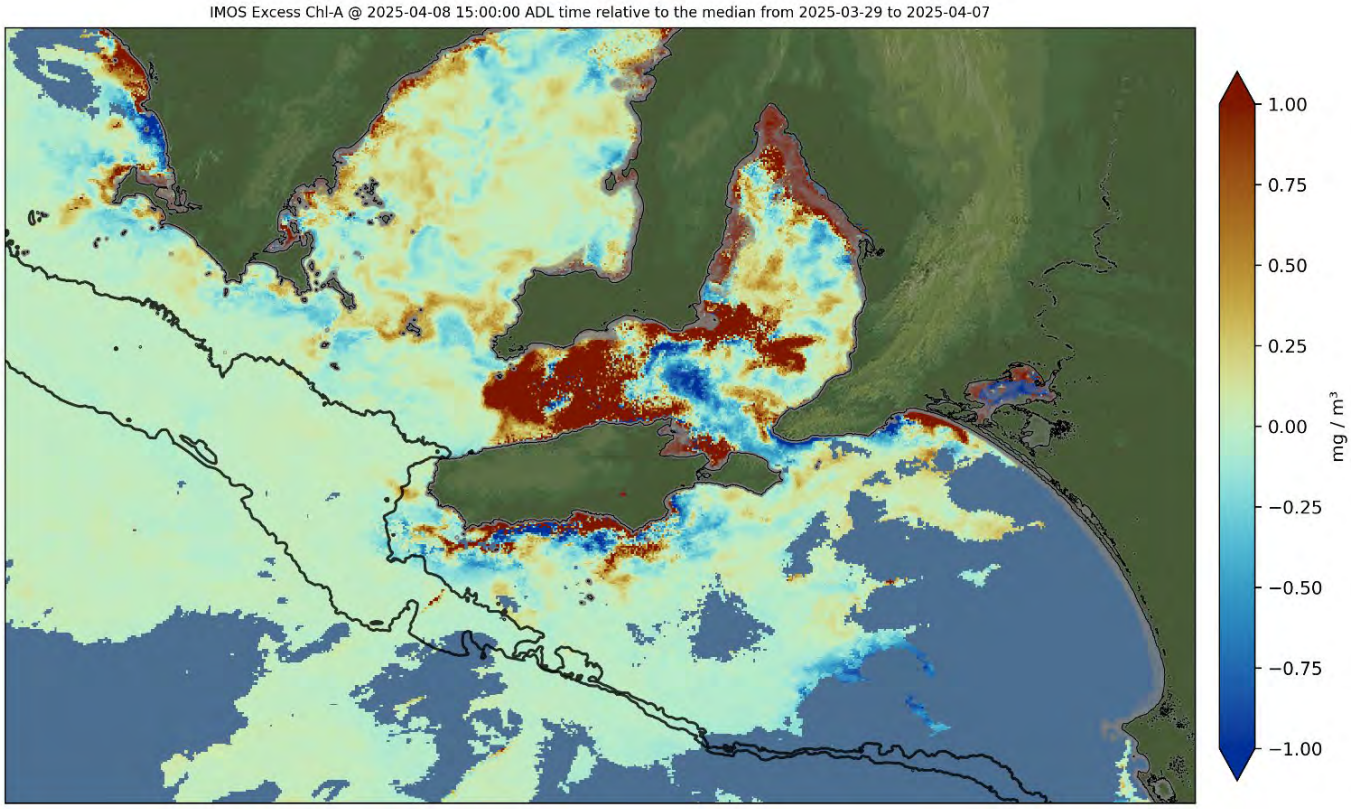
Get Outlook for iOS

COFFIN BAY COMMUNITY ...
Matt Stopp · 48m ·
Algal bloom from fleurieu has made its way to Gunyah beach birds and fish dead everywhere not a good sign
26
10 comments • 3 share
Like
Comment
Share

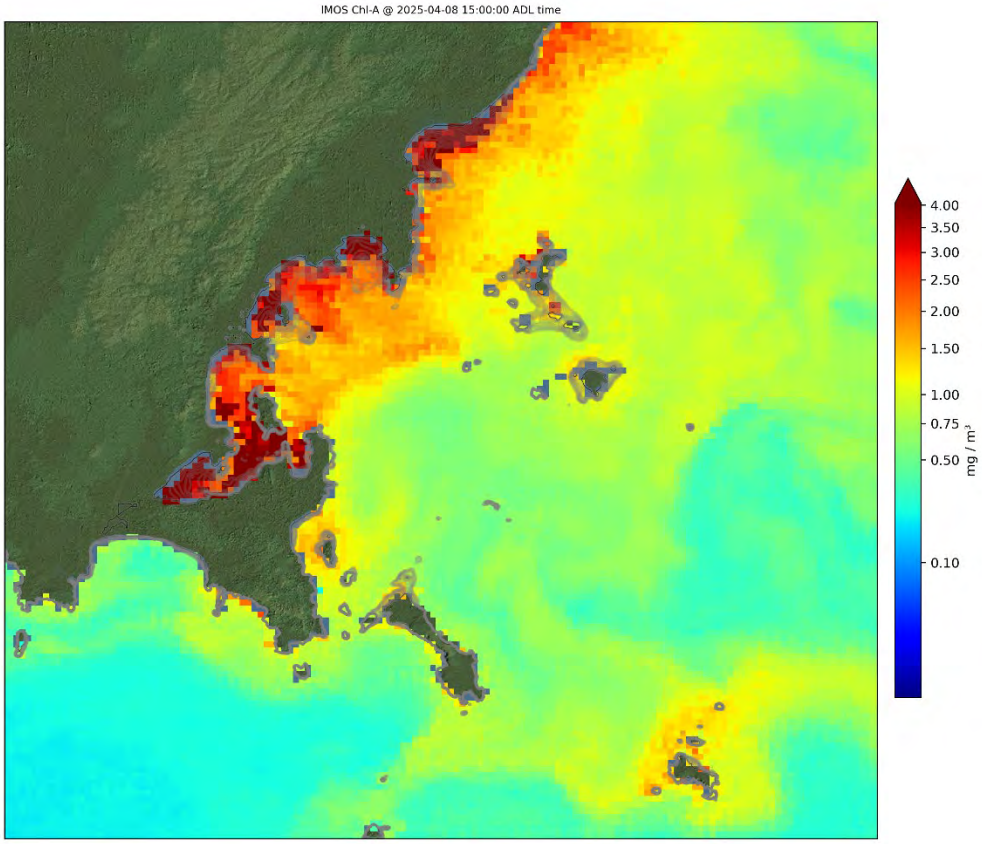
(Below) Latest sea surface chlorophyll-a (ssc) map taken on 08-04-2025 15:00 ACST re-plotted from https://oceancurrent.aodn.org.au/ . Grey/blue regions indicate areas affected by cloud cover.



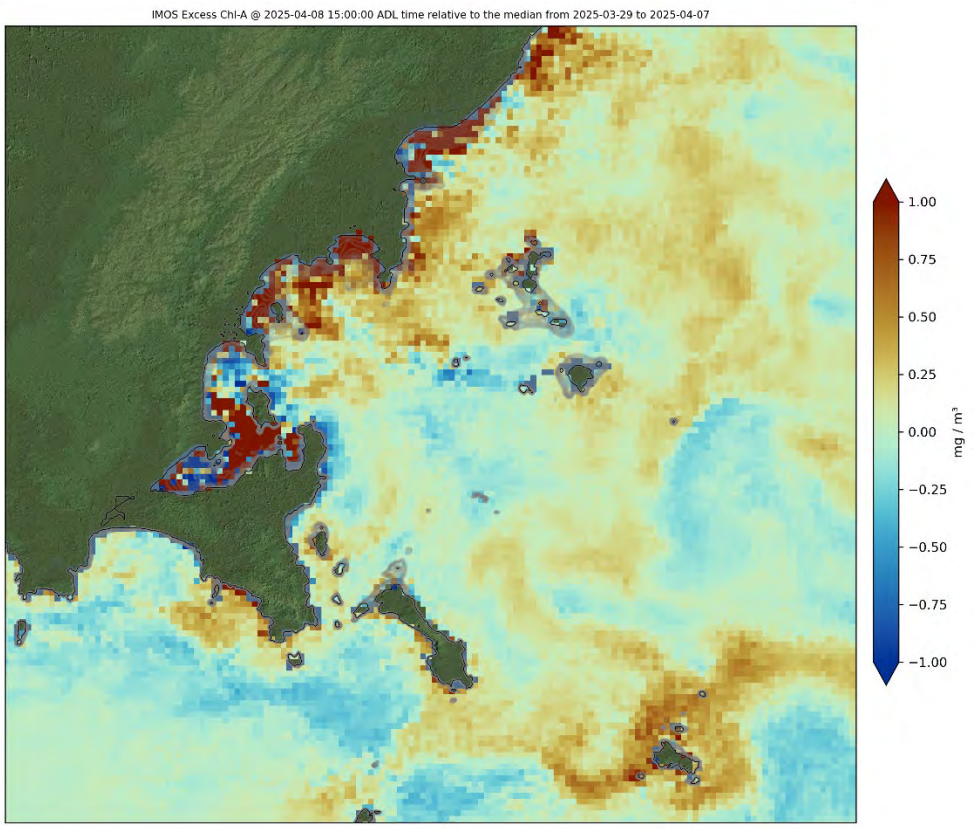
(Below) Latest map showing areas of ssc increase and decrease on 08-04-2025. Areas of ssc increase/decrease are determined by subtracting the median value of the previous 10-days ssc maps from the latest ssc map shown above. Increased ssc concentrations do not necessarily correlate with the presence of harmful alagal bloom (HAB) species and should be used in conjuction with Situtaion Report surveillance and oceanographic circulation forecasts to inform current and future conditions.



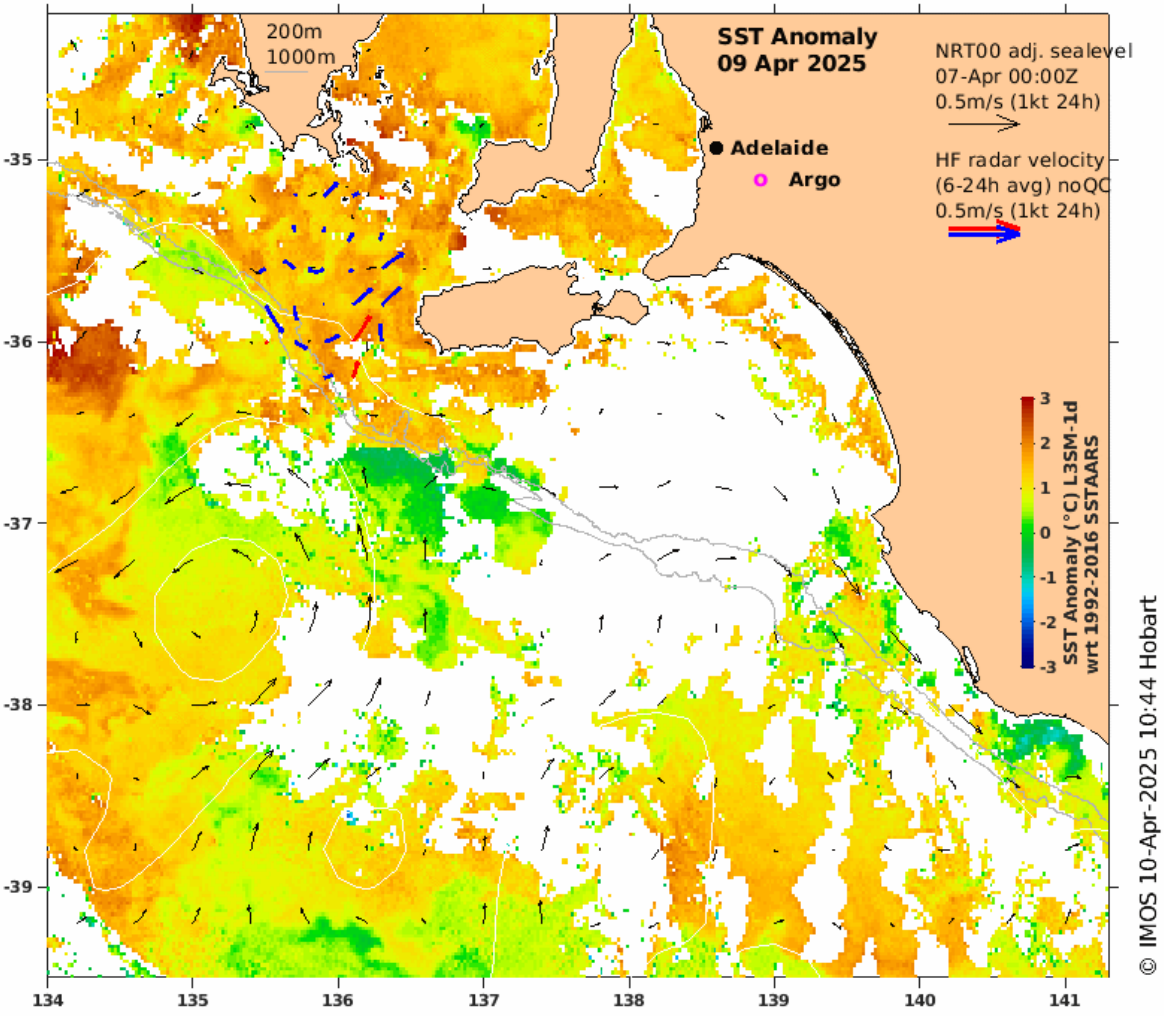
(Below) Zoom in of the latest sea surface chlorophyll-a (ssc) map taken on 08-04-2025 15:00 ACST for the Port Lincoln region. Grey/blue regions indicate areas affected by cloud cover.



(Below) Zoom in of the latest map showing areas of ssc increase and decrease on 08-04-2025 for the Port Lincoln region.



(Below) Map of sea surface temperaure (sst) anomly showing warm waters 1-2.5 degC persist over most of the region.



Doc 27

SARDI

Harmful Algal Bloom Situation Update

Drs Gretchen Grammer and Mark Doubell

15 May 2025

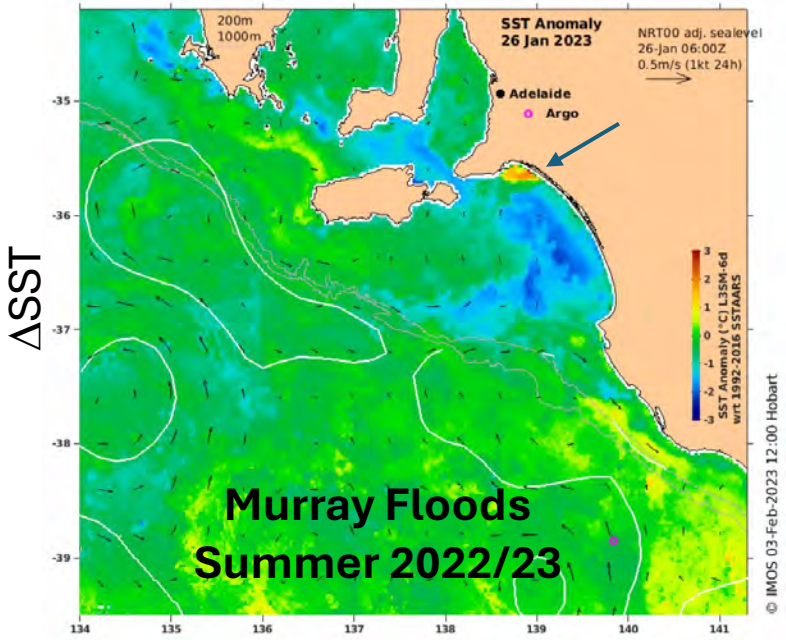
Government of South Australia
Department of Primary Industries and Regions

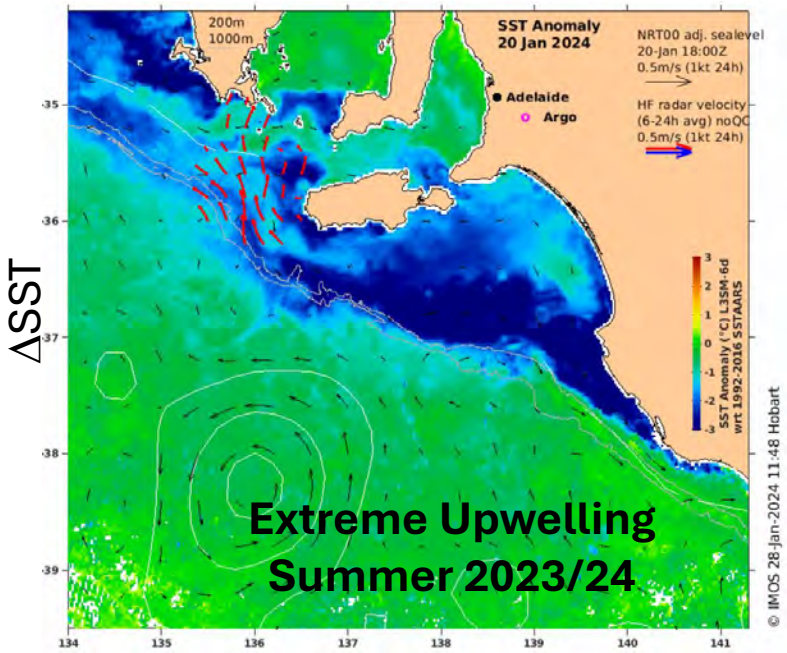
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Oceanographic Background

- South Australia's marine waters have experienced several broad-scale, record-breaking, climate driven events over the last 3 years.
- These events are characterised by extreme changes in environmental conditions.
- Examples:
  - 2022/23 summer Murray floods was the largest freshwater discharge event since 1956
  - 2023/24 summer coastal upwelling was the largest, most prolonged & coldest on record
- The Murray floods and unprecedent upwelling resulted in increased nutrient loads and organic matter to our coastal zones.

* The increased nutrient and organic load along with the current Marine Heat Wave are possible contributors to the current Harmful Algal Bloom event.



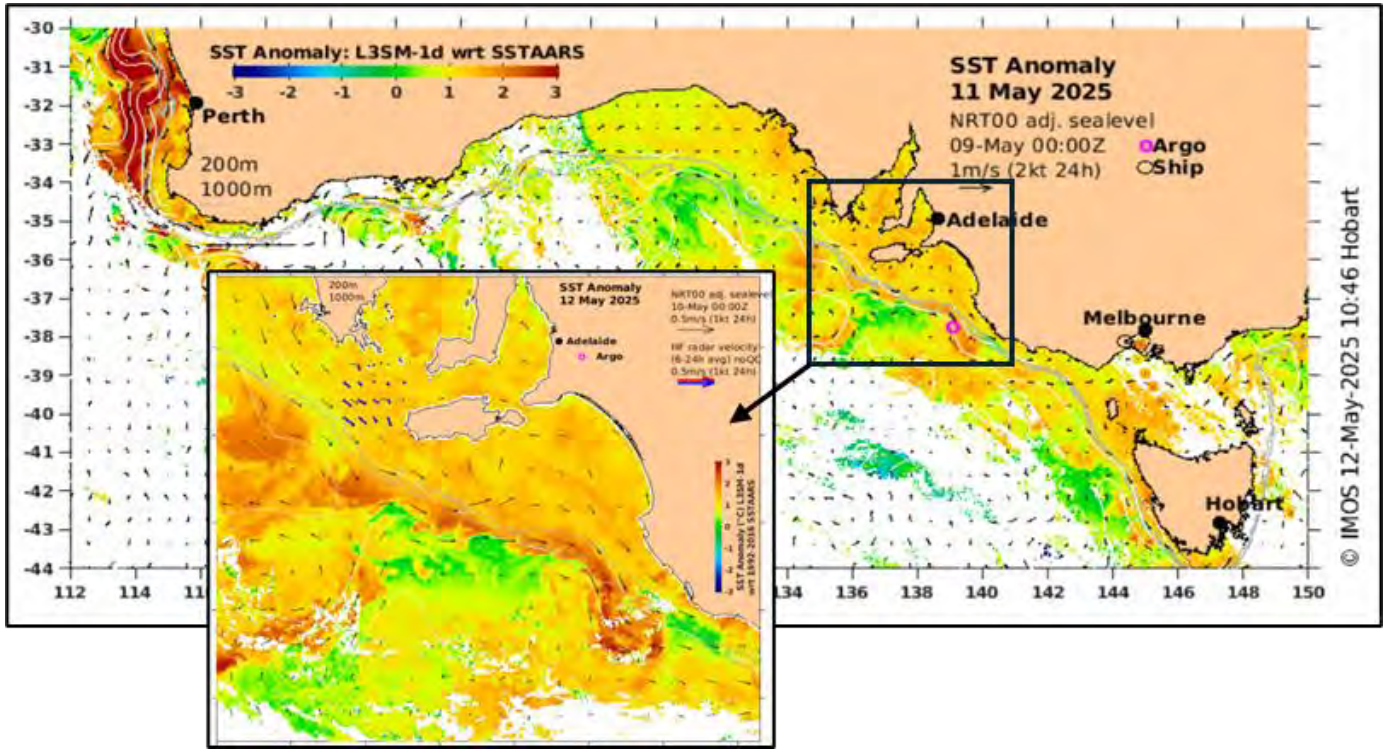


Government of South Australia
Department of Primary Industries and Regions

SARDI
South Australian Research and Development Institute

Current Situation

- A marine heatwave (MHW) is defined as a period of exceptionally warm ocean temperatures.
- A significant MHW has been affecting southern Australia since September 2024.
- Currently, sea surface temperatures remain up to 2.5 °C above average for this time of year.
- Note: this contrasts with the very cold upwelling conditions of last summer.



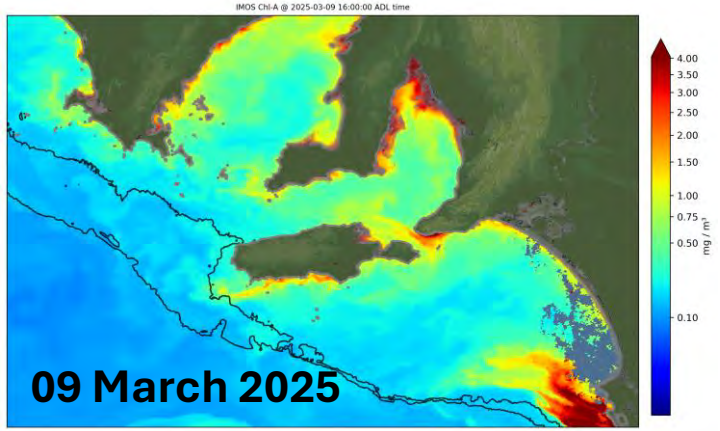
- In mid-March 2025, a significant harmful algae bloom (HAB) of the species *Karenia mikimotoi* was identified around the Fleurieu Peninsula.
- *K. mikimotoi* is a species of dinoflagellate microalgae known to cause deaths of marine fish, crustaceans and shellfish.
- The MHW is one factor that is likely allowing the HAB to persist.
- Factors that can lead to the end of the bloom include cooler temperatures, increased water flow, decreased sunlight, and decreased nutrient availability.

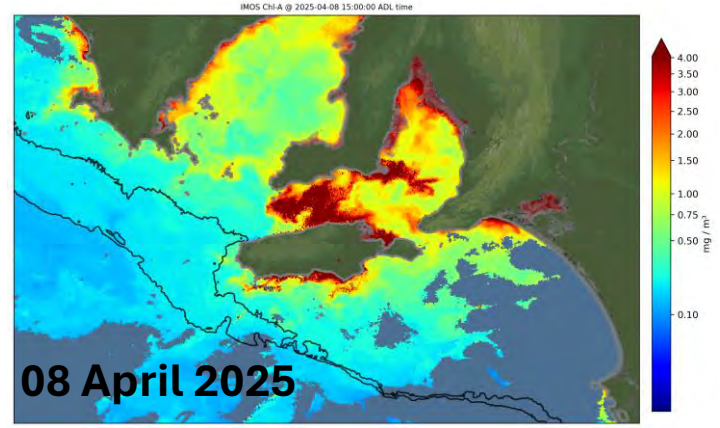
Current Situation

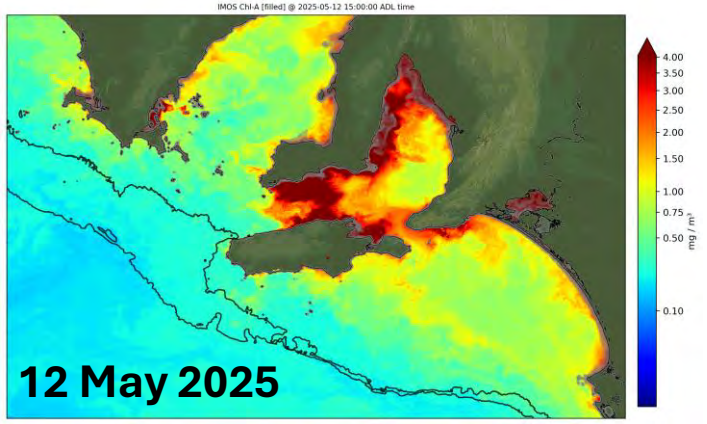
- SARDI has provided South Australian HAB Situation Updates to PIRSA Fisheries and Aquaculture since 11 April 2025.

- Satellite measures of algal concentration (chlorophyll a) have been used to understand changes in the spatial extent of the bloom with time.
- Chlorophyll-a (chla) is a general indicator of algae concentration. All microalgae contain chla but not all microalgae are harmful.
- Chla can be overestimated in shallow areas (<20m), due to the detection of chlorophyll in seagrass.
- Elevated chla levels appeared off the Fleurieu Peninsula in March 2025.
- Chla levels have increased and spread from the Fleurieu to different regions since then, consistent with ocean circulation patterns.

chlorophyll a concentrations (mg/m^3)







Government of South Australia
Department of Primary Industries and Regions

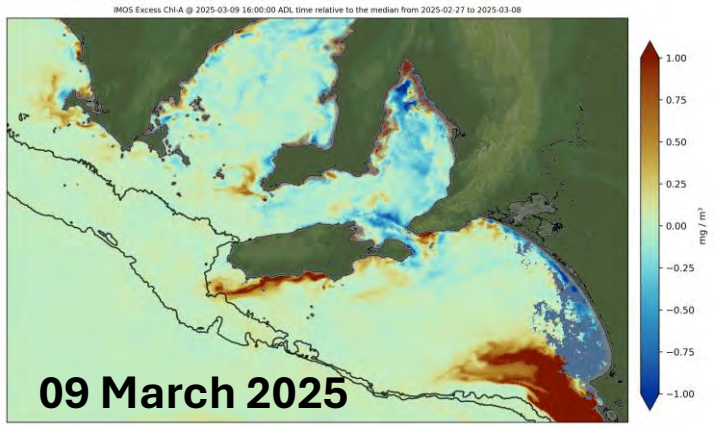
SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

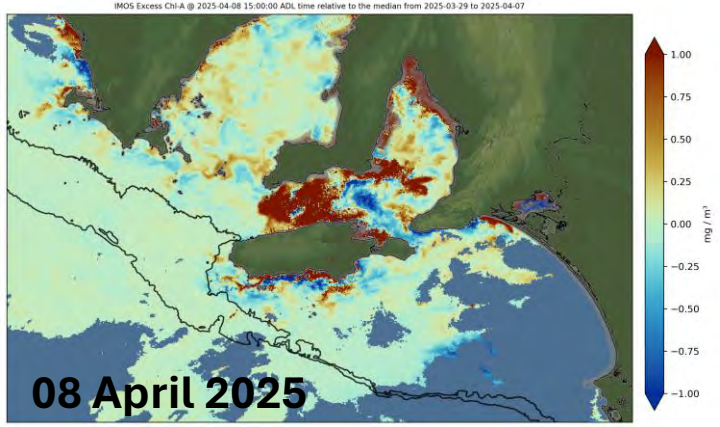
Latest SARDI HAB Situation Update

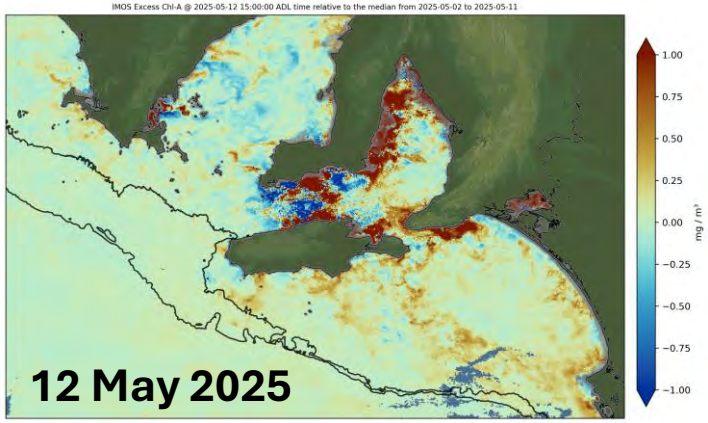
Current Situation

- The maps of increases/decreases in chla concentrations are produced to show areas of active growth or decline which is useful for tracking the HAB event.
- These maps also remove biases from the detection of seagrasses in shallow waters.
- BUT these maps do not necessarily confirm the presence of the specific HAB species.
- Water samples are required to confirm the presence and concentration of HAB species.

Index of increases and decreases in chlorophyll a (mg/m^3)







Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

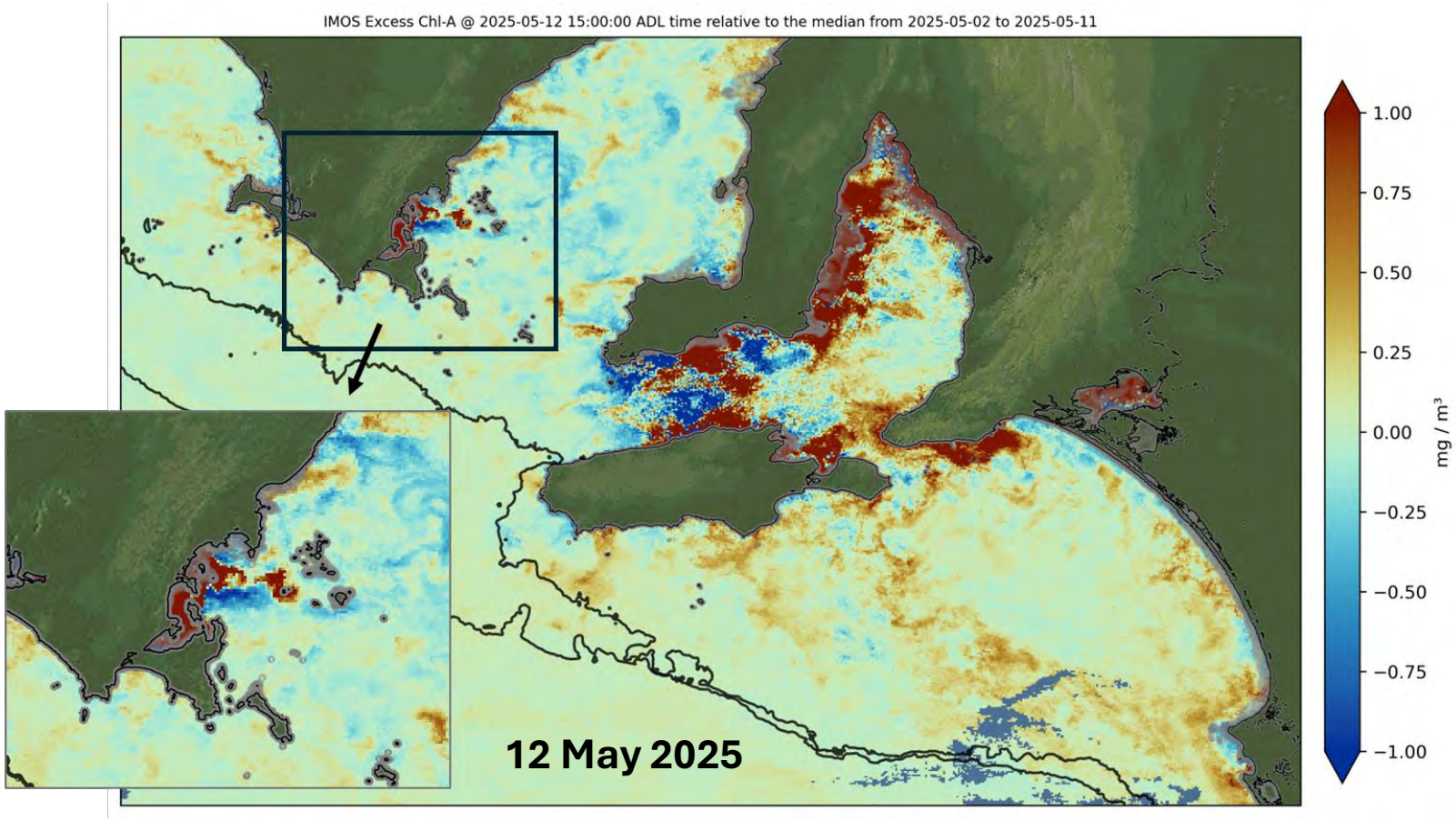
Current Situation

Currently, increasing chla levels with connectivity to the HAB origin are found in:

- Investigator Strait
- northern and eastern coasts of Kangaroo Island,
- western and northern regions of Gulf Saint Vincent,
- along the Fleurieu Peninsula from Myponga to Victor Harbor

Other areas of increasing chla levels are found:

- southwestern Spencer Gulf in embayments surrounding Port Lincoln,
- southeastern Spencer Gulf near Point Turton and Port Victoria,
- near Kingston and Robe in the southeast



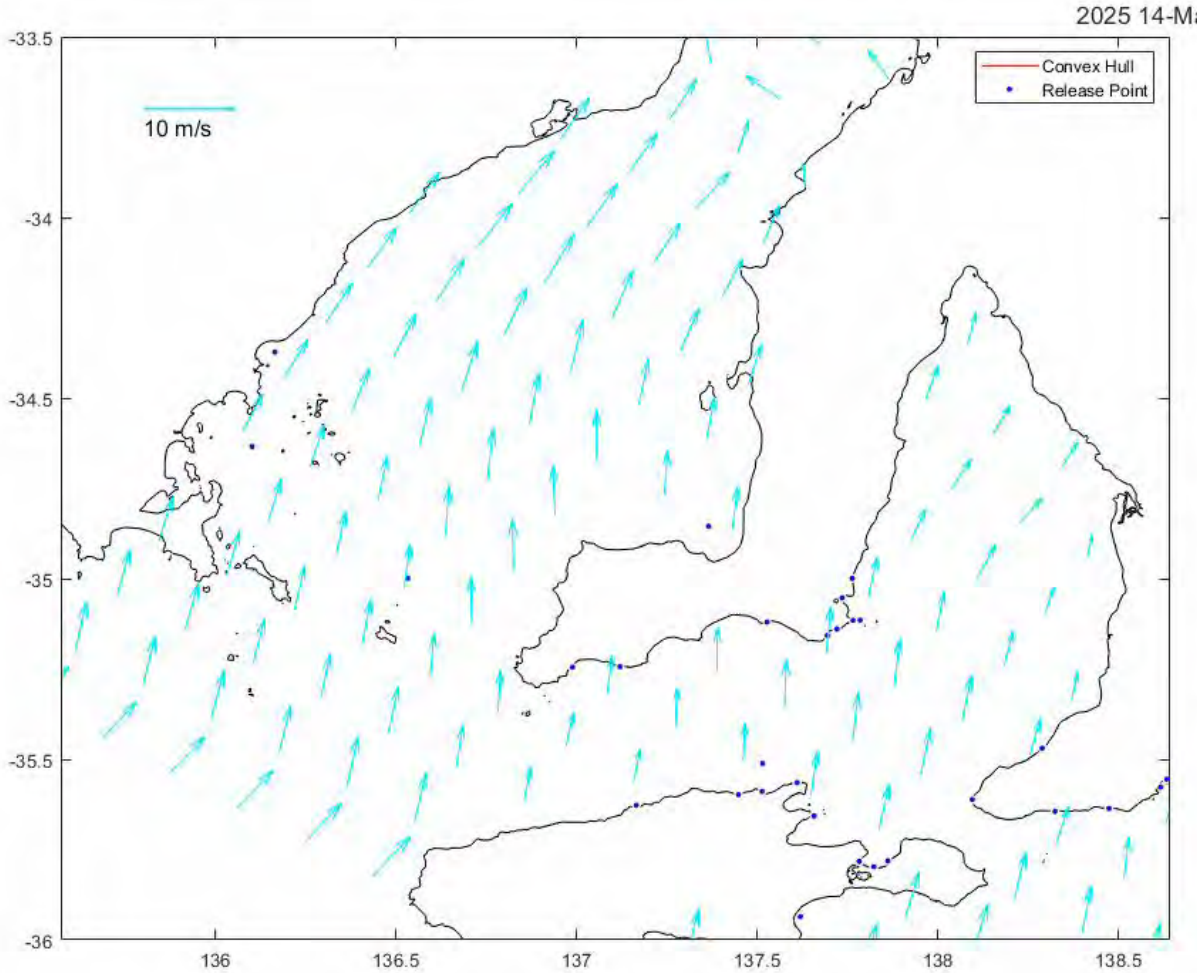
Index of increases and decreases in chlorophyll a (mg/m^3)

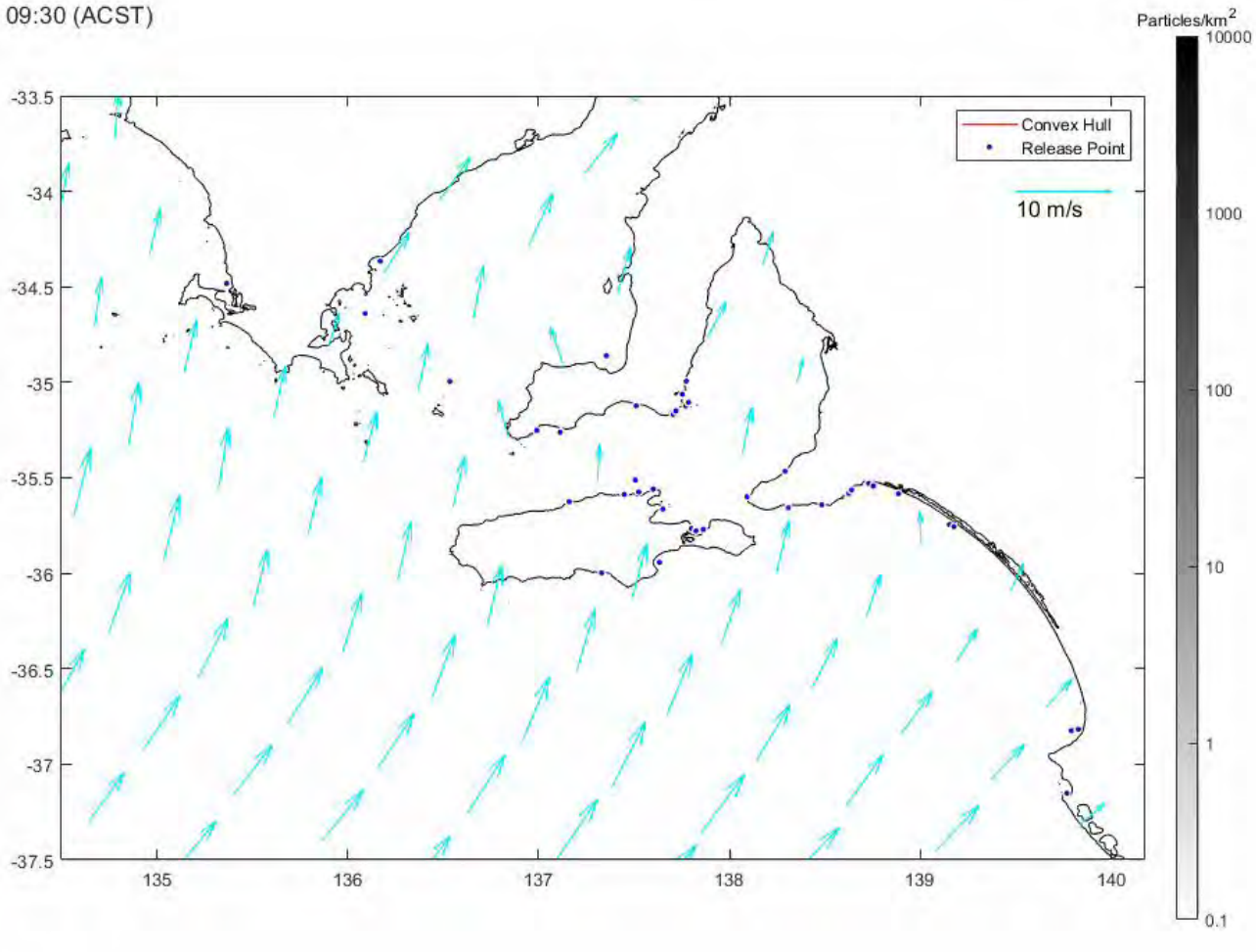
* This is the largest HAB event to have occurred in South Australia

Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Oceanographic forecast modelling of particles released from multiple source regions across the state was used to predict the trajectory of water masses over a period of 5 days, starting 13-May and ending 18-May 2025.



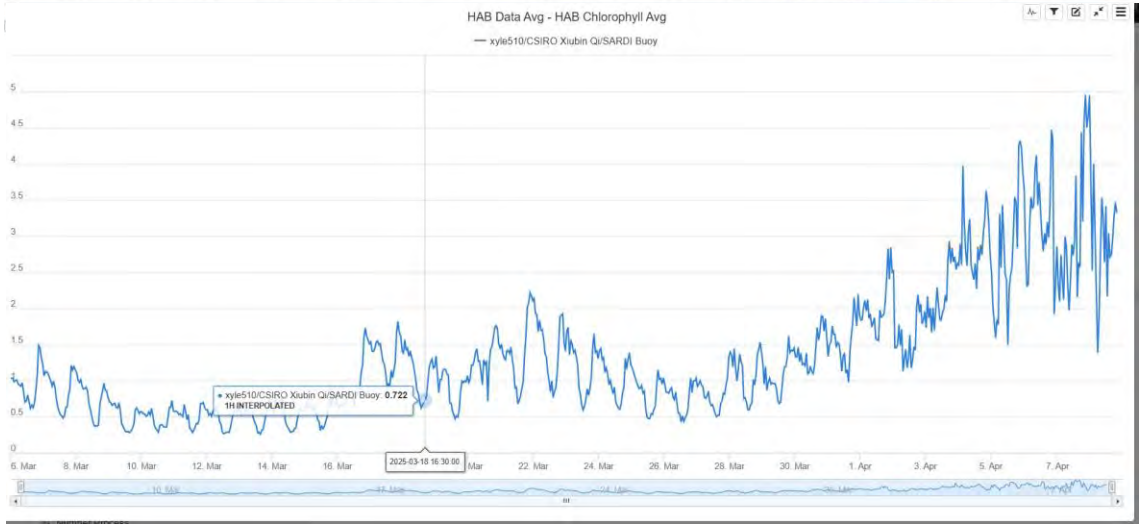


HAB early detection system

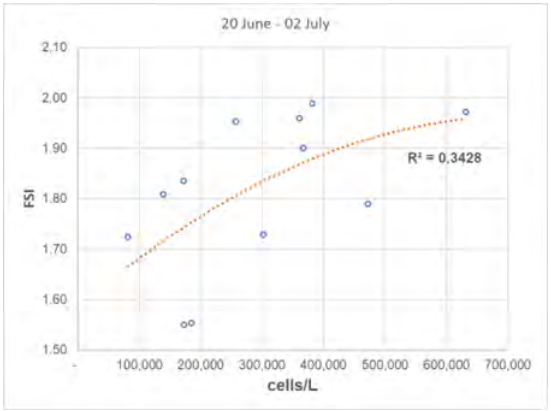
- Novel sensor for detecting *K. mikimotoi* and *Chatonella marina* HAB species being trialled in Boston bay (SARDI/CSIRO Aquawatch)
- FSI values above 1.95 indicate presence (requires further validation) – increasing likelihood of presence detected since 1-April against a background of increasing chl-a concentrations
- Data provided in real-time at 10-minute intervals
- Requires further validation and cross reference with HAB counts from Clinton (SASQAP)
- Could be combined with eSA-Marine model to provide an early detection and forecasting system to support Aquaculture Industries

FSI

Chl-a



Validation



Farley, Lisa (PIRSA)

From: Wilkinson, Clinton (PIRSA)
Sent: Monday, 31 March 2025 10:35 AM
To: Bansemer, Matthew (PIRSA)
Subject: FW: chlorophyll to yesterday

OFFICIAL

Hi Matt,

Check out the bloom, I am getting samples from KI either today or tomorrow.

Cheers
Clinton

From: Clause 6(1) <Clause 6(1)>
Sent: Sunday, 30 March 2025 10:33 AM
To: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>
Subject: FW: chlorophyll to yesterday

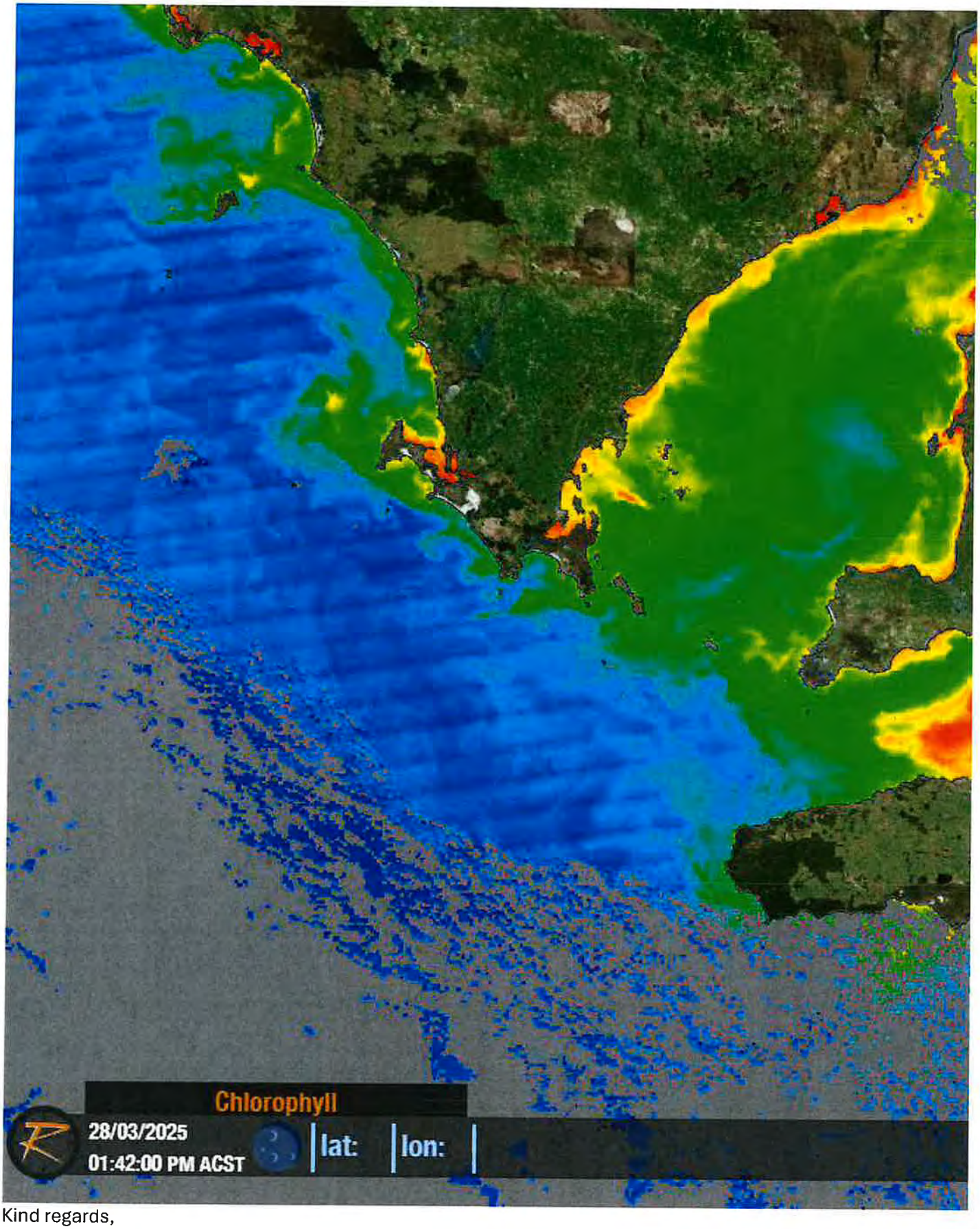
Hey mate,

The link to the paid service with SST, Chlorophyll etc. that I use.

Kind regards,

Clause 6(1)
Farm Manager- Port Lincoln
Yumbah Aquaculture
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com

From: Clause 6(1)
Sent: Saturday, 29 March 2025 1:31 PM
To: Clause 6(1) <Clause 6(1)>; Clause 6(1) <Clause 6(1)>
Subject: chlorophyll to yesterday



Kind regards,

Clause 6(1)
Farm Manager- Port Lincoln
Yumbah Aquaculture
M: Clause 6(1)
E: Clause 6(1)
W: www.yumbah.com

Farley, Lisa (PIRSA)

From: Doubell, Mark (PIRSA)
Sent: Friday, 28 March 2025 1:03 PM
To: Clause 6(1) (EPA); Rodgers, Giverny (PIRSA)
Cc: Moody, Ian (PIRSA); Grammer, Gretchen (PIRSA-SARDI); Mellor, Emily (PIRSA); Wilkinson, Clinton (PIRSA)
Subject: HAB situation update and watch

OFFICIAL: Sensitive

Hi All,
FYI and interest...

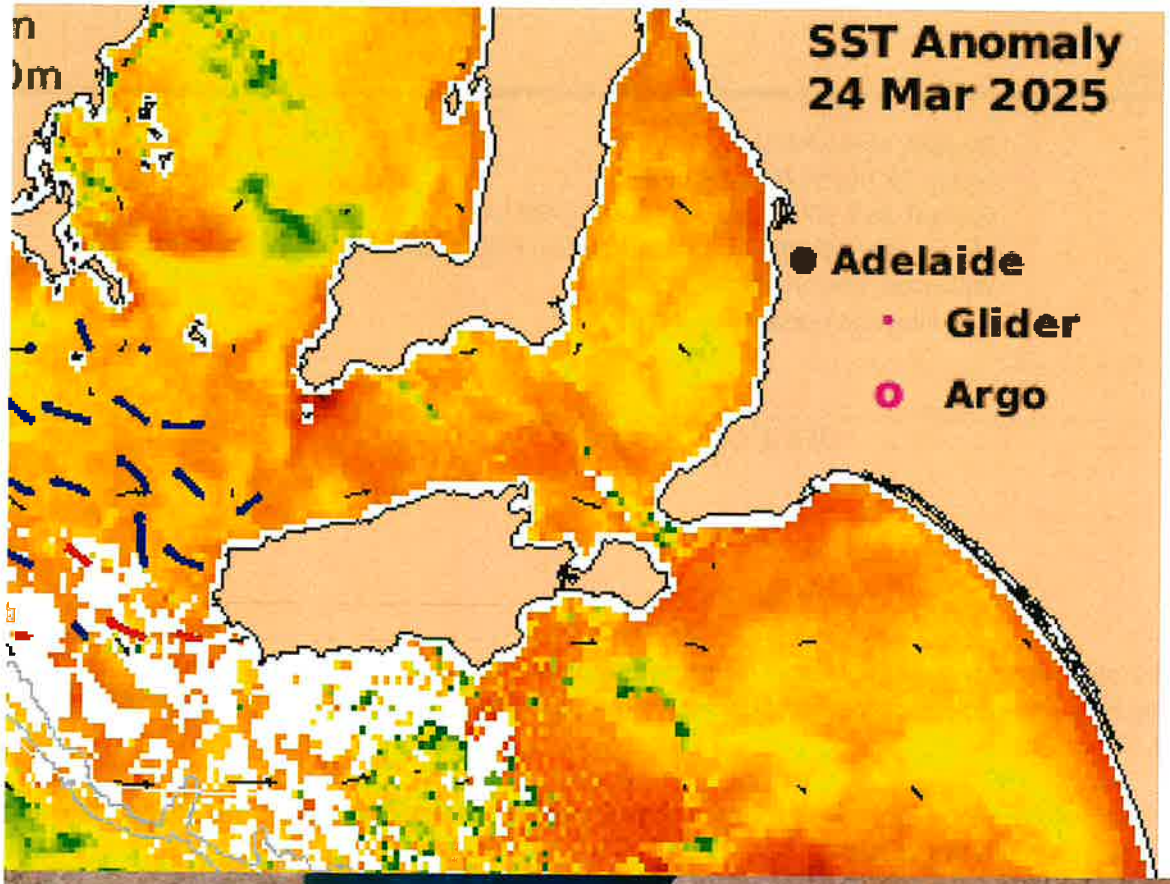
I just checked out the latest remote sensed images (sst anomaly, true color, chl a).
Seems the bloom and heatwave conditions are not backing down, and the bloom (at least in terms of chl a) may be intensifying!

Regarding samples collected by EPA at four sites (Waitpinga, Parsons, Encounter Bay and Petrel Cove) on March 18. SARDI processed and sent out the following....
A summary of where we are at...

- Shauna (UTS) received lives samples and identified and isolated K. mikimotoi---what's next?
- Microalgal Services (phytoplankton consultant we use for IMOS and other projects) – did a quick scan for HAB species and identified multiple HAB species- dominated by K. mikimotoi with cell concentrations up to 1.4 x 10^6 cells/L. Full community counts are coming soon.
- Microbial DNA samples were sent to Justin (UTS) -delivered yesterday. It might be interesting to ask Justin if his analysis will identify the presence of abalone AVG?
- We also sub-sampled for nutrients (TN , TP, NOx, PO4, NH4, SiO2), HPLC pigments (incl chl a), Flow cytometery (Vir, Bac, Pico phytoplankton). They are being processed by SARDI.

There's an update 😊

Regards,
Mark


SST Anomaly
24 Mar 2025
Adelaide
Glider
Argo

Gawler
Adelaide
Victor Harbor

Farley, Lisa (PIRSA)

From: Bansemer, Matthew (PIRSA)
Sent: Friday, 4 April 2025 11:46 AM
To: Mellor, Emily (PIRSA)
Cc: Gaut, Maddison (PIRSA)
Subject: FW: K. mikimotoi

For information, see below. Very low K. miki counts on farm at Yumbah KI.
Matt

Dr Matthew Bansemer | Manager, Aquatic Animal Health Program
Fisheries and Aquaculture | **Department of Primary Industries and Regions - PIRSA**
Government of South Australia | 2 Hamra Avenue, West Beach, 5024, SA
GPO Box 1625 Adelaide SA 5001 | Internal PIRSA DX 210
P: (08) 8429 2100 **M:** Clause 6(1) **E:** Matthew.Bansemer@sa.gov.au
pir.sa.gov.au

Government of South Australia
Department of Primary Industries and Regions

Service I Professionalism I Trust I Respect I Collaboration & Engagement I Honesty & Integrity I Courage & Tenacity I Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>
Sent: Friday, 4 April 2025 11:42 AM
To: 'Clause 6(1) <Clause 6(1) >; Clause 6(1) <Clause 6(1) >; Clause 6(1) ; trent@nutrisea.com.au
Cc: Bansemer, Matthew (PIRSA) <Matthew.Bansemer@sa.gov.au>
Subject: K. mikimotoi

OFFICIAL

Hi All,

Counts very low, which is good.

W Farm Outlet	3,096 cells/L
W2-1	175 cells/L
A4-6	756 cells/L

I will hold of on sending the abs, unless you want me to. If so they won't be going until next week.

Regards
Clinton

Clinton Wilkinson | Program Leader SASQAP
Department of Primary Industries and Regions
Government of South Australia | 1 Hindmarsh St.
PO Box 5 PORT LINCOLN SA 5606
T: +61 8 8688 3411 | **M:** Clause 6(1) | **E:** clinton.wilkinson@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Farley, Lisa (PIRSA)

From: Spurling, Sarah (PIRSA)
Sent: Tuesday, 6 May 2025 10:52 AM
To: Bansemer, Matthew (PIRSA)
Subject: Fwd: Stansbury Harvesting Area - CLOSED 05/05/2025

OFFICIAL: Sensitive

Please see status summary below.

Get Outlook for iOS

From: Spurling, Sarah (PIRSA) <Sarah.Spurling@sa.gov.au>
Sent: Monday, May 5, 2025 2:51:18 PM
To: Poulos, Con (PIRSA) <Con.Poulos@sa.gov.au>; O'Connor, Michelle (PIRSA) <Michelle.O'Connor@sa.gov.au>
Cc: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>; Cornish, Georgie (PIRSA) <georgie.cornish@sa.gov.au>
Subject: RE: Stansbury Harvesting Area - CLOSED 05/05/2025

Hi Con,

Quick status summary:

- Brevetoxin, preliminary results of 0.36 mg/kg (sample taken last week). Confirmed tomorrow. For reference it is a Neurotoxic Shellfish Toxin.
- Precautionary closure – Clinton has advised this has not been found in AUS before.
- Clinton has spoken with growers, minimal harvesting over the past week in Stansbury.
- Aus limit is 200 MU/kg (Mouse Units)
    - The US Food and Drug Authority acknowledge that 0.8 mg/kg brevetoxin-2 is equivalent to 200MU/kg.
    - NZ cut off is 0.8 mg/kg. (recognising the equivalence in methods)
    - Note – result is below this limit.
- Second sample collected today from Stansbury – sending Wednesday – results expected by Monday (12/5/25).
- Also identified in Coorong (lower levels 0.06 mg/kg) – this area is currently closed. Area will be sampled again tomorrow – sending Wednesday – results expected by Monday.
- Summary has been provided to SA Health (lead agency for food recalls).

Regards,
Sarah

From: Poulos, Con (PIRSA) <Con.Poulos@sa.gov.au>
Sent: Monday, 5 May 2025 1:17 PM
To: O'Connor, Michelle (PIRSA) <Michelle.O'Connor@sa.gov.au>
Cc: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>; Spurling, Sarah (PIRSA) <Sarah.Spurling@sa.gov.au>; Cornish, Georgie (PIRSA) <georgie.cornish@sa.gov.au>
Subject: RE: Stansbury Harvesting Area - CLOSED 05/05/2025

OFFICIAL: Sensitive

Thank you. I appreciate it.

From: O'Connor, Michelle (PIRSA) <Michelle.O'Connor@sa.gov.au>
Sent: Monday, 5 May 2025 1:14 PM
To: Poulos, Con (PIRSA) <Con.Poulos@sa.gov.au>
Cc: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>; Spurling, Sarah (PIRSA) <Sarah.Spurling@sa.gov.au>; Cornish, Georgie (PIRSA) <georgie.cornish@sa.gov.au>
Subject: RE: Stansbury Harvesting Area - CLOSED 05/05/2025

OFFICIAL: Sensitive

Hi Con

It is Brevetoxin that was detected. Clinton is currently on the phone however he can further explain. Ill get him to give you a call.

From: Poulos, Con (PIRSA) <Con.Poulos@sa.gov.au>
Sent: Monday, 5 May 2025 1:12 PM
To: O'Connor, Michelle (PIRSA) <Michelle.O'Connor@sa.gov.au>
Cc: Wilkinson, Clinton (PIRSA) <Clinton.Wilkinson@sa.gov.au>; Spurling, Sarah (PIRSA) <Sarah.Spurling@sa.gov.au>; Cornish, Georgie (PIRSA) <georgie.cornish@sa.gov.au>
Subject: FW: Stansbury Harvesting Area - CLOSED 05/05/2025

OFFICIAL: Sensitive

Thanks Michelle, can you let me know what particular algae / biotoxin caused this?

Regards
Con

Con Poulos
Director Animal Biosecurity

Department of Primary Industries and Regions
Government of South Australia
GPO Box 1671 Adelaide SA 5001
M: Clause 6(1) **E:** con.poulos@sa.gov.au
pir.sa.gov.au

The Department of Primary Industries and Regions respects Aboriginal people as the state's first people and nations. We recognise Aboriginal people as traditional owners and occupants of South Australian land and waters. We pay our respects to Aboriginal cultures and to Elders past, present and emerging.

Disclaimer: The information in this email may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

From: PIRSA:SASQAP <PIRSA.SASQAP@sa.gov.au>
Sent: Monday, 5 May 2025 1:06 PM
To: Clause 6(1) (Health) <Clause 6(1) @sa.gov.au>; Carr, Andrew (PIRSA) <andrew.carr@sa.gov.au>; Angel Oysters - Clause 6(1) <Clause 6(1) @angelseafood.com.au>; Barclay, Ann (PIRSA) <Ann.Barclay@sa.gov.au>; Begg, Gavin (PIRSA) <Gavin.Begg@sa.gov.au>; BST Oysters Supplies <Clause 6(1) @bstoysters.com>; BST Oysters Supplies - Clause 6(1) <Clause 6(1) @pcsms.com.au>; Burman, Lisa (PIRSA) <Lisa.Burman3@sa.gov.au>; Wilkinson, Clinton (PIRSA) <clinton.wilkinson@sa.gov.au>; Cornish, Georgie (PIRSA) <georgie.cornish@sa.gov.au>; Clause 6(1) <Clause 6(1) @pcsms.com.au>; Dept of Ag (DoA) <dairyeggsfish@agriculture.gov.au>; DoA Exports <foodexportdocumentation@agriculture.gov.au>; Doroudi, Mehdi (PIRSA) <Mehdi.Doroudi@sa.gov.au>; Dougherty, Tom (PIRSA) <Tom.Dougherty@sa.gov.au>; Dowsett, Paul (PIRSA) <Paul.Dowsett@sa.gov.au>; Hanchant, Janiece (PIRSA) <Janiece.Hanchant2@sa.gov.au>; Clause 6(1) <Clause 6(1) @agriculture.gov.au>; Buss, Jessica (PIRSA) <Jessica.buss@sa.gov.au>; Mellor, Emily (PIRSA) <Emily.Mellor@sa.gov.au>; PIRSA:Minister Scriven <minister.scriven@sa.gov.au>; Palomino, Alessandra (PIRSA) <alessandra.caceres@sa.gov.au>; Hill, John (PIRSA) <john.hill@sa.gov.au>; Bansemer, Matthew (PIRSA) <matthew.bansemer@sa.gov.au>; Cronin, Michael (PIRSA) <michael.cronin@sa.gov.au>; Spurling, Sarah (PIRSA) <sarah.spurling@sa.gov.au>; PIRSA Fisheries - Yolande Markey <Clause 6(1) @pcsms.com.au>; Markey, Yolande (PIRSA) <yolande.markey@sa.gov.au>; PIRSA:Media <PIRSA.Media@sa.gov.au>; O'Connor, Michelle (PIRSA) <Michelle.O'connor@SA.gov.au>; Poulos, Con (PIRSA) <Con.Poulos@sa.gov.au>; Puckridge, Trevor (PIRSA) <Trevor.Puckridge@sa.gov.au>; Rodrigues, Sam (PIRSA) <Sam.Rodrigues@sa.gov.au>; Clause 6(1) (Health) <Clause 6(1) @health.sa.gov.au>; SA Lobster Co - Clause 6(1) <Clause 6(1) @salco.co>; Executive Officer <Clause 6(1) @oysterssa.com.au>; Clause 6(1) <Clause 6(1) @agriculture.gov.au>; Clause 6(1) <Clause 6(1) @sydneyfishmarket.com.au>; Theil, Mandee (PIRSA-SARDI) <Mandee.Theil@sa.gov.au>; Clause 6(1) <seafood Clause 6(1) @bigpond.com>
Subject: Stansbury Harvesting Area - CLOSED 05/05/2025

OFFICIAL: Sensitive

Stansbury Harvesting Area CLOSED 05/05/2025 – please see email for documentation

Michelle O'Connor| Business Support Officer.
South Australia Shellfish Quality Assurance Program (SASQAP)
Department of Primary Industries and Regions
Government of South Australia | 1 Hindmarsh St,
PO Box 5 PORT LINCOLN SA 5606
P: +61 8 8688 3411 | **F:** +61 8 8688 3438 | **E:** michelle.o'connor@sa.gov.au
TEAMS NUMBER Clause 6(1)
pir.sa.gov.au
Work Days: Monday Tuesday Wednesday Thursday

Service I Professionalism I Trust I Respect I Collaboration & Engagement I Honesty & Integrity I Courage & Tenacity I Sustainability

Disclaimer: The information in this e-mail may be confidential and/or legally privileged. Use or disclosure of the information by anyone other than the intended recipient is prohibited and may be unlawful.

Doc 31a

To:	All Growers Dept Primary Industries and Regions Dept Health		Processors PIRSA Fishwatch Dept Ag, Fisheries and Forestry Minister's Liaison Officers
Date:	5/5/2025 1:04 PM		
From:	SOUTH AUSTRALIAN SHELLFISH QUALITY ASSURANCE PROGRAM (SASQAP)	Tel No:	(08) 8688 3409 / 0428 105 649
E. mail:	Clinton.wilkinson@sa.gov.au	Pages:	1

NOTICE PURSUANT TO REGULATION 8 (2) PRIMARY PRODUCE (FOOD SAFETY SCHEMES) (SEAFOOD) REGULATIONS 2017

SOUTH AUSTRALIAN SHELLFISH QUALITY ASSURANCE PROGRAM (SASQAP)

STATUS OF THE STANSBURY HARVESTING AREA: CLOSED

The **Stansbury Harvesting Area** of the **Stansbury Growing Area** is hereby closed for the sale and movement of all Bivalve Molluscan shellfish according to the requirement of the South Australian Shellfish Quality Assurance Program.

This closure will take effect from 13:00 pm on the 5th day of May 2025.

The closure is due to the *detection of biotoxins in shellfish.*

Please contact the SASQAP office on (08) 8688 3409 or 0428 105 649 for further information as required.

Clinton Wilkinson
Program Leader SASQAP
(Delegate of the MINISTER)

Information contained in this message may be private and may also be the subject of legal professional privilege of public interest immunity. If you are not the intended recipient, any use, disclosure or copying of this document is unauthorised. If you have received this document in error, please call the sender.

Clinton Wilkinson
Email: Clinton.wilkinson@sa.gov.au
Phone: 08 8688 3411
pir.sa.gov.au