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Annual report on the results of the Biotoxin and Phytoplankton Official Control Monitoring Programmes for England & Wales – 2019

March 2020

Annual report on the results of the Biotoxin and Phytoplankton Official Control Monitoring Programmes for England & Wales – 2019

FINAL report

38 pages

Not to be quoted without prior reference to the authors

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Quality statement: This report is a compilation of the information included on the reports provided daily/weekly to the FSA and showing the results of the phytoplankton and toxin analyses undertaken on samples submitted by local authorities. All results were quality checked and approved prior to release to the FSA and the results compiled in this report have been further checked against a copy of the original reports held on a central database. Information relating to the origin of the samples (place (including co-ordinates), date and time of collection) is as provided by local authority staff and has not undergone verification checks by Cefas.

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Contents

List of Tables

List of Figures

1 Summary

This report describes the results of the Official Control Biotoxin Monitoring Programme for England and Wales for the period 1st January to 31st December 2019.

The laboratory testing for biotoxins in shellfish and potentially harmful phytoplankton in water samples, the co-ordination of the programme and its logistics were conducted by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) on behalf of the Food Standards Agency (FSA), the central competent authority for food safety. The programme aimed at delivering the testing required for the statutory monitoring of marine biotoxins in shellfish from classified production and relaying areas in England and Wales, and for identification and enumeration of potentially harmful micro-algae in selected shellfish harvesting areas, as required by EC Regulations 854/2004, 882/2004 and 2074/2005. All results are compared to the maximum permitted levels (Table 1.1) as stipulated in EC regulation 853/2004 (Section VII, Chapter V: Health standards for live bivalve molluscs). Toxin test results must not exceed these limits in either whole body or any edible part separately.

Table 1.1 Maximum permitted limits of toxins in shellfish flesh[1]

Toxin	Maximum Permitted Limits (MPL)
ASP	20 mg [Domoic/epi-domoic acid]/kg [shellfish flesh]
LTs	Diarrhetic shellfish poisoning (DSP) toxins and pectenotoxins (PTX) together, exceeding 160µg [okadaic acid (OA) equivalents]/kg [shellfish flesh] or Yessotoxins, 3.75mg [yessotoxin (YTX) equivalents]/kg [shellfish flesh] or Azaspiracids, 160µg [azaspiracid (AZA) equivalents]/kg [shellfish flesh].
PSP	800µg [saxitoxin equivalents (STX di-HCl eq.)]/kg [shellfish flesh]

In the reported period, 55 of the 59 classified English and Welsh harvesting and relaying areas were monitored (directly or indirectly[2]) (Figure 1.2 and Figure 1.1), giving a coverage rate of 93.2 %[3]. The four classified areas which were not monitored in 2019 for toxins and phytoplankton consisted of:

- Chichester Harbour – Cobnor, Dell Quay and Northney Production areas were temporarily declassified during the reporting period as not commercially active. Prinstead Production Area is prohibited;
- Fal (Upper) were declassified during the reporting period (no samples were collected from these areas in 2019);
- Anglesey – Inland Sea, which is used for shellfish on growing only;
- Bigbury and Avon production area, which only produces shellfish for relaying at another site.

A total of 825 inshore shellfish samples and 907 phytoplankton samples were submitted for analysis by staff from 39 Local Authorities (LAs) (shellfish) 36 LAs for the phytoplankton samples. No samples were submitted in 2019 for the purpose of onshore verification of pectinidae.

[1] Regulation (EC) 853/2004
[2] In this case, the classified production areas were monitored by sampling adjacent areas where appropriate
[3] 3% of the classified production areas were supplying shellfish only for on growing

Results of the shellfish monitoring programme for the twelve-month period were as follows (all toxin results stated for Paralytic Shellfish Poisoning (PSP) toxins and Lipophilic Toxins (LTs) refer to the high value calculated from method uncertainty).

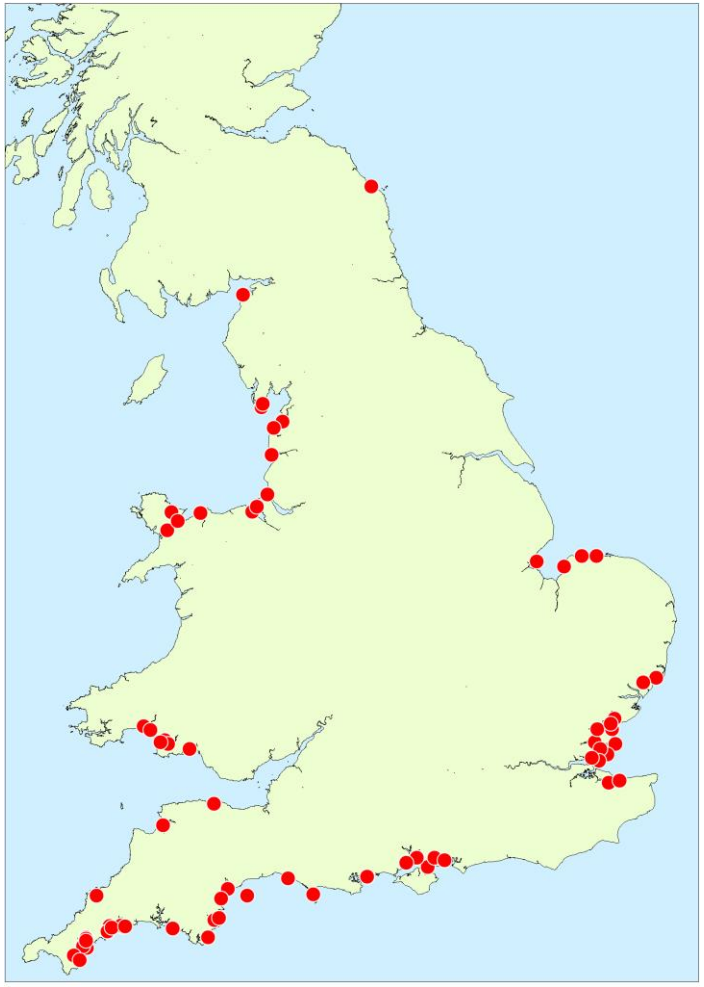

Figure 1.1 English and Welsh flesh sampling locations – 2019 Biotoxin monitoring programme

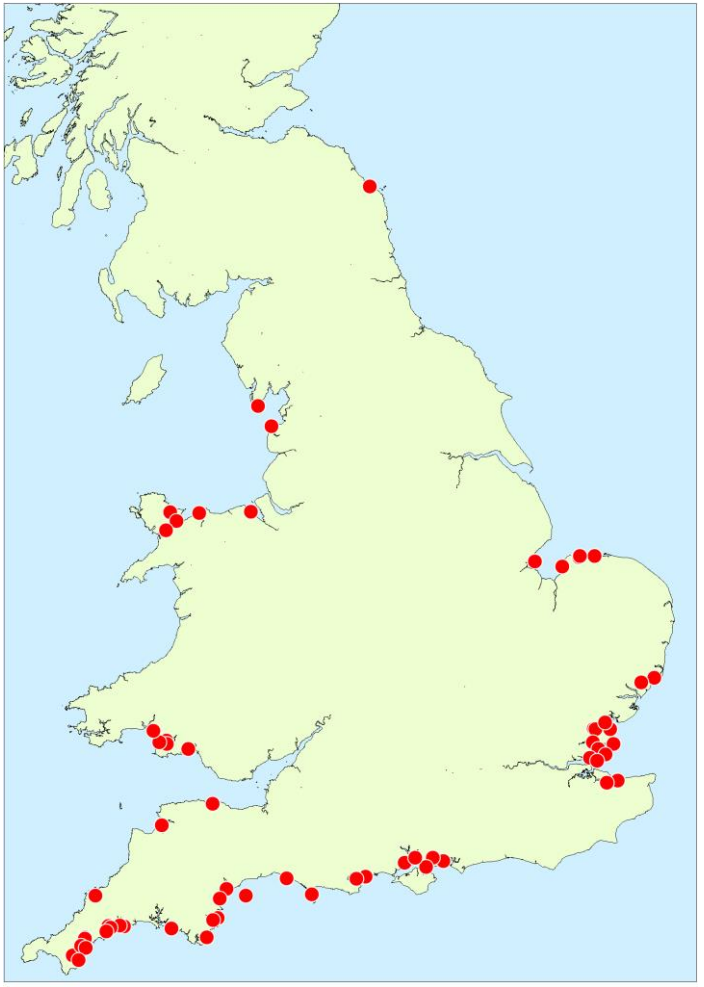

Figure 1.2 English and Welsh water sampling locations – 2019 Biotoxin monitoring programme

1.1 Amnesic Shellfish Poisoning (ASP) toxins - summary

A total of 707 inshore shellfish samples were tested for ASP toxins using a high-performance liquid chromatography (HPLC) method. ASP toxins were detected in 48 samples from 27 production areas (Figure 1.3). The greatest proportion of samples containing ASP originated from the south west of England (29 samples). The shellfish species affected included mussels (12 samples), Pacific oysters (17 samples), native oysters (2 samples), cockles (3 samples), hard clams (2 samples), razors (1 sample) and surf clams (11 samples). None of the inshore shellfish samples tested for ASP exceeded the maximum permitted level (MPL) of 20 mg/kg in 2019. ASP toxin levels ranged from 1 to 5.8 mg/kg. The highest ASP toxin concentration was recorded in February 2019 (5.8 mg/kg) from the South Hams DC production area. A total of 11 ASP toxin results were recorded in surf clams collected from this production area in 2019. Also, of note, every sample of surf clams collected from the coast of Devon in 2019 and tested for ASP toxins contained between 2.8 and 5.8 mg [Domoic+*epi*-domoic acid]/kg shellfish.

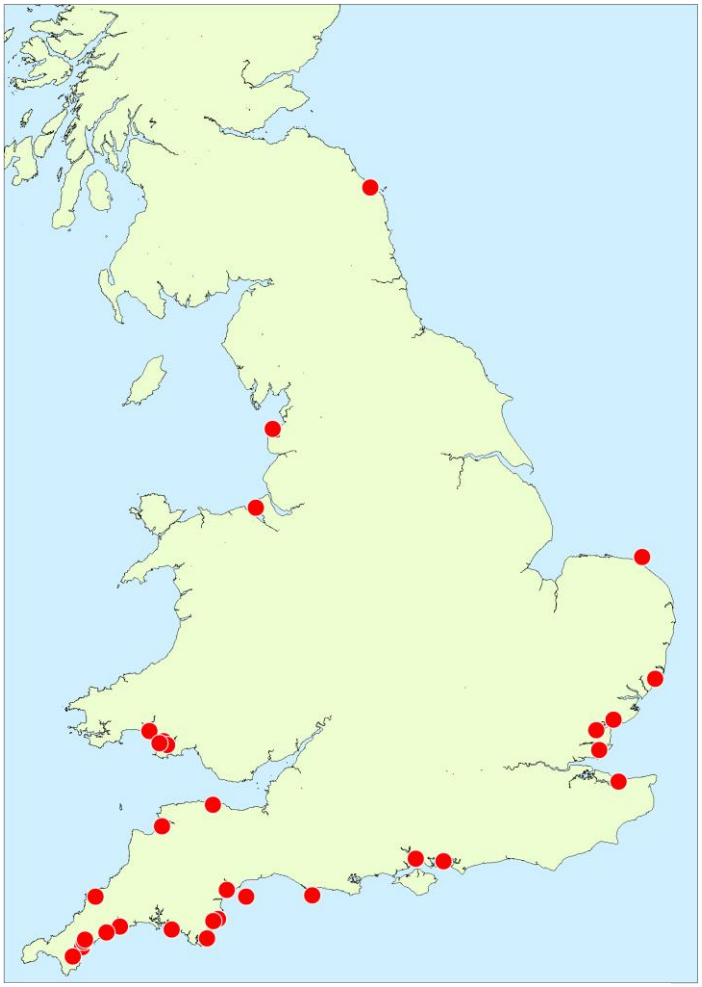

Figure 1.3 Location of classified production and/or relaying areas where ASP toxins were detected in 2019 (all below the MPL (20 mg [domoic+*epi*-domoic acid]/kg [shellfish tissue])

1.2 Paralytic Shellfish Poisoning (PSP) toxins - summary

A total of 778 inshore shellfish samples were screened for PSP toxins using the HPLC semi-quantitative method. Figure 1.4 shows the sampling points where PSP toxins were detected in 2019. Only four samples (all mussels from Fowey – Pont Pill) required analysis by the quantitative PSP method in 2019. Three of these samples recorded consecutive PSP toxin levels above the MPL (set at 800µg [STX di-HCl eq.]/kg). The maximum PSP toxin level was 4,766 µg [STX di-HCl eq.]/kg recorded in a sample collected on 19/08/2019 (Figure 1.5).

This is an increase in occurrences of PSP recorded in 2018, when no samples exceeded the MPL (800µg [STX di-HCl eq.]/kg) and it was only detected above the trigger level in three Pacific oyster samples taken from Holy Island – Ross Links on three occasions. Occurrences are similar to those recorded in 2017; three samples recorded PSP toxin levels above the MPL (800µg [STX di-HCl eq.]/kg and four samples recorded PSP toxin levels above the trigger level (400µg [STX di-HCl eq.]/kg), all from the South West. There has been an overall decline in PSP toxin levels in shellfish flesh since its peak in 2011, when PSP toxins were detected in 44 samples.

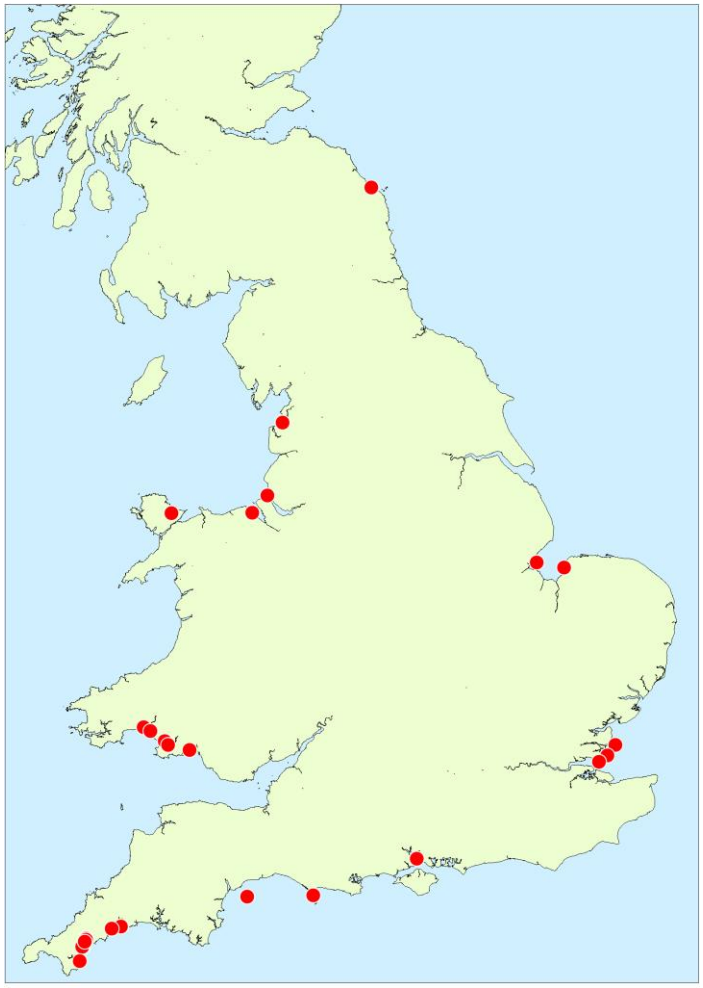

Figure 1.4 Location of classified production and/or relaying areas where PSP toxins were detected <u>below</u> the trigger level of 400µg [STX di-HCl eq.]/kg [shellfish tissue] in 2019

Figure 1.5 Location of classified production and/or relaying areas where PSP toxins were detected above the MPL of 800 µg [STX di-HCl eq.]/kg [shellfish tissue]

1.3 Lipophilic toxins (LTs) - summary

A total of 730 inshore samples were analysed for LTs using the Liquid Chromatography - tandem mass spectrometry (LC-MS/MS) method. The lipophilic toxins are sub-divided into three regulated groups each with a distinct MPL (see Table 1.1).

Yessotoxins (YTXs)
Not detected in any samples received in 2019. This is consistent with previous years, having only been detected once in 2014.

Azaspiracid group toxins (AZAs)
Not detected in any samples received in 2019. The detection of this toxin group has varied widely since the LC-MS method was introduced in 2011, with the number of detections ranging from not detected in 2017, 2018 & 2019 to 21 in 2015. However, levels have only rarely exceeded the MPL (3 times in 2015).

Okadaic Acid/Dinophysistoxins/Pectenotoxins (OA/DTX/PTX)
Detected in 60 samples from 10 production areas (Figure 1.6). Five mussel samples from 3 production areas (Porthallow Cove, St. Austell Bay, Lantivet Bay) contained OA/DTX/PTXs above the MPL (set at 160 µg OA eq./kg) (Table 1.1 & Figure 1.7). This is a decrease in concentrations and number of results recorded above the MPL compared to 2018, whereby 64 mussel samples from 6 production areas contained OA/DTX/PTXs above the MPL.

Lipophillic toxins were recorded above the MPL during the months of May to June 2019. All results exceeding the MPL were recorded in Cornwall, in the South West. Peak results were recorded at Porthallow, St. Austell Bay and Lantivet Bay. The first recorded result above the MPL in 2019 was at Ropehaven Outer on 29/05/2019 (338 µg OA eq./kg). Since 2018 there has been an overall reduction in LT toxin concentrations in monitored shellfish flesh.

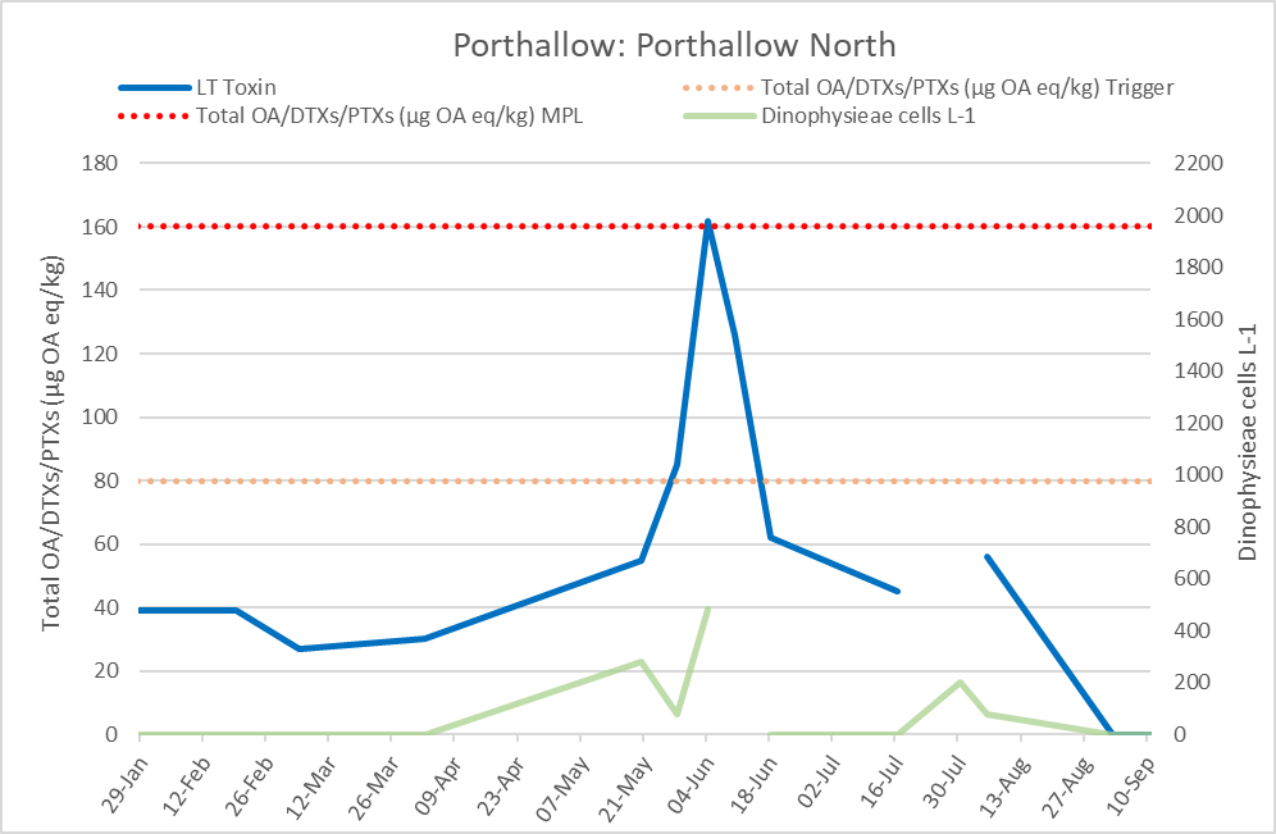

Figure **1.8** to Figure 1.10 display the *Dinophysieae* records against the shellfish toxin results taken from Porthallow, St. Austell Bay and Lantivet Bay production areas during 2019. It is evident that following a peak in the *Dinophysieae* levels (cells/L), after a short lag time, a peak in the shellfish toxins occurs. Following a result above MPL, the monitoring in the water column is suspended until a first result below the MPL is recorded in the shellfish flesh, therefore there are some gaps in the water monitoring results for areas with closures for this toxin group.

The Porthallow Cove production area recorded 1 result above the MPL in June 2019. There has been a reduction in the occurrences of above MPL LT results in shellfish flesh in 2019 compared to 2018. In 2018, 18 consecutive results recorded above the MPL in samples collected between June and October. The highest concentration recorded in 2019 was 162 µg OA eq./kg (sample collected on 04/06/2019) which is significantly less than the highest recorded result in August 2018 (2,476 µg OA

eq./kg).

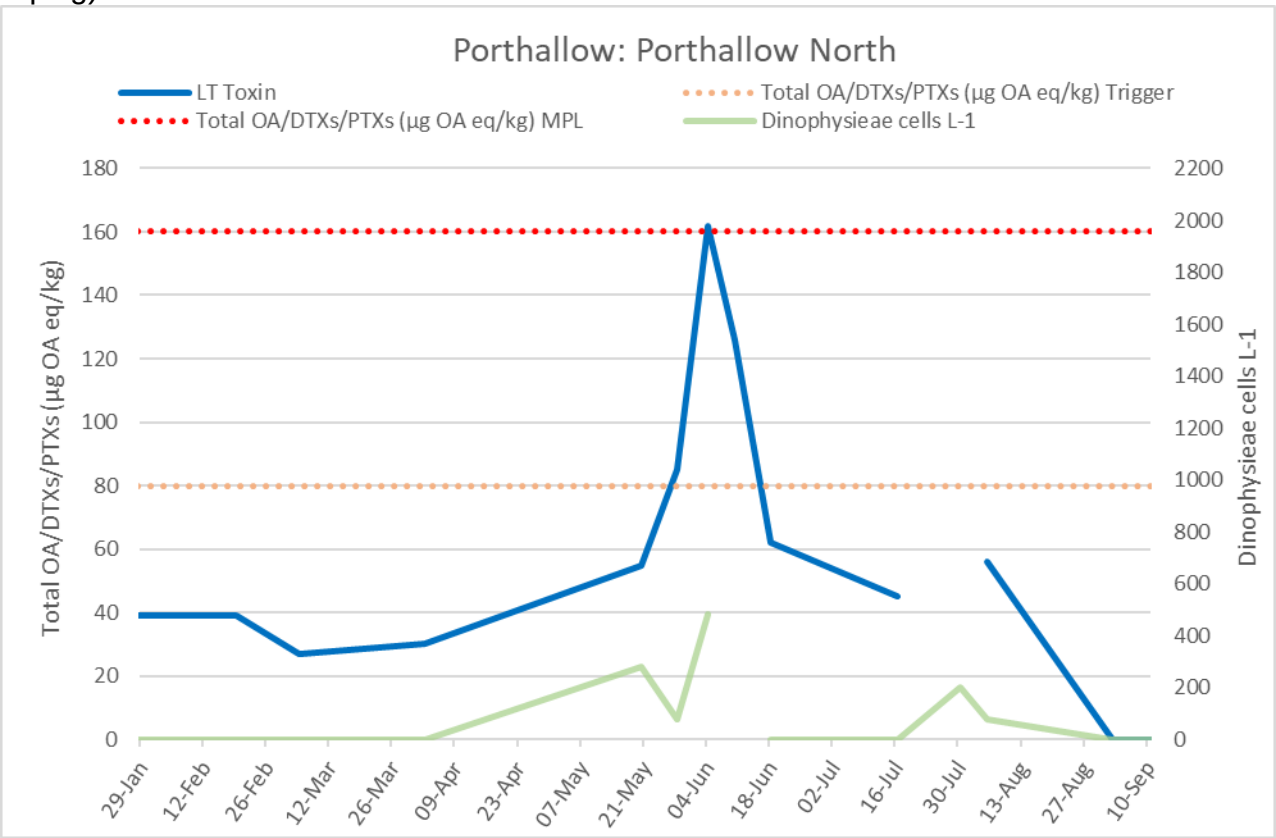

Figure **1.8** displays the *Dinophysieae* results and OA/DTX/PTX toxin results between January and September 2019. The *Dinophysieae* counts peaked to 480 cells/L at the same time (04/06/2019) as the first shellfish sample recorded a result above the MPL.

Figure 1.9 displays the *Dinophysieae* counts and OA/DTX/PTX toxin results between January and September 2019 for the Ropehaven Outer, St Austell production area. Three above MPL results were recorded in samples collected from this site between May and June 2019. There has been a decrease in occurrences when compared to 2018, when 18 consecutive results recorded above the MPL between June and October. This toxin group appeared at a similar time in 2017, however concentrations were lower; with no results above the MPL in 2017. The first above MPL result was recorded in a sample collected on 29/05/2019 and 2 consecutive weeks in June (04/06/2019, 499 µg OA eq./kg and 11/06/2019, 270 µg OA eq./kg). The highest concentration reported in 2019 was 499 µg OA eq/kg. This is considerably less than the levels recorded in 2018 for this area (3,778 µg OA eq./kg).

Figure 1.10 displays the *Dinophysieae* counts and OA/DTX/PTX toxin results between January and September 2019 for the Sandheap production area in Lantivet Bay. Only one above MPL result was recorded at this site in 2019, in a sample collected on 04/06/2019 (182 µg OA eq./kg). In 2018, 16 consecutive samples above the MPL were recorded at this site between June and October, with the highest concentration being recorded in a sample collected in August (4,199 µg OA eq./kg). This was the highest result recorded since implementation of the LC-MS method in 2011. In 2017, this production area recorded only one above trigger level result.

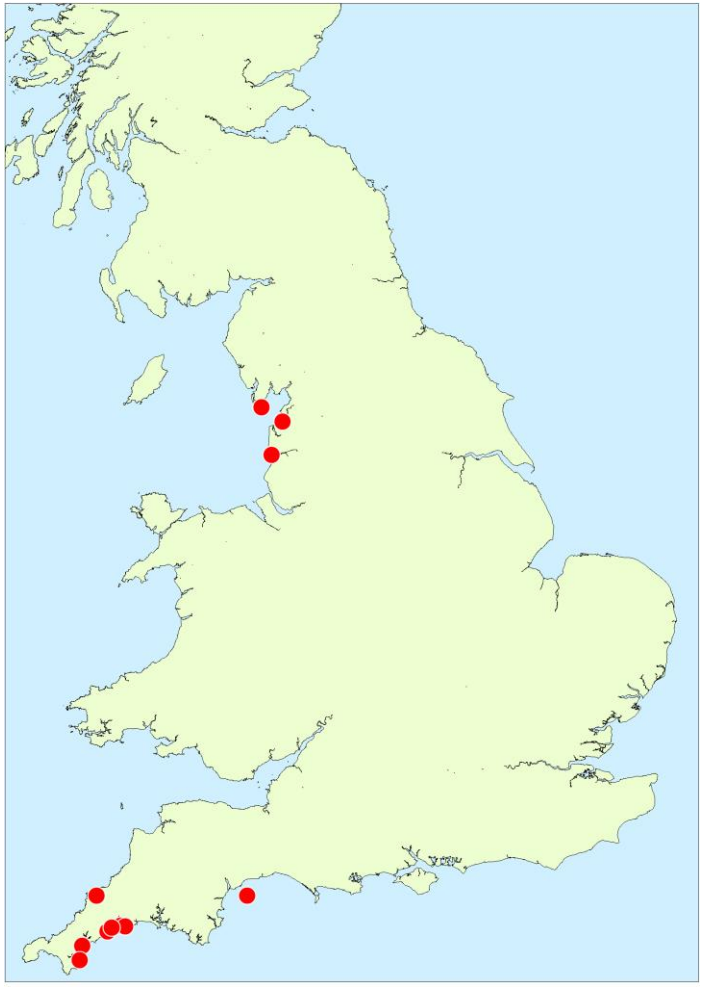

Figure 1.6 Location of classified production and/or relaying areas where OA/DTXs/PTXs group toxins were detected below the MPL of 160 µg [OA eq.]/kg [shellfish tissue] in 2019

Figure 1.7 Location of classified production and/or relaying areas where OA/DTXs/PTXs group toxins were detected above the MPL of 160 µg [OA eq.]/kg [shellfish tissue] in 2019

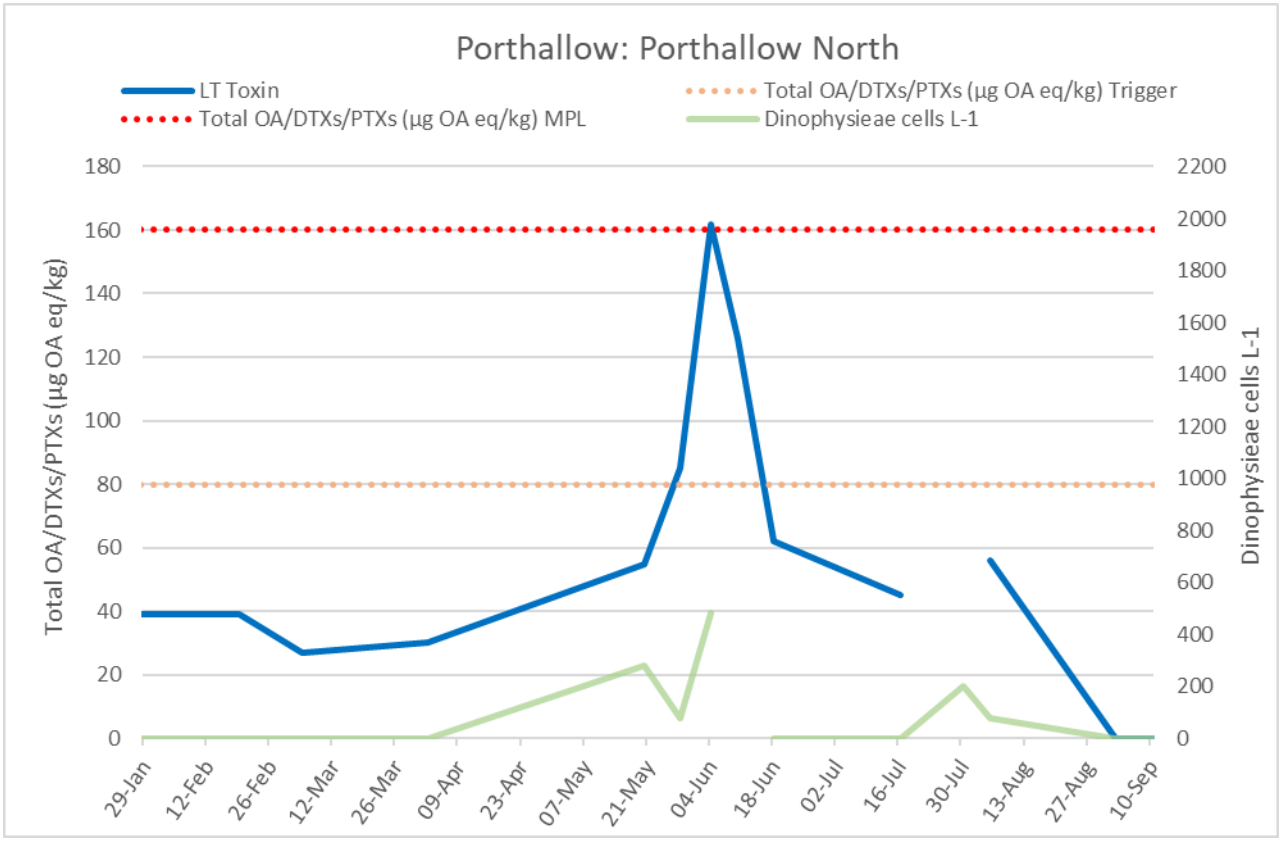

Figure 1.8 Results of LT testing and *Dinophysieae* enumeration in the Porthallow production area in 2019.

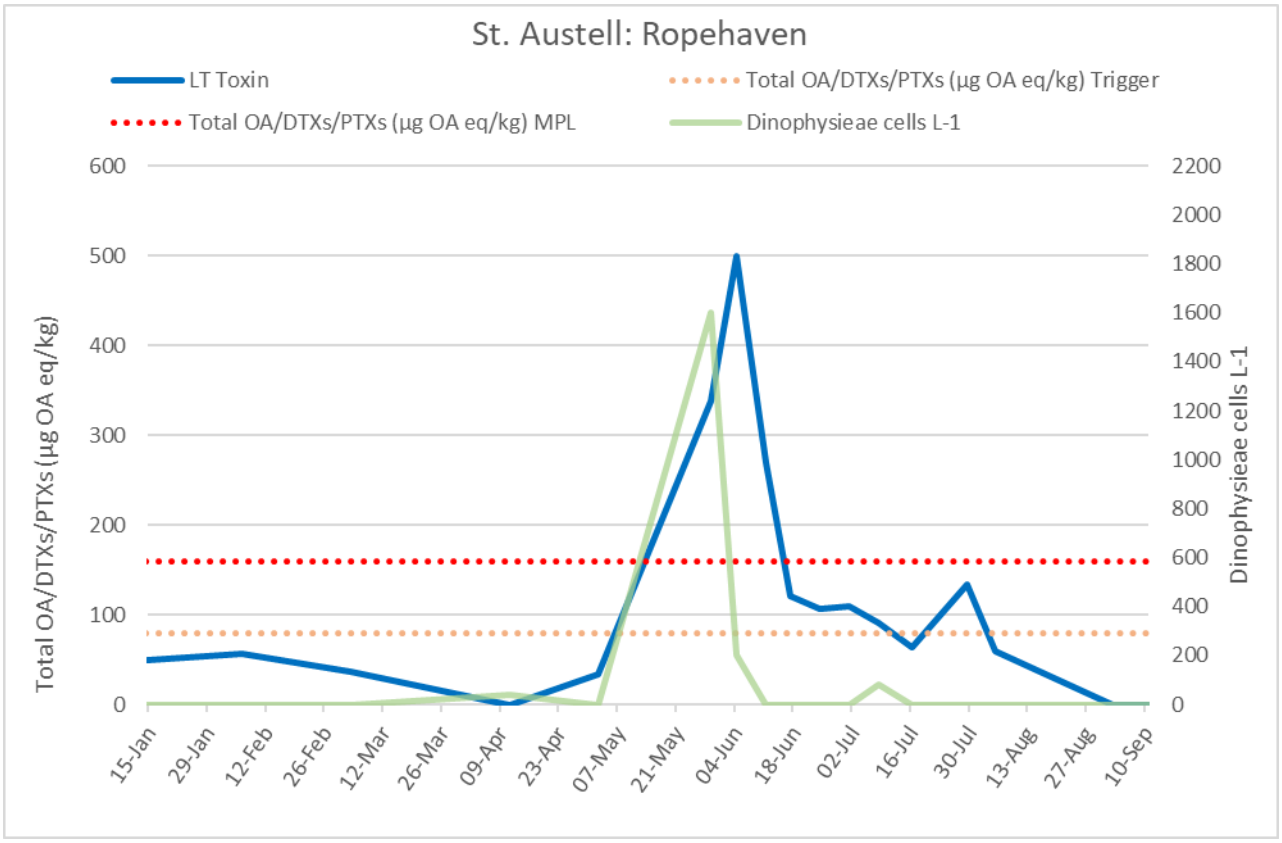

Figure 1.9 Results of LT testing and *Dinophysieae* enumeration in the St. Austell production area in 2019.

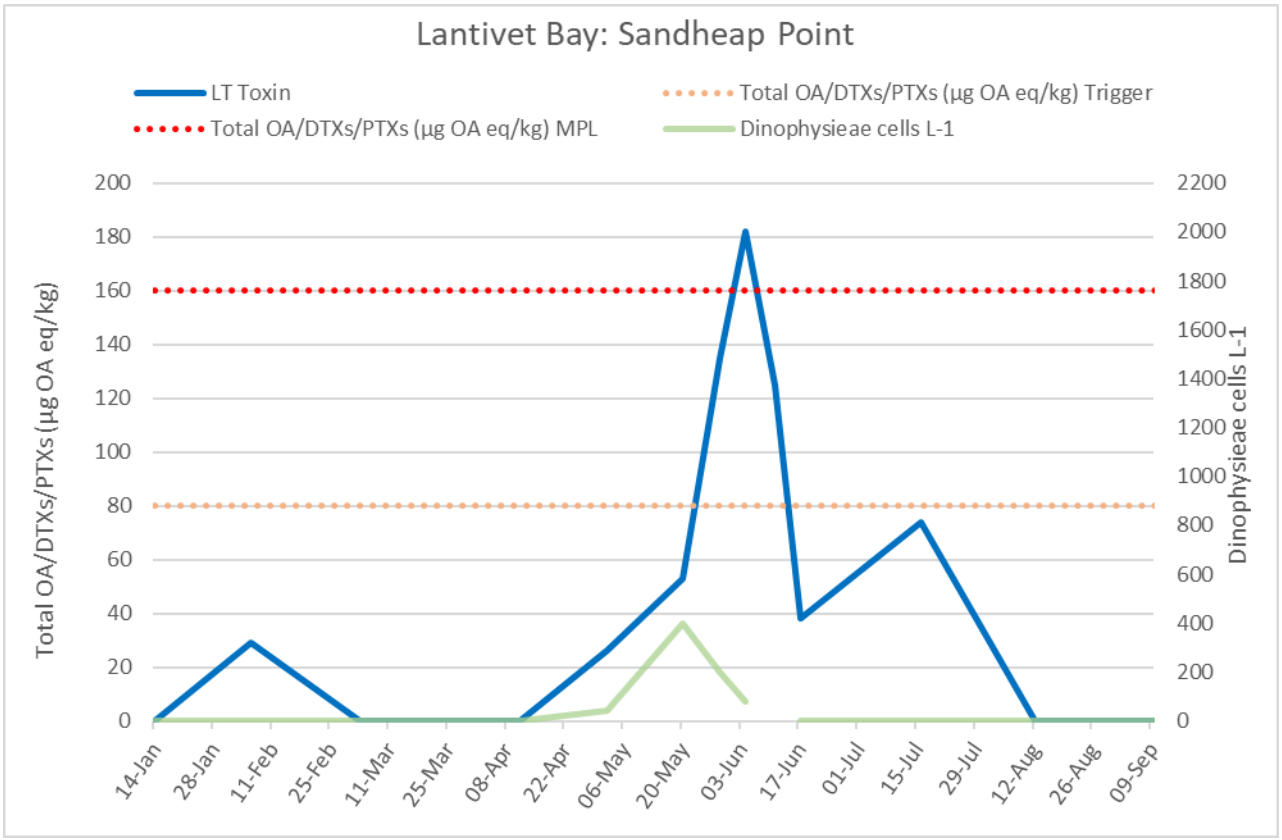

Figure 1.10 Results of LT testing and *Dinophysiaceae* enumeration in the Lantivet Bay area in 2019.

Table 1.2 Summary of sites where either ASP, PSP or lipophilic toxins were detected above the maximum permitted limits in 2019.

Toxin	**Samples where toxin levels exceeded the maximum permitted level** **(ASP: > 20 mg [domoic +*epi*-domoic acid]/kg [shellfish flesh]; OA/DTXs/PTXs: >160 µg [OA eq.]/kg [shellfish flesh]; AZAs: >160 µg [AZA1 eq.]/kg [shellfish flesh]; YTXs: >3.75 mg [YTX eq.]/kg [shellfish flesh]; PSP: > 800 µg [STX di-HCl eq.]/kg [shellfish flesh])**			
	Local Authority	**Production area & site**	**Date samples collected**	**Highest value reported (Shellfish species)**
ASP	None	None	None	None
OA/DTXs/PTXs	Cornwall PHA	Sandheap Point	04/06/2019: 1 sample	182 µg/kg (Mussels)
		Porthallow North	04/06/2019: 1 sample	162 µg/kg (Mussels)
		Ropehaven Outer	29/05/2019 to 11/06/2019: 3 samples	499 µg/kg (Mussels)
AZAs	None	None	None	None
YTXs	None	None	None	None
PSP	Cornwall PHA	Pont Pill	12/08/2019 to 27/08/2019: 3 samples	4,766 µg/kg (Mussels)

1.4 Insufficient/unsuitable samples

Seven shellfish samples (0.84% of all samples submitted) were rejected in the reporting period:

- two were rejected on the grounds of being unsuitable (<10 live shellfish on arrival);
- three were taken in error;
- one was the incorrect species;
- and one was submitted outside the testing frequency.

2 Phytoplankton monitoring - summary

The results of the phytoplankton monitoring of classified production and relaying areas in England and Wales for 2019 are summarised below. Where the stated trigger levels (see Appendix 2, Table 7.1) were exceeded, additional flesh and water samples were requested the following week.

- *Alexandrium* species (PSP toxins producers) were recorded in 20 samples from 9 production areas (Table 2.1 Figure 2.1), representing a decrease of 57% in the occurrence of this genus compared to last year. Recorded maximum cell density was greater than last year, with a density of 1,240 cells/L recorded from Fowey: Pont Pill on 12 August. These levels are comparable to those recorded over the period 2013 to 2015, when annual recorded occurrences did not exceed 55 samples. This is in sharp contrast to 2016 when annual recorded occurrences were from 107 samples, and maximum recorded cell densities was 13,617,000 cells/L. Figure 2.5 displays a heat map for *Alexandrium* species reported between 2006 and 2019 in England and Wales, with the values calculated on a daily accumulative basis. The darker the colour, the higher the concentration of cells found. All *Alexandrium* occurrences breach the trigger level. It is evident that *Alexandrium* species have not been as prevalent in 2019 as in other monitored years. There has been a marked decrease in the number of *Alexandrium spp.* cells recorded after 2013, with a small increase in 2016. Most of the cells were recorded between April and September.

- *Pseudo-nitzschia* species (ASP toxin producers) were recorded in 532 samples from 46 production areas. The trigger level (set at 150,000 cells/L) was exceeded on 16 occasions from 9 production areas (Table 2.1, Figure 2.2). The highest cell density was recorded in a sample from Bournemouth, Poole and Christchurch Council: Poole Coastal collected on 16 May (2,216,000 cells/L). The number of samples which exceed the trigger level for *Pseudo-nitzschia* species has fluctuated from year to year. There has been 129% increase in the number of breaches compared to 2018. Figure 2.5 displays a heat map for *Pseudo-nitzschia* species reported between 2006 and 2019 in England and Wales, with the values calculated on a daily accumulative basis. The darker the colour, the higher the accumulative concentration of cells found. Whilst it may appear that the darker three shades denote breaches, in some cases the figure of 150,000 or above will include *Pseudo-nitzschia* found in several samples at lower than breach levels. It is evident that *Pseudo-nitzschia* breaches have not been as prevalent in 2019 as in other monitored years, but the number of occurrences is similar. *Pseudo-nitzschia* have been regularly recorded throughout the year but with peak records tending to occur in early summer, between late April and early July.

- *Dinophysiaceae* (lipophilic toxins producers) were recorded in 85 samples from 29 production areas. The trigger level (set at 100 cells/L) was exceeded by 33 samples from 16 production areas (Table 2.1, Figure 2.3). This is a 58% decrease compared to 2018. The maximum cell density recorded in 2019 was 1,600 cells/L from St Austell Bay: Ropehaven Outer on 29 May. Figure 2.5 displays a heat map for *Dinophysiaceae* species reported between 2006 and 2019 in England and Wales, with the values calculated on a daily accumulative basis. The darker the colour, the higher the

accumulative concentration of cells found. It is evident that *Dinophysiaceae* species have not been as prevalent in 2019 as in other monitored years, although from 2014 onwards the recorded number of *Dinophysiaceae* cells has been higher. The peak occurrences tended to be late summer, but recent peaks have tended to show slightly earlier. This is potentially due to water sampling being suspended during bed closures in recent years.

- *Prorocentrum lima* (lipophilic toxins producers) were detected in 12 samples from 9 production areas (Table 2.1, Figure 2.4). The trigger level (set at 100 cells/L) was exceeded by 4 samples from 4 production areas. The highest cell density was 200 cells/L collected from Camel: Porthilly Rock B on 6 August. This is a 33% decrease on 2018. *Prorocentrum lima* is considered an epi-benthic species, and it is likely that its detection in the water column is associated with sediment disturbance.

Table 2.1 Summary of Phytoplankton taxa with trigger levels

Taxa with trigger levels (cells/L)	2019 Occurrences	2019 Breaches	% change in breach numbers compared to 2018	2019 max. recorded density (cells/L)
Alexandrium (40)	20	20	-57%	1,240
Pseudo-nitzschia (150,000)	532	16	+129%	2,216,000
Dinophysiaceae (100)	85	33	-58%	1,600
Prorocentrum lima (100)	12	4	-33%	200

- *Prorocentrum cordatum* were recorded in 28 samples from 20 production areas. These figures show a 76% decrease in occurrence, but cell densities have increased peaking in July at Burry Inlet: Machynys at 1,194,000 cells/L, compared to 68,280 cells/L in Swansea: Queen's Dock in August 2018.
- *Lingulodinium polyedrum* and *Protoceratium reticulatum* were not recorded during 2019. Both *P. reticulatum* and *L. polyedrum* have typically been recorded at relatively low frequencies and densities in samples from English and Welsh shellfish production areas over the last twelve years.

Of the 907 phytoplankton samples submitted in 2019, 17 (1.98%) were rejected for analysis, 13 due to high sediment content. This is an increase of 30% in the number of high sediment samples compared to 2018. A further 4 samples were not analysed due to incorrect frequency of submission, and 1 sample was not analysed because the bottle had split in transit. The sample had leaked out into the special delivery bag and was not suitable for analysis.

Figure 2.1 Locations of sites where *Alexandrium* species were detected above trigger level in 2019

Figure 2.2. Locations of sites where *Pseudo – nitzschia* species were detected above trigger level in 2019

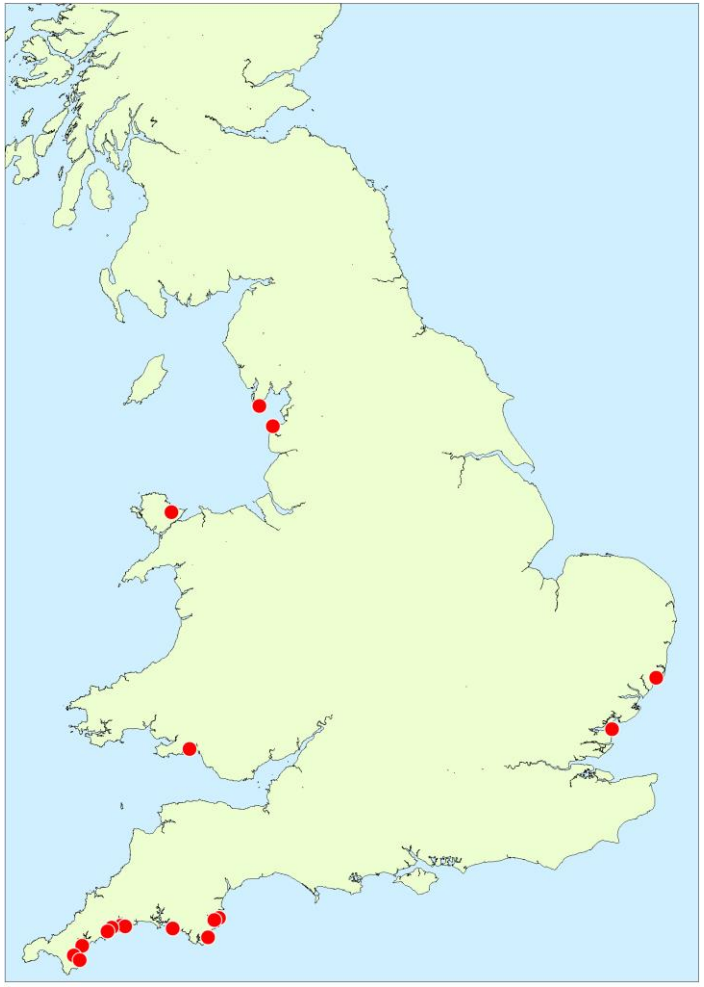

Figure 2.3 Locations of sites where *Dinophysiaceae* were detected above trigger level in 2019

Figure 2.4 Locations of sites where *Prorocentrum lima* was detected above trigger level in 2019

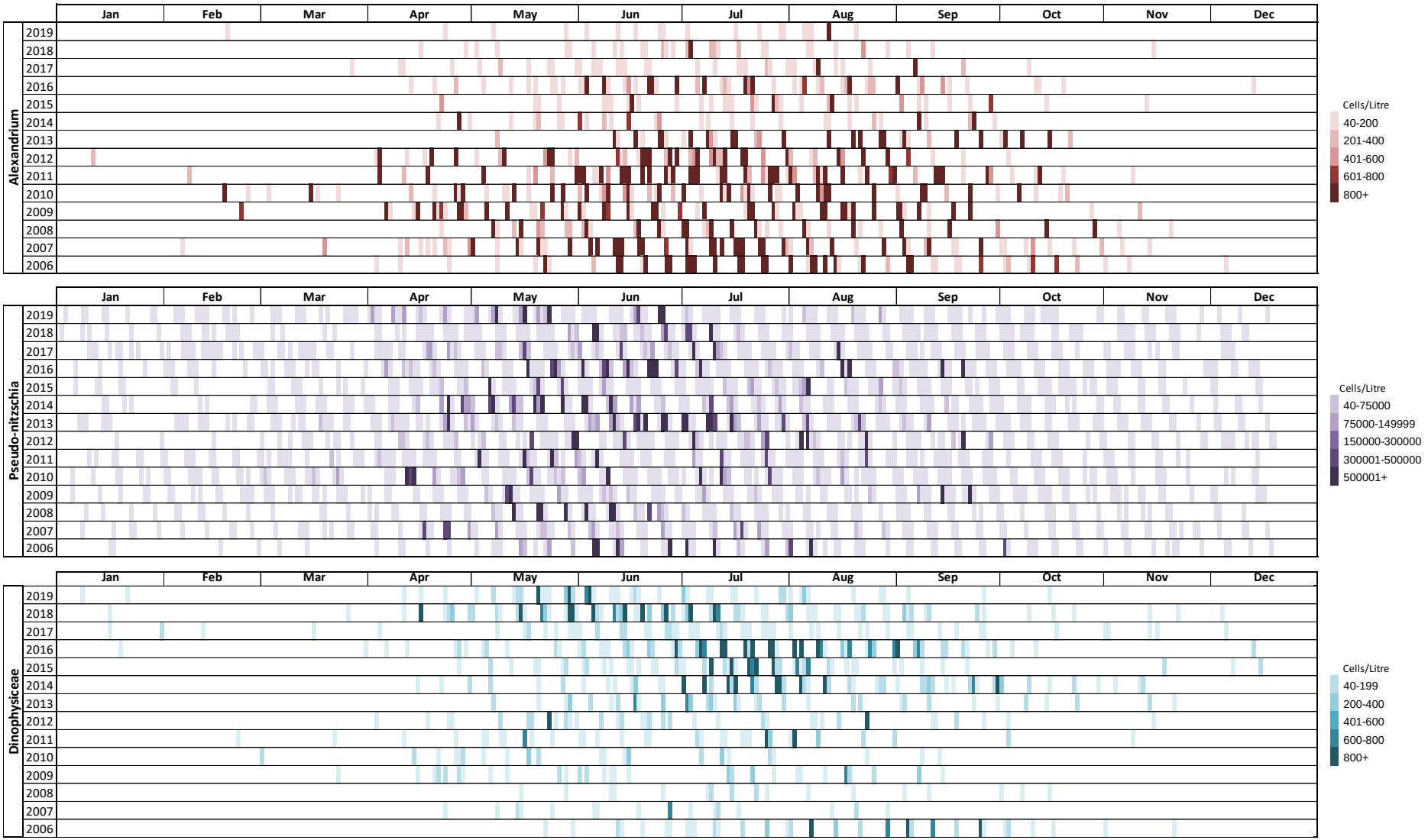

Figure 2.5 Heat Maps for *Alexandrium*, *Dinophysiceae* and *Pseudo-nitzschia* occurrences in England and Wales (2006-2019) – Calculated on an accumulative daily basis

3 Biotoxin sample results in 2019

3.1 Amnesic Shellfish Poisoning (ASP) and Pseudo-nitzschia species

No samples recorded ASP toxins above the trigger level of 10mg [Domoic+*epi*-domoic acid]/kg [shellfish flesh].

Table 3.1 Summary of *Pseudo-nitzschia* species detected above the trigger level of 150,000 cells/L during 2019. Results ordered by Local Authority.

Production Area	Bed ID	Local Authority	Sampling Point	Date Sample Collected	*Pseudo-nitzschia* spp. cells/L
Poole	B54CU	Bournemouth, Poole and Christchurch Council	Poole Coastal	23/05/2019	1,500,000
Poole	B54CL	Bournemouth, Poole and Christchurch Council	West Brownsea 1	23/05/2019	172,000
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	02/04/2019	159,000
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	18/06/2019	324,000
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	24/06/2019	292,000
St Austell Bay	B70AL	Cornwall PHA	Pentewan	24/06/2019	180,000
Fal	B33AN	Cornwall PHA	Mylor Creek	25/06/2019	301,000
Poole	B54CU	Poole BC	Poole Coastal	16/05/2019	2,216,000
Poole	B54CL	Poole BC	West Brownsea 1	16/05/2019	249,000
Dart	B028B	South Hams DC	Waddeton	17/06/2019	165,000
Dart	B028B	South Hams DC	Waddeton	24/06/2019	153,000
Solent	B24BK	Southampton PHA	Browndown	08/05/2019	476,000
Solent	B24BK	Southampton PHA	Browndown	20/05/2019	205,400
Southampton Water	B021Y	Southampton PHA	Hamble Estuary	08/05/2019	26,2000
Swansea	B037U	Swansea PHA	Queens Dock	24/06/2019	183,000
Lyme Bay	B090M	Torbay BC	Site 1	24/06/2019	192,000

Table colour coding: Green (above causative algae trigger level)

3.2 Paralytic Shellfish Poisoning (PSP) and Alexandrium species

Table 3.2 Summary of PSP toxins and *Alexandrium* spp. detected above the trigger levels of 400 µg [STX di-HCl eq[./kg [shellfish flesh] and 40 cells/L respectively during 2019. Results ordered by Local Authority. (Please note; in the table, toxin and algal results are only shown when the trigger levels have been breached).

Production Area	Bed ID	Local Authority	Sampling Point	Date Sample Collected	High value calculated from method uncertainty	*Alexandrium* spp. cells/L
Fal	B033Y	Cornwall PHA	Ruan Pontoon/Tregothnan	28/05/2019		40
Fal	B33BD	Cornwall PHA	Trelissick Pontoon	23/07/2019		40
Fal	B33BD	Cornwall PHA	Trelissick Pontoon	06/08/2019		40
Fal	B33AN	Cornwall PHA	Mylor Creek	20/08/2019		40
Fowey	B70AB	Cornwall PHA	Pont Pill	29/07/2019		40
Fowey	B70AB	Cornwall PHA	Pont Pill	05/08/2019	661	40
Fowey	B70AB	Cornwall PHA	Pont Pill	12/08/2019	2,271	1,240
Fowey	B70AB	Cornwall PHA	Pont Pill	19/08/2019	4,766	
Fowey	B70AB	Cornwall PHA	Pont Pill	27/08/2019	1,177	
The Fleet	B25AI	Dorset Council	Fleet Oysters	16/07/2019		40
The Fleet	B25AI	Dorset Council	Fleet Oysters	07/08/2019		160
The Thames	B16CM	London PHA	East of Havengore Creek	16/07/2019		40
Dart	B028B	South Hams DC	Waddeton	19/02/2019		40
Southampton Water	B021Y	Southampton PHA	Hamble Estuary	17/06/2019		40
Southampton Water	B021Y	Southampton PHA	Hamble Estuary	02/07/2019		40
Swansea	B037U	Swansea PHA	Queens Dock	23/04/2019		40
Swansea	B037U	Swansea PHA	Queens Dock	07/05/2019		40
Swansea	B037U	Swansea PHA	Queens Dock	24/06/2019		160
Swansea	B037U	Swansea PHA	Queens Dock	30/07/2019		40
Taw/Torridge	B36AB	Torridge DC	Spratt Ridge East	12/06/2019		40
Taw/Torridge	B36AB	Torridge DC	Spratt Ridge East	25/06/2019		40
Anglesey - Red Wharf Bay	B057J	Ynys Mon CC	Nodwydd	03/06/2019		40

Table colour coding: Red (above toxin MPL), Green (above primary causative algal species trigger level)

3.3 Lipophilic Toxins, Dinophysiaceae and Prorocentrum lima

Table 3.3 Summary of results for samples recording Lipophilic toxins; Okadaic acid (OA), Dinophysistoxins (DTXs) and Pectenotoxins (PTXs), above the trigger level of 80 µg [OA eq.]/kg [shellfish flesh] in 2019. The table also includes samples recording the LTs causative algal species (*Dinophysiaceae* and *Prorocentrum lima*), above the trigger level of 100 cells/L. Results ordered by Local Authority. (Please note; in the table, toxin and algal results are only shown when the trigger levels have been breached).

Production Area	Bed ID	Local Authority	Sampling Point	Date Sample Collected	Total OA/DTXs/PTXs (µg OA eq/kg) High value calculated from MU	Dinophysieae cells/L	*Prorocentrum lima* cells/L
Morecambe Bay - Barrow	B077R	Barrow-in-Furness BC	Foulney	20/06/2019	81		
Morecambe Bay - Barrow	B077Q	Barrow-in-Furness BC	Roa Island	07/05/2019		240	
Morecambe Bay - Barrow	B077Q	Barrow-in-Furness BC	Roa Island	15/05/2019		200	
Morecambe Bay - Barrow	B077Q	Barrow-in-Furness BC	Roa Island	20/05/2019		500	
Morecambe Bay - Barrow	B077Q	Barrow-in-Furness BC	Roa Island	03/06/2019		400	
Morecambe Bay - Barrow	B077Q	Barrow-in-Furness BC	Roa Island	17/06/2019		320	
North Kent Coast	B17BS	Canterbury CC	WOCO Westbeach	19/08/2019			120
Camel	B35AE	Cornwall CC	Porthilly Rock B	06/08/2019			200
Fal	B33AN	Cornwall PHA	Mylor Creek	14/05/2019		100	
Fal	B33AN	Cornwall PHA	Mylor Creek	28/05/2019		440	
Fowey	B70AB	Cornwall PHA	Pont Pill	20/05/2019		680	
Fowey	B70AB	Cornwall PHA	Pont Pill	29/05/2019		400	
Fowey	B70AB	Cornwall PHA	Pont Pill	04/06/2019		120	
Fowey	B70AB	Cornwall PHA	Pont Pill	08/07/2019		120	
Fowey	B70AB	Cornwall PHA	Pont Pill	29/07/2019		120	
Helford	B034W	Cornwall PHA	Porth Navas Quay	03/06/2019		120	
Helford	B034W	Cornwall PHA	Porth Navas Quay	05/08/2019		300	
Lantivet Bay	B70AI	Cornwall PHA	Sandheap Point	04/06/2019	182		
Lantivet Bay	B70AI	Cornwall PHA	Sandheap Point	20/05/2019		400	
Lantivet Bay	B70AI	Cornwall PHA	Sandheap Point	29/05/2019	135	200	
Lantivet Bay	B70AI	Cornwall PHA	Sandheap Point	11/06/2019	125		
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	20/05/2019		280	
Porthallow Cove	B34AA	Cornwall PHA	Porthallow North	28/05/2019	85		
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	04/06/2019	162	480	
Porthallow Cove	B34AA	Cornwall PHA	Porthallow North	10/06/2019	126		
Porthallow Cove	B34AA	Cornwall PHA	Porthallow Cove North	30/07/2019		200	

St. Austell Bay	B70AL	Cornwall PHA	Pentewan	24/06/2019	102		

Table 3.3 continued

Production Area	Bed ID	Local Authority	Sampling Point	Date Sample Collected	Total OA/DTXs/PTXs (µg OA eq/kg) High value calculated from MU	Dinophysieae cells/L	*Prorocentrum lima* cells/L
St Austell Bay	B70AL	Cornwall PHA	Pentewan	01/07/2019		440	
St. Austell Bay	B70AM	Cornwall PHA	Pentewan	08/07/2019	102		
St. Austell Bay	B70AM	Cornwall PHA	Pentewan	16/07/2019	91		
St. Austell Bay	B70AM	Cornwall PHA	Pentewan	22/07/2019	125		
St Austell Bay	B70AL	Cornwall PHA	Pentewan	29/07/2019		120	
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	29/05/2019	338	1,600	
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	04/06/2019	499		
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	11/06/2019	270		
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	17/06/2019	121		
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	08/07/2019	91		
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	24/06/2019	106		
St. Austell Bay	B70AE	Cornwall PHA	Ropehaven Outer	01/07/2019	109		
Butley	B009E	East Suffolk DC	Pumping Station Outfall	03/06/2019		200	
The Thames	B16CN	London PHA	Crouch Approach	03/09/2019			100
Blackwater	B14AD	Maldon DC	St Peters Flats	15/05/2019		100	
Holy Island-Ross Links	B001M	Northumberland CC	Ross Links	01/09/2019			100
Yealm	B031J	Plymouth PHA	Thorn	05/06/2019		100	
Dart	B028B	South Hams DC	Waddeton	21/01/2019		100	
Start Bay	B087J	South Hams DC	Off Torcross	18/06/2019		120	
Butley	B009E	Suffolk Coastal DC	Pumping Station Outfall	02/05/2019		100	
Swansea	B037U	Swansea PHA	Queens Dock	30/07/2019		120	
Brixham	B082B	Torbay BC	Fishcombe SW Corner	14/05/2019		120	
Lune	BO66Z	Wyre BC	Knott Spit	30/05/2019		200	
Anglesey - Red Wharf Bay	B057J	Ynys Mon CC	Nodwydd	01/08/2019		100	

Table colour coding: Red (above toxin MPL), Green (above primary causative algal species trigger level)

No samples contained Azaspiracids (AZAs) above the trigger level of 80 µg [AZA1 eq.]/kg [shellfish flesh] during 2019.

No samples contained Yessotoxins (YTXs) above the trigger level of 1.875 mg [YTX eq.]/kg [shellfish flesh] during 2019.

4 Glossary

AOAC	AOAC International
ASP	Amnesic Shellfish Poisoning
AZA	Azaspiracid
AZP	Azaspiracid Poisoning
Cefas	The Centre for Environment, Fisheries and Aquaculture Sciences
DA	Domoic Acid
DSP	Diarrhetic Shellfish Poisoning
DTX	Dinophysistoxin
dcSTX	decarbomoyl Saxitoxin
EC	European Commission
EU	European Union
EURL	European Union Reference Laboratory for Marine Biotoxins
EHO	Environmental Health Officer
FSA	Food Standards Agency
GTX	Gonyautoxin
HPLC	High Performance Liquid Chromatography
LA(s)	Local Food Authority(ies)
LC-MS	Liquid Chromatography – Mass Spectrometry
LTs	Lipophilic toxins
MPL	Maximum permitted limit
N/A (na)	Not Applicable
ND	Not Detected
OC	Official Controls
OA	Okadaic Acid
PSP	Paralytic Shellfish Poisoning
PST	Paralytic Shellfish Toxins
PTX	Pectenotoxin
PTX2sa	Pectenotoxin 2 seco acid
7-*epi* PTX2sa	7-epi-Pectenotoxin 2 seco acid
RL (<RL)	Reporting Limit
SOP(s)	Standard Operating Procedure(s)
STX	Saxitoxin
UKNRL	UK National Reference Laboratory for Marine Biotoxins
YTX	Yessotoxin

5 References

European Communities (2004). Regulation (EC) 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption.

European Communities (2005). Regulation (EC) 2074/2005 of the European Parliament and of the Council of 5th December 2005 which lays down the implementing measures for certain products under Regulation (EC) 853/2004 and for the organisation of official controls under Regulation (EC) 854/2004 and 882/2004, derogating from Regulation (EC) No 852/2004 and amending Regulations (EC) Nos 853/2004 and 854/2004.

European Communities (2004). Regulation (EC) 882/2004 of the European Parliament and of the Council of 29th April 2004, which prescribes requirements for Official Controls performed to ensure the verification of compliance with feed and food law.

European Communities (2004). Regulation (EC) 853/2004 of the European Parliament and of the Council of 29th April 2004 laying down the specific hygiene rules for the hygiene of foodstuffs.

6 Appendix 1 – Methodology for official control monitoring of toxins in shellfish

6.1 Shellfish collection and transport

In 2019, 39 local authorities (LAs) contributed to the sampling of shellfish from 73 sampling points (Figure 6.1).

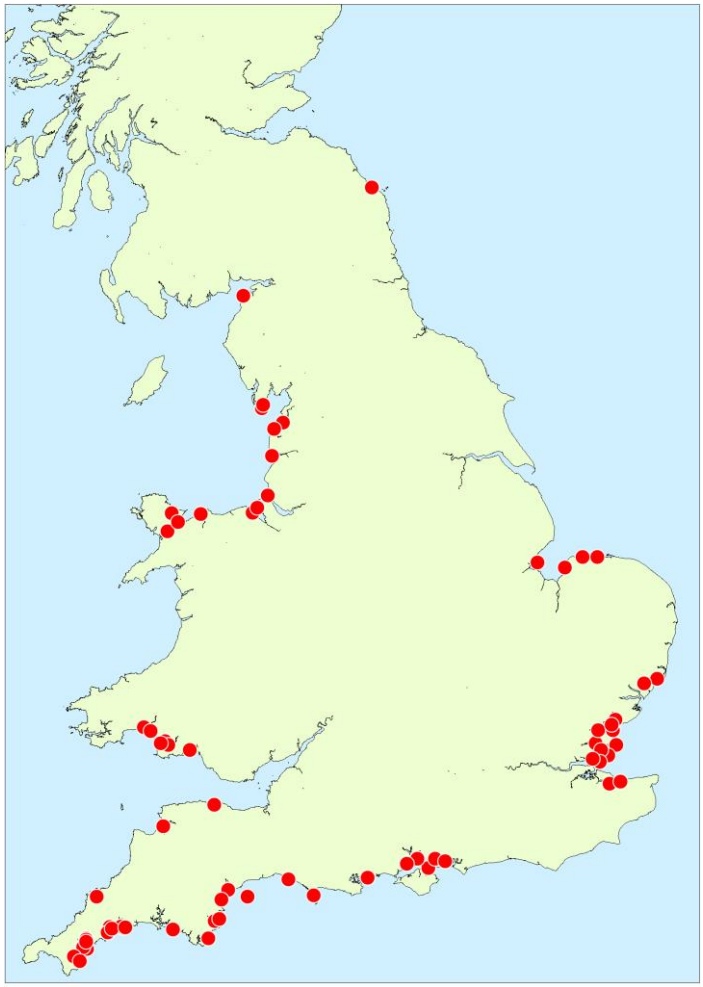

Figure 6.1 English and Welsh flesh sampling locations - Biotoxin monitoring programme 1st January to 31st December 2019

In total, 825 shellfish samples were submitted from classified production and relaying areas. Samples were submitted for amnesic shellfish poisoning (ASP) toxins, paralytic shellfish poisoning (PSP) toxins and/or lipophilic toxins (LTs) testing. Environmental Health Officers (EHOs) from Local Authorities (LAs) collected or supervised the collection of shellfish samples from designated monitoring points within classified shellfish production or relaying areas. The samples received from classified production and relaying areas comprised mainly of mussels (*Mytilus* spp.), native oysters (*Ostrea edulis)*, common cockles (*Cerastoderma edule)* and Pacific oysters (*Crassostrea gigas)* (Table 6.1). The remainder of the samples consisted of surf clams (*Spisula solida*), manila clams (*Tapes philipinarum)*, hard clams (*Mercenaria mercenaria*) and razors (Ensis spp.)

Shellfish samples reached Cefas between 1 and 72 hours post collection, with 92.8% of samples reaching the laboratory within 1 working day, 7.0% 2 working days post collection and 0.2% 3 working days post collection.

Shellfish samples were transported to the testing laboratory using a validated chilled transport system (Coleman 16 Qrt coolboxes). 99% of the samples transported in these boxes arrived at the laboratory within the recommended temperature range (2-10°C). Seventy-seven samples recorded temperatures above 10°C. However, upon inspection, all these samples met the criteria set by the UK Marine Biotoxins National Reference Laboratory (UKNRL) for testing.

6.2 Shellfish sample assessment

Unsuitable samples

On arrival at the laboratory, samples were assigned a unique laboratory number and their temperature recorded before they were assessed for their suitability for analysis, in accordance with UKNRL SOPs. Shellfish which failed to respond to a percussion test and/or did not exhibit organoleptic characteristics associated with freshness were excluded from testing and reported as unsuitable for analysis.

Samples were assessed on the basis of their compliance with the requirement of the monitoring programme (namely; shellfish species submitted, frequency of submission and geographical origin of the sample). Samples taken from non-active sites or unclassified species were queried with the LA. If no suitable reason was provided, then the sample was rejected. One sample was rejected on the grounds of being submitted outside the scheduled testing frequency. Three samples were rejected as they were sent in error. One sample was rejected as the incorrect species was submitted. Two were rejected on the grounds that less than 10 live shellfish were available on arrival either due to some being dead, empty shells or the sample submitted contained less than 10 shellfish.

Insufficient samples

Samples which were assessed as suitable for analysis were then prepared for ASP, PSP and/or lipophilic toxins analyses as required. In accordance with agreed procedures, should the amount of shellfish available provide insufficient material for all required tests, prioritisation of analyses is based on the historic prevalence of toxin group or lack of previous monitoring results for any toxin group at each site. Where no information is available, or prioritisation cannot be ascertained on the above criteria, PSP toxin analyses are prioritised over LT and ASP analyses. No samples were found to be insufficient for the required tests in 2019.

Table 6.1 Summary of samples received and found insufficient/unsuitable for ASP, PSP or lipophilic toxins analyses, by species, in 2019.

Species	Total no. of samples submitted for analysis	No. of samples found insufficient for any of the required tests	No. of samples where shellfish found unsuitable	No. of samples found unsuitable due to location or frequency	Percentage of samples found insufficient/unsuitable for the required tests (%)
Mussels	402	0	1	1	0.49
Pacific oysters	219	0	1	2	1.37
Native oysters	47	0	0	0	0
Common cockles	92	0	1	0	1.09
Surf clams	11	0	0	0	0
Manila clams	5	0	0	1	20
Hard clams	25	0	0	0	0
Razors	24	0	0	0	0
TOTAL	***825***	***0***	***3***	***4***	***0.84***

6.3 Methodology of shellfish analysis

The methods used for routine toxin analysis of shellfish were those specified by the FSA and involved the application of a range of analytical methods. These included liquid chromatography (LC) with Ultra-violet (UV) or fluorescence (FLD) detection or LC with tandem mass spectrometry (MS/MS) for either, a semi-quantitative screen or full toxin quantitation of samples. The methods used for toxin testing were as follows:

ASP testing

- Shellfish species received in the reporting period were tested by LC-UV analysis following extraction with 50% aqueous methanol and filtration of the crude extracts. The quantitative method was applied to all shellfish species and is based on the method of Quilliam et al., 1995.
- ASP results are reported as mg/kg of domoic and epi-domoic acid combined.

PSP testing

- Shellfish species received in the reporting period have all been validated at Cefas for the use of a refined LC-FLD method based on AOAC 2005.06. Samples were all extracted with 1% acetic acid and forwarded for semi-quantitation by LC-FLD. Any samples returning a semi-quantitative total toxicity of >400 µg STX eq/kg were then forwarded for full quantitation by LC-FLD.
- Screen positive samples under this limit were reported as <400 µg STX eq/kg.
- Quantitation was conducted following the fully quantitative AOAC 2005.06 method, with final results reported as total toxicities in µg STX eq/kg.

Lipophilic toxins testing

- All shellfish species were analysed by LC-MS/MS for the quantitation of all EU regulated lipophilic toxins. The method used was validated at Cefas and conforms to the performance characteristics and conditions stipulated by the EU Reference Laboratory (EU RL) for Marine Biotoxins.
- Results are reported as total toxicities in µg eq/kg for the OA, AZA and YTX groups separately.

Table 6.2 summarises the methods of analysis used throughout this reporting period together with a summary of the current UKAS accreditation status of each method to ISO 17025:2017 standard.

Table 6.2 List of analytical methods used, by species, in 2019

Toxin group	Methods employed	Species tested	Dates	Accreditation status (as of 31st December 2019) to ISO 17025:2017 standard
ASP	LC-UV	All species	1st January to 31st December 2019	Accredited
PSP	LC-FLD (semi-quantitative screen & full quantitation)	All species	1st January to 31st December 2019	Accredited
Lipophilic toxins	LC-MS/MS	All species	1st January to 31st December 2019	Accredited

Test outcome

Samples were considered as positive if they were found to breach the maximum permitted limits (MPL) for marine toxins specified in EC regulation 853/2004 (Table 6.3).

Where these levels were exceeded, recommendations were for temporary harvesting restrictions to be put in place for all shellfish species classified in the affected area until two consecutive negative or below action level (action level equals MPL) results were achieved for the toxin which was the cause of the closure, and at least one further negative or below action level result for the toxin groups which had not exceeded the MPL.

Routine flesh testing frequencies were defined by the FSA and followed one of the following set plans:

1. **Areas with a historic risk of PSP toxins occurrence AND/OR have insufficient historic data**.
   Fortnightly from 1st of April to 30th of September
   Four weekly from 1st of October to 31st of March

2. **Areas with no historic risk of PSP toxins AND historic data**
   Four weekly throughout the year

In addition, requests were made for weekly shellfish monitoring to be instigated when set trigger levels, indicative of heightened toxicity risk were breached. The trigger levels used in the 2019 reporting period are summarised in Table 6.3.

Table 6.3 Flesh trigger levels

Toxin group	Levels of toxin or cell concentrations triggering additional monitoring if breached
ASP	≥10mg domoic/epi-domoic acid/kg shellfish flesh
LTs	OA/DTX/PTX group: ≥80 µg [OA eq.]/kg [shellfish flesh] AZA group: ≥80 µg [AZA1 eq.]/kg [shellfish flesh] YTX group: ≥1.8 mg [YTX eq.]/kg [shellfish flesh]
PSP	≥400µg [STX di-HCl eq.]/kg [shellfish flesh]

6.4 Reporting of results

Upon completion of the required analyses, the results were collated, and quality controlled prior to submission to the Local Authority and FSA (Note: from January 2019, all daily results have been submitted direct to local authorities as well as FSA; in the past results were first submitted to FSA who then forwarded these on to LAs).

Results were reported on a daily basis. A summary of results turnaround times, from day of receipt to completion of each analysis for 2019 is given in Table 6.4. For reference, the turnaround times agreed with the FSA and required from Cefas during the reporting period are given in Table 6.5.

Table 6.4 Turnaround times, by test carried out, for samples received from classified production and relay areas in 2019

Territory	No. of tests performed	No. of completed results reported within one working day of receipt of sample	No. of completed results reported two working days post receipt of sample	No. of completed results reported three working days post receipt of sample
ASP by HPLC	707	701 (99.2%)	6 (0.8%)	0
Lipophilic toxins by LC-MS	730	724 (99.2%)	6 (0.8%)	0
PSP by HPLC (screen)	778	771 (99.1%)	7 (0.9%)	0
PSP by HPLC (quantitation)	4	1 (25%)	3 (75 %)	0
Totals	**2219**	**2197 (99%)**	**22 (1%)**	**0**

Table 6.5 Sample turnaround times (from sample receipt) specified by FSA

Toxin and analysis method	FSA specified targets
ASP by HPLC	90% within 1 working day 98% within 3 working days
Lipophilic toxins by LC-MS	90% within 1 working day 98% within 3 working days
PSP by HPLC (screen/semi-quantitation)	90% within 1 working day 98% within 3 working days
PSP by HPLC (quantitation)	90% within 2 working days 98% within 4 working days

Required turnaround times were therefore all met and for all analyses. Delivery by the laboratory exceeded the targets agreed with FSA.

In addition to the daily reporting schedule, all results from samples received between Monday and Friday the previous week were collated and reported in a weekly results sheet to FSA, released the following week.

7 Appendix 2 – Methodology for official control monitoring of toxic phytoplankton in classified shellfish production areas

7.1 Phytoplankton sample collection and transport

907 phytoplankton samples were collected by environmental health officers from 50 classified production or relaying areas around the coast of England and Wales (Figure 7.1)

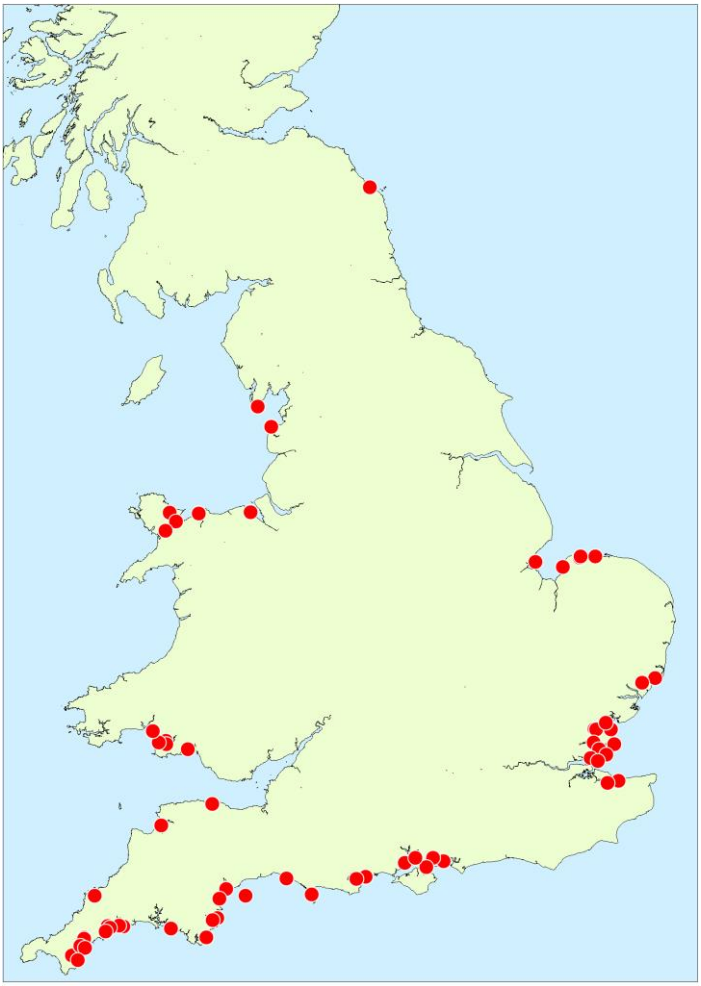

Figure 7.1 English and Welsh water sampling locations – 2019 Biotoxin monitoring programme

Sample collectors were requested to take depth integrated water samples from above the harvesting areas, at high water when possible. Tube samplers were provided to local authority staff who had access to boats, or where piers and jetties were sufficiently close to the flesh sampling points to allow a depth integrated sample to be taken. However, it was recognised that their use was not always practical in shallow, coastal areas and a homogenised sample, collected from three depths (near bottom, midwater and near surface) using a pole sampler, was recommended as a preferential alternative to sampling surface water with a bucket.

A 500 mL nalgene bottle was filled with water from each sample collection, which was preserved with the addition of 2 mL of acidified Lugol's Iodine. Preserved samples were then posted in pre-paid special delivery bags, together with a completed sample collection form, to the Cefas plankton laboratory for analysis.

7.2 Assessment of sample suitability

On arrival at the laboratory, samples were assigned a unique laboratory number. Sub-samples were then set up in 25mL Utermöhl chambers and allowed to settle. After three hours, each sample was given a preliminary examination. If the viewing area contained too much sediment or too much overlapping plankton, then an additional sub-sample was set up in a 10mL or 5mL Utermöhl chamber. All samples were allowed to settle for a minimum of 12 hours before the final suitability assessment was made. If after 12 hours, the viewing area of the smaller chamber was also obscured by sediment then these samples were reported as "unable to analyse" in the weekly results sheet.

A total of 17 samples (1.98%) were rejected, of these 13 (1.43%) were due to high sediment concentrations in the water. This is an increase on the previous year's figures, of 10 (1.4%) which were rejected due to high sediment concentrations. A further 4 samples were rejected as they had been submitted outside of the agreed testing frequency. One sample was rejected because the sample had leaked out of the sample bottle into the delivery bag and was not suitable for analysis.

7.3 Water sample analysis

Water analyses followed the standard operating procedures drawn up by the UK national reference laboratory for marine biotoxins. Phytoplankton analyses are accredited to ISO 17025:2017 standard.

Test outcome

'Trigger levels' remained at the same cell concentrations as in previous years (Table 7.1). When these levels were breached, the Local Authority and FSA were immediately contacted and requests were made for additional water and shellfish samples to be collected. These were submitted for analysis the following week. When shellfish flesh samples breached trigger levels the water sampling was suspended until such time as toxin levels in the flesh fell below the trigger level.

Table 7.1 Trigger levels for toxin producing algae

Toxin	Toxin producing algae (trigger Level)
ASP	*Pseudo-nitzschia spp.* (150,000 cells/L)
LTs	*Dinophysiaceae* (100 cells/L) *Prorocentrum lima* (100 cells/L)
PSP	*Alexandrium spp.* (40 cells/L)

7.4 Reporting of results

Upon completion of analyses, the results were collated, and quality control checked prior to submission to the Local Authority and FSA (Note: from January 2019, as for toxin results, all daily phytoplankton results have been submitted direct to local authorities as well as FSA; in the past results were first submitted to FSA who then forwarded these on to LAs).

During 2019, Cefas was able to report all results within one working day of sample receipt. This turnaround time is in full compliance with the targets specified by the FSA which is set at 98% of results reported within 3 working days of sample receipt. In addition to the daily reporting schedule, all results from samples received the previous week were collated and reported in a weekly results summary which was released to the FSA by the following week.