Monitoring for Toxin Producing and Nuisance Microalgae in Northern Ireland Coastal Waters

Reporting Period 1st January 2022 - 31st December 2022

Final Report – Version 1

Pages 35

Quality statement: This report is a compilation of the information included on the reports provided daily/ weekly to FSANI and showing the results of the phytoplankton analyses undertaken on samples submitted by third parties. All results were quality checked and approved prior to release to FSANI 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, date and time of collection) is as provided by sampling staff and has not undergone verification checks by AFBI.

Contents

Shellfish production waters: reporting period: 1st January 2022- 31st December 2022.

Summary

During the period of this report a total of 362 water samples were received and reported to the customer, Food Standards Agency Northern Ireland (FSANI). Performance indicators set by the customer were met with 100% of samples reported within the stipulated time frame. Three of the four main target phytoplankton groups were recorded (*Alexandrium* spp., Dinophysiales (genera *Dinophysis* and *Phalacroma*) and *Pseudo-nitzschia* spp.. *Prorocentrum lima* wasn't recorded in samples tested during 2022.The samples collected during 2022 also contained three other target species; *Prorocentrum cordatum*, *Karenia mikimotoi* and *Noctiluca scintillans.*

Cells of the genus *Alexandrium*, a potential producer of Paralytic Shellfish Toxins (PST's), were recorded on one occasion during 2022 (0.3% of samples). Cell numbers were recorded at 20 cells L^{-1} in a sample taken from C11-AFFNI 84 on 26th July.

No official control shellfish flesh samples tested during the year contained levels above the regulatory value of 800µg STX/ Kg.

Monitored target species, responsible for the production of lipophilic toxins, includes some members of the taxonomic order Dinophysiales as well as *Prorocentrum lima*. Target species belonging to the Order Dinophysiales were recorded in six of the seven monitored areas, the exception being Lough Foyle. Overall, they were present in 8.6% of the samples analysed in 2022. This ranged from their absence in Lough Foyle samples to 18.3% of Belfast samples. The trigger level of ≥ 100 cells L^{-1} was breached on 9 occasions. A maximum cell abundance of 1100 cells L^{-1} was recorded on 15th August in a water sample taken from site B12 AFFNI 54 in Belfast Lough. *Prorocentrum lima* was not recorded in any of the samples tested in 2022.

No official control samples tested during 2022 contained lipophilic toxins above the set regulatory limit. More details can be found in the AFBI Biotoxin Report for 2022.

The cosmopolitan diatom genus *Pseudo-nitzschia* contains species which have the potential to produce domoic acid. Cells of the genus were present in all 7 monitored areas and in 52.8% of all samples tested. Their presence ranged from 19.4% of Lough Foyle water samples to 76.9% of samples tested from Killough. A maximum abundance of 113,200 L^{-1} was recorded on 15th August in a sample taken from the B3-AFFNI 50 site in Belfast Lough.

No official control samples from the Biotoxin Monitoring Programme contained domoic acid above the regulatory level of 20 µg/g.

Three other target species were identified in water samples taken as part of the Official Control Programme during 2022. *Prorocentrum cordatum* was recorded in three samples during the year. A maximum abundance of 120 cells $^{L-1}$ was recorded in a water sample Larne Lough on 6th June. The ichthyotoxic dinoflagellate, *Karenia mikimotoi* was recorded on two occasions with both present at the limit of detection (20 cells L^{-1}). The two occasions were 7th June (S2-AFFNI 42) and 24th October

(DB1-AFFNI 95A) The large dinoflagellate *Noctiluca scintillans* was recorded on one occasion during 2022, this was in a sample from the C15-AFFNI 89 site in Carlingford Lough on 24th October when a cell count of 620 cells L^{-1} was recorded.

Introduction

Fisheries and Aquatic Ecosystems Branch of the Agri-Food and Biosciences Institute (AFBI) deliver the Official Control Phytoplankton Monitoring Programme for Northern Ireland on behalf of the competent authority, the Food Standards Agency (FSANI). A monitoring programme has been in place since mid-1993. This report presents the phytoplankton programme results for the period 1st January 2022– 31st December 2022.

A total of 362 water samples were received and reported in 2022. Samples were examined by light microscopy and results reported within 3 working days of sample receipt.

Water samples were obtained from all the classified shellfish production areas in Northern Ireland which included five sea loughs as well as Dundrum Bay and Killough Harbour (Table 1 and Figure 1). Samples were screened for the presence of the toxin producing and nuisance microalgae listed in Table 2.

Sampling

FSANI are responsible for the logistics of the water sampling programme including delivery to the laboratory by designated sampling officers. Sampling officers were asked to take water samples as close to high tide as possible and to deliver these to AFBI for analysis as soon as possible, following the sampling and transport protocol issued by FSANI. Sampling was generally carried out on a fortnightly basis.

Laboratory procedures

Once received in the laboratory each preserved sample was given a unique identifying code and sample details were entered into the laboratory log book. A 50 ml subsample was then taken from each water sample and left to settle overnight in a sedimentation (Utermöhl) chamber (limit of detection of 20 cells L^{-1}). Samples were examined the following day using an inverted microscope. Each sample was screened for the target phytoplankton listed in Table 2 and the results reported to FSANI the same day. These procedures are based on those of the UK National Reference Laboratory (UKNRL). AFBI have maintained ISO17025 accreditation for the test method since 2012.

Results

The occurrence (as a percentage) and maximum abundance (in cells per litre) for the four most important taxon groups are reported by individual shellfish site (Table 3) and coastal area (Table 4). Positive results for *Alexandrium* spp., Dinophysiales and *Pseudo-nitzschia* spp. are reported in tabular form in Appendix 1 (*Prorocentrum lima* was not detected during 2022).

Table 1. Shellfish production areas monitored for the presence of toxin producing and nuisance microalgae in water in 2022.

Coastal area	Site identification reference (SIR)
Lough Foyle	PA3-Wild fishery
Lough Foyle	PA4-Wild fishery
Larne Lough	L3-AFFNI 88
Belfast Lough	B1-AFFNI 55
Belfast Lough	B3-AFFNI 50
Belfast Lough	B12-AFFNI 54
Belfast Lough	B20-AFFNI 53
Strangford Lough	S2-AFFNI 42
Strangford Lough	S7-AFFNI 76
Killough	K1-AFFNI 18
Dundrum Bay	DB1-AFFNI 95A
Carlingford Lough	C1-AFFNI 27
Carlingford Lough	C7-AFFNI 73 (sampling ceased from 10th January 2022)
Carlingford Lough	C9-AFFNI 39 (sampling ceased from 10th January 2022)
Carlingford Lough	C11-AFFNI 84
Carlingford Lough	C15-AFFNI 89 (new site from 25th January 2022)
Carlingford Lough	NW-Wild fishery

Figure 1 – Current sampling sites

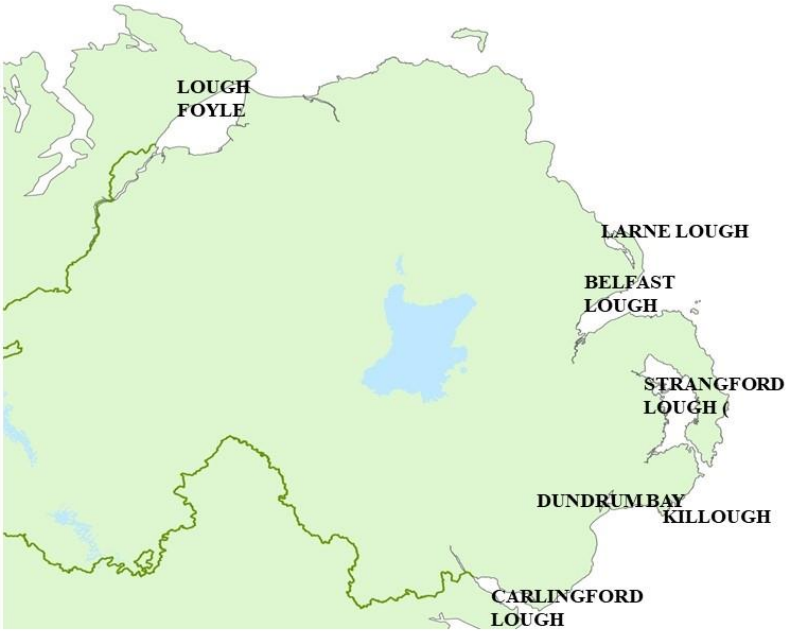


Table 2 – Monitored phytoplankton species.

Species	Toxin	Threshold value
Alexandrium spp.	Paralytic Shellfish Toxin (PST)	40 cells L^{-1}
Dinophysis acuminata	Diarrhetic Shellfish Toxin (DST)	100 cells L^{-1}
Dinophysis acuta	DST	100 cells L^{-1}
Dinophysis norvegica	DST	100 cells L^{-1}
Phalacroma rotundatum (previously known as *Dinophysis rotundata*)	DST	100 cells L^{-1}
Dinophysis spp.	DST	100 cells L^{-1}
Prorocentrum lima	DST	100 cells L^{-1}
Lingulodinium polyedra	Yessotoxin (YTX)	None
Protoceratium reticulatum	YTX	None
Pseudo-nitzschia spp.	Amnesic Shellfish Toxin (AST)	150,000 cells L^{-1}
Prorocentrum cordatum	Hepatotoxins	None
Karenia mikimotoi	Toxic to fish (TTF)	None
Noctiluca scintillans	TTF	None
Phaeocystis spp.	Not known	None

Results by species

Alexandrium spp.

Cells of the potential paralytic shellfish toxin producer *Alexandrium* spp. were recorded in only one sample during 2022 (0.3% of samples, Figure 2A). This sample was taken from a site in Carlingford Lough and recorded an abundance of 20 cells L^{-1} (Figure 3A).

No Paralytic Shellfish Toxins (PST's) above the regulatory level were detected in shellfish tested as part of the Official Control Monitoring Programme during 2022.

Dinophysiales (*Dinophysis* species and *Phalacroma rotundatum*)

Cells of the target Dinophysiales (Table 2) were present in 6 of the 7 coastal areas monitored, the exception being Lough Foyle (Figure 2B). In 2022 they were recorded in 8.6% of all samples tested, a slight decrease on the 2021 figure of 11.6% and greatly reduced from the 21.7% recorded in 2019. Their maximum cell abundance in 2022 was 1100 cells L^{-1} in a water sample taken from Belfast Lough (B12-AFFNI 54) on 15th August (Figure 3B and Table 6). *Dinophysis acuminata* was the dominant *Dinophysis* species recorded in Northern Ireland waters.

No lipophilic toxins above the regulatory limit were recorded in shellfish tested as part of the Official Control Programme. More detailed information can be found in the AFBI Biotoxin report.

Prorocentrum lima

The DST producer and benthic dinoflagellate *Prorocentrum lima* has a historically low occurrence in samples submitted for testing (Figure 4C). In 2022 it was not recorded in any of the samples tested.

Pseudo-nitzschia spp.

Pseudo-nitzschia is a diatom genus frequently recorded in Northern Ireland coastal waters (Figure 4D). In 2022 it was recorded in 52.8% of samples tested, a figure which masks its spatial variation which ranges 19.4% of Lough Foyle samples to 76.9% of Killough samples.

No shellfish samples, tested as part of the 2022 Official Control Programme, contained domoic acid above the EU regulatory limit.

Other species

Three other target species were identified in water samples taken as part of the Official Control Programme during 2022. *Prorocentrum cordatum* was recorded in three samples during the year,

from Strangford Lough (26th April and 20th June) and Larne Lough (6th June). A maximum cell abundance of 120 cells L^{-1} was recorded from the Larne site. The ichthyotoxic dinoflagellate, *Karenia mikimotoi* was recorded on two occasions, both were at the limit of detection of the test (20 cells L^{-1}). The 2 occasions were 7th June (S2-AFFNI 42) and 24thOctober (DB1-AFFNI 95A). The large dinoflagellate, *Noctiluca scintillans*, was recorded once in 2022 when 620 cells L^{-1} were recorded in the water sample tested from C15-AFFNI 89 on 24th October.

Table 3. The total number of samples collected, their occurrence (presence of cells in sample as a percentage of the total number of samples analysed) and maximum abundance (cells L-1) from each site in 2022.

Sampling site	No. of samples received	No. of samples rejected	*Alexandrium* spp. occurrence	*Alexandrium* spp.* max abundance	*Dinophysis* spp.* occurrence	*Dinophysis* spp. max abundance	*P.lima* occurrence	*P.lima* max abundance	*Pseudo-nitzschia* spp. occurrence	*Pseudo-nitzschia* spp. max abundance
Lough Foyle										
PA3-Wild fishery	18	0	0	0	0	0	0	0	11.1	120
PA4-Wild fishery	18	0	0	0	0	0	0	0	27.8	700
Larne Lough										
L3-AFFNI 88	21	0	0	0	4.8	80	0	0	33.3	9400
Belfast Lough										
B1-AFFNI 55	26	0	0	0	15.4	20	0	0	69.2	19,120
B3-AFFNI 50	26	0	0	0	19.2	300	0	0	76.9	113,200
B12-AFFNI 54	26	0	0	0	19.2	1100	0	0	69.2	29,600
B20-AFFNI 53	26	0	0	0	19.2	180	0	0	80.8	33,200
Strangford Lough										
S2-AFFNI 42	26	0	0	0	7.7	140	0	0	50	10,080
S7-AFFNI 76	26	0	0	0	7.7	20	0	0	42.4	920
Killough										
K1-AFFNI 18	26	0	0	0	7.7	480	0	0	76.9	11,640

Dundrum Bay										
DB1-AFFNI 21A	26	0	0	0	3.9	20	0	0	65.4	12,940
Carlingford Lough										
C1-AFFNI 27	24	0	0	0	4.2	20	0	0	12.5	1600
C7-AFFNI 73 (last sample taken 10/1/22)	1	0	0	0	0	0	0	0	100	80
C9-AFFNI 39 (last sample taken 10/1/22)	1	0	0	0	0	0	0	0	100	120
C11-AFFNI 84	24	0	4.2	20	12.5	40	0	0	58.3	49,200
C15-AFFNI 89 (sampled from 25th January 2022)	23	0	0	0	0	0	0	0	56.5	15,000
NW-Wild fishery	24	0	0	0	0	0	0	0	29.2	2220

362 samples received

0 samples rejected

362 samples reported

*Includes *Phalacroma rotundatum*

Table 4. The total number of samples collected, their occurrence (presence of cells in sample as a percentage of the total number of samples analysed) and maximum abundance (cells L-1) from each lough in 2022.

Sampling site	No of samples received	No. of samples rejected	Alexandrium spp. occurrence	Alexandrium spp. max abundance	Dinophysis spp.* occurrence	Dinophysis spp.* max abundance	P.lima occurrence	P.lima max abundance	Pseudo-nitzschia spp. occurrence	Pseudo-nitzschia spp. max abundance
Lough Foyle	36	0	0	0	0	0	0	0	19.4	700
Larne Lough	21	0	0	0	4.8	80	0	0	33.3	9400
Belfast Lough	104	0	0	0	18.3	1100	0	0	74	113,200
Strangford Lough	52	0	0	0	7.7	140	0	0	46.2	10,080
Killough	26	0	0	0	7.7	480	0	0	76.9	11,640
Dundrum Bay	26	0	0	0	3.9	20	0	0	65.4	12,940
Carlingford Lough	97	0	1.03	20	4.1	40	0	0	40.2	49,200

362 samples received

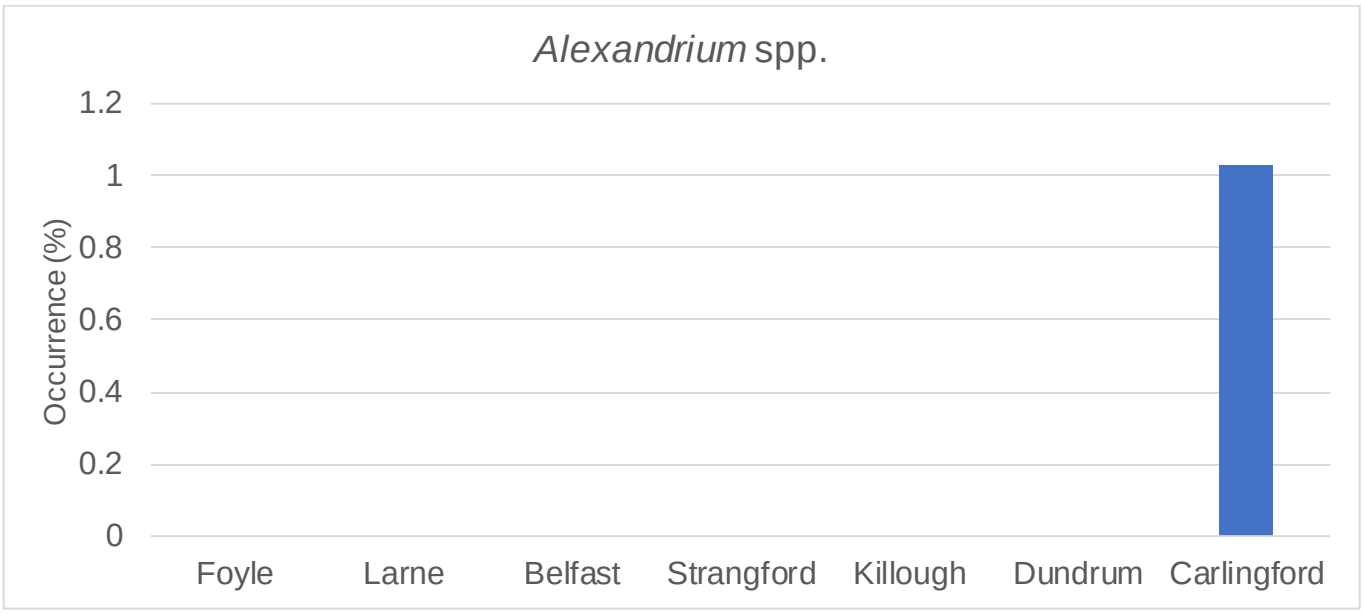
0 samples rejected

362 samples reported

*Includes *Phalacroma rotundatum*

Figure 2. Occurrence (%) of three of the four major target organisms in 2022. (presence of cells in water samples as a percentage of the total number of samples reported for each area). (Please note that *Prorocentrum lima* was not present in any samples tested during 2022).

A



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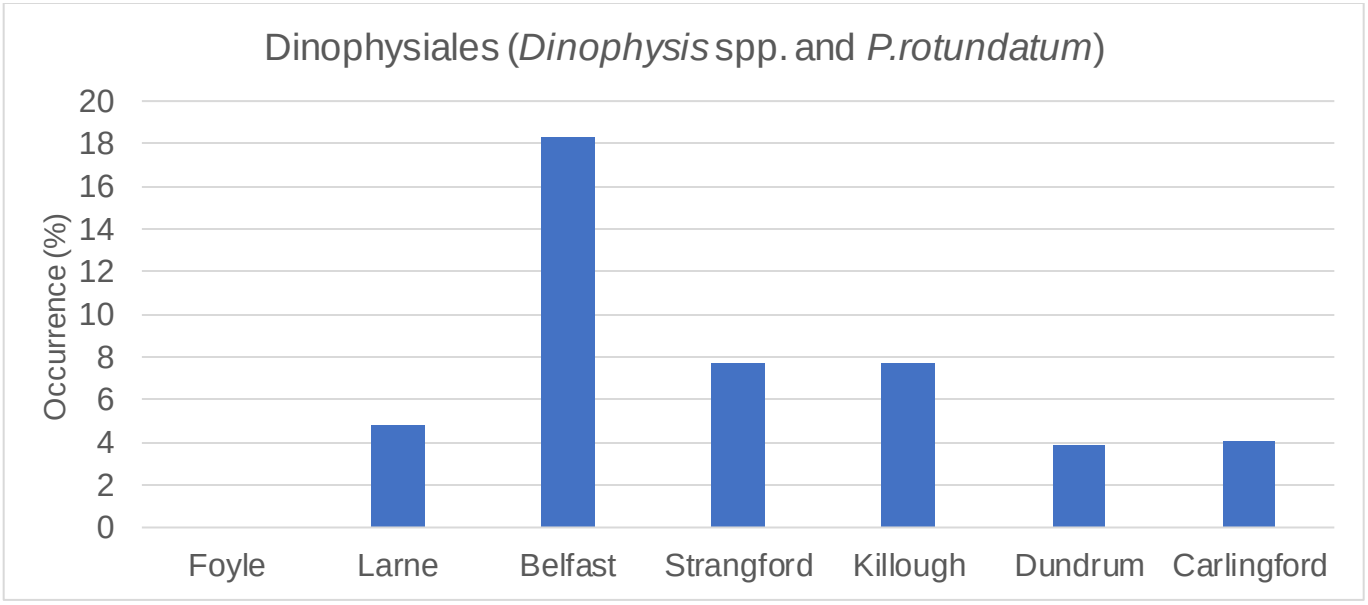

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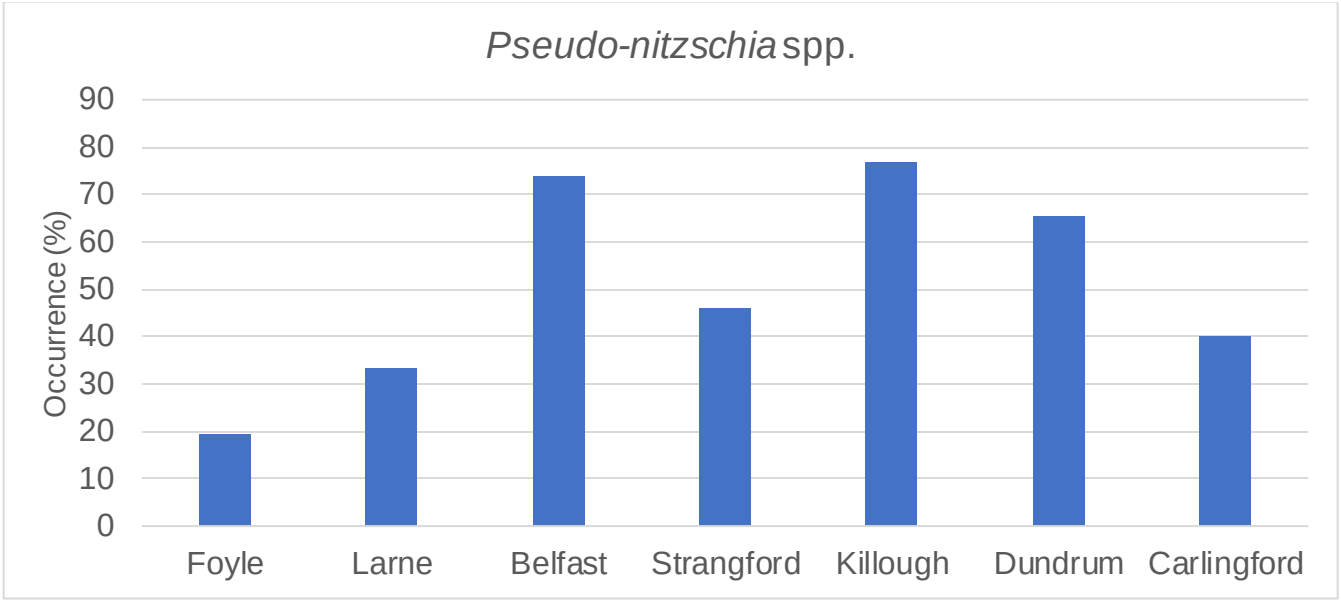
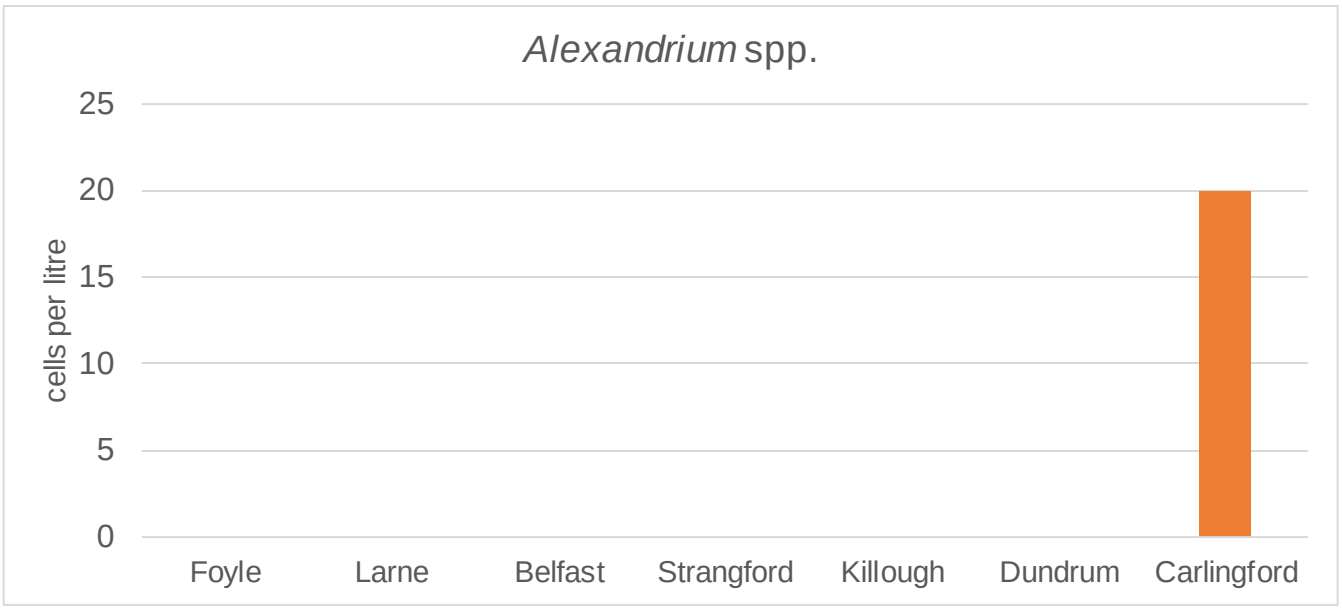

Pseudo-nitzschia spp.
Occurrence (%)
90
80
70
60
50
40
30
20
10
0
Foyle
Larne
Belfast
Strangford
Killough
Dundrum
Carlingford

Figure 3 – Maximum abundance (cells per litre) of three of the four major target groups in 2022 in water samples taken from each area. (Please note that *Prorocentrum lima* was not present in any samples tested during 2022).

A



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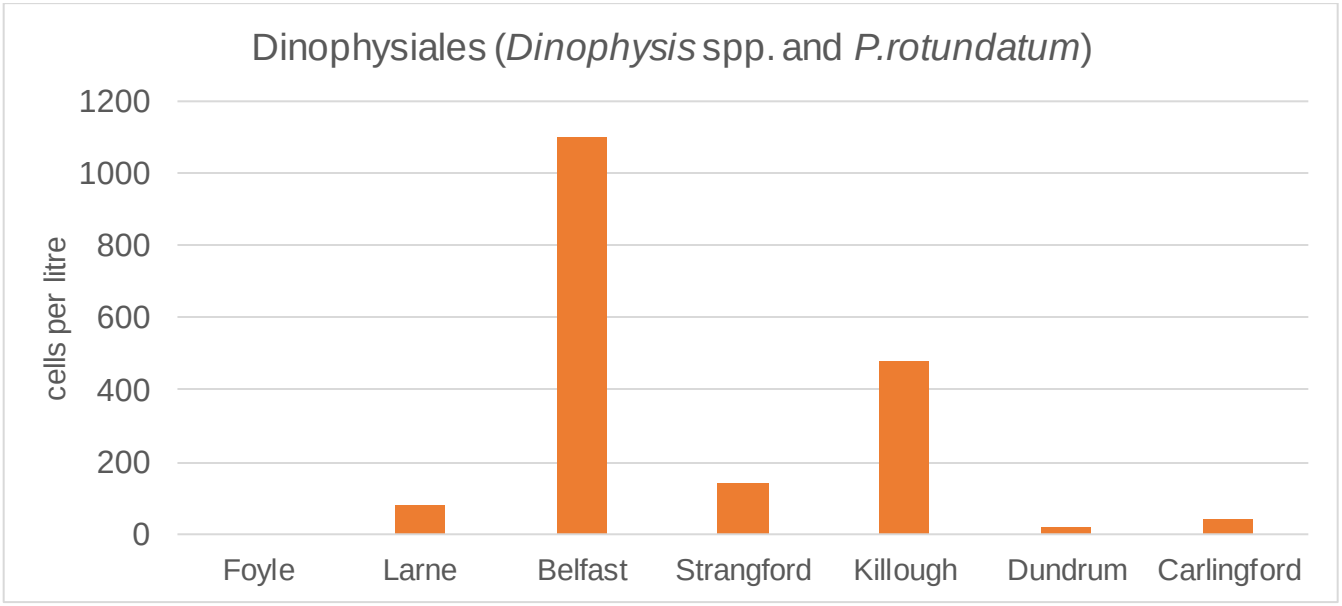

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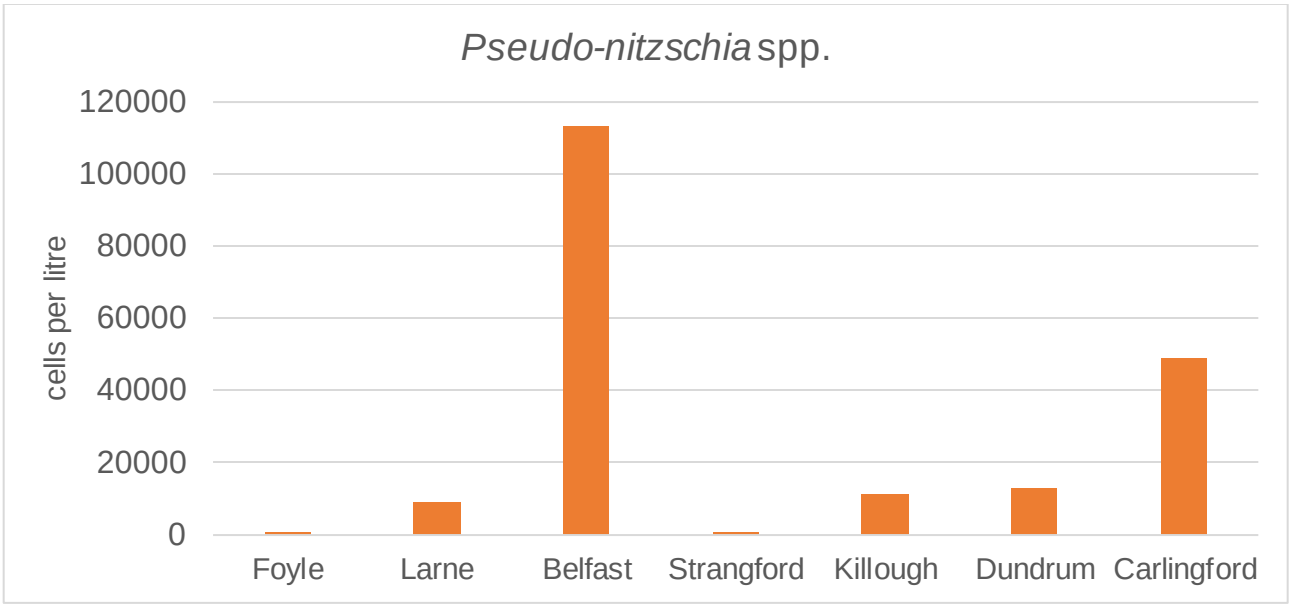
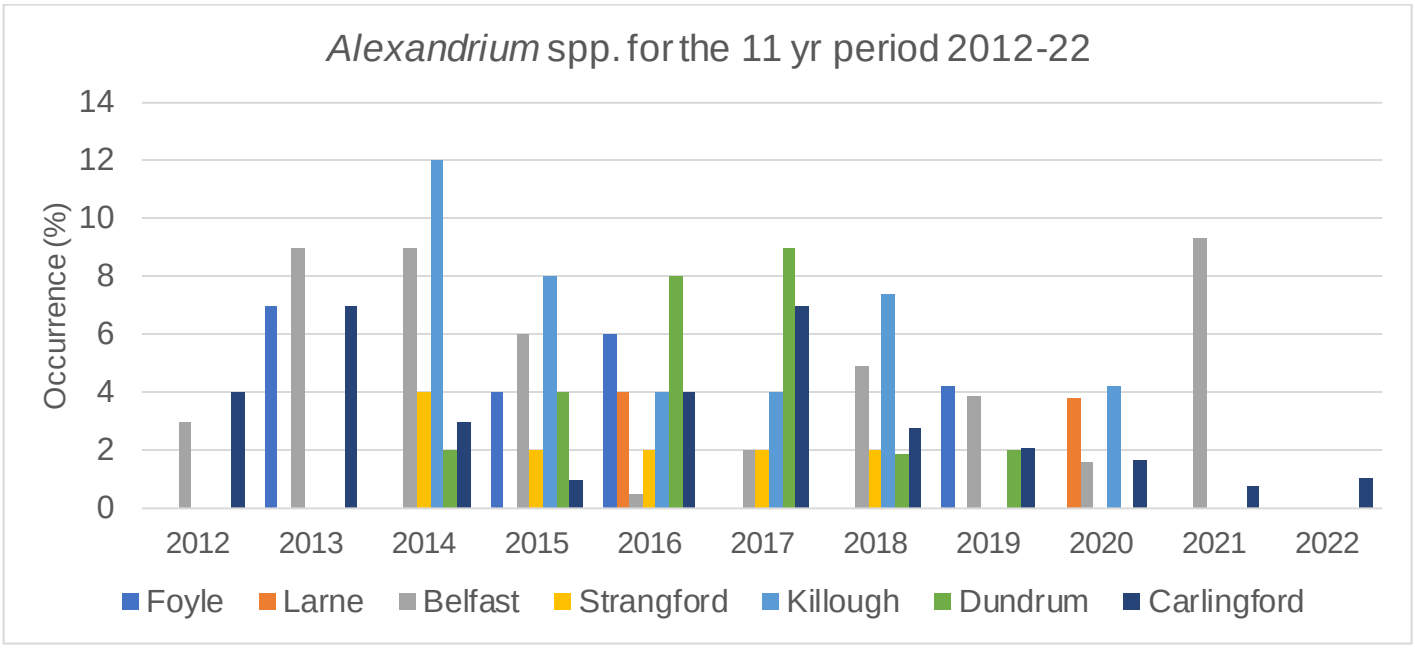

Pseudo-nitzschia spp.
120000
100000
80000
60000
40000
20000
0
cells per litre
Foyle
Larne
Belfast
Strangford
Killough
Dundrum
Carlingford

Figure 4 – Occurrence of the four major target organisms for period 2012-2022 (presence of cells in water samples as a % of the total number of samples reported for each sampling area in each year).

A



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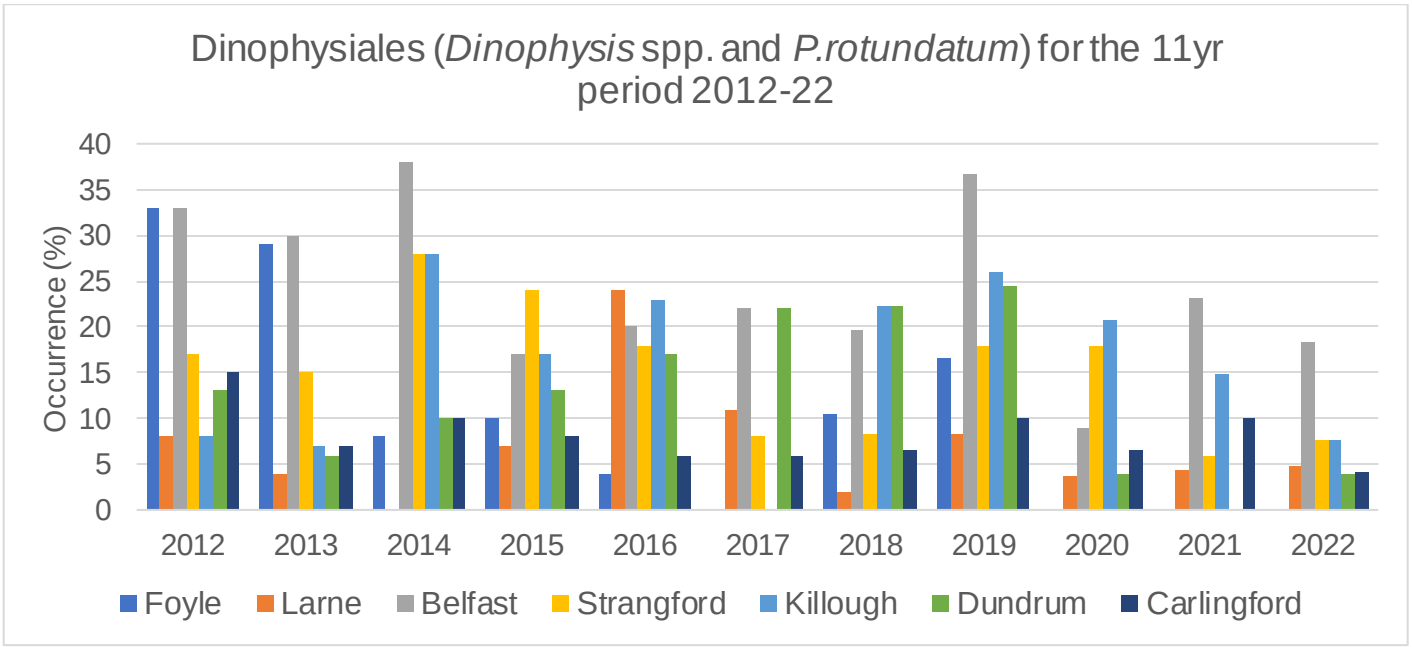

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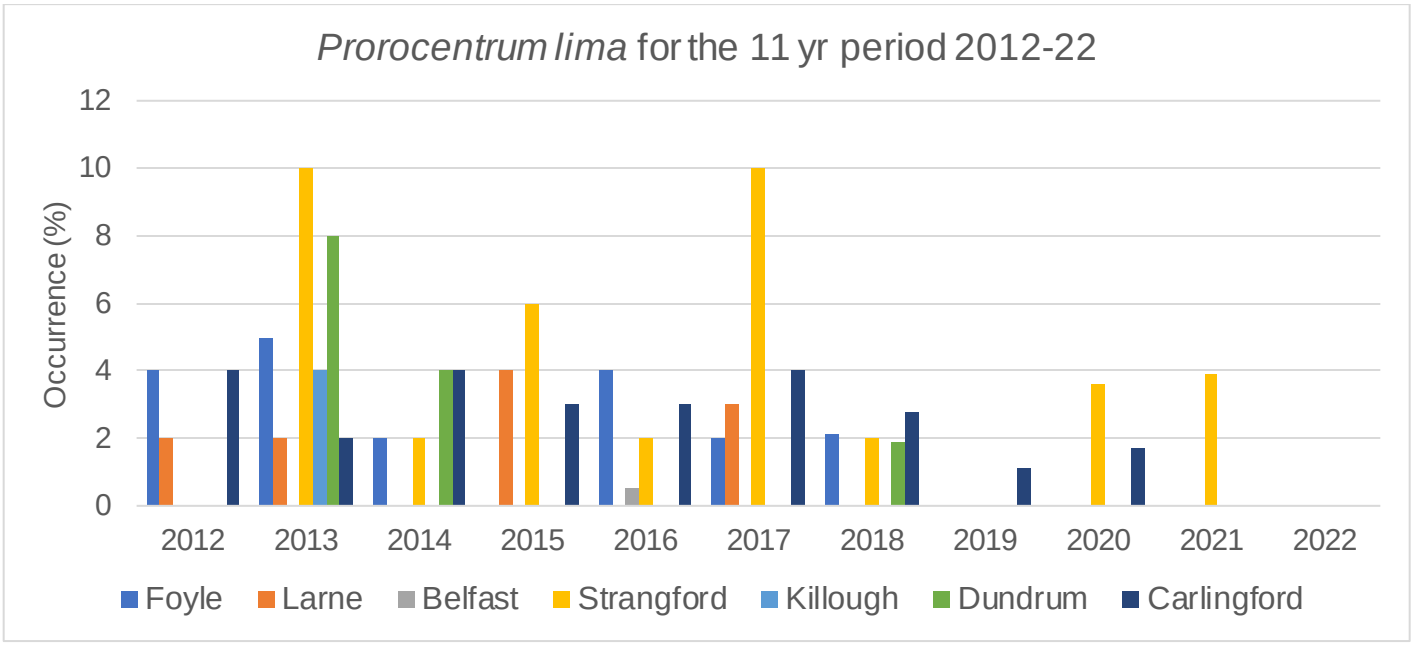
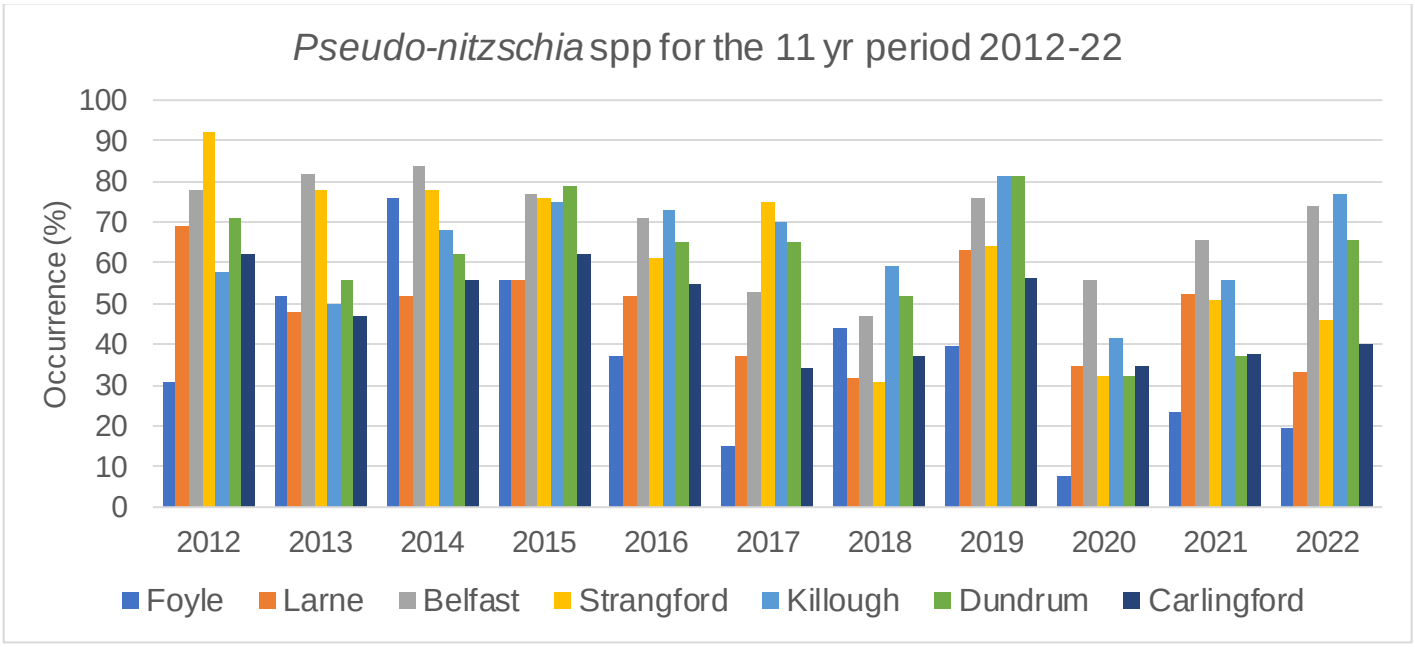

Prorocentrum lima for the 11 yr period 2012-22
Occurrence (%)
0
2
4
6
8
10
12
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Foyle
Larne
Belfast
Strangford
Killough
Dundrum
Carlingford

D


Pseudo-nitzschia spp for the 11 yr period 2012-22
Occurrence (%)
0
10
20
30
40
50
60
70
80
90
100
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Foyle
Larne
Belfast
Strangford
Killough
Dundrum
Carlingford

Results by area

Lough Foyle

Pseudo-nitzschia spp. was the only target species recorded from Lough Foyle in 2022.

A total of 36 samples were received and analysed from the two monitoring sites in Lough Foyle (Table 3). Phytoplankton analysis was suspended from July- September due to harvesting inactivity in the lough. Sampling recommenced in October 2022. As in the previous year, *Pseudo-nitzschia* was the only target species detected in samples received from the lough in 2022.This result may reflect the fact that sampling was suspended during the phytoplankton growth period. *Pseudo-nitzschia* spp. reached a maximum abundance of 700 cells L^{-1} in a sample taken from the PA4 Wild fishery site on 25thApril (Table 7).

Larne Lough

The following target species were recorded in water samples from Larne Lough in 2022; *Dinophysis acuminata, Prorocentrum cordatum* and *Pseudo-nitzschia* spp.

A total of 21 samples were received from the one site (L3-AFFNI 88) monitored in Larne Lough (Table 3). Cells of the *Dinophysis* genus were counted in 4.8% of samples from the lough. A maximum cell count of 80 cells L^{-1} was recorded in the water sample taken on 6th June (Table 7). *Pseudo-nitzschia* spp. was recorded in 33.3% of samples with a maximum abundance of 9,400 cells L^{-1} counted in the sample taken on 18th June (Table 7).

Belfast Lough

Target species recorded in water samples from Belfast Lough during the reporting period were as follows; *D.acuminata*, *Dinophysis acuta* and *Pseudo- nitzschia* spp..

A total of 104 samples were submitted for analysis in 2022. Unlike the previous year the PST producer, *Alexandrium* spp. was not detected in samples tested in 2022. Cells from the taxonomic order Dinophysiales have been recorded regularly over the past years in samples from Belfast Lough (Figure 4B). In 2022 they were present in 18.3% of samples (Figure 4B). The dominant species present in samples was *Dinophysis acuminata* which is in keeping with that found in other local production areas. The maximum cell abundance recorded was 1100 cells L^{-1} in a sample taken from B12-AFFNI 54 on 15th August (Table 6).

Cells of the genus *Pseudo-nitzschia* were found in 74% of samples (Table 4 and Figure 2D) reaching a peak abundance of 113,200 cells L^{-1} in a sample from B3-AFFNI 50 on 15th August.

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Strangford Lough

Target species recorded from Strangford Lough during the year included; *D.acuminata*, D.acuta, *Dinophysis spp.,Prorocentrum cordatum, Pseudo-nitzschia* spp. and *Karenia mikimotoi*.

Two sites were monitored in the lough during 2022, S2-AFFNI 42 and S7-AFFNI 76. As in the previous year, cells of *Alexandrium* spp. were not detected in the lough. Dinophysiales were present in 7.7% of samples with a maximum cell abundance of 140 cells L^{-1} recorded from the S2-AFFNI 42 site on the 7th June (Table 7). Cells of *Pseudo-nitschia* were present in just under half (46.2%) of the samples analysed (Table 4). Cell abundance reached a maximum of 10,080 cells L^{-1} in a sample from S2-AFFNI 42 on 7th June (Table 7).

Killough

The following target species were recorded from Killough waters during 2022; *Dinophysis acuminata* and *Pseudo-nitzschia* spp..

Cells of the Dinophysiales order were recorded in 7.7% of samples (Table 3) with a maximum cell abundance of 480 cells L^{-1} recorded on 14th July. (Table 6). *Pseudo-nitzschia* spp. was recorded in 76.9% of samples with a maximum cell abundance of 11,640 cells L^{-1} recorded on the 25th May (Table 7).

Dundrum Bay

Target species recorded at this site in 2022 included; *Dinophysis acuta, Pseudo-nitzschia* spp. and *Karenia mikimotoi.*

Dinophysis acuta was recorded on one occasion during the year with a cell count of 20 cells L^{-1} recorded on 20th September. *Pseudo-nitzschia* spp. was present in 65.4% of Dundrum samples (Table 4) recording a maximum cell abundance of 12,940 cells L^{-1} on 14th July. (Table 7). *Karenia mikimotoi* was present in one sample during the year with cell numbers of 20 cells L^{-1} recorded on 24th October.

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Carlingford Lough

Target species recorded from Carlingford Lough during 2022 were; *Alexandrium* spp., *D.acuminata*, *D.norvegica*, *Pseudo-nitzschia* spp. and *Noctiluca scintillans*.

As the result of a risk assessment carried out by FSA the sites C7-AFFNI 73 and C9-AFFNI 39 were removed from the Monitoring Programme and a new site added, C15-AFFNI 89 (Table 1). *Alexandrium* spp. was detected in one sample from the lough in 2022. This was in a water sample

from C11 AFFNI 84 on 26th July when a count of 20 cells L^{-1} was made (Table 5).

Members of the Dinophysiales order were present in 4.1% of samples (Table 4) with a maximum abundance of 40 cells L^{-1} recorded in a water sample from the C11-AFFNI 84 site on 7th June (Table 6).

Pseudo-nitzschia spp. was recorded in 40.2% of all samples tested from Carlingford Lough (Table 4). As in previous years the outer lough site had the highest occurrence (58.3% of samples) compared to the inner sites of C1-AFFNI 27 and NW-wild fishery with 12.5% and 29.2% respectively (Table 3). A maximum cell abundance of 49,200 cells L^{-1} was recorded on 20th June in a sample from C11 AFFNI 84 (Table 7). The large dinoflagellate *Noctiluca scintillans* was recorded in the water sample taken from C15-AFFNI 89 on the 24th October . A cell count of 620 cells L^{-1} was recorded on this occasion.

Appendix 1

Table 5 - Positive occurrences of *Alexandrium* spp. (cells L^{-1}) in 2022

System id	Region	Site ID ref	Report no.	Collection date	Alexandrium spp.
phy2200207	Carlingford	C11-AFFNI 84	phy22-30b	26/07/2022	20

Table 6 Positive occurrences of monitored Dinophysiales (cells L^{-1}) in 2022

Abbreviations in table

- Da – *Dinophysis acuminata*
- Dac – *Dinophysis acuta*
- Dn – *Dinophysis norvegica*
- Pr – *Phalacroma rotundatum*
- Din. – *Dinophysis* spp. not identified to species level

SYSTEM ID	REGION	Site ID ref	REPORT NO	COLLECTION DATE	Da	Dacuta	Dn	Dr	Din	Total Dinophysis spp.
phy2200107	Belfast	B1-AFFNI 55	phy22-17a	25/04/2022	20	0	0	0	0	20
phy2200137	Belfast	B1-AFFNI 55	phy22-21a	23/05/2022	20	0	0	0	0	20
phy2200138	Belfast	B3-AFFNI 50	phy22-21a	23/05/2022	20	0	0	0	0	20
phy2200139	Belfast	B12-AFFNI 54	phy22-21a	23/05/2022	60	0	0	0	0	60
phy2200154	Belfast	B1-AFFNI 55	phy22-23a	05/06/2022	20	0	0	0	0	20
phy2200155	Belfast	B3-AFFNI 50	phy22-23a	05/06/2022	40		0	0	0	40
phy2200158	Larne	L3-AFFNI 88	phy22-23b	06/06/2022	80	0	0	0	0	80
phy2200159	Strangford	S2-AFFNI 42	phy22-23a	07/06/2022	140	0	0	0	0	140
phy2200162	Carlingford	C11-AFFNI 84	phy22-23c	07/06/2022	40	0	0	0	0	40
phy2200171	Belfast	B12-AFFNI 54	phy22-25a	20/06/2022	120	20	0	0	0	140
phy2200172	Belfast	B20-AFFNI 53	phy22-25a	20/06/2022	140	0	0	0	0	140

phy2200173	Strangford	S2-AFFNI 42	phy22-25b	21/06/2022	0	0	0	0	20	20
phy2200179	Carlingford	C11-AFFNI 84	phy22-25b	20/06/2022	0	0	20	0	0	20
phy2200185	Belfast	B3-AFFNI 50	phy22-27a	04/07/2022	20	0	0	0	0	20
phy2200187	Belfast	B20-AFFNI 53	phy22-27a	04/07/2022	20	0	0	0	0	20
phy2200190	Strangford	S7-AFFNI 76	phy22-27b	05/07/2022	20	0	0	0	0	20
phy2200195	Killough	K1-AFFNI 18	phy22-28a	14/07/2022	480	0	0	0	0	480
phy2200204	Killough	K1-AFFNI 18	phy22-30a	25/07/2022	20	0	0	0	0	20
phy2200207	Carlingford	C11-AFFNI 84	phy22-30b	26/07/2022	20	0	0	0	0	20
phy2200210	Belfast	B1-AFFNI 55	phy22-31a	01/08/2022	20	0	0	0	0	20
phy2200212	Belfast	B12-AFFNI 54	phy22-31a	01/08/2022	20	0	0	0	0	20
phy2200213	Belfast	B20-AFFNI 53	phy22-31a	01/08/2022	140	0	0	0	0	140
phy2200224	Belfast	B3-AFFNI 50	phy22-33a	15/08/2022	300	0	0	0	0	300
phy2200225	Belfast	B12-AFFNI 54	phy22-33a	15/08/2022	1100	0	0	0	0	1100
phy2200226	Belfast	B20-AFFNI 53	phy22-33a	15/08/2022	180	0	0	0	0	180
phy2200227	Strangford	S7-AFFNI 76	phy22-33b	15/08/2022	0	20	0	0	0	20
phy2200239	Belfast	B3-AFFNI 50	phy22-35a	30/08/2022	120	0	0	0	0	120
phy2200240	Belfast	B12-AFFNI 54	phy22-35a	30/08/2022	60	0	0	0	0	60
phy2200241	Belfast	B20-AFFNI 53	phy22-35a	30/08/2022	20	0	0	0	0	20
phy2200257	Dundrum	DB1-AFFNI 95A	phy22-38a	20/09/2022	0	20	0	0	0	20
phy2200293	Carlingford	C1-AFFNI 27	phy22-43b	24/10/2022	20	0	0	0	0	20

Table 7 - Positive occurrences of *Pseudo-nitzschia* spp. (cells L^{-1}) in 2022

SYSTEM ID	REGION	Site ID ref	REPORT NO	COLLECTION DATE	*Pseudo-nitzschia* spp.
phy2200001	Strangford	S2-AFFNI42	phy22-01a	04/01/2022	80
phy2200006	Belfast	B3-AFFNI50	phy22-02a	10/01/2022	160
phy2200007	Belfast	B12-AFFNI54	phy22-02a	10/01/2022	40
phy2200008	Belfast	B20-AFFNI53	phy22-02a	10/01/2022	160
phy2200010	Carlingford	C7-AFFNI73	phy22-02b	10/01/2022	80
phy2200011	Carlingford	C9-AFFNI39	phy22-02b	10/01/2022	120
phy2200017	Strangford	S7-AFFNI76	phy22-03a	17/01/2022	120
phy2200018	Killough	K1-AFFNI18	phy22-03a	17/01/2022	220
phy2200019	Dundrum	DB1-AFFNI95A	phy22-03a	17/01/2022	160
phy2200021	Belfast	B3-AFFNI50	phy22-04a	24/01/2022	1020
phy2200022	Belfast	B12-AFFNI54	phy22-04a	24/01/2022	640
phy2200023	Belfast	B20-AFFNI53	phy22-04a	24/01/2022	480
phy2200030	Killough	K1-AFFNI18	phy22-05a	31/01/2022	200
phy2200035	Belfast	B3-AFFNI50	phy22-06a	07/02/2022	160
phy2200036	Belfast	B12-AFFNI54	phy22-06a	07/02/2022	1020
phy2200037	Belfast	B20-AFFNI53	phy22-06a	07/02/2022	640

phy2200039	Carlingford	C11-AFFNI84	phy22-06b	07/02/2022	80
phy2200044	Strangford	S2-AFFNI42	phy22-07a	14/02/2022	720
phy2200048	Belfast	B1-AFFNI55	phy22-08a	21/02/2022	320
phy2200049	Belfast	B3-AFFNI50	phy22-08a	21/02/2022	260
phy2200050	Belfast	B12-AFFNI54	phy22-08a	21/02/2022	260
phy2200051	Belfast	B20-AFFNI53	phy22-08a	21/02/2022	80
phy2200058	Killough	K1-AFFNI18	phy22-09a	28/02/2022	100
phy2200059	Dundrum	DB1-AFFNI95A	phy22-09a	28/02/2022	400
phy2200060	Strangford	S2-AFFNI42	phy22-09b	01/03/2022	40
phy2200062	Belfast	B1-AFFNI55	phy22-10a	07/03/2022	1000
phy2200063	Belfast	B3-AFFNI50	phy22-10a	07/03/2022	760
phy2200064	Belfast	B12-AFFNI54	phy22-10a	07/03/2022	1240
phy2200065	Belfast	B20-AFFNI53	phy22-10a	07/03/2022	640
phy2200067	Foyle	PA4-wild fishery	phy22-10b	07/03/2022	60
phy2200073	Killough	K1-AFFNI18	phy22-11a	14/03/2022	420
phy2200075	Strangford	S2-AFFNI42	phy22-11b	15/03/2022	260
phy2200079	Carlingford	C15-AFFNI89	phy22-12a	21/03/2022	120

phy2200082	Foyle	PA4-wild fishery	phy22-12a	21/03/2022	80
phy2200084	Killough	K1-AFFNI18	phy22-13a	28/03/2022	220
phy2200085	Dundrum	DB1-AFFNI95A	phy22-13a	28/03/2022	1040
phy2200086	Belfast	B1-AFFNI55	phy22-13a	28/03/2022	2760
phy2200087	Belfast	B3-AFFNI50	phy22-13a	28/03/2022	6840
phy2200088	Belfast	B12-AFFNI54	phy22-13a	28/03/2022	960
phy2200089	Belfast	B20-AFFNI53	phy22-13a	28/03/2022	1620
phy2200091	Strangford	S7-AFFNI76	phy22-13b	29/03/2022	100
phy2200092	Strangford	S2-AFFNI42	phy22-15a	11/04/2022	140
phy2200093	Strangford	S7-AFFNI76	phy22-15a	11/04/2022	520
phy2200094	Belfast	B1-AFFNI55	phy22-15b	12/04/2022	120
phy2200099	Carlingford	C11-AFFNI84	phy22-15c	12/04/2022	940
phy2200100	Carlingford	C15-AFFNI89	phy22-15c	12/04/2022	3040
phy2200101	Carlingford	NW-wild fishery	phy22-15c	12/04/2022	280
phy2200105	Killough	K1-AFFNI18	phy22-15d	13/04/2022	3120
phy2200106	Dundrum	DB1-AFFNI95A	phy22-15d	13/04/2022	6200
phy2200107	Belfast	B1-AFFNI55	phy22-17a	25/04/2022	200

phy2200109	Belfast	B12-AFFNI54	phy22-17a	25/04/2022	40
phy2200110	Belfast	B20-AFFNI53	phy22-17a	25/04/2022	120
phy2200112	Foyle	PA4-wild fishery	phy22-17b	25/04/2022	700
phy2200113	Larne	L3-AFFNI88	phy22-17b	25/04/2022	200
phy2200115	Strangford	S7-AFFNI76	phy22-17b	26/04/2022	480
phy2200117	Carlingford	C11-AFFNI84	phy22-17c	26/04/2022	60
phy2200118	Carlingford	C15-AFFNI89	phy22-17c	26/04/2022	900
phy2200119	Carlingford	NW-wild fishery	phy22-17c	26/04/2022	200
phy2200120	Killough	K1-AFFNI18	phy22-17c	27/04/2022	280
phy2200121	Dundrum	DB1-AFFNI95A	phy22-17c	27/04/2022	700
phy2200122	Belfast	B1-AFFNI55	phy22-19a	08/05/2022	1880
phy2200123	Belfast	B3-AFFNI50	phy22-19a	08/05/2022	1600
phy2200124	Belfast	B12-AFFNI54	phy22-19a	08/05/2022	2360
phy2200125	Belfast	B20-AFFNI53	phy22-19a	08/05/2022	580
phy2200130	Strangford	S7-AFFNI76	phy22-19b	10/05/2022	100
phy2200132	Carlingford	C15-AFFNI89	phy22-19c	10/05/2022	400
phy2200135	Killough	K1-AFFNI18	phy22-19c	11/05/2022	9740

phy2200136	Dundrum	DB1-AFFNI95A	phy22-19c	11/05/2022	12100
phy2200137	Belfast	B1-AFFNI55	phy22-21a	23/05/2022	3740
phy2200138	Belfast	B3-AFFNI50	phy22-21a	23/05/2022	2920
phy2200139	Belfast	B12-AFFNI54	phy22-21a	23/05/2022	6740
phy2200140	Belfast	B20-AFFNI53	phy22-21a	23/05/2022	3580
phy2200142	Strangford	S2-AFFNI42	phy22-21b	24/05/2022	700
phy2200143	Strangford	S7-AFFNI76	phy22-21b	24/05/2022	360
phy2200146	Killough	K1-AFFNI18	phy22-21c	25/05/2022	11640
phy2200147	Dundrum	DB1-AFFNI95A	phy22-21c	25/05/2022	920
phy2200149	Carlingford	C11-AFFNI84	phy22-21c	24/05/2022	2380
phy2200150	Carlingford	C15-AFFNI89	phy22-21c	24/05/2022	80
phy2200151	Carlingford	NW-wild fishery	phy22-21c	24/05/2022	540
phy2200152	Killough	K1-AFFNI18	phy22-22a	30/05/2022	4780
phy2200153	Dundrum	DB1-AFFNI95A	phy22-22a	30/05/2022	1300
phy2200154	Belfast	B1-AFFNI55	phy22-23a	05/06/2022	15660
phy2200155	Belfast	B3-AFFNI50	phy22-23a	05/06/2022	18320
phy2200156	Belfast	B12-AFFNI54	phy22-23a	05/06/2022	12340

phy2200157	Belfast	B20-AFFNI53	phy22-23a	05/06/2022	1820
phy2200158	Larne	L3-AFFNI88	phy22-23b	06/06/2022	1540
phy2200159	Strangford	S2-AFFNI42	phy22-23a	07/06/2022	10080
phy2200160	Strangford	S7-AFFNI76	phy22-23b	06/06/2022	60
phy2200162	Carlingford	C11-AFFNI84	phy22-23c	07/06/2022	900
phy2200163	Carlingford	C15-AFFNI89	phy22-23c	07/06/2022	260
phy2200167	Killough	K1-AFFNI18	phy22-24a	13/06/2022	6980
phy2200168	Dundrum	DB1-AFFNI95A	phy22-24a	13/06/2022	780
phy2200169	Belfast	B1-AFFNI55	phy22-25a	20/06/2022	2700
phy2200170	Belfast	B3-AFFNI50	phy22-25a	20/06/2022	1460
phy2200171	Belfast	B12-AFFNI54	phy22-25a	20/06/2022	18000
phy2200172	Belfast	B20-AFFNI53	phy22-25a	20/06/2022	33200
phy2200173	Strangford	S2-AFFNI42	phy22-25b	21/06/2022	7860
phy2200174	Strangford	S7-AFFNI76	phy22-25b	20/06/2022	920
phy2200178	Carlingford	C1-AFFNI27	phy22-25b	20/06/2022	1600
phy2200179	Carlingford	C11-AFFNI84	phy22-25b	20/06/2022	49200
phy2200180	Carlingford	C15-AFFNI89	phy22-25c	20/06/2022	15000

phy2200181	Carlingford	NW-wild fishery	phy22-25c	20/06/2022	2220
phy2200182	Dundrum	DB1-AFFNI95A	phy22-26a	27/06/2022	2340
phy2200183	Killough	K1-AFFNI18	phy22-26a	27/06/2022	4920
phy2200184	Belfast	B1-AFFNI55	phy22-27a	04/07/2022	340
phy2200185	Belfast	B3-AFFNI50	phy22-27a	04/07/2022	200
phy2200186	Belfast	B12-AFFNI54	phy22-27a	04/07/2022	120
phy2200187	Belfast	B20-AFFNI53	phy22-27a	04/07/2022	140
phy2200188	Larne	L3-AFFNI88	phy22-27b	04/07/2022	880
phy2200189	Strangford	S2-AFFNI42	phy22-27b	05/07/2022	80
phy2200190	Strangford	S7-AFFNI76	phy22-27b	05/07/2022	160
phy2200191	Carlingford	C1-AFFNI27	phy22-27c	05/07/2022	740
phy2200192	Carlingford	C11-AFFNI84	phy22-27c	05/07/2022	8720
phy2200193	Carlingford	C15-AFFNI89	phy22-27c	05/07/2022	2840
phy2200194	Carlingford	NW-wild fishery	phy22-27c	05/07/2022	920
phy2200195	Killough	K1-AFFNI18	phy22-28a	14/07/2022	1220
phy2200196	Dundrum	DB1-AFFNI95A	phy22-28a	14/07/2022	12940
phy2200197	Belfast	B1-AFFNI55	phy22-29a	18/07/2022	220

phy2200198	Belfast	B3-AFFNI50	phy22-29a	18/07/2022	140
phy2200201	Larne	L3-AFFNI88	phy22-29b	18/07/2022	9400
phy2200202	Strangford	S7-AFFNI76	phy22-29b	18/07/2022	120
phy2200203	Strangford	S2-AFFNI42	phy22-29b	19/07/2022	240
phy2200204	Killough	K1-AFFNI18	phy22-30a	25/07/2022	800
phy2200205	Dundrum	DB1-AFFNI95A	phy22-30a	25/07/2022	2300
phy2200207	Carlingford	C11-AFFNI84	phy22-30b	26/07/2022	200
phy2200208	Carlingford	C15-AFFNI89	phy22-30b	26/07/2022	480
phy2200210	Belfast	B1-AFFNI55	phy22-31a	01/08/2022	1580
phy2200211	Belfast	B3-AFFNI50	phy22-31a	01/08/2022	2020
phy2200212	Belfast	B12-AFFNI54	phy22-31a	01/08/2022	2260
phy2200213	Belfast	B20-AFFNI53	phy22-31a	01/08/2022	540
phy2200214	Larne	L3-AFFNI88	phy22-31b	01/08/2022	360
phy2200215	Strangford	S7-AFFNI76	phy22-31b	01/08/2022	620
phy2200216	Strangford	S2-AFFNI42	phy22-31b	02/08/2022	200
phy2200217	Killough	K1-AFFNI18	phy22-32a	09/08/2022	4600
phy2200218	Dundrum	DB1-AFFNI95A	phy22-32a	09/08/2022	840

phy2200220	Carlingford	C11-AFFNI84	phy22-32b	09/08/2022	120
phy2200221	Carlingford	C15-AFFNI89	phy22-32b	09/08/2022	80
phy2200223	Belfast	B1-AFFNI55	phy22-33a	15/08/2022	19120
phy2200224	Belfast	B3-AFFNI50	phy22-33a	15/08/2022	113200
phy2200225	Belfast	B12-AFFNI54	phy22-33a	15/08/2022	29600
phy2200226	Belfast	B20-AFFNI53	phy22-33a	15/08/2022	780
phy2200228	Strangford	S2-AFFNI42	phy22-33b	16/08/2022	160
phy2200230	Killough	K1-AFFNI18	phy22-34a	23/08/2022	640
phy2200231	Dundrum	DB1-AFFNI95A	phy22-34a	23/08/2022	600
phy2200233	Carlingford	C11-AFFNI84	phy22-34b	23/08/2022	80
phy2200236	Strangford	S2-AFFNI42	phy22-35b	30/08/2022	40
phy2200237	Larne	L3-AFFNI88	phy22-35a	29/08/2022	320
phy2200238	Belfast	B1-AFFNI55	phy22-35a	30/08/2022	6080
phy2200239	Belfast	B3-AFFNI50	phy22-35a	30/08/2022	6240
phy2200240	Belfast	B12-AFFNI54	phy22-35a	30/08/2022	2620
phy2200241	Belfast	B20-AFFNI53	phy22-35a	30/08/2022	740
phy2200244	Carlingford	C11-AFFNI84	phy22-36a	05/09/2022	160

phy2200245	Carlingford	C15-AFFNI89	phy22-36a	05/09/2022	80
phy2200247	Killough	K1-AFFNI18	phy22-36a	06/09/2022	160
phy2200248	Dundrum	DB1-AFFNI95A	phy22-36a	06/09/2022	880
phy2200249	Belfast	B1-AFFNI55	phy22-37a	12/09/2022	1460
phy2200250	Belfast	B3-AFFNI50	phy22-37a	12/09/2022	800
phy2200251	Belfast	B12-AFFNI54	phy22-37a	12/09/2022	980
phy2200252	Belfast	B20-AFFNI53	phy22-37a	12/09/2022	400
phy2200256	Killough	K1-AFFNI18	phy22-38a	20/09/2022	720
phy2200257	Dundrum	DB1-AFFNI95A	phy22-38a	20/09/2022	340
phy2200259	Carlingford	C11-AFFNI84	phy22-38b	20/09/2022	940
phy2200261	Carlingford	NW-wild fishery	phy22-38b	20/09/2022	320
phy2200262	Belfast	B1-AFFNI55	phy22-39a	25/09/2022	8260
phy2200263	Belfast	B3-AFFNI50	phy22-39a	25/09/2022	8500
phy2200264	Belfast	B12-AFFNI54	phy22-39a	25/09/2022	3040
phy2200265	Belfast	B20-AFFNI53	phy22-39a	25/09/2022	680
phy2200269	Belfast	B1-AFFNI55	phy22-40a	03/10/2022	1840
phy2200270	Belfast	B3-AFFNI50	phy22-40a	03/10/2022	480

phy2200272	Belfast	B20-AFFNI53	phy22-40a	03/10/2022	300
phy2200274	Carlingford	C11-AFFNI84	phy22-40b	03/10/2022	120
phy2200281	Foyle	PA3-wild fishery	phy22-41b	10/10/2022	120
phy2200282	Foyle	PA4-wild fishery	phy22-41b	10/10/2022	40
phy2200285	Belfast	B3-AFFNI50	phy22-42a	16/10/2022	160
phy2200287	Belfast	B20-AFFNI53	phy22-42a	16/10/2022	560
phy2200288	Larne	L3-AFFNI88	phy22-42b	17/10/2022	160
phy2200289	Killough	K1-AFFNI18	phy22-43a	24/10/2022	120
phy2200293	Carlingford	C1-AFFNI27	phy22-43b	24/10/2022	60
phy2200294	Carlingford	C11-AFFNI84	phy22-43b	24/10/2022	140
phy2200295	Carlingford	C15-AFFNI89	phy22-43b	24/10/2022	420
phy2200296	Carlingford	NW-wild fishery	phy22-43b	24/10/2022	80
phy2200301	Belfast	B12-AFFNI54	phy22-44a	31/10/2022	200
phy2200302	Belfast	B20-AFFNI53	phy22-44a	31/10/2022	120
phy2200304	Killough	K1-AFFNI18	phy22-45a	07/11/2022	80
phy2200308	Belfast	B1-AFFNI55	phy22-46a	14/11/2022	140
phy2200309	Belfast	B3-AFFNI50	phy22-46a	14/11/2022	40

phy2200311	Belfast	B20-AFFNI53	phy22-46a	14/11/2022	40
phy2200312	Foyle	PA3-wild fishery	phy22-46b	14/11/2022	40
phy2200313	Foyle	PA4-wild fishery	phy22-46b	14/11/2022	40
phy2200320	Dundrum	DB1-AFFNI95A	phy22-47a	21/11/2022	40
phy2200329	Carlingford	C15-AFFNI89	phy22-48b	29/11/2022	40