



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

Reporting Period 1st January 2020 - 31st December 2020

Final Report – Version 1

Pages 33

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 2020- 31st December 2020.....	3
Summary	3
Introduction	5
Sampling.....	5
Laboratory procedures	5
Results	5
Results by species.....	8
Alexandrium spp	8
Dinophysiales (includes Dinophysis and Phalacroma species)	8
Prorocentrum lima.....	8
Pseudo-nitzschia <i>spp.</i>	8
Other species	9
Results by area	19
Lough Foyle.....	19
Larne Lough	19
Belfast Lough	19
Strangford Lough	20
Killough	20
Dundrum Bay	20
Carlingford Lough.....	21
Appendix 1	22

Shellfish production waters: reporting period: 1st January 2020- 31st December 2020.

Summary

During the period of this report a total of 374 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. As well as the four main target phytoplankton groups (*Alexandrium* spp., Dinophysiales (genera *Dinophysis* and *Phalacroma*), *Prorocentrum lima* and *Pseudo-nitzschia* spp. the samples collected during 2020 also contained one other target species, the dinoflagellate *Karenia mikimotoi*.

Cells of the genus *Alexandrium*, a potential producer of PST's (Paralytic Shellfish Toxins), were recorded in 4 of the 7 areas monitored and were present in 1.6 % of samples analysed. The trigger level for *Alexandrium* spp. (≥ 40 cells L⁻¹) was breached on only 1 occasion during the year with a maximum cell abundance of 40 cells L⁻¹ recorded on 29th June in a sample from C11-AFFNI 84 in Carlingford Lough.

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

The trigger value for the species responsible for production of lipophilic toxins (includes some members of the Dinophysiales as well as *Prorocentrum lima*) is set at ≥ 100 cells L⁻¹. Target species belonging to the Order Dinophysiales were recorded in six of the seven monitored areas the exception being Lough Foyle. Overall they were recorded present in 8.3% of the samples analysed. This ranged from 3.8% of Larne samples to 20.8% of Killough samples. The trigger level of ≥ 100 cells L⁻¹ was breached on 4 occasions. A maximum cell abundance of 140 cells L⁻¹ was recorded on two occasions, from site B20-AFFNI 53 on 14th July and site NW Wild fishery on 10th August. *Prorocentrum lima* was detected in three samples during 2020 with a maximum abundance of 40 cells L⁻¹ recorded on 29th June in a water sample taken from C7-AFFNI 73.

No official control samples tested during 2020 contained lipophilic toxins above the set regulatory limit. More details can be found in the AFBI Biotoxin Report for 2020.

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 39.8% of samples. Their presence ranged from 7.7% of Lough Foyle water samples to 55.6% of samples tested from Belfast Lough. A maximum abundance of 22,800 cells L⁻¹ was recorded on 10th August in a sample taken from B12 AFFNI 54. This is considerably lower than the maximum cell values recorded in previous years.

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

Karenia mikimotoi was the only other target species identified in water samples taken as part of the Official Control Programme during 2020. It was present on 4 occasions and recorded a maximum abundance of 40 cells L⁻¹ on 27th January (B12-AFFNI 54).

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 2020– 31st December 2020.

A total of 374 water samples were received and reported in 2020. 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 after the FSANI risk based approach to sampling frequency was implemented.

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 next 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, *Prorocentrum lima* and *Pseudo-nitzschia* spp. are reported in tabular form in Appendix 1.

Table 1. Shellfish production areas monitored for the presence of toxin producing and nuisance microalgae in water in 2020.

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 (until 9/3/20)
Killough	K1-AFFNI 18
Dundrum Bay	DB1-AFFNI 95A
Carlingford Lough	C7-AFFNI 73
Carlingford Lough	C9-AFFNI 39
Carlingford Lough	C11-AFFNI 84
Carlingford Lough	C3-AFFNI 94 (until 15/3/20)
Carlingford Lough	C4-AFFNI 68 (until 15/3/20)
Carlingford Lough	NW-Wild fishery
Carlingford Lough	C1-AFFNI 27 (until 15/3/20)

Figure 1 – Current sampling sites

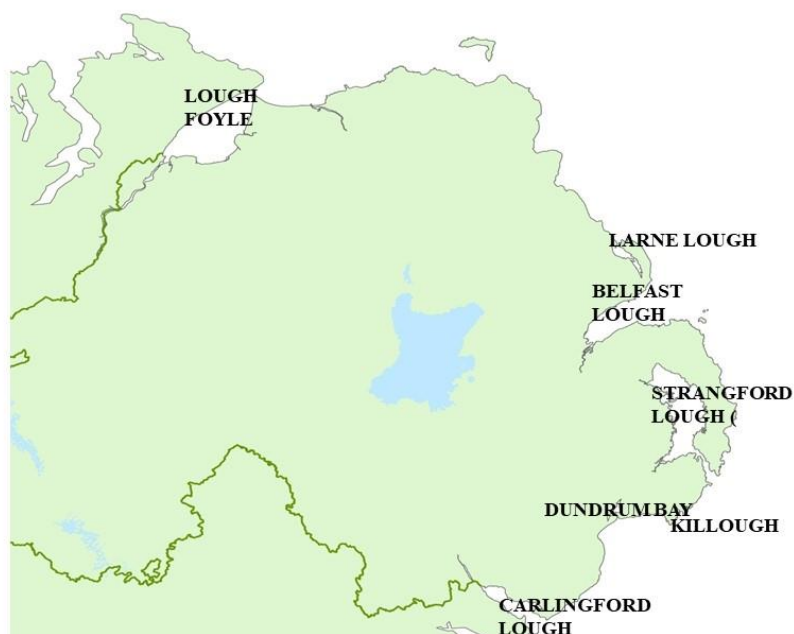


Table 2 – Monitored phytoplankton species.

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

Results by species

***Alexandrium* spp.**

Cells of the potential paralytic shellfish toxin producer *Alexandrium* spp. were recorded in 4 of the 7 coastal areas monitored, the exceptions being Lough Foyle, Strangford Lough and Dundrum Bay (Figure 2A). *Alexandrium* spp. were present in 1.6% of all samples received, the lowest figure recorded since 2012. Cell abundance was low with a maximum of 40 cells L⁻¹ recorded on 29th June in a sample taken from the C11-AFFNI 84 site in Carlingford Lough (Figure 3A and Table 5).

No Paralytic Shellfish Toxins (PST's) were detected in shellfish tested as part of the Official Control Monitoring Programme during 2020.

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

Cells of the Dinophysiales order were present in 6 of the 7 coastal areas monitored, the exception being Lough Foyle (Figure 2B). In 2020 they were recorded in 8.3% of samples received, a figure greatly reduced from the 21.7% recorded in 2019. The maximum cell abundance recorded in 2020 was 140 cells L⁻¹ in water samples taken from Belfast Lough (B20-AFFNI 53) and Carlingford Lough (NW Wild fishery) on 14th July and 10th August respectively (Figure 3B and Table 7). The majority of samples analysed contained cells of *Dinophysis acuminata*, the most common of the *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 dinoflagellate *Prorocentrum lima* was recorded in three (0.8%) of the samples tested in 2020. A peak cell abundance of 40 cells L⁻¹ was recorded on 29th June in a sample tested from C7-AFFNI 73 (Figure 3B and Table 6). This agrees with the historical pattern of its low abundance across all sites (Figure 4C).

***Pseudo-nitzschia* spp.**

Pseudo-nitzschia is a diatom genus frequently recorded in Northern Ireland coastal waters (Figure 4D). All monitored areas contained cells of this species ranging from 7.7% of Lough Foyle samples to 55.6 % of Killough samples (Table 4 and Figure 2D)). No samples breached the threshold value of 150,000 cells L⁻¹ during 2020. The B12-AFFNI 54 site recorded the highest abundance with a value of 22,800 cells L⁻¹ recorded on 10th August (Table 8). This is the lowest number recorded in many years and in stark contrast to that recorded in 2019 (648,400 cells L⁻¹).

No shellfish samples, tested as part of the Official Control Programme, contained domoic acid above

the EU regulatory limit.

Other species

The ichthyotoxic species *Karenia mikimotoi* was the only other target species recorded as part of the Official Control Phytoplankton Monitoring Programme in 2020. It was recorded in 4 samples and reached a maximum abundance of 40 cells L⁻¹ in a water sample taken from B12-AFFNI 54 on the 27th January.

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 2020.

Sampling site	No. of samples received	No. of samples rejected	<i>Alexandrium</i> spp. occurrence	<i>Alexandrium</i> spp.* max abundance	<i>Dinophysis</i> spp.* occurrence	<i>Dinophysis</i> spp. max abundance	<i>P.lima</i> occurrence	<i>P.lima</i> max abundance	<i>Pseudo-nitzschia</i> spp. occurrence	<i>Pseudo-nitzschia</i> spp. max abundance
Lough Foyle										
PA3-Wild fishery	13	0	0.0	0	0.0	0	0.0	0	7.7	80
PA4-Wild fishery	13	0	0.0	0	0.0	0	0.0	0	7.7	160
Larne Lough										
L3-AFFNI 88	26	0	3.8	20	3.8	80	0.0	0	34.6	3,920
Belfast Lough										
B1-AFFNI 55	31	0	3.2	20	3.2	20	0.0	0	64.5	14,060
B3-AFFNI 50	31	0	0.0	0	6.5	20	0.0	0	45.2	18,120
B12-AFFNI 54	31	0	0.0	0	16.1	120	0.0	0	58.1	22,800
B20-AFFNI 53	31	0	3.2	20	9.7	140	0.0	0	54.8	6,200
Strangford Lough										
S2-AFFNI 42	23	0	0.0	0	21.7	60	4.3	20	34.8	8,040
S7-AFFNI 76	5	0	0.0	0	0.0	0	0.0	0	20.0	300
Killough										
K1-AFFNI 18	24	0	4.2	20	20.8	100	0.0	0	41.7	13,600

Sampling site	No. of samples received	No. of samples rejected	<i>Alexandrium</i> spp. occurrence	<i>Alexandrium</i> spp.* max abundance	<i>Dinophysis</i> spp.* occurrence	<i>Dinophysis</i> spp. max abundance	<i>P.lima</i> occurrence	<i>P.lima</i> max abundance	<i>Pseudo-nitzschia</i> spp. occurrence	<i>Pseudo-nitzschia</i> spp. max abundance
Dundrum Bay										
DB1-AFFNI 21A	25	0	0.0	0	4.0	20	0.0	0	32.0	8,560
Carlingford Lough										
C1-AFFNI 27	6	0	0.0	0	0.0	0	0.0	0	0.0	0
C3-AFFNI 94	6	0	0.0	0	0.0	0	0.0	0	0.0	0
C4-AFFNI 68	6	0	0.0	0	0.0	0	0.0	0	0.0	0
C7-AFFNI 73	25	0	0.0	0	0.0	0	4.0	40	24.0	1,680
C9-AFFNI 39	26	0	0.0	0	7.7	60	0.0	0	38.5	4,600
C11-AFFNI	26	0	7.7	40	15.4	60	3.8	20	50.0	2,900
NW-Wild fishery	26	0	0.0	0	7.7	140	0.0	0	50.0	2,660

374 samples received

0 samples rejected

374 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 2020.

Sampling site	No of samples received	No. of samples rejected	<i>Alexandrium</i> spp. occurrence	<i>Alexandrium</i> spp. max abundance	<i>Dinophysis</i> spp.* occurrence	<i>Dinophysis</i> spp.* max abundance	<i>P.lima</i> occurrence	<i>P.lima</i> max abundance	<i>Pseudo-nitzschia</i> spp. occurrence	<i>Pseudo-nitzschia</i> spp. max abundance
Lough Foyle	26	0	0.0	0	0.0	0	0.0	0	7.7	160
Larne Lough	26	0	3.8	20	3.8	80	0.0	0	34.6	3,920
Belfast Lough	124	0	1.6	20	8.9	140	0.0	0	55.6	22,800
Strangford Lough	28	0	0.0	0	17.9	60	3.6	20	32.1	8,040
Killough	24	0	4.2	20	20.8	100	0.0	0	41.7	13,600
Dundrum Bay	25	0	0.0	0	4.0	20	0.0	0	32.0	8,560
Carlingford Lough	121	0	1.7	40	6.6	140	1.7	40	34.7	4,600

374 samples received

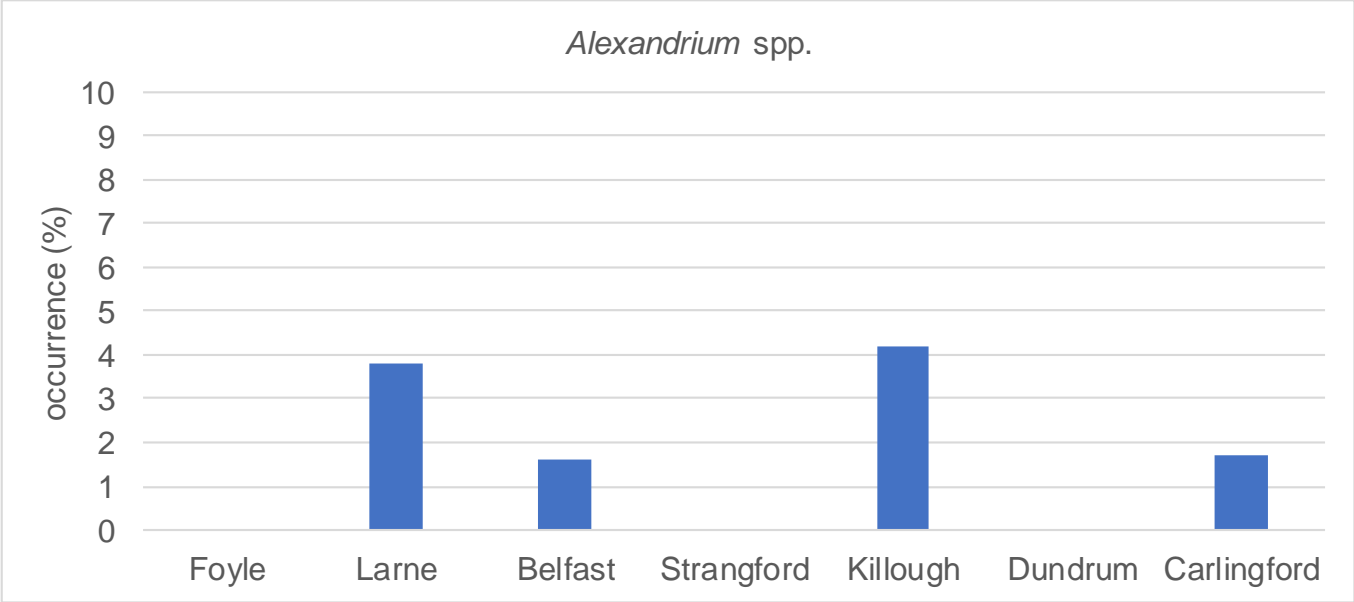
0 samples rejected

374 samples reported

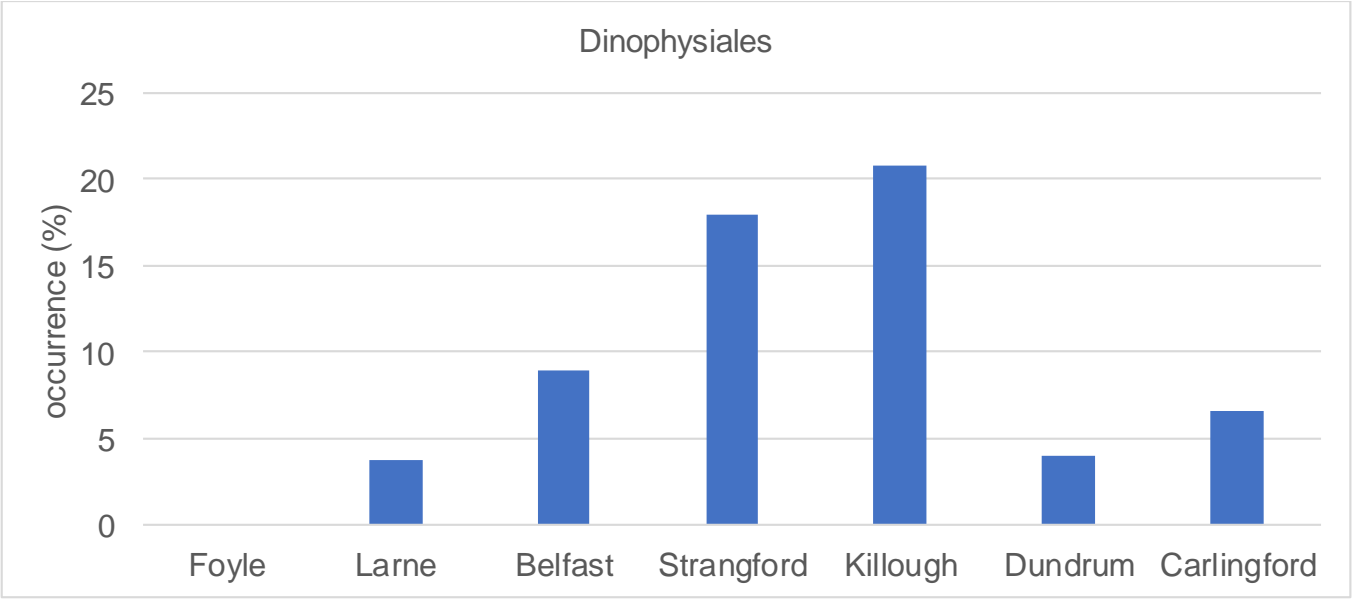
*Includes *Phalacroma rotundatum*

Figure 2. Occurrence (%) of the four major target organisms in 2020 (presence of cells in water samples as a percentage of the total number of samples reported for each area)

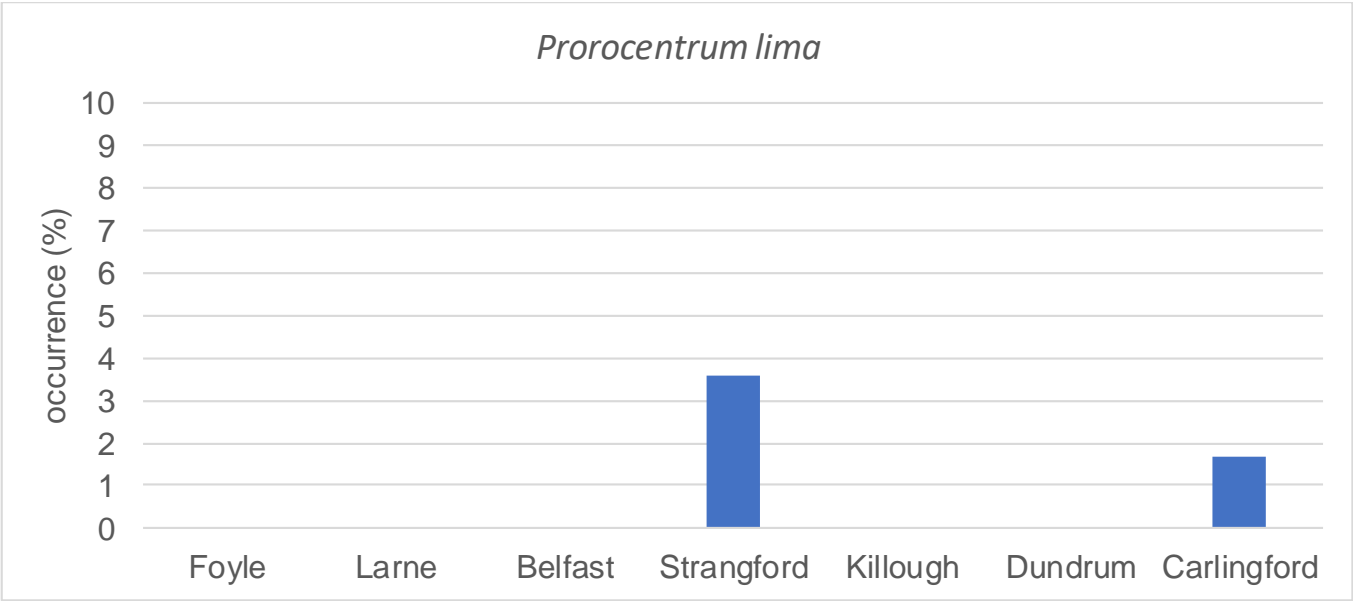
A



B



C



D

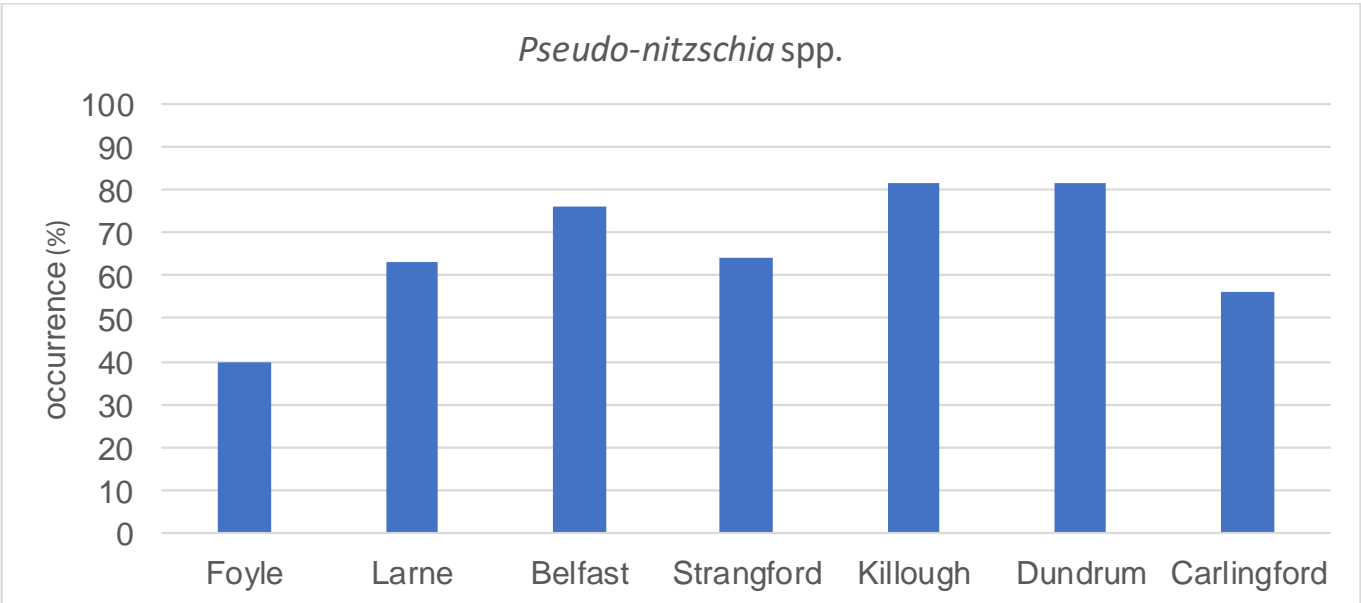
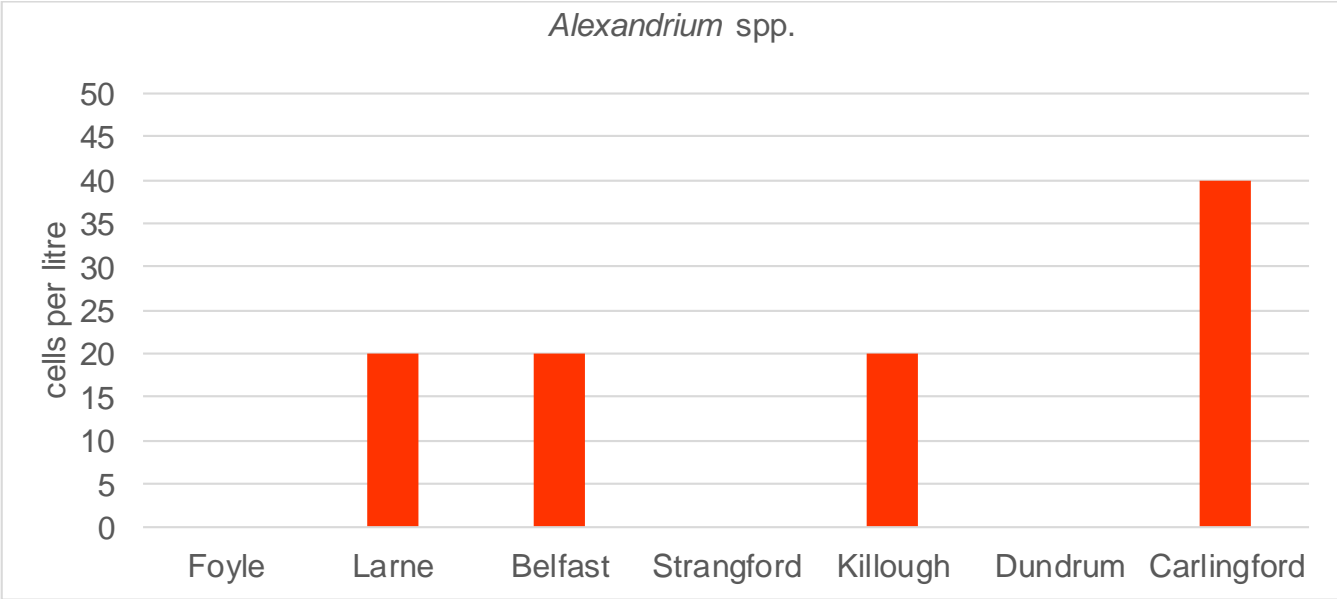
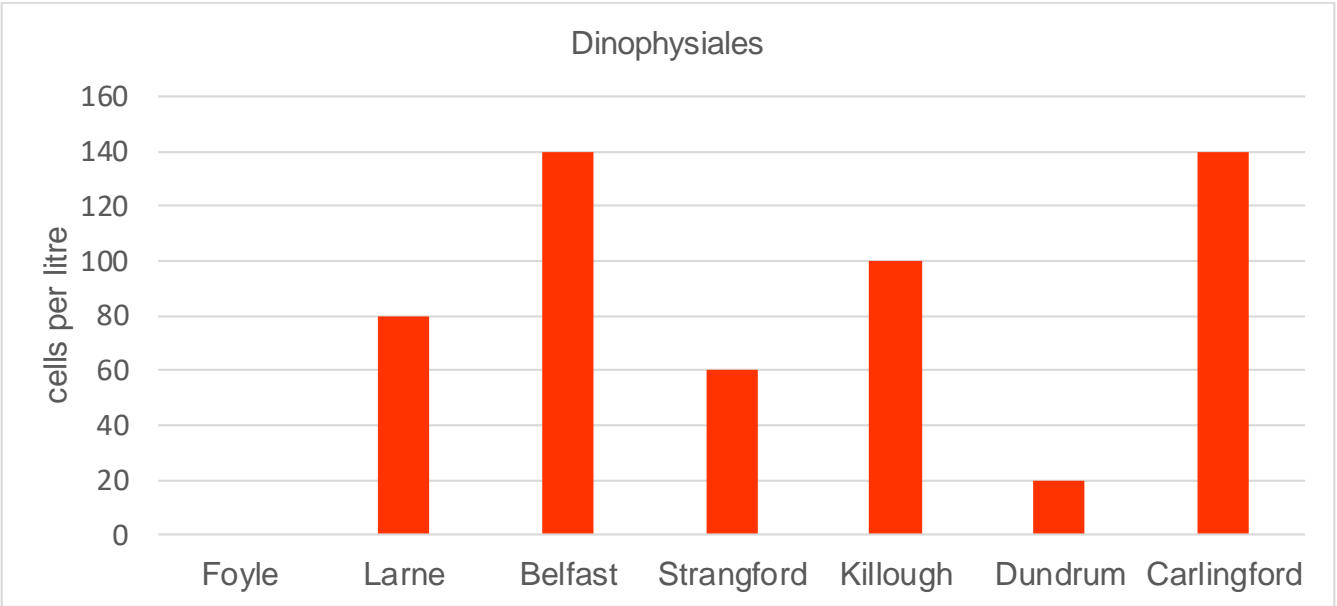


Figure 3 – Maximum abundance (cells per litre) of the four major target groups in 2020 in water samples taken from each area.

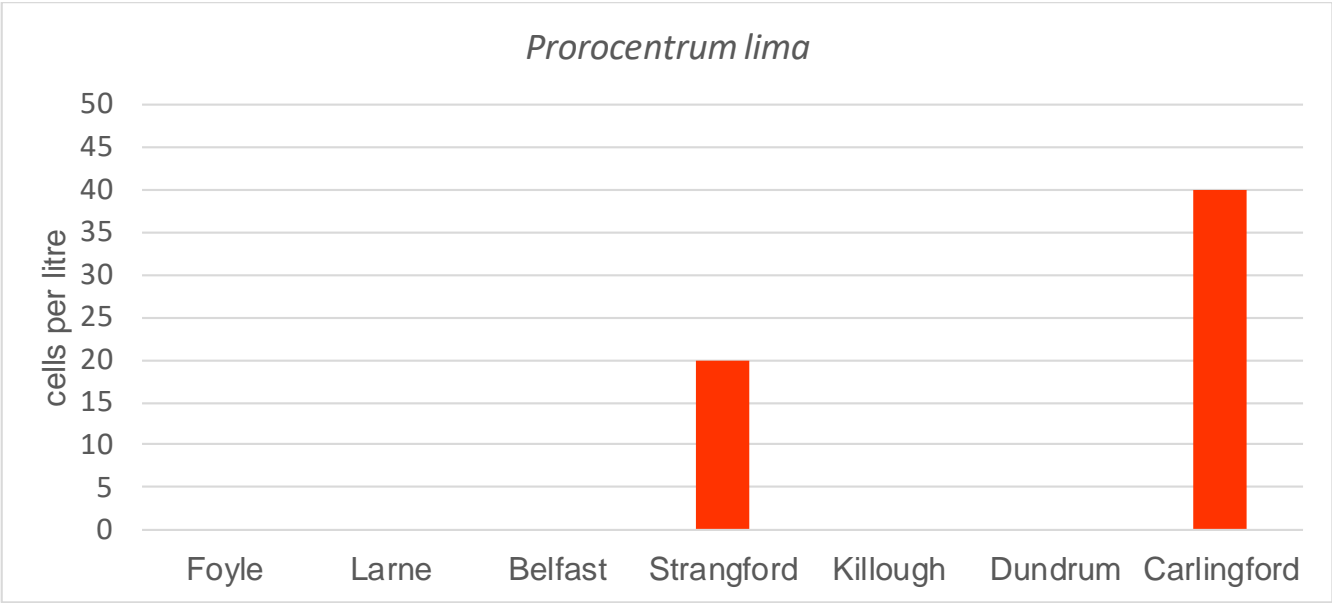
A



B



C



D

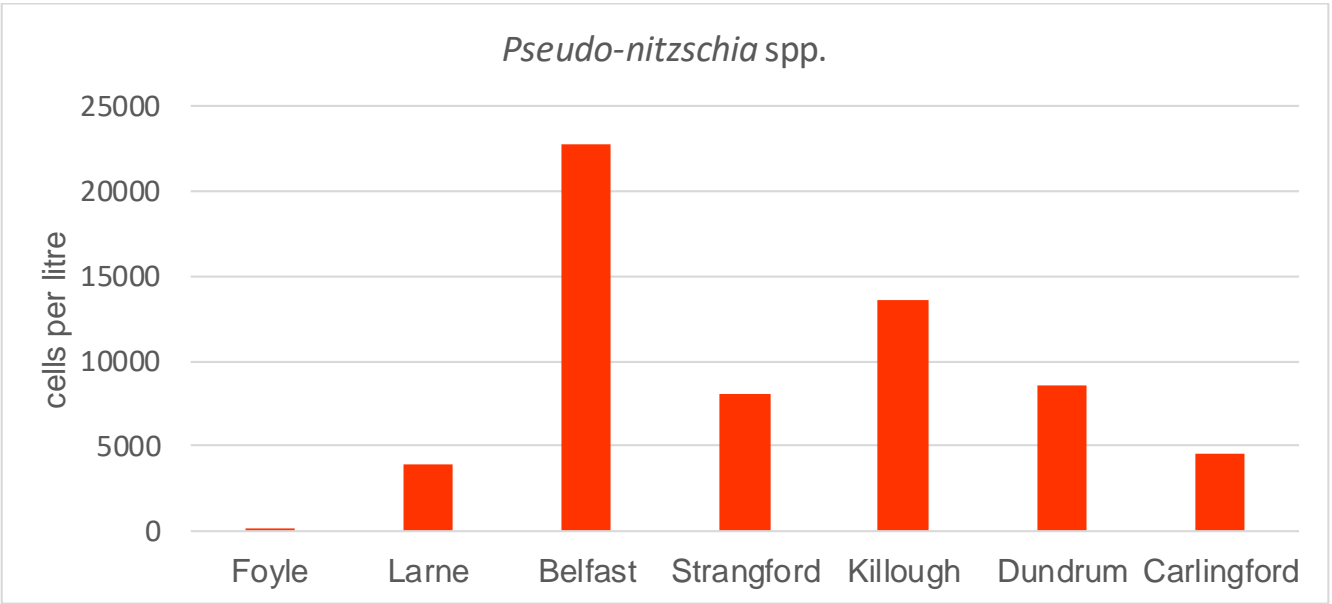
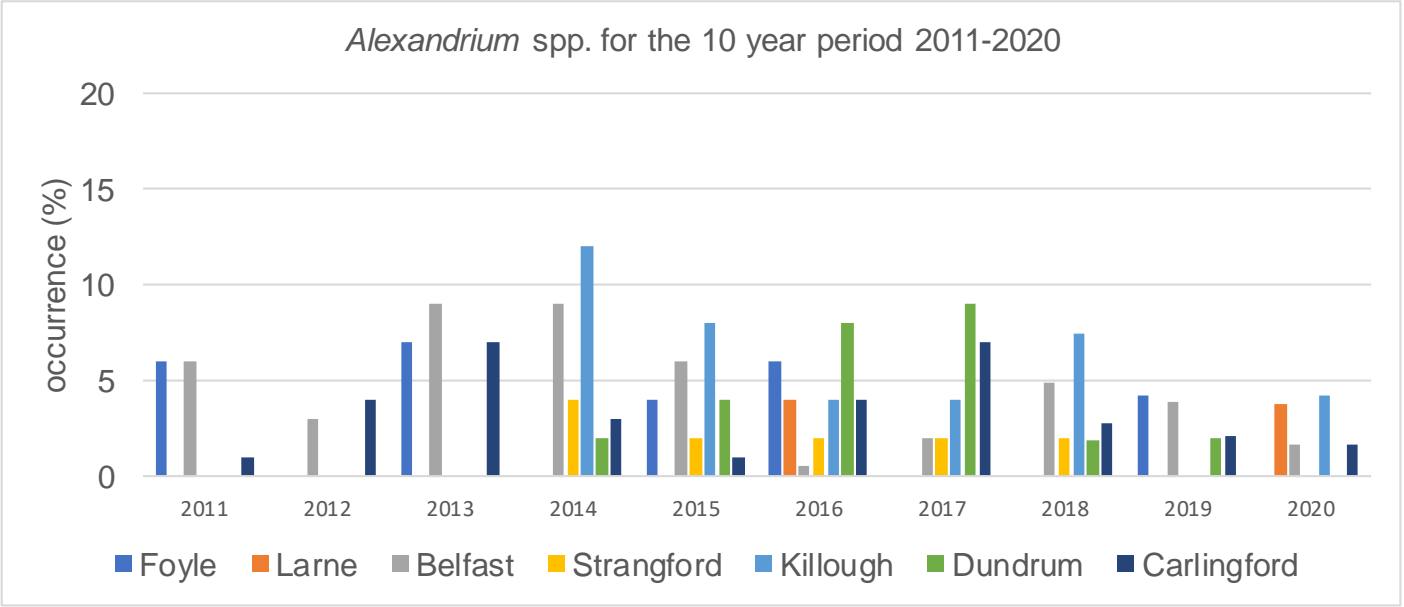
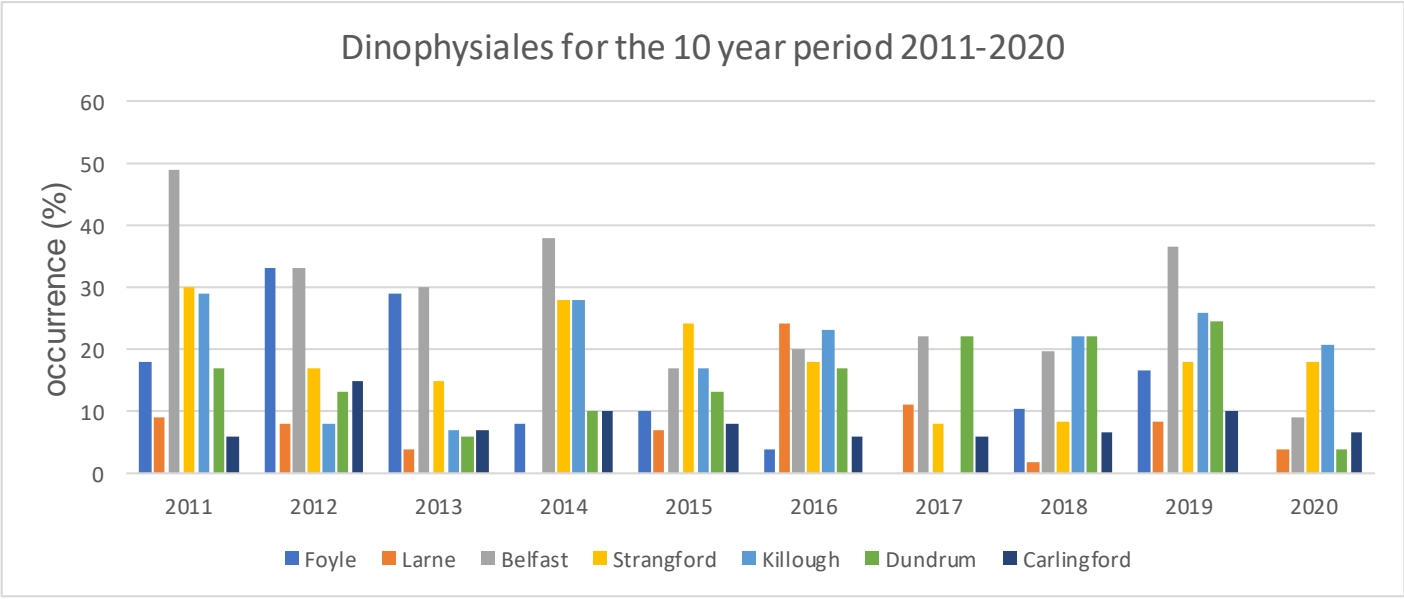


Figure 4 – Occurrence of the four major target organisms for period 2011-2020 (presence of cells in water samples as a % of the total number of samples reported for each sampling area in each year.

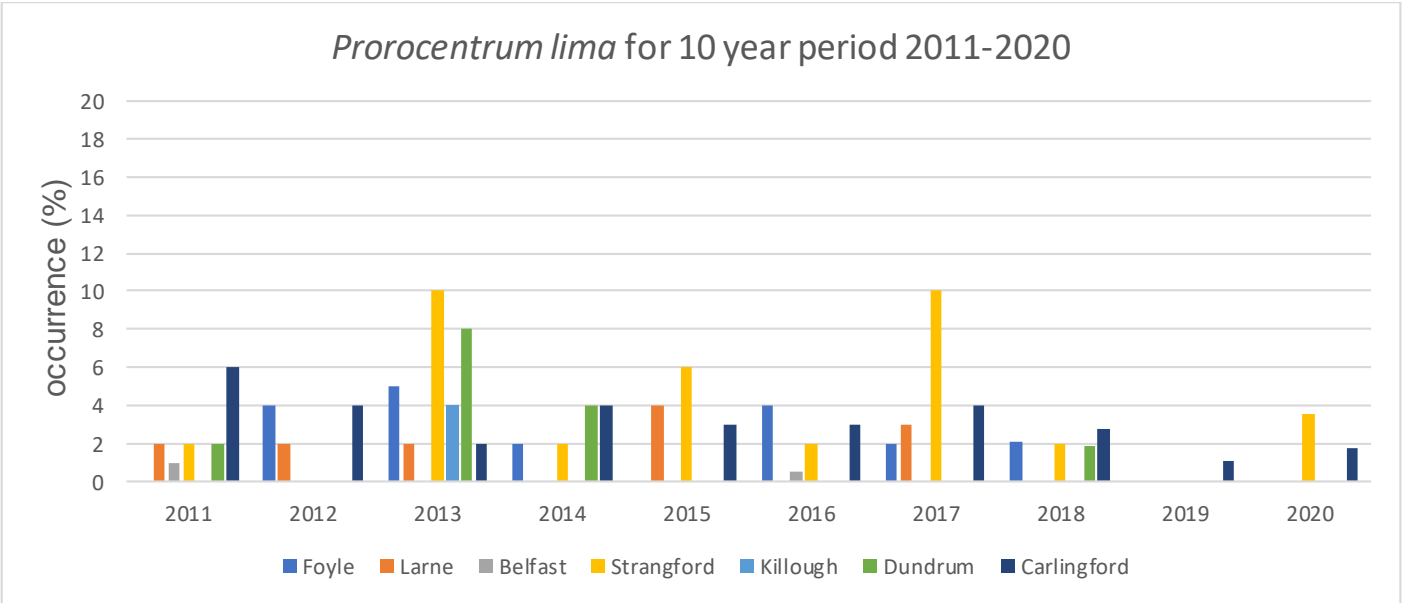
A



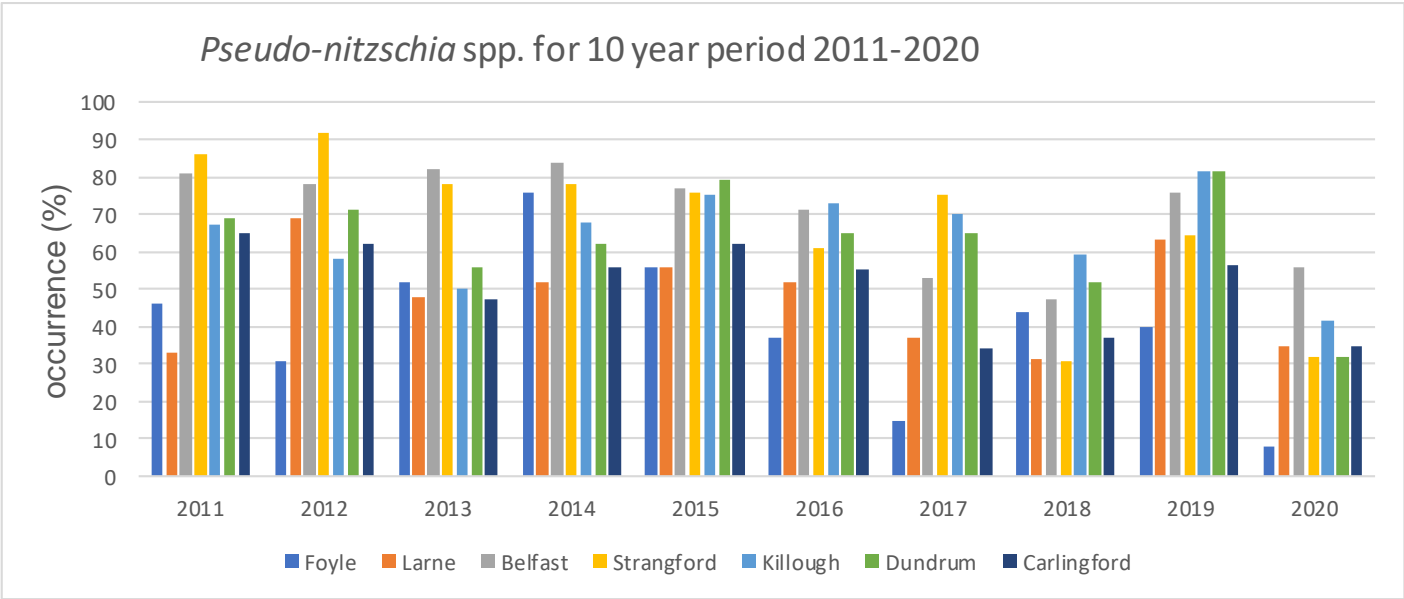
B



C



D



Results by area

Lough Foyle

Pseudo-nitzschia spp. was the only target species recorded from Lough Foyle in 2020.

A total of 26 samples were received and analysed from the two monitoring sites in Lough Foyle (Table 3). This was a substantial reduction from previous years and was due to the suspension of sampling from 26th March-29th September whilst Covid19 restrictions were in place. *Pseudo-nitzschia* was the only species detected in samples received from the lough in 2020. This is more than likely as a consequence of sampling being ceased over the phytoplankton growth period. *Pseudo-nitzschia* spp. reached a maximum abundance of 160 cells L⁻¹ in a sample taken from the PA4 Wild fishery site on 9th November (Table 8).

Larne Lough

The following target species were recorded in water samples from Larne Lough in 2020; *Alexandrium* spp., *Dinophysis acuminata* and *Pseudo-nitzschia* spp..

A total of 26 samples were received from the one site (L3-AFFNI 88) monitored in Larne Lough (Table 3). The PST producer, *Alexandrium* spp. was detected in 3.8% of water samples (Figure 2A) reaching a maximum abundance of 20 cells L⁻¹ on 10th June (Table 5). This is in keeping with the historically low presence of this genus in the lough (Figure 4A). Cells of the *Dinophysis* genus were counted in 3.8% of samples from the lough but abundance was low (Figure 3B). A maximum cell count of 80 cells L⁻¹ was recorded in the water sample taken on 10th June. *Pseudo-nitzschia* spp. was recorded in 34.6% of samples with a maximum abundance of 3,920 cells L⁻¹ counted in the sample taken on 18th August (Table 7).

Belfast Lough

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

Belfast Lough is an important shellfish production area in Northern Ireland. Its four Representative Monitoring Points (RMP's) were sampled weekly up until the end of March 2020 when, after the introduction of a FSANI risk based assessment, it was reduced to fortnightly. *Alexandrium* spp. were counted in 1.6% of samples a figure in keeping with the historically low levels recorded in recent years (Fig.4A). The maximum abundance recorded in 2020 was 20 cells L⁻¹ from the B1-AFFNI 55 and B20-AFFNI 53 sites on 27th April (Table 5). Cells from the taxonomic order Dinophysiales have been recorded regularly over the past years in samples from Belfast Lough (Figure 4B). In 2020 they were present in 8.9% of samples a significant reduction to the 36.6% of samples recorded in 2019 (Figure 4B). The maximum cell abundance recorded was 140 cells L⁻¹ in a sample taken from B20-AFFNI 53 on 14th July (Table 7).

Cells of the genus *Pseudo-nitzschia* were found in 55.6% of samples (Table 4 and Figure 2D)

reaching a peak abundance of 22,800 cells L⁻¹ in a sample from B12-AFFNI 54 on 10th August.

The only other target species recorded in Belfast Lough samples was *Karenia mikimotoi* which reached a maximum abundance of 40 cells L⁻¹ on 27th January.

Strangford Lough

Target species recorded from Strangford Lough during the year included; *D.acuminata*, *Prorocentrum lima* and *Pseudo-nitzschia* spp..

At the beginning of 2020 two sites were monitored as part of the official control programme, S2-AFFNI 42 and S7-AFFNI 76. However, the latter ceased to be monitored after the 9th March. Similarly to 2019, *Alexandrium* spp. were not detected in any samples received during 2020 (Figure 4A). Dinophysiales were present in 17.9% of samples although cell concentrations were low. A maximum cell abundance of 60 cells L⁻¹ was recorded from the S2-AFFNI 42 site on the 27th July (Table 7). *Prorocentrum lima* was present on one occasion when a cell count of 20 cells L⁻¹ was recorded. *Pseudo-nitzschia* were present in 32.1% of samples (Table 4) with cell abundance reaching a maximum of 8,040 cells L⁻¹ in a sample from S2-AFFNI 42 on 10th August (Table 8). There were no other target species recorded from the lough in 2020.

Killough

The following target species were recorded from Killough waters during 2020. *Alexandrium* spp., *Dinophysis acuminata* and *Pseudo-nitzschia* spp..

Alexandrium spp. was recorded in 4.2% of samples and reached a peak abundance of 20 cells L⁻¹ (3rd August). This is similar to the level recorded in previous years (Figure 4A). Cells of the Dinophysiales order were recorded in 20.8% of samples (Table 3) although cell counts were low with one sample breaching the threshold level of ≥ 100 cells L⁻¹. This was on 17th August when a value of 100 cells L⁻¹ was recorded (Table 5). *Pseudo-nitzschia* spp. was recorded in 41.7% of samples with a maximum cell abundance of 13,600 cells L⁻¹ recorded on the 3rd August a significant reduction on the 108,800 cells L⁻¹ recorded in 2019.

Dundrum Bay

Target species present in Dundrum Bay included *D.acuminata* and *Pseudo-nitzschia* spp.

Dinophysis acuminata was recorded in only one sample submitted in 2020 with abundance being recorded at 20 cells L⁻¹ (22nd June).

Pseudo-nitzschia spp. was present in 32% of Dundrum samples (Table 4), a significant reduction in the 81.6% of samples recorded in 2019 (Figure 4D). Unlike the previous year there were no breaches in the trigger level with a maximum cell abundance of 8,560 cells L⁻¹ on 3rd August (Table 8).

No other target species were recorded during 2020.

Carlingford Lough

Target species recorded in Carlingford Lough during 2020 were; *Alexandrium* spp., *D.acuminata*, *P.lima* and *Pseudo-nitzschia* spp..

Alexandrium spp. was recorded in 1.7% of the water samples received from Carlingford Lough in 2020, a figure in keeping with that recorded in previous years (Figure 4A). Cell abundance was low with a maximum abundance of 40 cells L⁻¹ recorded on the 29th June (C11-AFFNI 84). Members of the Dinophysiales order were present in 6.6% of samples (Table 4) with a maximum abundance of 140 cells L⁻¹ recorded in a water sample from the NW Wild fishery site on 10th August (Table 7).

P.lima occurred in a small number of samples (1.7%) with a maximum of 40 cells L⁻¹ recorded on 29th June in a sample received from C7-AFFNI 73. *Pseudo-nitzschia* spp. was recorded in 34.7% of the samples tested from Carlingford Lough (Table 4). Cell abundance was low across all sites with a maximum value of 4,600 cells L⁻¹ recorded on 27th July in a sample from C9-AFFNI 39.

Appendix 1

Table 5 - Positive occurrences of *Alexandrium* spp. (cells L⁻¹) in 2020

System id	Region	Site ID ref	Report no.	Collection date	<i>Alexandrium</i> spp.
phy2000151	Belfast	B1-AFFNI 55	phy20-18a	27/04/2020	20
phy2000152	Belfast	B20-AFFNI 53	phy20-18a	27/04/2020	20
phy2000191	Larne	L3-AFFNI 88	phy20-24c	10/06/2020	20
phy2000207	Carlingford	C11-AFFNI 84	phy20-27b	29/06/2020	40
phy2000232	Carlingford	C11-AFFNI 84	phy20-31a	27/07/2020	20
phy2000234	Killough	K1-AFFNI 18	phy20-32a	03/08/2020	20

Table 6 - Positive occurrences of *Prorocentrum lima* (cells L⁻¹) in 2020

System id	Region	Site ID ref	Report no.	Collection date	<i>Prorocentrum lima</i>
phy2000205	Carlingford	C7-AFFNI 73	phy20-27b	29/06/2020	40
phy2000207	Carlingford	C11-AFFNI 84	phy20-27b	29/06/2020	20
phy2000221	Strangford	S2-AFFNI 42	phy20-30a	20/07/2020	20

Table 7 Positive occurrences of Dinophysiales (cells L⁻¹) in 2020**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	Dac	Dn	Pr	Din	Tot Din
phy2000078	Belfast	B1-AFFNI 55	phy20-09a	23/02/2020	0	0	0	0	20	20
phy2000155	Carlingford	C9-AFFNI 39	phy20-18b	27/04/2020	20	0	0	0	0	20
phy2000160	Carlingford	C11-AFFNI 84	phy20-20b	11/05/2020	40	0	0	0	0	40
phy2000182	Belfast	B3-AFFNI 50	phy20-24a	08/06/2020	20	0	0	0	0	20
phy2000185	Killough	K1-AFFNI 18	phy20-24a	08/06/2020	40	0	0	0	0	40
phy2000191	Larne	L3-AFFNI 88	phy20-24c	10/06/2020	80	0	0	0	0	80
phy2000195	Belfast	B12-AFFNI 54	phy20-26a	22/06/2020	60	0	0	0	0	60
phy2000198	Dundrum	DB1-AFFNI 95A	phy20-26a	22/06/2020	20	0	0	0	0	20
phy2000207	Carlingford	C11-AFFNI 84	phy20-27b	29/06/2020	60	0	0	0	0	60
phy2000210	Killough	K1-AFFNI 18	phy20-28a	06/07/2020	20	0	0	0	0	20
phy2000215	Belfast	B12-AFFNI 54	phy20-29a	14/07/2020	20	0	0	0	20	40

System id	Region	Site ID ref	Report no.	Collection date	Da	Dac	Dn	Pr	Din	Tot Din
phy2000216	Belfast	B20-AFFNI 53	phy20-29a	14/07/2020	140	0	0	0	0	140
phy2000220	Carlingford	NW-wild fishery	phy20-29a	14/07/2020	20	0	0	0	0	20
phy2000221	Strangford	S2-AFFNI 42	phy20-30a	20/07/2020	20	0	0	0	0	20
phy2000222	Killough	K1-AFFNI 18	phy20-30a	20/07/2020	20	0	0	0	0	20
phy2000225	Strangford	S2-AFFNI 42	phy20-31a	27/07/2020	60	0	0	0	0	60
phy2000227	Belfast	B3-AFFNI 50	phy20-31a	27/07/2020	20	0	0	0	0	20
phy2000228	Belfast	B12-AFFNI 54	phy20-31a	27/07/2020	40	0	0	0	0	40
phy2000229	Belfast	B20-AFFNI 53	phy20-31a	27/07/2020	20	0	0	0	0	20
phy2000232	Carlingford	C11-AFFNI 84	phy20-31a	27/07/2020	40	0	0	0	0	40
phy2000234	Killough	K1-AFFNI 18	phy20-32a	03/08/2020	60	0	0	0	0	60
phy2000237	Strangford	S2-AFFNI 42	phy20-33a	10/08/2020	20	0	0	0	0	20
phy2000240	Belfast	B12-AFFNI 54	phy20-33a	10/08/2020	120	0	0	0	0	120
phy2000241	Belfast	B20-AFFNI 53	phy20-33a	10/08/2020	40	0	0	0	0	40
phy2000243	Carlingford	C9-AFFNI 39	phy20-33a	10/08/2020	60	0	0	0	0	60

System id	Region	Site ID ref	Report no.	Collection date	<i>Da</i>	<i>Dac</i>	<i>Dn</i>	<i>Pr</i>	<i>Din</i>	Tot <i>Din</i>
phy2000244	Carlingford	C11-AFFNI 84	phy20-33a	10/08/2020	20	0	0	0	0	20
phy2000245	Carlingford	NW-wild fishery	phy20-33a	10/08/2020	140	0	0	0	0	140
phy2000246	Killough	K1-AFFNI 18	phy20-34a	17/08/2020	100	0	0	0	0	100
phy2000249	Strangford	S2-AFFNI 42	phy20-35a	24/08/2020	20	0	0	0	0	20
phy2000252	Belfast	B12-AFFNI 54	phy20-35a	24/08/2020	20	0	0	0	0	20
phy2000273	Strangford	S2-AFFNI 42	phy20-38c	15/09/2020	40	0	0	0	0	40

Table 8 - Positive occurrences of *Pseudo-nitzschia* spp. (cells L⁻¹) in 2020

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000025	Belfast	B12-AFFNI 54	phy20-04a	20/01/2020	320
phy2000026	Belfast	B20-AFFNI 53	phy20-04a	20/01/2020	240
phy2000036	Belfast	B1-AFFNI 55	phy20-05a	27/01/2020	140
phy2000037	Belfast	B3-AFFNI 50	phy20-05a	27/01/2020	220
phy2000039	Belfast	B20-AFFNI 53	phy20-05a	27/01/2020	100
phy2000045	Belfast	B1-AFFNI 55	phy20-06a	02/02/2020	420
phy2000046	Belfast	B3-AFFNI 50	phy20-06a	02/02/2020	80
phy2000047	Belfast	B12-AFFNI 54	phy20-06a	02/02/2020	100
phy2000048	Belfast	B20-AFFNI 53	phy20-06a	02/02/2020	80
phy2000055	Carlingford	NW-wild fishery	phy20-06b	03/02/2020	80
phy2000060	Strangford	S7-AFFNI 76	phy20-07a	10/02/2020	300
phy2000063	Belfast	B1-AFFNI 55	phy20-07c	12/02/2020	140
phy2000078	Belfast	B1-AFFNI 55	phy20-09a	23/02/2020	160
phy2000080	Belfast	B12-AFFNI 54	phy20-09a	23/02/2020	320

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000089	Belfast	B1-AFFNI 55	phy10-10a	02/03/2020	80
phy2000091	Belfast	B12-AFFNI 54	phy20-10a	02/03/2020	40
phy2000104	Belfast	B12-AFFNI 54	phy20-11a	09/03/2020	80
phy2000105	Belfast	B20-AFFNI 53	phy20-11a	09/03/2020	40
phy2000106	Strangford	S2-AFFNI 42	phy20-11a	09/03/2020	60
phy2000118	Belfast	B1-AFFNI 55	phy20-12a	16/03/2020	80
phy2000119	Belfast	B3-AFFNI 50	phy20-12a	16/03/2020	100
phy2000120	Belfast	B12-AFFNI 54	phy20-12a	16/03/2020	220
phy2000124	Belfast	B1-AFFNI 55	phy20-13a	23/03/2020	560
phy2000125	Belfast	B3-AFFNI 50	phy20-13a	23/03/2020	720
phy2000126	Belfast	B12-AFFNI 54	phy20-13a	23/03/2020	1360
phy2000127	Belfast	B20-AFFNI 53	phy20-13a	23/03/2020	920
phy2000131	Belfast	B1-AFFNI 55	phy20-14a	30/03/2020	1000
phy2000132	Belfast	B3-AFFNI 50	phy20-14a	30/03/2020	820

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000133	Belfast	B12-AFFNI 54	phy20-14a	30/03/2020	1460
phy2000134	Belfast	B20-AFFNI 53	phy20-14a	30/03/2020	1180
phy2000135	Carlingford	NW-wild fishery	phy20-14b	31/03/2020	760
phy2000138	Carlingford	C11-AFFNI 84	phy20-14b	31/03/2020	180
phy2000139	Larne	L3-AFFNI 88	phy20-15a	06/04/2020	720
phy2000147	Larne	L3-AFFNI 88	phy20-17a	20/04/2020	360
phy2000153	Carlingford	NW-wild fishery	phy20-18b	27/04/2020	160
phy2000156	Carlingford	C11-AFFNI 84	phy20-18b	27/04/2020	80
phy2000157	Larne	L3-AFFNI 88	phy20-20a	11/05/2020	220
phy2000161	Carlingford	C9-AFFNI 39	phy20-20b	11/05/2020	80
phy2000164	Belfast	B1-AFFNI 55	phy20-20b	12/05/2020	60
phy2000165	Belfast	B3-AFFNI 50	phy20-20b	12/05/2020	260
phy2000166	Belfast	B12-AFFNI 54	phy20-20b	12/05/2020	300
phy2000167	Belfast	B20-AFFNI 53	phy20-20b	12/05/2020	760
phy2000169	Belfast	B1-AFFNI 55	phy20-22a	26/05/2020	420
phy2000170	Belfast	B3-AFFNI 50	phy20-22a	26/05/2020	40
phy2000171	Belfast	B12-AFFNI 54	phy20-22a	26/05/2020	160
phy2000172	Belfast	B20-AFFNI 53	phy20-22a	26/05/2020	480
phy2000175	Larne	L3-AFFNI 88	phy2000175	26/05/2020	80
phy2000176	Carlingford	C11-AFFNI 84	phy20-22b	26/05/2020	140

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000183	Belfast	B12-AFFNI 54	phy20-24a	08/06/2020	200
phy2000184	Belfast	B20-AFFNI 53	phy20-24a	08/06/2020	2060
phy2000185	Killough	K1-AFFNI 18	phy20-24a	08/06/2020	1560
phy2000189	Carlingford	C7-AFFNI 73	phy20-24b	08/06/2020	120
phy2000191	Larne	L3-AFFNI 88	phy20-24c	10/06/2020	20
phy2000192	Strangford	S2-AFFNI 42	phy20-25a	15/06/2020	220
phy2000193	Belfast	B1-AFFNI 55	phy20-26a	22/06/2020	4120
phy2000194	Belfast	B3-AFFNI 50	phy20-26a	22/06/2020	1740
phy2000195	Belfast	B12-AFFNI 54	phy20-26a	22/06/2020	18600
phy2000196	Belfast	B20-AFFNI 53	phy20-26a	22/06/2020	6200
phy2000197	Killough	K1-AFFNI 18	phy20-26a	22/06/2020	6640
phy2000198	Dundrum	DB1-AFFNI 95A	phy20-26a	22/06/2020	4200
phy2000201	Carlingford	C9-AFFNI 39	phy20-26b	22/06/2020	40
phy2000204	Strangford	S2-AFFNI 42	phy20-27a	29/06/2020	940
phy2000207	Carlingford	C11-AFFNI 84	phy20-27b	29/06/2020	700
phy2000208	Carlingford	NW-wild fishery	phy20-27b	29/06/2020	540
phy2000210	Killough	K1-AFFNI 18	phy20-28a	06/07/2020	5580
phy2000213	Belfast	B1-AFFNI 55	phy20-29a	14/07/2020	2280
phy2000214	Belfast	B3-AFFNI 50	phy20-29a	14/07/2020	720
phy2000215	Belfast	B12-AFFNI 54	phy20-29a	14/07/2020	3240
phy2000216	Belfast	B20-AFFNI 53	phy20-29a	14/07/2020	3660

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000217	Carlingford	C7-AFFNI 73	phy20-29a	14/07/2020	1680
phy2000218	Carlingford	C9-AFFNI 39	phy20-29a	14/07/2020	520
phy2000219	Carlingford	C11-AFFNI 84	phy20-29a	14/07/2020	180
phy2000220	Carlingford	NW-wild fishery	phy20-29a	14/07/2020	1340
phy2000222	Killough	K1-AFFNI 18	phy20-30a	20/07/2020	5200
phy2000223	Dundrum	DB1-AFFNI 95A	phy20-30a	20/07/2020	940
phy2000224	Larne	L3-AFFNI 80	phy20-30b	21/07/2020	80
phy2000225	Strangford	S2-AFFNI 42	phy20-31a	27/07/2020	1160
phy2000226	Belfast	B1-AFFNI 55	phy20-31a	27/07/2020	120
phy2000227	Belfast	B3-AFFNI 50	phy20-31a	27/07/2020	260
phy2000228	Belfast	B12-AFFNI 54	phy20-31a	27/07/2020	180
phy2000229	Belfast	B20-AFFNI 53	phy20-31a	27/07/2020	1040
phy2000230	Carlingford	C7-AFFNI 73	phy20-31a	27/07/2020	1400
phy2000231	Carlingford	C9-AFFNI 39	phy20-31a	27/07/2020	4600
phy2000232	Carlingford	C11-AFFNI 84	phy20-31a	27/07/2020	2100
phy2000233	Carlingford	NW-wild fishery	phy20-31a	27/07/2020	2660
phy2000234	Killough	K1-AFFNI 18	phy20-32a	03/08/2020	13600
phy2000235	Dundrum	DB1-AFFNI 95A	phy20-32a	03/08/2020	8560
phy2000236	Larne	L3-AFFNI 88	phy20-32b	03/08/2020	1600
phy2000237	Strangford	S2-AFFNI 42	phy20-33a	10/08/2020	8040

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000238	Belfast	B1-AFFNI 55	phy20-33a	10/08/2020	11000
phy2000239	Belfast	B3-AFFNI 50	phy20-33a	10/08/2020	15240
phy2000240	Belfast	B12-AFFNI 54	phy20-33a	10/08/2020	22800
phy2000241	Belfast	B20-AFFNI 53	phy20-33a	10/08/2020	3980
phy2000244	Carlingford	C11-AFFNI 84	phy20-33a	10/08/2020	980
phy2000245	Carlingford	NW-wild fishery	phy20-33a	10/08/2020	540
phy2000246	Killough	K1-AFFNI 18	phy20-34a	17/08/2020	12300
phy2000247	Dundrum	DB1-AFFNI 95A	phy20-34a	17/08/2020	6820
phy2000248	Larne	L3-AFFNI 88	phy20-34b	18/08/2020	3920
phy2000249	Strangford	S2-AFFNI 42	phy20-35a	24/08/2020	240
phy2000250	Belfast	B1-AFFNI 55	phy20-35a	24/08/2020	14060
phy2000251	Belfast	B3-AFFNI 50	phy20-35a	24/08/2020	18120
phy2000252	Belfast	B12-AFFNI 54	phy20-35a	24/08/2020	12200
phy2000253	Belfast	B20-AFFNI 53	phy20-35a	24/08/2020	2280
phy2000255	Carlingford	C7-AFFNI 73	phy20-36b	01/09/2020	80
phy2000256	Carlingford	C9-AFFNI 39	phy20-36b	01/09/2020	260
phy2000257	Carlingford	C11-AFFNI 84	phy20-36b	01/09/2020	580
phy2000258	Carlingford	NW-wild fishery	phy20-36b	01/09/2020	240
phy2000259	Killough	K1-AFFNI 18	phy20-36b	02/09/2020	3080
phy2000260	Dundrum	DB1-AFFNI 95A	phy20-36b	02/09/2020	600

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000261	Strangford	S2-AFFNI 42	phy20-37a	07/09/2020	40
phy2000262	Belfast	B1-AFFNI 55	phy20-37a	07/09/2020	120
phy2000266	Killough	K1-AFFNI 18	phy20-38a	14/09/2020	1260
phy2000267	Dundrum	DB1-AFFNI 95A	phy20-38a	14/09/2020	1140
phy2000268	Larne	L3-AFFNI 88	phy20-38b	14/09/2020	80
phy2000269	Carlingford	C7-AFFNI 73	phy20-38b	14/09/2020	160
phy2000270	Carlingford	C9-AFFNI 39	phy20-38b	14/09/2020	460
phy2000271	Carlingford	C11-AFFNI 84	phy20-38b	14/09/2020	2900
phy2000272	Carlingford	NW-wild fishery	phy20-38b	14/09/2020	40
phy2000273	Strangford	S2-AFFNI 42	phy20-38c	15/09/2020	1460
phy2000274	Belfast	B1-AFFNI 55	phy20-39a	21/09/2020	380
phy2000275	Belfast	B3-AFFNI 50	phy20-39a	21/09/2020	1260
phy2000276	Belfast	B12-AFFNI 54	phy20-39a	21/09/2020	800
phy2000277	Belfast	B20-AFFNI 53	phy20-39a	21/09/2020	320
phy2000278	Killough	K1-AFFNI 18	phy20-40a	28/09/2020	200
phy2000279	Dundrum	DB1-AFFNI 95A	phy20-40a	28/09/2020	280
phy2000282	Carlingford	C7-AFFNI 73	phy20-40b	28/09/2020	80
phy2000283	Carlingford	C9-AFFNI 39	phy20-40b	28/09/2020	360
phy2000284	Carlingford	C11-AFFNI 84	phy20-40b	28/09/2020	80
phy2000285	Carlingford	NW-wild fishery	phy20-40b	28/09/2020	840

System id	Region	Site ID ref	Report no.	Collection date	<i>Pseudo-nitzschia</i> spp.
phy2000297	Carlingford	C9-AFFNI 39	phy20-42c	13/10/2020	200
phy2000298	Carlingford	C11-AFFNI 84	phy20-42c	13/10/2020	60
phy2000299	Carlingford	NW-wild fishery	phy20-42c	13/10/2020	80
phy2000301	Dundrum	DB1-AFFNI 95A	phy20-42c	14/10/2020	1700
Phy2000305	Belfast	B20-AFFNI 53	phy20-44a	26/10/2020	80
phy2000311	Carlingford	C9-AFFNI 39	phy20-44c	27/10/2020	40
phy2000312	Carlingford	C11-AFFNI 84	phy20-44c	27/10/2020	80
phy2000313	Carlingford	NW-wild fishery	phy20-44c	27/10/2020	380
phy2000314	Killough	K1-AFFNI 18	phy20-44c	28/10/2020	60
phy2000324	Foyle	PA3-wild fishery	phy20-46b	09/11/2020	80
phy2000325	Foyle	PA4-wild fishery	phy20-46b	09/11/2020	160
phy2000327	Carlingford	C9-AFFNI 39	phy20-46b	09/11/2020	120
phy2000329	Carlingford	NW-wild fishery	phy20-46b	09/11/2020	40
phy2000334	Belfast	B1-AFFNI 55	phy20-48a	23/11/2020	60
phy2000336	Belfast	B12-AFFNI 54	phy20-48a	23/11/2020	40
phy2000337	Belfast	B20-AFFNI 53	phy20-48a	23/11/2020	80
phy2000340	Carlingford	C11-AFFNI 84	phy20-48b	23/11/2020	80
phy2000356	Belfast	B1-AFFNI 55	phy20-51a	14/12/2020	80
phy2000368	Belfast	B1-AFFNI 55	phy20-53a	28/12/2020	80
phy2000369	Belfast	B3-AFFNI 50	phy20-53a	28/12/2020	60