



Bord Iascaigh Mhara
Irish Sea Fisheries Board

2015 Southeast Coast Spring Mussel Larvae Monitoring Report



**BIM Aquaculture Technical
Section**

27/07/2015

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Background:

For the past four years, the wild bottom seed mussel settlements have been limited, from over 20000 tons in 2009 to little over 2000 tons in 2013 and finally over 10000 tons for 2014 all Ireland included (BIM). A multitude of factors could be responsible for this shortage; lack of suitable substrate, a possible decline of the brood stock affecting the amount of larvae (less seed mussel fished = less viable mature mussels), change of current patterns in the Irish Sea, settlements in areas not suitable for fishing and non-viable larvae.

It was proposed that a larval survey in the South Irish Sea could contribute to our knowledge on the dynamics of seed settlements. At a minimum it would establish a background level of larvae in the coastal waters and provide additional information on the distribution of mussel larvae in that area. In addition, this survey would provide valuable data for seed collections projects proposed along this area of the coastline.

Survey objective:

The main objective is to establish the amount and timing of mussel larvae in the area and its distribution over a number of years. A similar survey was carried out in 2005, but it was not replicated in the following years.

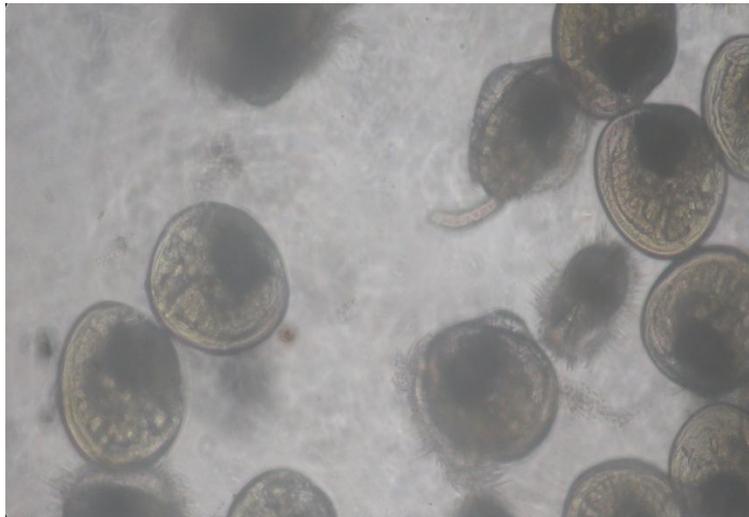


Fig. 1: Mussel Larvae

Sampling location:

In the first year of monitoring, three locations were chosen. The reason behind the choice of those three sampling stations is mainly due to the location of known brood stock (i.e. Wexford harbour), as well as empirical knowledge on current direction and historical seed mussel settlements. In addition, those sites were chosen for the practicality of access (local fisherman daily in Wexford/Cahore, charter boat weekly for Wicklow). The three sampling points are: (see maps):

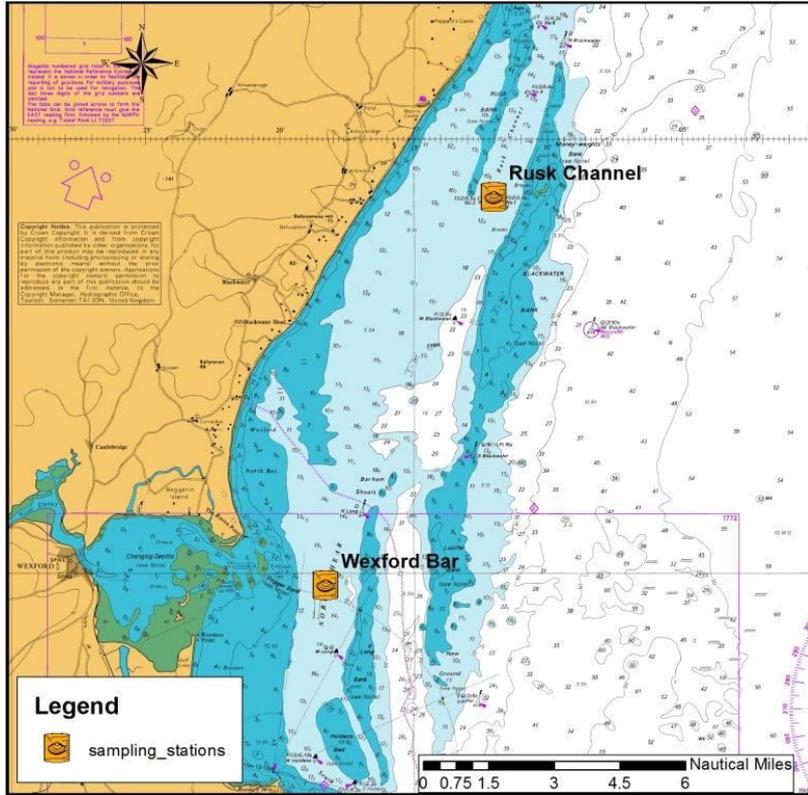


Fig. 2: Sampling Stations Location on the Wexford Coast

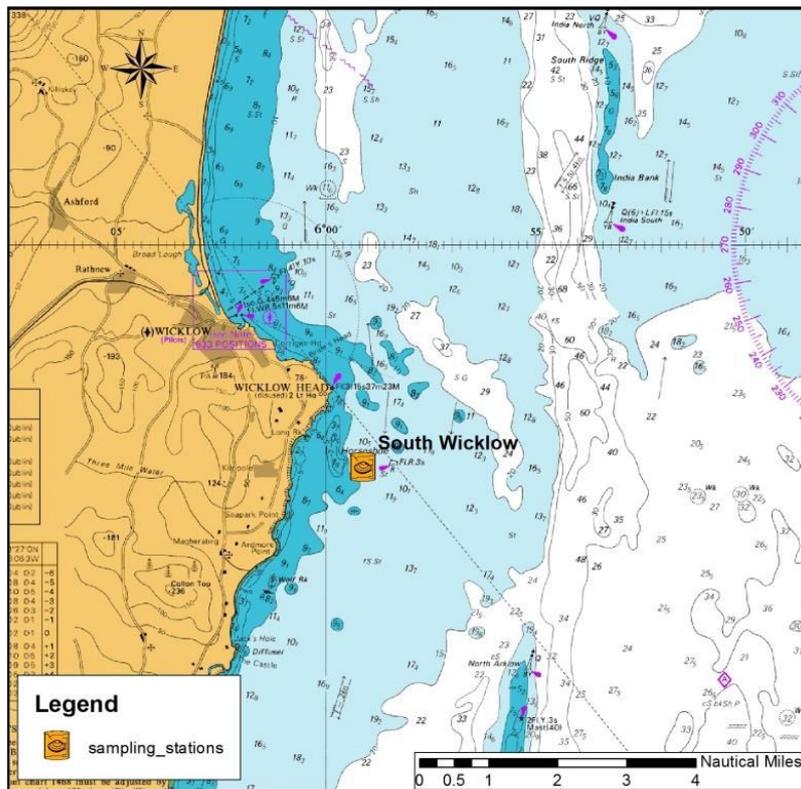


Fig. 3: Sampling Station Location on the Wicklow Coast

Sampling Locations Coordinates (WGS 84)

Location	Latitude	Longitude
Wexford Bar	52° 19.741' N	006° 18.351' W
Rusk Channel	52° 28.689' N	006° 12.067' W
South Wicklow	52° 56.799' N	005° 59.171' W

Methodology:

Weekly samples were taken from March 23rd, 2015 to July 11th, 2015 (calendar week 13 to week 27) at each location. A Wexford fisherman undertook the sampling for the Wexford Bar and the Rusk Channel while the Wicklow samples were collected by the operator of a local angling charter.

The samples were collected using a 100µm mesh plankton net weighted at the bottom to allow a vertical haul through the entire water column. The net was deployed within 2 to 3 meters of the seabed and hauled at a slow pace to the surface.



Fig. 4: Plankton net being deployed

Once on deck, the contents of the net were washed gently into a labelled jar and fixed with Lugol's iodine and sea water. At each location various parameters were recorded;

- Date and time of sampling
- Depth (sounder reading)
- Weather conditions (wind) and sea state
- Water temperature
- Current speed and direction

The samples were then posted and processed a few days after. All the data was recorded on a spreadsheet for analysis (see appendix). The analysis consisted of the identification of mussel larvae within the samples as well establishing an age classification throughout the mussel larvae using the development of the larvae internal organs.

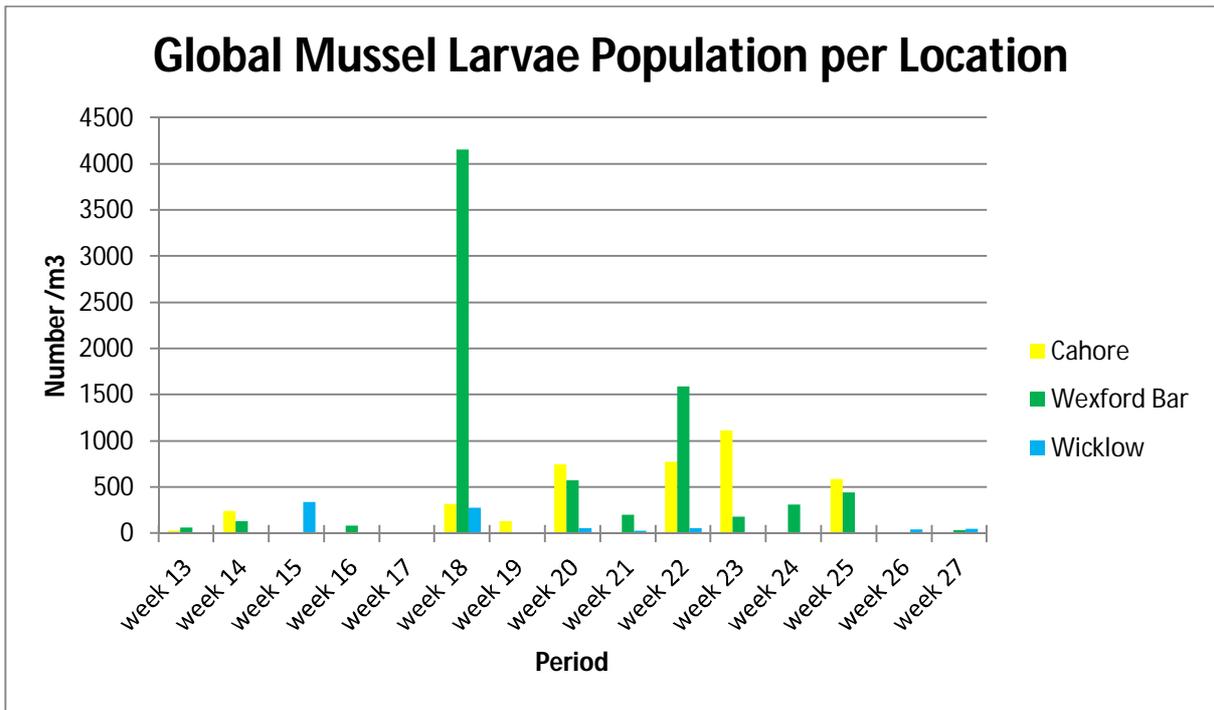
Results:

A total of 38 samples were collected. On those 38, 5 were broken during postage and could not be analysed. 9 samples could not be collected due to bad weather conditions; nevertheless the sample collection success rate was 80% across the 3 sampling stations. Two extra samples were collected as controls, one at the Wexford Bar sampling station and the second one in the South Shear across from Rosslare (those samples are included in the Wexford Bar results).

At the processing level, 75% of the samples from the Rusk Channel (3 broken during postage), 86% of the samples from Wicklow (2 broken) and 100% of the samples from the Wexford Bar were analysed.

Table 1: Global Larvae Population per Samples and Location in Number/ m³

Period	Cahore	Wexford Bar	Wicklow
week 13	27	68	*0
week 14	245	132	NS
week 15	NS	NS	340
week 16	*0	83	NS
week 17	NS	NS	NS
week 18	320	4156	277
week 19	136	*0	*0
week 20	752	574	59
week 21	NS	204	33
week 22	779	1596	56
week 23	1118	186	*0
week 24	NS	317	NS
week 25	591	442	NS
week 26	NS	NS	47
week 27	NS	37	52
* no larvae in sample	1	1	3
NS – no samples/ damage jar	6	3	5

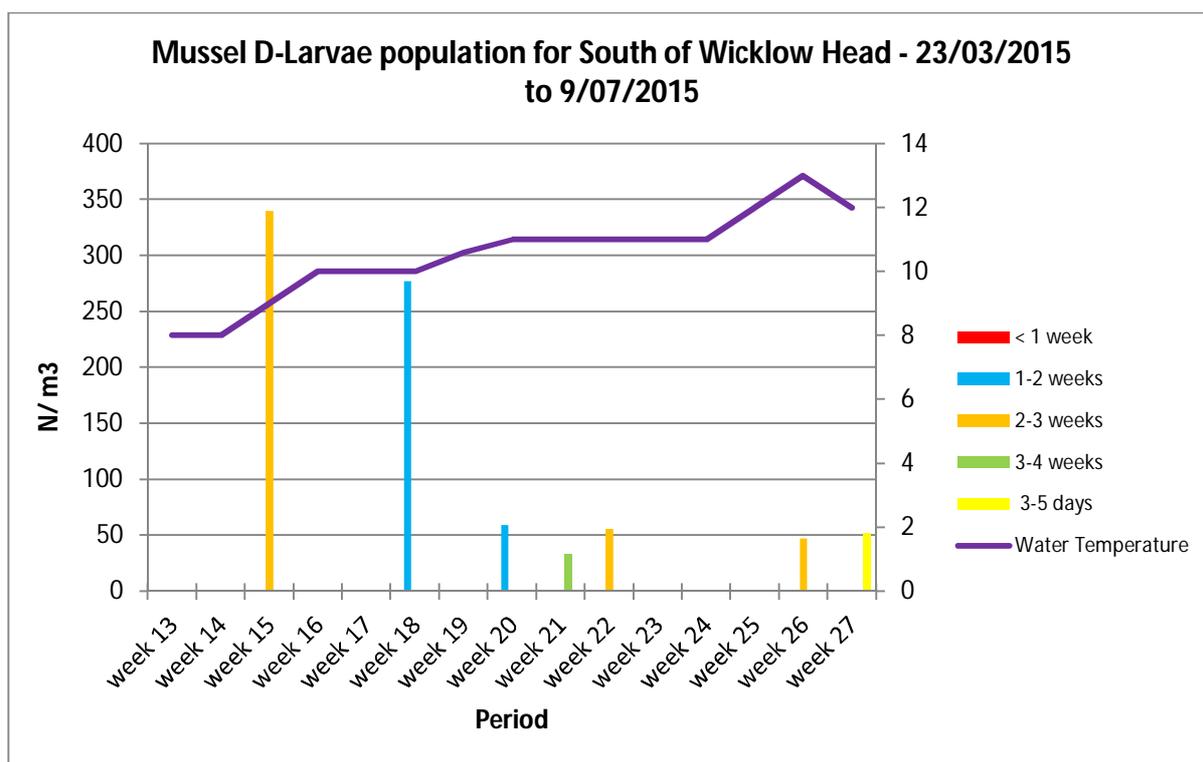


Five classes were defined in the larvae population: less than 1 week old, D-Larvae 1-2 weeks old, D-larvae 2-3 weeks old, D-larvae 3-4 old and finally D-Larvae over 4 weeks old.

➤ *Details per location:*

Table 2: D-Larvae Population for Wicklow South (Number/ m³)

Period	< 1 week	1-2 weeks	2-3 weeks	3-4 weeks	3-5 days	Water Temperature	Total larvae/week
week 13						8	0
week 14						8	0
week 15			340			9	340
week 16						10	0
week 17						10	0
week 18		277				10	277
week 19						10.6	0
week 20		59				11	59
week 21				33		11	33
week 22			56			11	56
week 23						11	0
week 24						11	0
week 25						12	0
week 26			47			13	47
week 27					52	12	52



There were two peaks in the mussel larvae population South of Wicklow Head, the first one occurred in the sample taken on April 7th when more than 300 larvae/m³ were observed (2 to 3 weeks old larvae). The second one occurred on the last week of April (sample taken on April 28th) with a new batch of larvae (1 to 2 weeks old); samples taken on the two other stations showed high number of 1 to 2 weeks old larvae as well.

Following an industry report in early summer, a large bed of young seed mussel was found in mid-July, South of Wicklow Head, which could correspond to the week 15 and the week 18 larvae settling. Regardless of those two high numbers, a steady amount of larvae at various stages were in the water until the first week of July (between 30 and 60 larvae/m³).

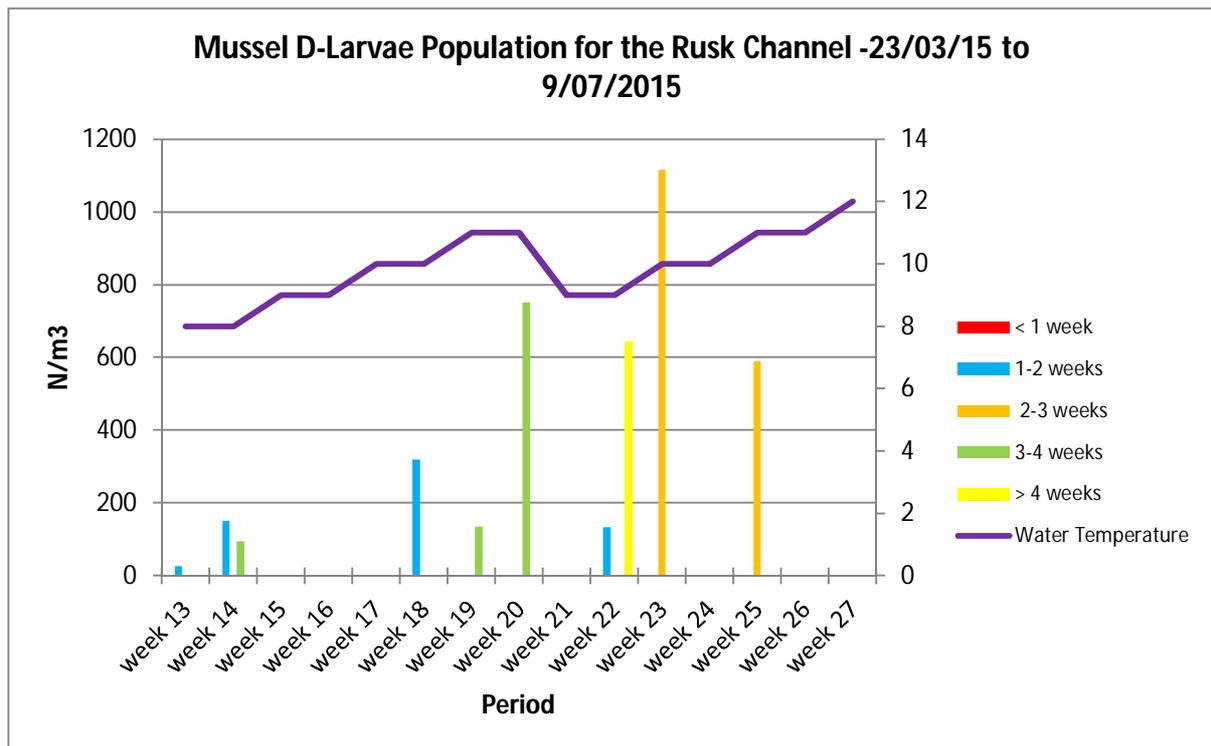
There was no sample taken on Week 16, 24 and 25 due to bad weather conditions and the samples from Week 2 and 5 were empty on arrival for processing.



Fig. 5: July 2015 Seed Mussel from Wicklow

Table 3: D-Larvae Population for the Rusk Channel/Cahore (Number/ m³)

Period	< 1 week	1-2 weeks	2-3 weeks	3-4 weeks	> 4 weeks	Water Temperature	Total larvae/week
week 13		27				8	27
week 14		151		94		8	245
week 15						9	0
week 16						9	0
week 17						10	0
week 18		320				10	320
week 19				136		11	136
week 20				752		11	752
week 21						9	0
week 22		134			645	9	779
week 23			1118			10	1118
week 24						10	0
week 25			591			11	591
week 26						11	0
week 27						12	0



The increase in larval levels at the entry of the Rusk Channel started around the Week 18 (1 to 2 weeks old larvae), which matches increases at the other sampling stations. No larvae were found in the sample taken on week 16, nevertheless we can see a rise in the population through Week 20 (2 to 3 weeks old larvae), Week 22 (over 4 weeks old larvae) and finally in Weeks 23 and 25 (new batch of 2 to 3 weeks old larvae). It can be assumed that the larvae in Week 18, 20 and 22 are the same ones only they are growing: 1 to 2 weeks old at first on week 18, two weeks after there is a peak of 2 to 3 weeks old larvae and two more weeks later, we can see a peak in the 4 weeks old population.

The Rusk Channel station had the highest number of broken and missed samples: three were broken during postage (Week 21, 24 and 27) and three others could not be collected due to bad weather conditions (Week 15, 17 and 26). Despite those gaps, the area showed good amounts of larvae at various stages of development.

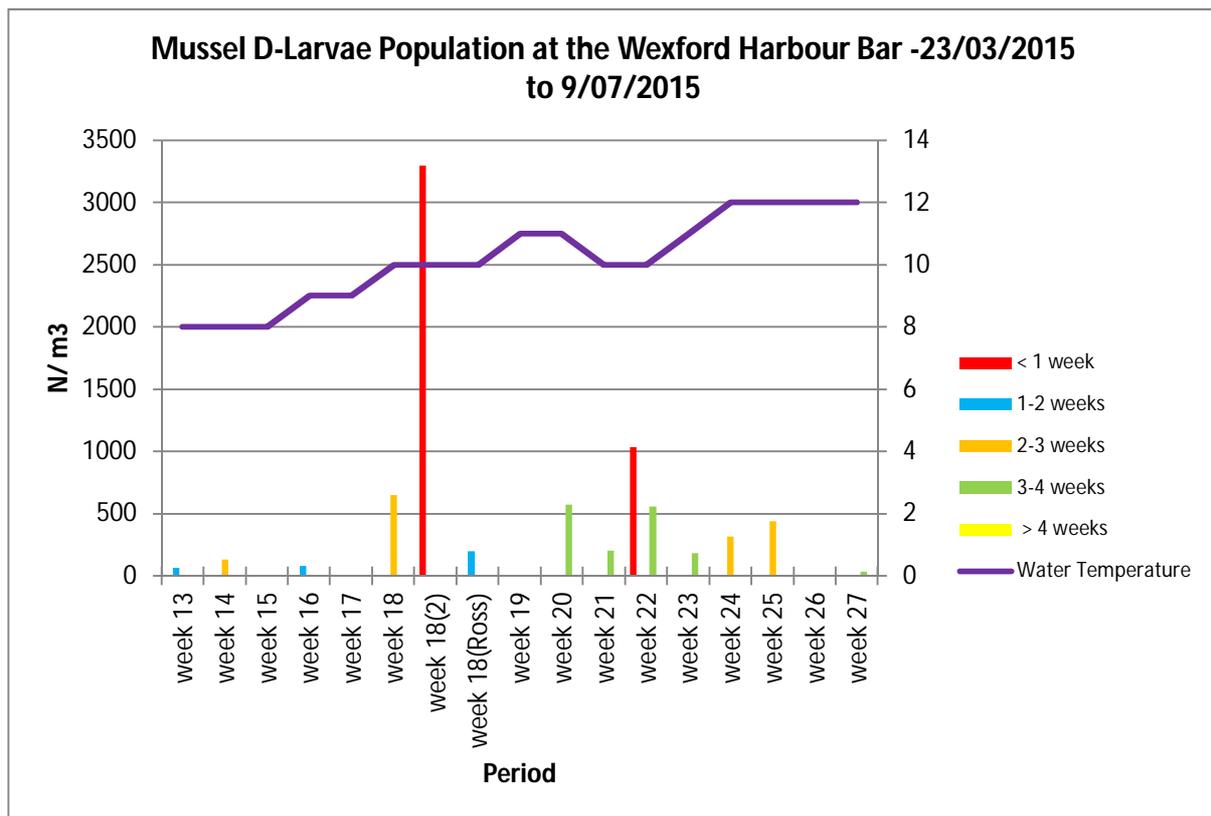
Good signs of seed were found close to where the samples were taken (between buoy No. 1 and buoy No. 2) around May 21st, which could correspond to the high amount of larvae at the location the previous month (Week 18).



Fig. 6: Rusk Channel Spat from May 21st

Table 4: D-Larvae Population at the Wexford Bar (Number/ m³)

Period	< 1 week	1-2 weeks	2-3 weeks	3-4 weeks	> 4 weeks	Water Temperature	Total larvae/ week
week 13		68				8	68
week 14			13			8	132
week 15						8	0
week 16		83				9	83
week 17						9	0
week 18			654			10	654
week 18(2)	3300					10	3300
week 18(Ross)		202				10	202
week 19						11	0
week 20				574		11	574
week 21				204		10	204
week 22				559		10	1596
week 23				186		11	186
week 24			317			12	317
week 25			442			12	442
week 26						12	0
week 27				37		12	37



The samples taken at the Wexford Bar are the only ones showing very young larvae due to the proximity of the main brood stock, and both samples have a very high content: over 3000/m³ for Week 18 and over 1000/m³ for Week 22.

We can observe a pattern on Week 20 and 21 as well as on Week 22 and 23. Both Week 20 and 22 show high numbers of larvae of 3 to 4 weeks old and both Week 21 and 23 show over 50% decrease in that category and no increase in the over 4 weeks old, which can indicate possible settling of the larvae on the seabed.

Only one sample showed no larvae (Week 19). Three samples could not be collected due to bad weather conditions.

One control sample was taken in the South Shear across from Rosslare harbour, over 200 larvae/m³ were found in the sample.

Conclusion:

- Given the three sampling stations remote from each other, the results show that mussel larvae are widespread in the southern Irish Sea. In 2015, it is postulated that larvae originating in Wexford Harbour went mainly North toward Cahore Point (according to tidal current study in the Irish Sea)¹, but a decent amount was observed around Rosslare.
- Although there were low signs of young larvae coming out of Wexford on Week 13 and 14, there was a good amount of 2 to 3 weeks old larvae in South Wicklow on Week 15.
- It is possible to observe a pattern in terms of larvae age through the weeks as well as possible signs of settling spat (see Wexford Week 20, 21, 22 and 23).

Improvements needed:

- The sampling containers need to be changed, as the current ones are too fragile.
- An extra sampling station should be established in the South Shear (Rosslare Channel).
- Sampling vessels should get temperature and salinity probes (provided by BIM).

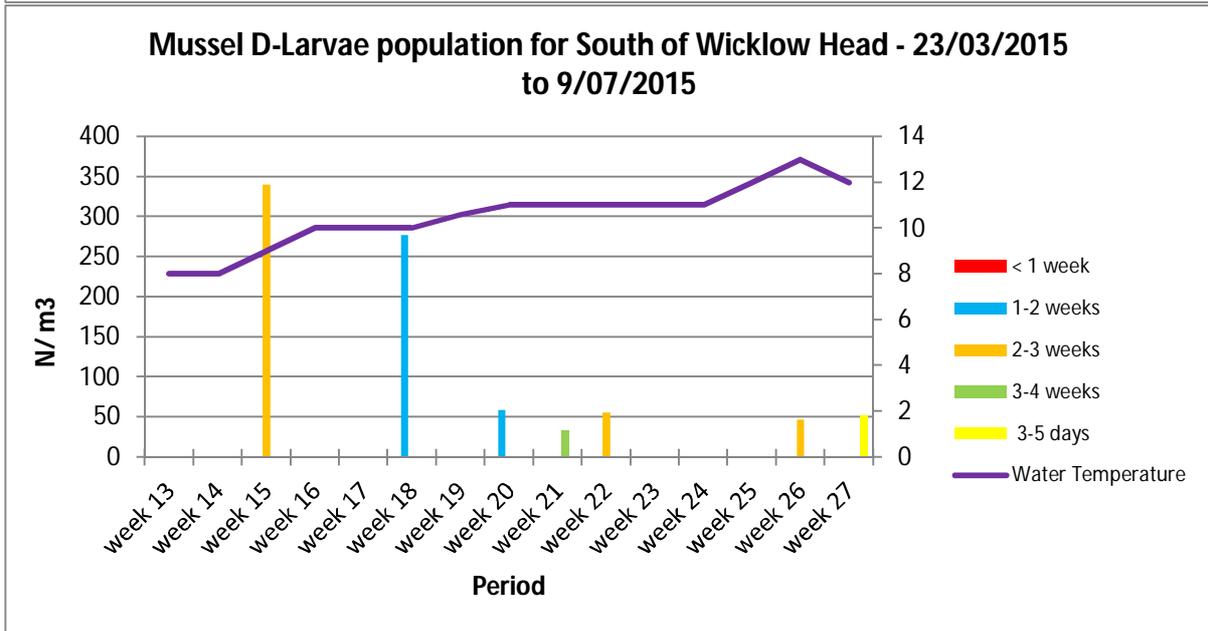
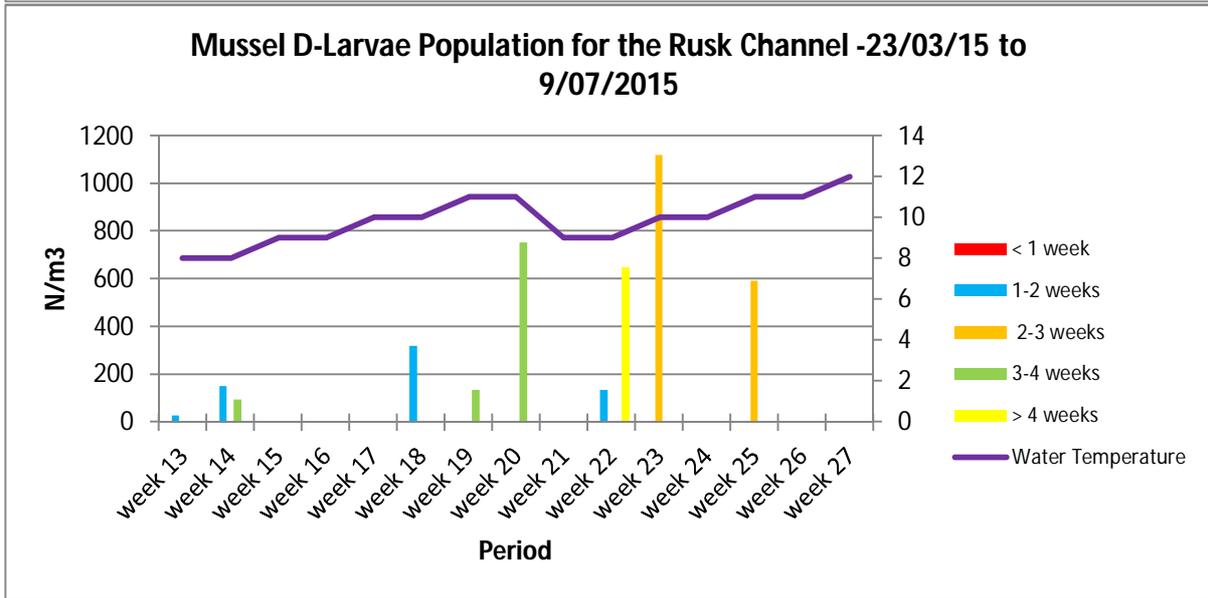
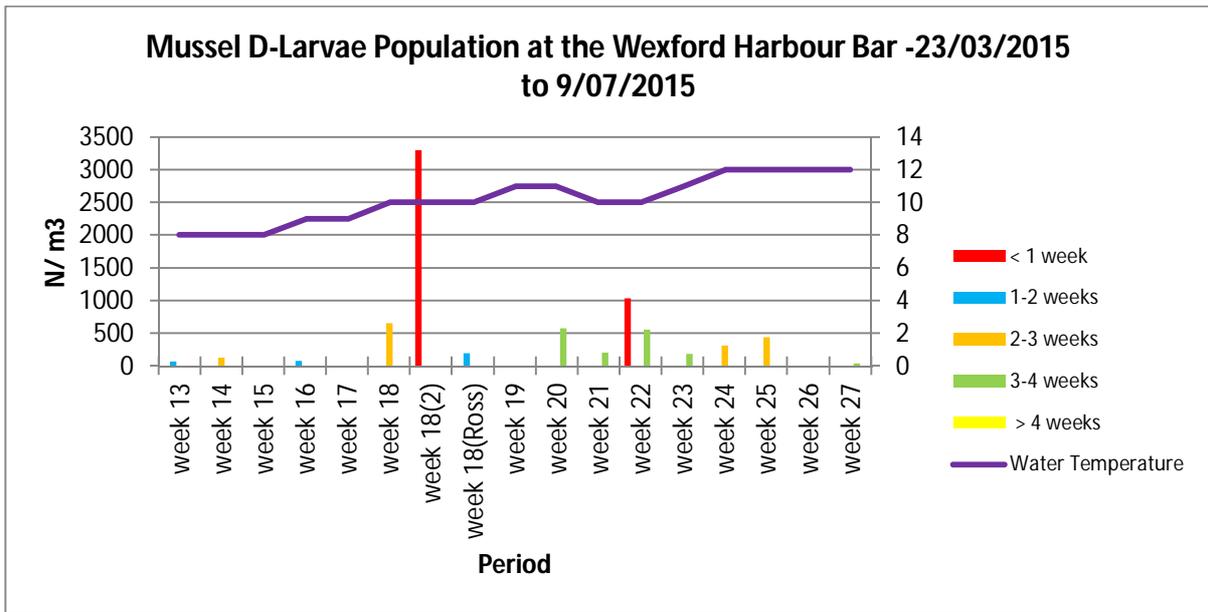
Samples analyst opinion:

April to June appeared to be the most productive periods in terms of 'spat' during the course of this project. In general, based on specific historical inner bay sheltered areas, levels of 500 spat/m³, at 3-4wks plus, with low/no competing biofouling is considered viable commercially as a settlement indicator. Using this broad guide, based on what is a 'good level', and then this level was achieved 4 times. High levels, in excess of 1000 blastula stage larvae, are not to be considered as an indicator – the main D larvae levels at week 3 plus can be considerably less following predation, adverse weather and low phytoplanktonic food. Full analysis of each site trend should be completed based on data recorded each week.

¹ Regional modelling of the 21st century climate changes in the Irish Sea – Olbert et al., 2012

Appendix:

- Graphs
- Data collection sheet



Net diameter 1ft Rope length 6m

	Tide	Weather	Depth under the boat	Sea Conditions	time	Date	Water temp.	Larvae stage/age	Spat/m3	Comments	
WX week 1	1 kt S	10 kts W	14.2 m	Calm	14:15	23/3/2015	8	D larvae- 1-2weeks mixed	68.42 (low)	Biomass moderate, Coscinodiscus dominant Bryozoa (sea matting) and Sea squirts low.	
CH week 1	1 kt S	15 kts NW	15.4 m	Calm	08:30	23/3/2015	8	D larvae- 1-2weeks mixed	27.37 (low)	Biomass low - mixed diatoms- Bacillaria dominant.Low Bryozoa . 2nd bivalve spp present- low levels.	
WW week 1	Last of ebb	NW slack	11 m	little chop	17:30	23/3/2015 rec 1-4-15	8	0	0	No visible iodine - sample live- live samples can lead to false (low) spat results due to predation.High biomass- mixed coscinodiscus spp dominant.Note some spp. Coscinodiscus have been linked to spat mortalities.No Biofouling spp present or other bivalve competitor species for settlement substrate. spat results due to predation.High biomass- mixed coscinodiscus dominant.Note some spp. Coscinodiscus have been linked to spat mortalities.No Biofouling spp present or other bivalve competitor species for settlement substrate.	
Please note - worth taking samples to within 2 metres of bottom depth - depth must be stated on each sample.wash net between sites to avoid false results from cross contamination .(This comment can be removed once read/received)											
WX week 2	1.5 kt S	15 kts E	13.6 m	choppy	14:35	04/04/2015 rec 8-4-15	8	D Larvae- 2-3 weeks	132.2	No iodine issue - Biomass low to mod - mixed diatoms , Coscinodiscus and Odonatella spp. dominant. and Odonatella spp. dominant.Low squirts and low bivalve eggs. (Fertilised eggs too soon to id re species -early blastula)	
CH week 2	2kts S	15 kts E	13.9 m	choppy	13:40	04/04/2015 rec 8-4-15	8	D Larvae 1-2 weeks D Larvae 3-4 weeks	151 94.34	No iodine issue - Biomass moderate - mixed diatoms. Odonatella spp dominant.Low tube worm levels.	
WW week 2 **	1h after HW	NW light	13.2 m	slight wave	13:00	02/04/2015 rec 8-4-15	8	empty on arrival	N/A	Empty on arrival -no black tape- no date on container	
WX week 3 *	no sample	All based on 6 metres depth - Please state depth on each site label.No depth detail Please put iodine in samples							No samples (bad weather)	N/A	NO samples for week 3 from Wexford and Cahore
CH week 3 *	no sample							No samples (bad weather)	N/A	NO Samples	
WW week 3	30 mn after HW	No wind	13.9 m	calm	14:50	07/04/2015 rec 8-4-15	9	D Larvae 2-3 weeks	340	No iodine issue - Biomass low-moderate.Coscinodiscus spp. dominant.	
WX week 4	slack	5 kts SE	14 m	calm	14:10	15/04/2015 rec 17-4-15	9	D Larvae 2weeks av	83	No visible iodine, no depth details - results based on 6 metres.Low biomass. Low copepods (predators).low clam type larvae.Mixed diatoms present, Coscinodiscus spp. dominant.	
CH week 4	0.5 kt S	5 kts SE	14.8 m	calm	13:10	15/04/2015 rec 17-4-15	9	na	0	No visible iodine.No depth data presumed 6 metres.166 sea squirt larvae, low tube worms. V.low biomass, Odonatella and Bacillaria spp.dominant.	
WW week 4 *								No samples (bad weather)	N/A	NO Samples	
WX week 5 *								No samples (bad weather)	N/A	NO Samples	
CH week 5 *								No samples (bad weather)	N/A	NO Samples	
WW week 5 **	0.5 kt S	No wind	13 m	calm	07:20	23/04/2015		empty on arrival	N/A	empty on arrival	
WX week 6	0.5 kt S	15 kts SW	14.2 m	choppy	13:30	27/04/2015 rec 29-4-15	10	D Larvae - 10% 3 weeks plus 90% - 2 weeks	654	High Biomass - Phaeocystis spp- can cause environmental related spat mortalities.Low barnacle larvae. Low iodine and 6 metres presumed depth.	
CH week 6	1 kt S	10kts W	15 m	calm	09:30	27/04/2015 rec 29-4-15	10	D larvae - 1.5-2.5 weeks	320	V.low iodine, 6metres presumed depth.V low biomass.Coscinodiscus dominant. Low squirts and moderate copepods mixed (predators).	
WW week 6	2 kts N	strong SSW	14 m	choppy	18:55	28/04/2015 rec 30/4/15	10	D Larvae - - 2 weeks	277	Low iodine, presumed depth 6 metres.V.Low biomass, Coscinodiscus spp dominant. Low barnacle and squirt larvae type.	
Rosslare Test	Slack	W 2 to 3	6 m (depth of the net)	Calm	12:40	30/04/2015 rec 6-5-15	10	D.Larvae 1-2 weeks old	202	iodine disappeared after les than 24 hours (12 drops) No vis iodine.V.low biomass, copepods moderate.	
WX test	1 kt S	W 2 to 3	6m (depth of the net)	Calm	09:10	30/04/2015 rec 6-5-15	10	Blastula bivalve	3300	iodine disappeared after les than 24 hours (12 drops) NOTE -Could be any species - 24-48 hrs after fertilisation.V.low phytoplankton and very high copepods.	
WX week 7	0.5 kt S	10 kts SW	13.8 m (net @ 11m)	calm	14:25	07/05/2015 rec 13-5-15	11	0	0	(extra rope, net 2 m from seabed) need depth total written on all containers Excessive live organic contamination,v low phyto, copepods, high live microflagellate debris.Low sand particulate material.	
CH week 7	0.5 kt N	light variable	14.7 m (net@ 12 m)	calm	12:40	07/05/2015 rec 13-5-15	11	D. Larvae - 3-4wks	136	(extra rope, net 2 m from seabed) need depth total written on all containers Excessive live organic contamination,v low phyto, copepods, high live microflagellate debris.Low sand particulate material.	
WW week 7	2 kts S	3 southerly	12.2 m (net @ 9 m)	calm	18:35	07/05/2015 rec 14-5-15	10.6	0	0	(extra rope, net 3 m from seabed) - need depth total written on all containers Excessive live organic contamination, low phyto - Coscinodiscus spp dominant., copepods, high live microflagellate debris. High sand particulate material.	
WX week 8	2 kts S	W 20 kts	13.9 m (net @11 m)	choppy	13:40	16/05/2015 rec 20-5-15	11	D.Larvae 3-4 weeks plus	574	Low Phytoplankton, coscinodiscus dominant.low Squirt/fouling organisms 1:3 spat.Moderate copepods.Based on 6 m.Live material still issue.	
CH week 8	2.5 kts S	W 20 kts	14.1 m (net@11 m)	choppy	12:45	16/05/2015 rec 20-5-15	11	D.Larvae 3-4 weeks plus	752	Low Phytoplankton, coscinodiscus dominant.low Squirt/fouling organisms 1:3 spat.Moderate copepods.Based on 6 m.Live material still issue.	
WW week 8	3 kts S	light variable	13.7 m (net @ 10 m)	choppy	20:10	12/05/2015 rec 21-5-15	11	D Larvae 1-2weeks	59	Live material- High bacteria levels due to transit time etc.Moderate land pollen, Copepods and Rhizosolenia dominant in phytoplankton.	
WX week 9	slack	10 kts SW	13.9 m(net @12m)	calm	14:10	23/05/2015 rec 26-5-15	10	D Larvae 3-4 weeks	204	Live material- Excessive copepods and mixed zooplankton , crab larvae dominant , sea squirts nearly as high as spat..Heterocapsa spp.high. Container slightly cracked.	
CH week 9 **	0.5 kt N	light easterly	14.1 m(net@12m)	calm	09:00	23/05/2015 rec 26-5-15	9	Empty on arrival	N/A	Container totally split in length.	
WW week 9	3 kts S	West Fresh	12 m (net @10m)	choppy	16:00	17/05/2015 rec 21-5-15	11	0	0	Live - High bacteria, High Rhizosolenia and copepods.	
WW week 9 (2)	3 kts N	Light variable	12.4 m (net@10m)	calm	10:00	22/05/2015	11	D larvae 4weeks plus	33	same ratio sea squirts, excessive copepods and fine sand debris.V.low phytoplankton.	

WX week 10	1.5 kt N	5 kts SW	14.5 m (net@12.5m)	calm	05:00	30/05/2015 rec 3-6-15	10	D larvae 65% 3-5 days 35% 3-4 weeks	1037 559	Live sample, v.high mixed copepods, crabs.V.low phytoplankton (diatoms), low squirts, cucumbers,starfish and urchins.
CH week 10	1 Kt N	Light variable	15.1 m (net@13 m)	calm	07:20	30/05/2015 rec 3-6-15	9	D.Larvae - 4 weeks plus D.Larvae 1-2 weeks	645 134	Live sample,602 blastulas end stage - no id confirmed yet -too early.Moderate copepods.V.low phytoplankton- mixed diatoms.
WW week 10	0.5 kt N	Light variable	12.4 m(net@10m)	slight chop	21:00	06/06/2015 rec15-6-15	11	D - Larvae 2-3wks old	56	High Diatoms and Copepods.Barnacle type larva high.
WX week 11	1 kt S	5 kts NW	14 m	calm	05:30	07/06/2015 rec 11-5-15	11	D.Larvae -3-4wks plus	186	Sample borderline reject due to excessive particulate material, sand type, - count may be higher.V.low biomass visible.No visible iodine.
CH week 11	0.5 kt N	5 kts NW	15.4 m (net@13 m)	calm	08:45	07/06/2015 rec 11-5-15	10	D.Larvae - 1-2 wks	1118	V.low phytoplankton, low copepods and no visible iodine.
WW week 11	3.5 kts S	light variable	13.2 m (net@11 m)	calm	09:45	11/06/2015 rec15-6-15	11	0	0	moderate mixed diatoms and copepods.Low to moderate mixed Barnacle type larvae.
WX week 12	1kt N	5 kts SW	14.5 m (net@ 12m)	calm	05:30	16/06/2015 rec 18-6-15	12	D. Larvae 2 weeks	317	Weak preservation.Low phytoplankton,moderate copepods, high Barnacle and Sea squirt plankton.
CH week 12 **	2.5 kts N	5 kts SW	15.6 m (net@13 m)	calm	07:45	16/06/2015 rec 18-6-15	10	broken and empty on arrival	N/A	
WW week 12 *								No samples (bad weather)	N/A	No samples (bad weather)
WX week 13	2 kts S	5 kts N	13.7 m (net @12 m)	calm	05:35	23/06/2015 rec 26--6-15	12	D.larvae 2-3 weeks	442	Moderate mixed diatoms, high copepods, low second bivalve spp (clam type)
CH week 13	2kts N	10 kts S	15.4 m (net @ 13m)	calm	11:40	23/06/2015 rec26-6-15	11	D.Larvae 2-3 wks	591	Low to moderate mixed diatoms, moderate copepods, low Heterocapsa spp and second Bivalve spp.
WW week 13 *								No samples (bad weather)	N/A	No samples (bad weather)
WX week 14 *								No samples (bad weather)	N/A	No samples (bad weather)
CH week 14 *								No samples (bad weather)	N/A	No samples (bad weather)
WW week 14	0.5 kt N	light variable	12.2 m (net@ 11m)	calm	18:00	01/07/2015 rec 6-7-15	12	D. Larvae 2-3 weeks	47	Excessive mixed particulate and live debris, v.low phytoplankton - Ceratium dominant.Low sea squirts and barnacle larvae.
WX week 15	1.5 kt S	NW 5 kts	14 m (net @12m)	calm	07:45	09/07/2015 rec 13-7-15	13	D.Larvae 3-4 wks	37	Excessive organic debris- sample live and putrifying.Phytoplankton biomass low, High mixed copepods and starfish larvae.
CH week 15 **	2 kts S	NW 5 kts	14.5 m *	calm	05:35	09/07/2015 rec 13-7-15	12	Cracked and empty on arrival	N/A	* strong drift, net not straight to the bottom
WW week 15	0.5 kt N	Southerly 3 to 4	12.2 m (net	moderate	14:00	11/07/2015	12	D Larvae 4 wks plus	52	High pollen and fish eggs,low sea squirts and low 2nd species bivalve , low phytoplankton and high debris.

* No sample = 9

** Empty on arrival= 5

	no sample	empty/broken
cahore	3	3
wexford	3	0
wicklow	3	2

	Cahore	Wexford	Wicklow
Success Rate (a)	75%	100%	67%
Success Rate (f)	80%	80%	80%