The STREAM project is part-funded by the European Regional Development Fund (ERDF) through the Ireland-Wales Cooperation programme

Ronan Browne (PhD) – presentation end of STREAM project

Some STREAM work and findings
Dr Joseph O'Mahony, John Ronan, Benyuan Yu, Mitra Abedini and Ailish Tierney

Collaboration between Ireland and Wales

Institutions involved: SETU, MTU, SU (WCPC, CSAR)

Funding: European Regional Development Fund (ERDF)

Budget: €4.3 million over five years

Focus: Addressing climate change challenges

Goal: Collecting data to protect coastal environments

Presentation today

1) Purpose of STREAM

2) Overview of work being undertaken

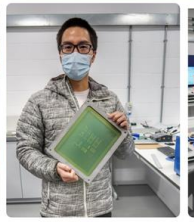
3) Some Findings (ongoing)

STREAM objectives

- A **monitoring system** for safeguarding the marine environment.
- An **online portal** connecting a diverse user community to raise awareness about climate change's effects on nutrients, marine ecosystems, and biodiversity.
- **Toolkits for coastal communities** to enhance their resilience against climate change impacts.
- **Improved ICT and sensor development expertise** in the cross-border region, focused on economically viable marine monitoring and adaptation strategies.

Diverse and complementary team

Physicists, electronic engineers, programmers, chemists, biologists, finance officers, and administrative personnel



Thermometer

In **1654**, Ferdinand II de' Medici, created sealed tubes containing alcohol that relied on liquid expansion and contraction. This was the **first thermometer** to operate independently of barometric pressure.

In **1665, Christian Huygens proposed using the melting point of ice and the boiling point of water** as reference points.

Because of the use of the thermometer we know that global heating is occurring.

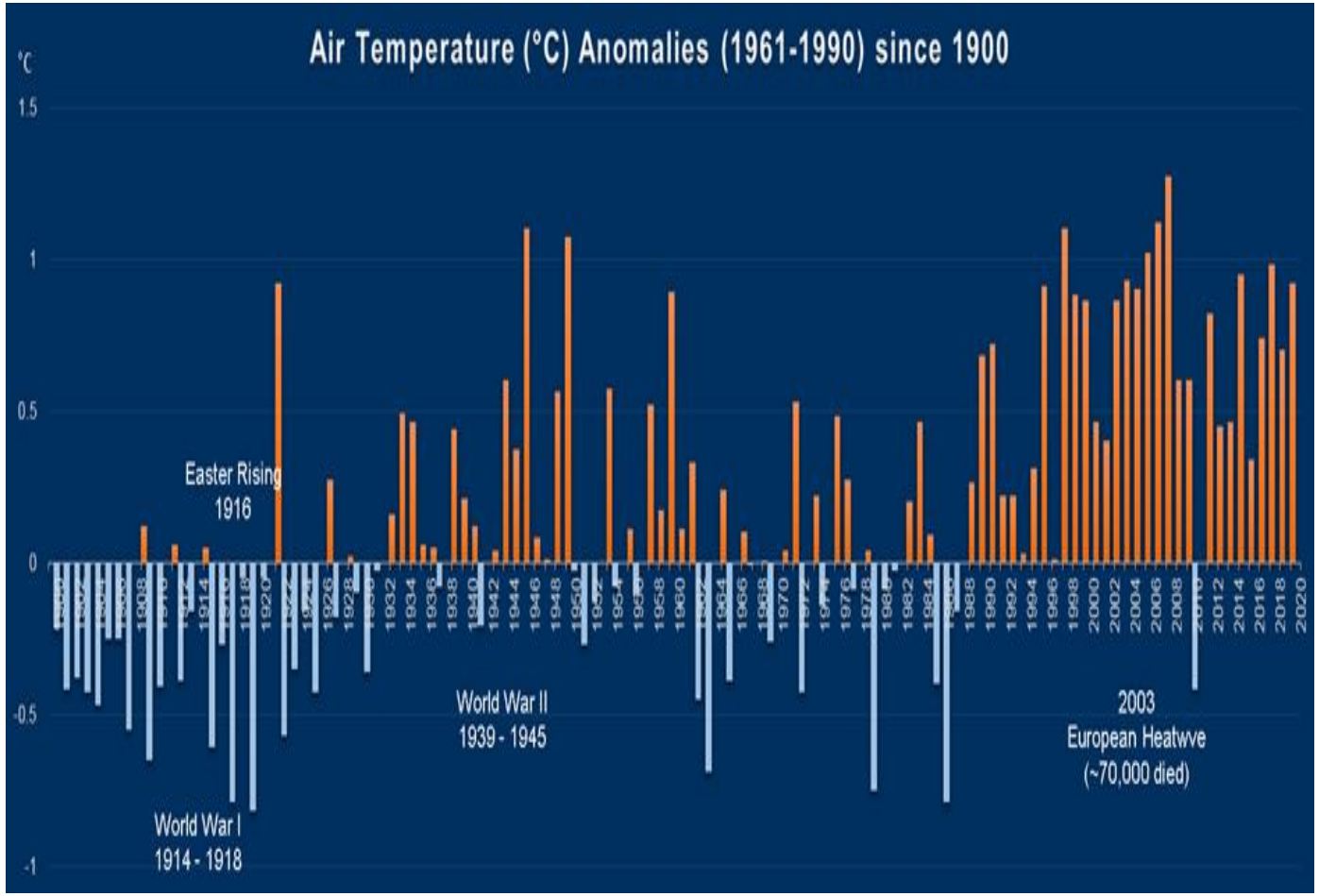
Climate change – global warming – global heating

Met Éireann (https://www.met.ie/climate/what-we-measure/temperature)

The air temperature anomalies from the year 1900 to 2019.

The difference between a mean annual temperature in the range and the mean annual temperature for the LTA 1961-1990 of 9.55°C

Met Éireann (https://www.met.ie/climate/what-we-measure/temperature) illustrates the air temperature anomaly from the year 1900 to 2019.



Some of the climate change risks and challenges facing Ireland/Wales.

Climate change is expected to have impacts on biodiversity and existing pressures.

Increasing temperatures will impact phenology (the timing of lifecycle events) and the geographical range of species.

Shifts in climate, temperature, and precipitation may increase invasive species and competitive pressures for Ireland's native species.

Erosion and flooding pose a severe risk to Ireland's coastal areas.

Physicochemical changes in the marine environment will have implications for the Marine and Fisheries sector, particularly with their ranges (decrease in northerly and increase in southerly).

Warmer waters sustain lower levels of dissolved oxygen and provide favourable conditions for the growth of individual species.

Climate change will pose risks to freshwater management, exacerbating existing pressures of supply, quality, and flooding.

For summer and autumn, projected decreases in surface water flow.

Marine Institute research indicates that the ocean off southwest Ireland will likely become warmer and less salty by the year 2035 (Marine Institute, 2021).

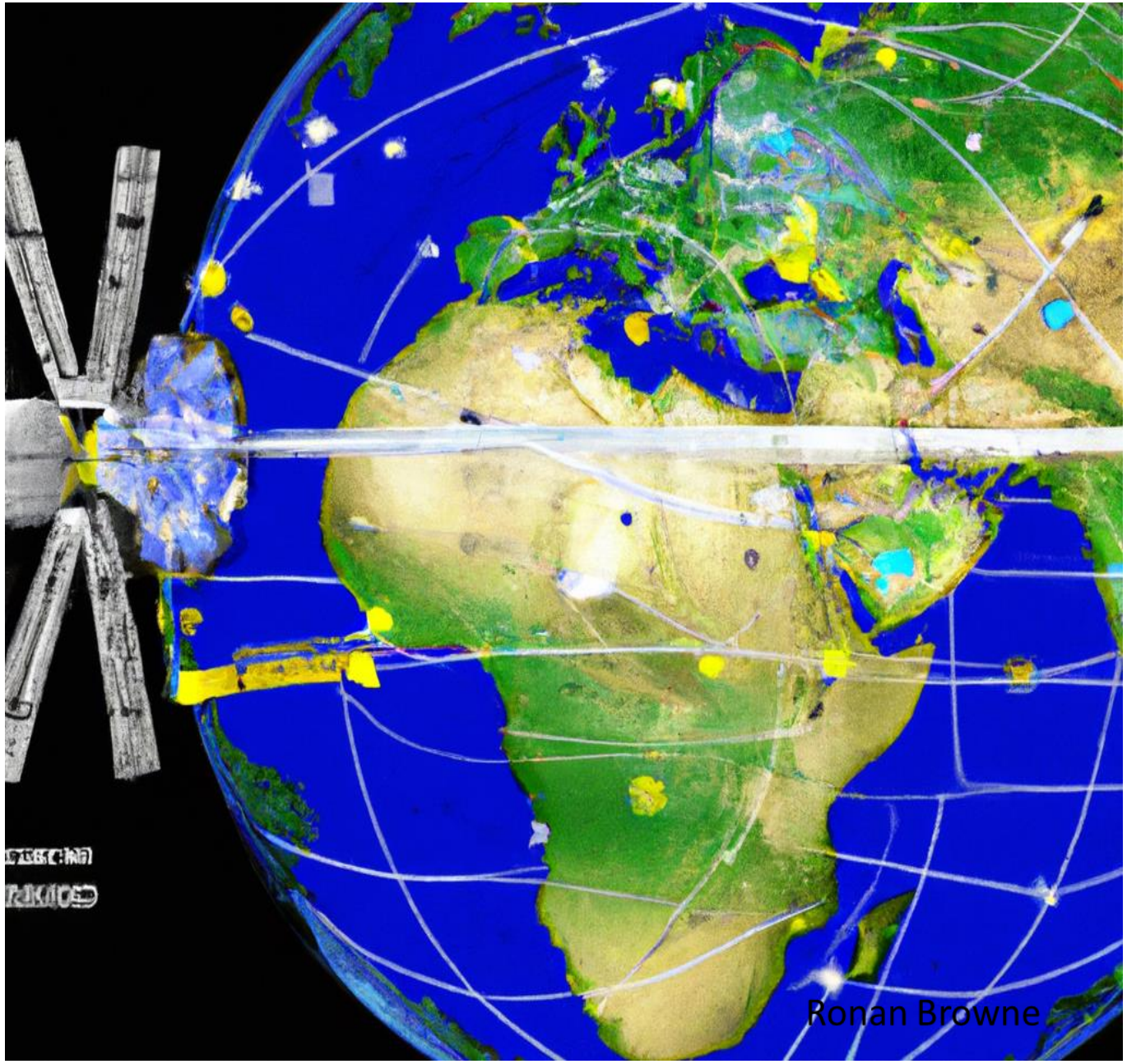
Tipping Points.

Tipping points may occur when global warming reaches temperatures beyond critical levels, leading to accelerated irreversible impacts. These events (glacier melt, methane release etc.) can create even more significant uncertainty about future climate, its extremes and, therefore, are best avoided by adopting a cautionary approach to greenhouse emissions.

Satellite and models

Satellite imagery can be used to look at some surface water quality parameters.

Mathematical climate models (like a weather forecast) are being used to predict the impacts of climate change but there is a need for more localised information (ground truthing) to improve their performance (and also “hind-casting”)



The monitoring of water quality relies on routine sampling programs involve (spot sampling):

1) The use of thermometers (sensors) to measure physiochemical parameters.

2) The physical collection of water samples.

3) The transportation of sample to a laboratory.

4) Laboratory analyses.

5) Reporting results (both laboratory and physiochemical).

Remote sensors will not remove the need for good water quality analysis but they can show out of hours water trends

Sonde and sensors – what are we measuring

Temperature,

Conductivity (salinity),

Dissolved Oxygen,

pH,

Turbidity,

Chlorophyll,

Nutrients (nitrates),

and organic carbon (TOC - DOC),

Each sensor typically focuses on monitoring a single parameter.

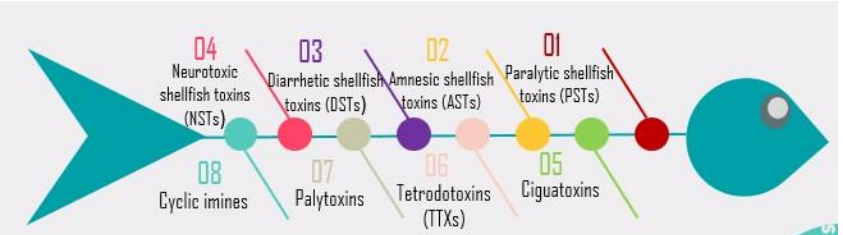
STREAM project (SETU)

Development and testing of innovative water quality sensors: Detecting nutrients in water bodies

Portable systems with optical UV spectrometers for real-time data

Simulating detection of marine toxins

Development of a network of commercial sensors/weather stations- Ireland



economic impact of marine toxins

Impact	USA	Europe
Economic losses from shellfish closures	$40 million per year	€70 million per year
Costs of toxin monitoring and testing	$10-12 million	€10-15 million
Costs of treating toxin-related illnesses	$40 million	
Economic impacts on tourism	$3 million	to £22 million

Marine toxins

Online portal for data access and engagement

Collaboration with coastal communities, researchers, and governmental bodies

Enhancing knowledge of climate change through interdisciplinary research and information sharing

Welsh Centre for Printing and Coating (WCPC)

Construction of low-cost 2D printed sensors

Monitoring water temperature, conductivity, oxygen levels, and pH

Designing housing solutions for sensor electronics

Deployment of commercial sonde's in association with CSAR

Centre for Sustainable Aquatic Research (CSAR)

Studies on the impact of climate change on fish species in the Irish Sea

Insights into future population distribution based on temperature preferences and behaviour (four species worked on)

Munster Technological University (MTU)

Analysing/ Monitoring Harmful Algal Blooms biotoxins (HABs)

Customized monitoring platform: SEAMOTE

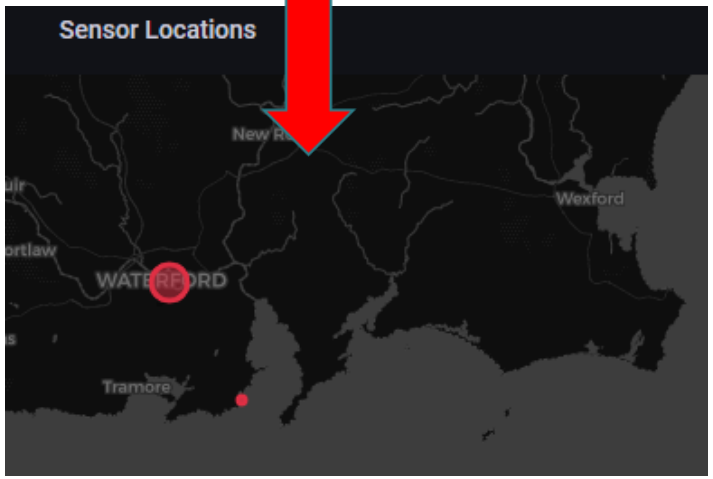
Smart pump development

Collaboration with Swansea University (SU) for weather monitoring radar systems

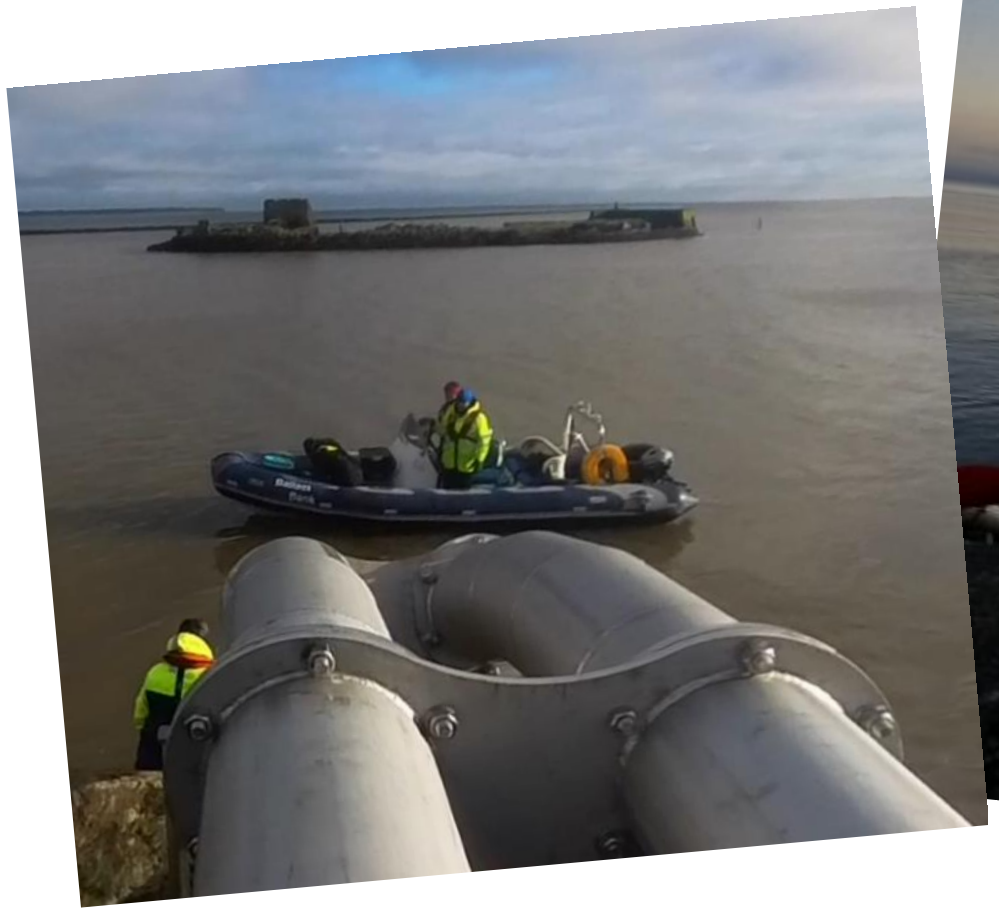
Multi parameter SONDE sites (five) – Two sites in Swansea

Weather Stations (Five)
Weather radars

STREAM
Temperature Sensor sites (two)



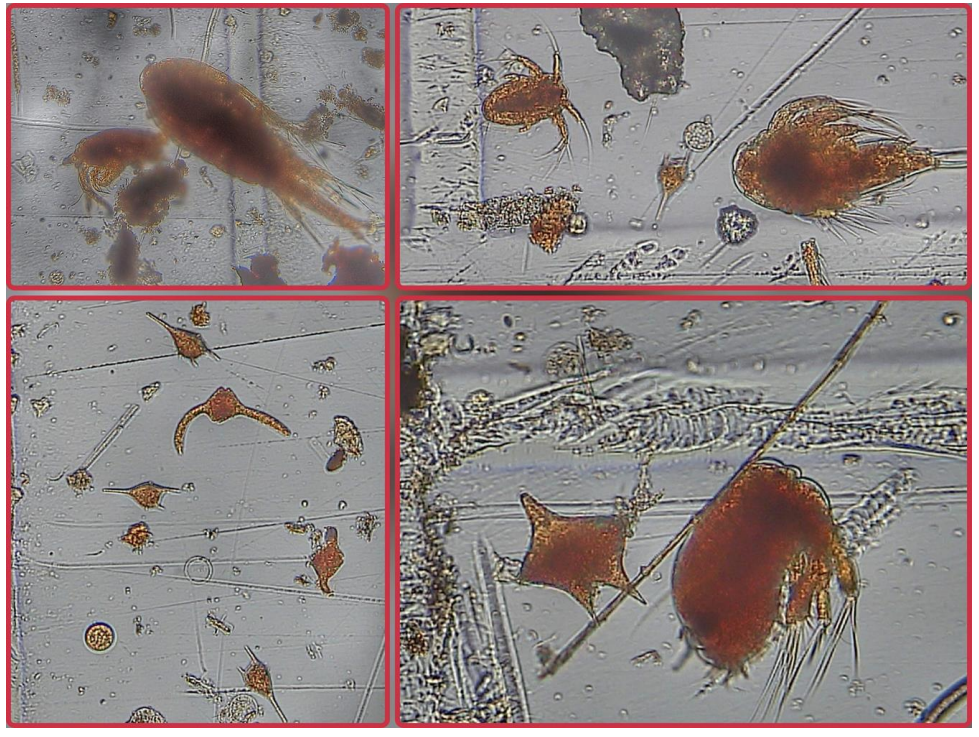
Intercalibration (comparing our sensor data with others) – EPA / Wexford Co. Co.

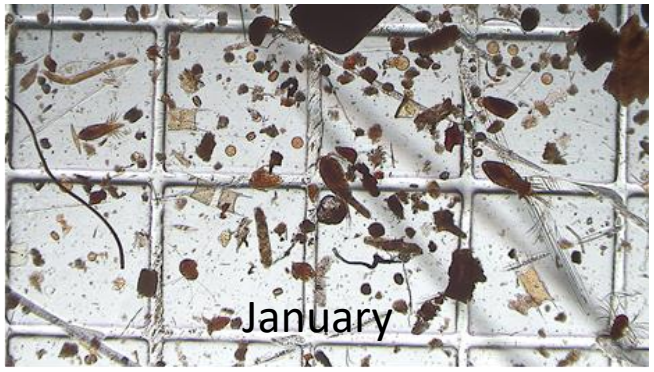


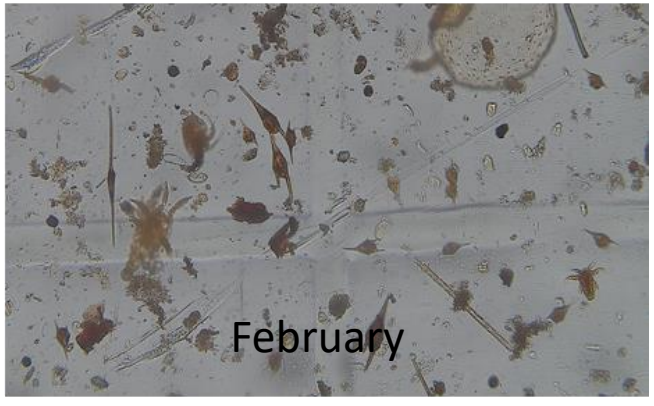
Sampling at STREAM sites for accredited analysis of saline waters
For comparison commercial and STREAM developed sensors

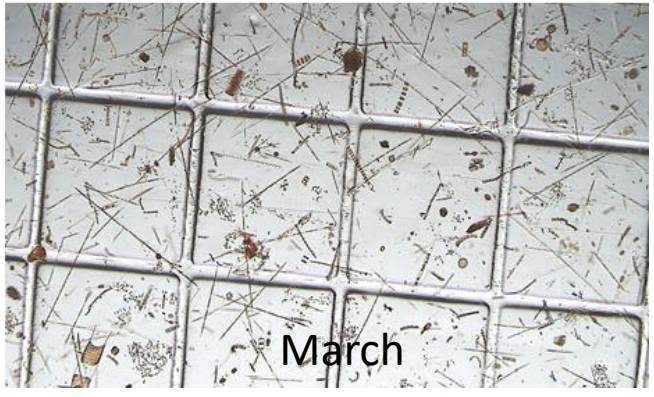
Sample No.	Report No.	Receipt Date	Sample ID	Date sampled	Time (red estimates to confirm)	Salinity	Phosphate as P filtered (low level SW or saline)	Nitrate as N saline waters	Nitrite as N saline waters	Chlorophyll a	Suspended solids	pH	TOC	DOC	Ammonia as N (saline water)
						ppt	mg/l	mg/l	mg/l	ug/l	mg/l	pH Units	mg/l	mg/l	mg/l
1514550	495290	12/08/22	Dungarvan	11/08/2022	13:00	33.6	0.010	<0.003	<0.003	10.3					
1514552	495292	12/08/22	Wexford	11/08/2022	08:30	30.2	0.024	0.118	0.005	5.78					
1514553	495293	12/08/22	Wellington	10/08/2022	09:30	5.9	0.003	2.39	0.028	250					
1537626	500961	07/10/22	Wexford Harbour, sampled 7th October at 18:30	07/10/2022	18:30	25.7	0.023	0.661	0.023	2.40	14	8.0	2.89	2.07	0.128
1537627	500962	07/10/22	Wellington Bridge, sampled 7th October at 19:10	07/10/2022	19:10	2.4	0.106	3.70	0.021	8.28	13	7.8	2.24	2.47	0.100
1537628	500962	07/10/22	Castletownbere A (Composite surface and 5m), sam	03/10/2022	13:00	34.5	0.009	0.036	0.006	<1	13	8.0	1.48	<1	0.027
1537629	500963	07/10/22	Castletownbere B (Composite 10m and 15m), samp	03/10/2022	13:00	34.5	0.011	0.043	0.007	<1	12	8.1	1.62	<1	<0.010
1547444	503624	04/11/22	Wexford 03/11/2022 @09:00	03/11/2023	09:00	1.3	0.036	3.20	0.018	1.53	30	7.7	7.90	7.66	0.079
1547445	503625	04/11/22	Wellington Bridge, 03/11/2022 @10.15	03/11/2023	10:15	<1	0.063	2.00	0.015	1.19	8	7.1	8.06	7.72	0.043
1547446	503626	04/11/22	Bannow 03/11/2022 @10.45	03/11/2023	10:45	11.0	0.043	1.96	0.021	4.01	31	7.7	6.06	5.70	0.102
1547447	503627	04/11/22	Waterford Pontoon 03/11/2022 @12.05	03/11/2023	12:05	<1	0.065	1.71	0.016	3.20	35	8.0	9.63	9.21	0.154
1547448	503628	04/11/22	Dunmore East 03/11/2022 @12.30	03/11/2023	12:30	21.4	0.036	1.02	0.010	<1	12	8.0	5.09	4.87	0.046
1547449	503629	04/11/22	Castletownbere 03/11/2022 @11.30	03/11/2023	11:30	33.0	0.007	0.046	0.006	1.07		8.0	1.52	1.29	0.025
1553102	504990	18/11/22	Wexford	16/11/2022	07:30	18.4	0.021	1.90	0.019	<1	<2	7.8	3.63	3.01	0.117
1553103	504991	18/11/22	Wellington Bridge	16/11/2022	08:30	<1	0.043	3.13	0.021	<1	<2	7.2	6.16	5.53	0.029
1553104	504992	18/11/22	Bannow	16/11/2022	09:00	12.5	0.043	2.19	0.027	<1	11	7.6	4.73	4.34	0.087
1553105	504993	18/11/22	Waterford Pontoon	16/11/2022	10:45	1.7	0.036	2.17	0.019	<1	<2	7.9	6.63	6.01	0.079
1553106	504994	18/11/22	Dunmore East	16/11/2022	11:30	19.3	0.030	1.45	0.011	<1	10	7.9	4.79	4.35	0.034
1553107	504995	18/11/22	Castletownbere	17/11/2022	11:00	31.3	0.015	0.100	0.009	1.07	6	7.9	1.82	1.20	<0.010
1560991	506852	08/12/22	Wexford	07/12/2022	08:00	10.4	0.034	3.26	0.014	1.14	13	7.8	3.53	2.83	0.051
1560992	506853	08/12/22	Wellington Bridge	07/12/2022	08:35	<1	0.021	2.92	<0.003	1.87	4	7.5	3.49	3.03	0.038
1560993	506854	08/12/22	Dungarvan	07/12/2022	11:00	26.8	0.011	0.908	0.009	1.64	13	8.1	2.39	2.07	0.056
1560994	506855	08/12/22	Castletownbere	08/12/2022	11:00	33.5	0.021	0.131	0.005	<1	5	8.1	1.98	1.37	<0.010
1583660	512330	20/02/2023	Wexford	16/02/2022	07:30	12.9	0.02	0.675	0.013	1.07	5	8.1	2.12	2.07	0.038
1583661	512331	20/02/2023	Wellington Bridge	16/02/2022	08:15	<1	0.017	0.999	0.011	<1	<2	7.5	1.81	1.51	0.022
1583662	512332	20/02/2023	Dungarvan	12/02/2022	13:40	29.5	0.017	0.719	0.007	<1	13	8	1.5	1.39	0.028
1583663	512333	20/02/2023	Waterford Pontoon	16/02/2023	11:14	5.3	0.031	0.775	0.008	1.34	11	8.2	2.34	2.27	0.038
1583664	512334	20/02/2023	Dunmore East	16/02/2023	11:55	26.8	0.02	1.14	0.005	1.07	7	8	1.91	1.54	<0.010
1583665	512335	20/02/2023	Castletownbere	17/02/2023	10:52	34.5	0.021	0.119	0.003	<1	4	8	1.11	1	0.018
1593776	514882	16/03/2023	Wexford	14/03/2023	11:10	16.6	0.015	2.05	0.01	2.14	7	8.1	2.57	2.18	0.037
1593777	514883	16/03/2023	Wellington Bridge	14/03/2023	12:00	<1	0.053	2.7	0.013	2.4	5	7.3	6.95	6.69	0.05
1593779	514885	16/03/2023	Bannow	14/03/2023	12:41	9.3	0.035	2.09	0.015	2.14	17	7.8	5.83	5.44	0.086
1593781	514886	16/03/2023	Waterford Pontoon	14/03/2023	13:30	<1	0.036	2.74	0.01	11.3	108	8.1	4.34	3.95	0.038
1593782	514887	16/03/2023	Dunmore East	14/03/2023	14:30	32.7	0.014	0.07	0.004	1.33	18	8	1.33	1.05	0.013
1593784	514889	16/03/2023	Castletownbere	15/03/2023	11:00	34.3	0.019	0.02	0.004	2.14	9	8.1	1.25	<1	<0.010
1601464	517034	07/04/2023	Wexford	05/04/2023	07:45	20.2	0.023	1.455	0.01	<1	11	7.9	3.3	3.38	0.022
1601465	517035	07/04/2023	Wellington Bridge	05/04/2023	08:40	<1	0.018	4.195	0.008	<1	7	7.7	2.41	2.43	0.018
1601466	517036	07/04/2023	Bannow	05/04/2023	08:59	25.4	0.022	1.16	0.009	2.14	15	8	1.96	1.86	0.047
1601467	517037	07/04/2023	Waterford Pontoon	05/04/2023	10:45	2.7	0.019	2.987	0.01	2.14	70	7.9	4.26	4.04	0.044
1601468	517038	07/04/2023	Dunmore East	05/04/2023	11:20	29.9	0.011	0.119	0.007	1.33	31	8	2.02	1.92	0.014
1601469	517039	07/04/2023	Castletownbere	06/04/2023	12:00	33.9	0.026	0.014	0.004	2.14	17	8	1.36	1.32	0.06

Castletownbere – MTU SONDE
Plankton - Greek verb meaning “to wander”
zooplankton – phytoplankton – interested in looking at their relationship to physiochemical measurements





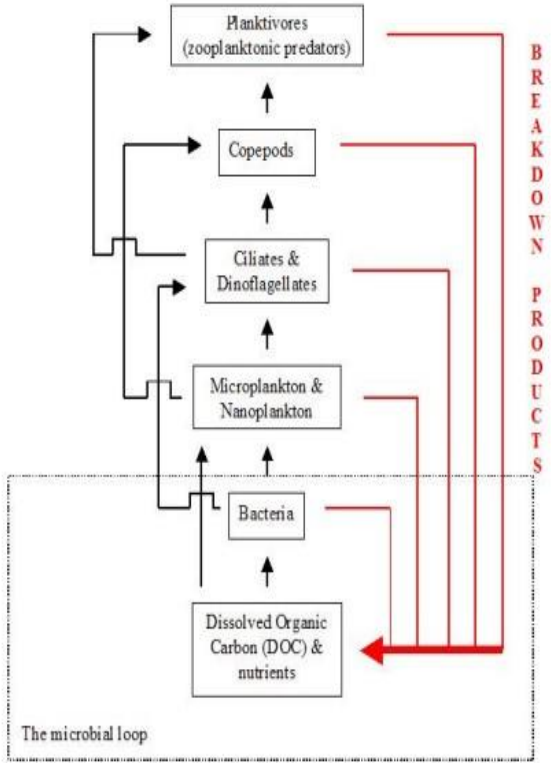




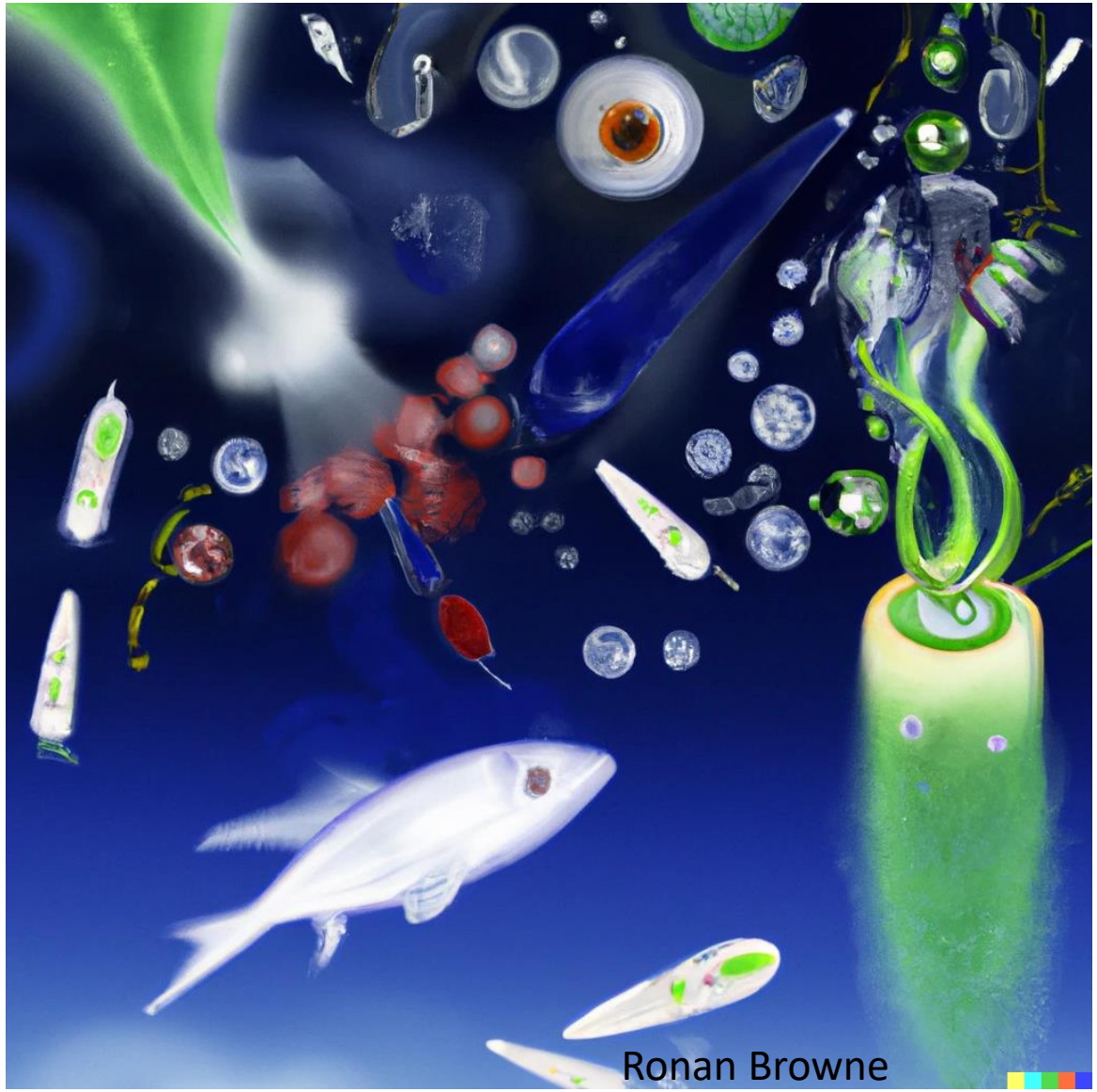
Nutrients, physiochemical properties, bacteria, phytoplankton, zooplankton,

Concern about changes in the marine food web

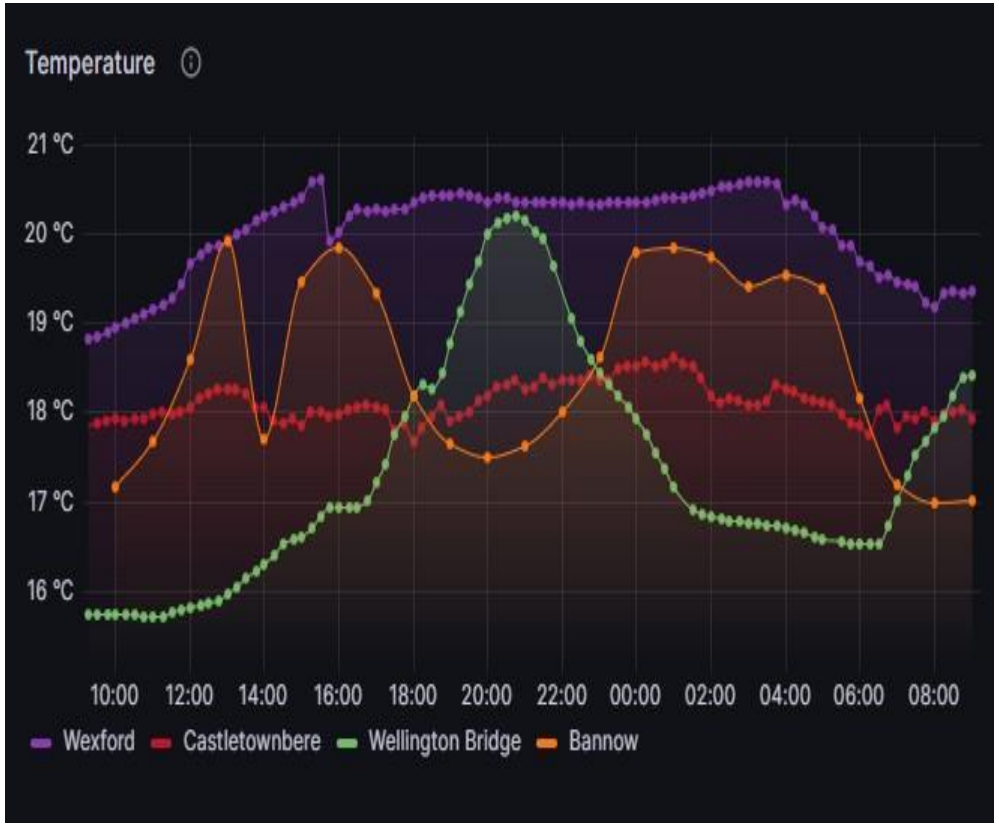
Simplified planktonic food web showing direction of consumption (blacklines) and recycling of waste material (red lines).



K. Kennington & W. Ll. Rowlands



Data for sites available live and also historically (an excel file each month)

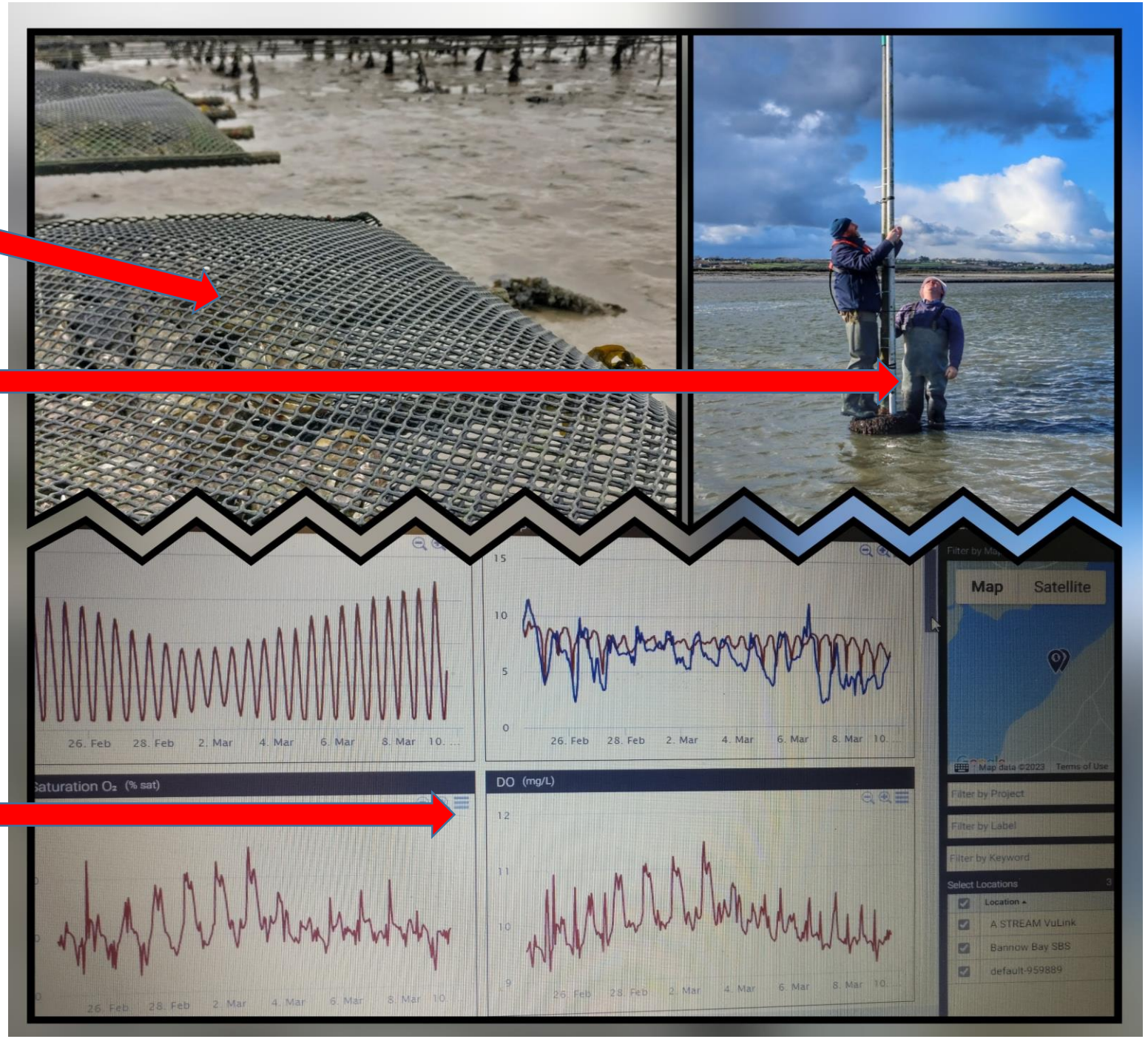


1 Bannow Bay Oyster Farm

Oysters in bags on trestles

Commercial sonde with telemetry (aerial)

Live data



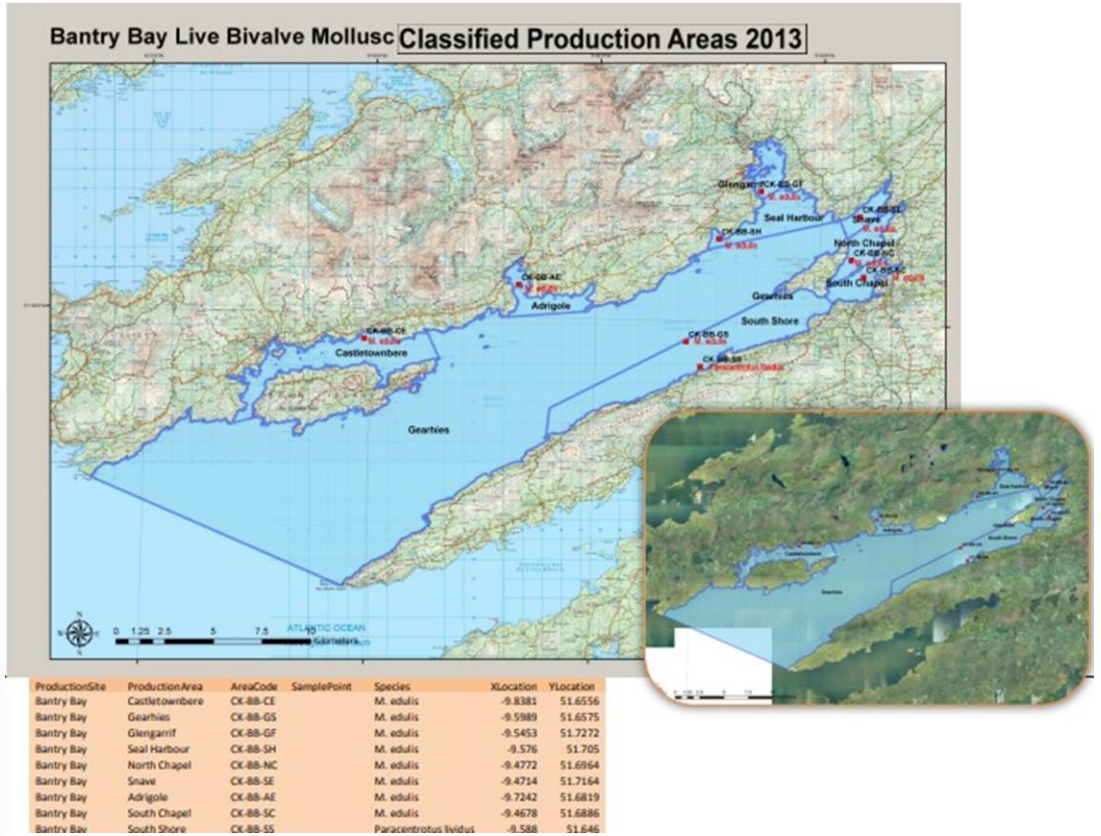
From the office PC

1) They can now decide on when to leave for the shore (10 minute drive)

2) They can see the extremes of temperature (air and water) that the oysters have been exposed to

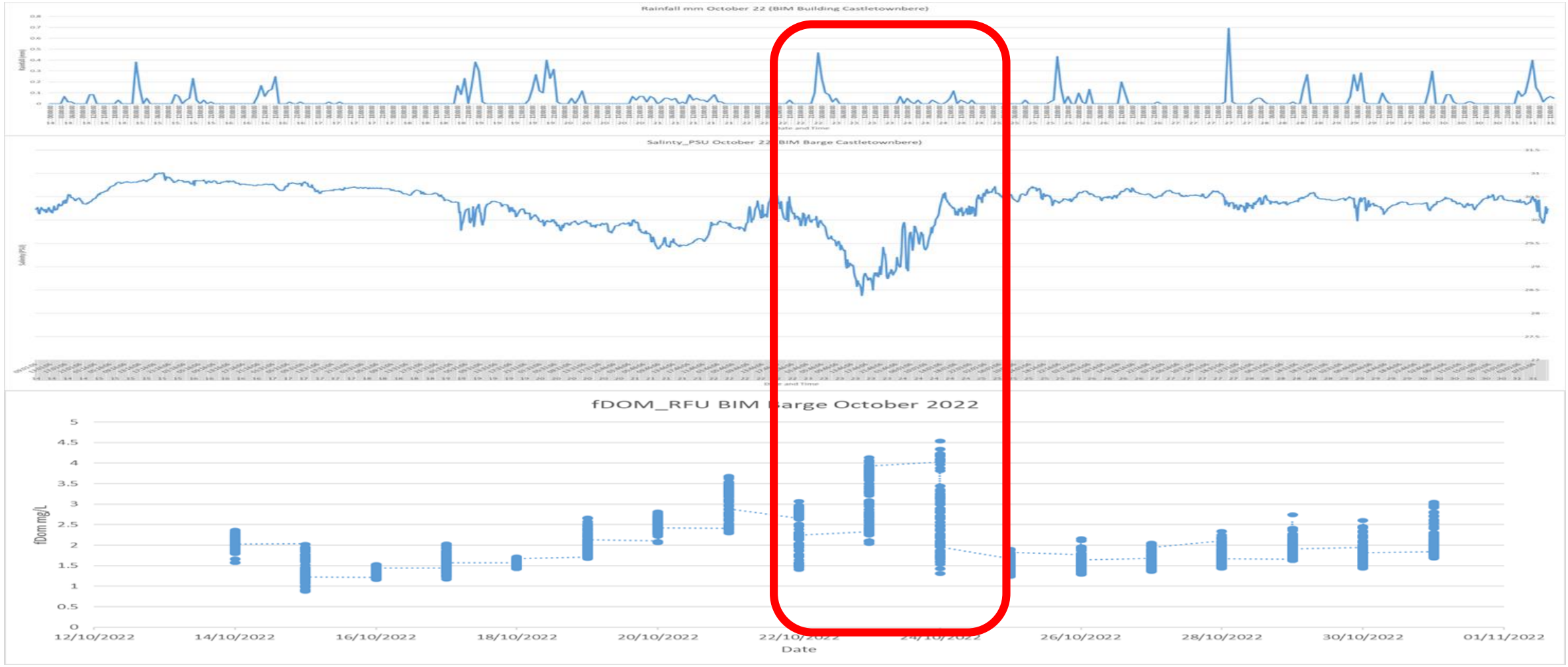
3) They can see how low the oxygen level may have fallen overnight

Mussels (*M. edulis and M. galloprovincialis*)



ProductionSite	ProductionArea	AreaCode	SamplePoint	Species	XLocation	YLocation
Bantry Bay	Castletownbere	CK-BB-CE		M. edulis	-9.8381	51.6556
Bantry Bay	Gearhies	CK-BB-GS		M. edulis	-9.5989	51.6575
Bantry Bay	Glengarrif	CK-BB-GF		M. edulis	-9.5453	51.7272
Bantry Bay	Seal Harbour	CK-BB-SH		M. edulis	-9.576	51.705
Bantry Bay	North Chapel	CK-BB-NC		M. edulis	-9.4772	51.6964
Bantry Bay	Snave	CK-BB-SE		M. edulis	-9.4714	51.7164
Bantry Bay	Adrigole	CK-BB-AE		M. edulis	-9.7242	51.6819
Bantry Bay	South Chapel	CK-BB-SC		M. edulis	-9.4678	51.6886
Bantry Bay	South Shore	CK-BB-SS		Paracentrotus lividus	-9.588	51.646

Below are the BIM Barge (STREAM sensors) Castletownbere October 2022 showing rainfall, salinity and fDOM. All the data points shown on the fDOM chart are recorded over the course of a day.



Conclusion and impact of the STREAM project

There is a need for a more extensive network of sensors – that have inbuilt redundancies and that are well managed.

Require more biological information to compare with the physiochemical and nutrient readings.

There is a need for collaborative work and centralisation of data and its quality control.

1) Temperature, Salinity (Cond) and oxygen (depth).
2) Other parameters are an advantage but need careful appraisal.

STREAM to do list

Data to be studied from over the last year and a half.

Presentation of work at local meetings

Production of reports, factsheets, and climate change toolkits

Thank you!

- Acknowledgment of project team members and partners

- Wexford County Council - Brendan Cooney
- EPA – Dr Robert Wilkes
- BIM Brian O’Loan
- BIM Shane Begley - Weather Station and Barge (Castletownbere), Dave Millard, Geoff Robinson
- Marine Institute -Dave Clarke, Jonathan Kelly
- Tramore Coast Guard
- Dunmore East Harbour - Monitoring sites
- Waterford City River Rescue - Monitoring sites
- Southern Regional Assembly - Breda Curran

STREAM

Sensor Technologies for Remote Environmental Aquatic Monitoring

The STREAM project is part-funded by the European Regional Development Fund (ERDF) through the Ireland-Wales Cooperation programme

SETU MTU


Clár Na hÉireann - Na Breataine Bige 2014-2020
Rhaglen Iwerddon Cymru 2014-2020
Ireland Wales Programme 2014-2020
Cronfa Datblygu Rhanbarthol Ewrop
European Regional Development Fund
UNDEB EWROPEAIDD
EUROPEAN UNION
Llywodraeth Cymru
Welsh Government
Tionól Réigiúnach an Deiscirt
Southern Regional Assembly
Ireland's European Structural and Investment Funds Programmes 2014-2020
Co-funded by the Irish Government and the European Union

STREAM