ANChor:

Appraisal of network connectivity between North Sea oil and gas platforms

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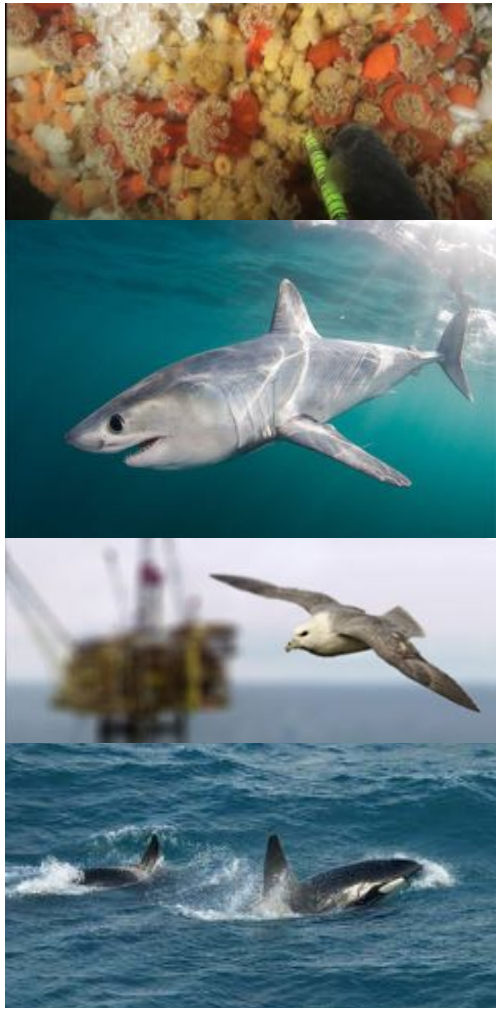
INSITE

High Level Ambitions

ANChor is part of a suite of INSITE projects that appraise whether structures can anchor (connect) species, populations and North Sea ecosystems

Rationale behind environmental management decisions must be rigorously tested

Can INSITE's different approaches come to a consensus about connectivity?



INSITE

Project Overview

(1) Analysis of industry marine growth surveys

(2) Biologically realistic particle tracking

(3) Network analyses

(4) Decommissioning scenarios

INSITE

ArcGIS geodatabase of marine growth from 66 North Sea platforms

- depth range, peak abundance
- agreements to share/publish data coming in place
- focus on 5 common, native marine growth species

Spawning season
Depth range on rig
Pre- & post competency
Pelagic larval duration
Swimming behaviours





	Stony coral	Soft coral	Blue mussel	Barnacle	Anemone
Pre-competency period (days)	32	10	20	10	15
Competency period (days)	28	8	10	8	7
Planktonic larval duration (days)	60	18	30	18	22
Spawning season	Jan-Feb	Dec-Jan	Apr-Sep	Mar-May	Aug-Sep
References	www.marlin.ac.uk/biotic; Larsson et al., 2014; Strömberg, 2016	www.marlin.ac.uk/biotic; Hartnoll, 1975	www.marlin.ac.uk/biotic; Sprung, 1984; Fuchs and DiBacco, 2011	www.marlin.ac.uk/biotic; Rainbow, 1984; DiBacco et al., 2011; Miller et al., 2013 compiled data from various sources; mostly observations from other species	www.marlin.ac.uk/biotic; Scott and Harrison, 2007 for the anemones *Entacmaea quadricolor* and *Heteractis crispa*
Total # particles released	61180	166376	408408	283374	218736

SCIENCE GAP: Relevant larval biology studies

Industry data and biological traits used to make simulations realistic

5 x Individual-Based Models (i.e., species-specific simulations)

Ocean circulation model: NEMO 3D ocean circulation model of the Atlantic Margin Model 1/60º,1.8 km horizontal resolution

Particle tracking model: LTRANS, a particle-tracking code that can include complex larval behaviours

Simulations run for the year 2010 (a conservative base-case)*

***for protected coral *Lophelia*, 2010-2012 to cover range of circulation patterns**

Major Findings

"To what extent, if any, the man-made structures in the North Sea represent a large inter-connected hard substrate system"

Man-made structures show strong potential to form large inter-connected systems:
***ANChor* measured clustering, centrality, betweeness, in- & out-degree**

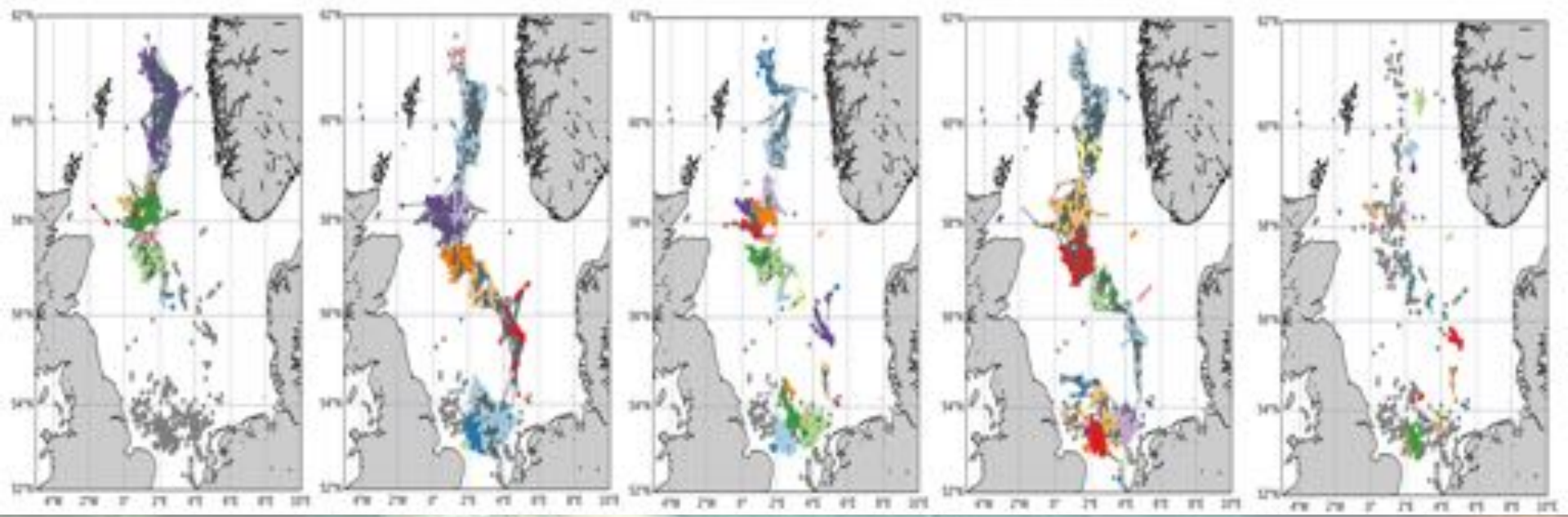
- **some species more than others**
- **some years more than others**
- **some structures more important than others**

Major Findings

"The magnitude of the effects of man-made structures compared to the spatial and temporal variability of the North Sea ecosystem, considered on different time and space scales"

- **Man-made structures have potential to contribute to natural ecosystems downstream**
- **Platform ecosystems are evolving to mimic those in the wild**

Major Findings - Connectivity



Stony coral
Lophelia pertusa

Blue mussel
Mytilus edulis

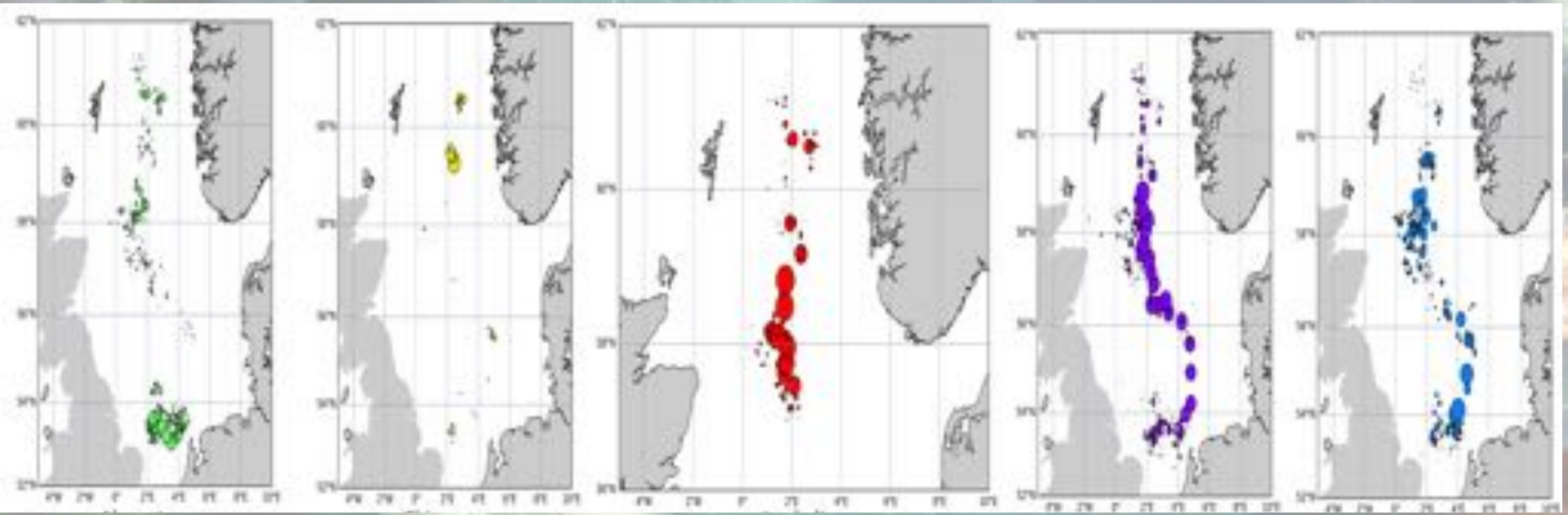
Soft coral
Alcyonium digitatum

Anemone
Metridium senile

Barnacle
Chirona hameri

“Clusters” – groups of highly connected structures:
***Lophelia* had fewest, *Chirona* had the most**

Major Findings - Connectivity



Soft coral
Alcyonium digitatum

Barnacle
Chirona hameri

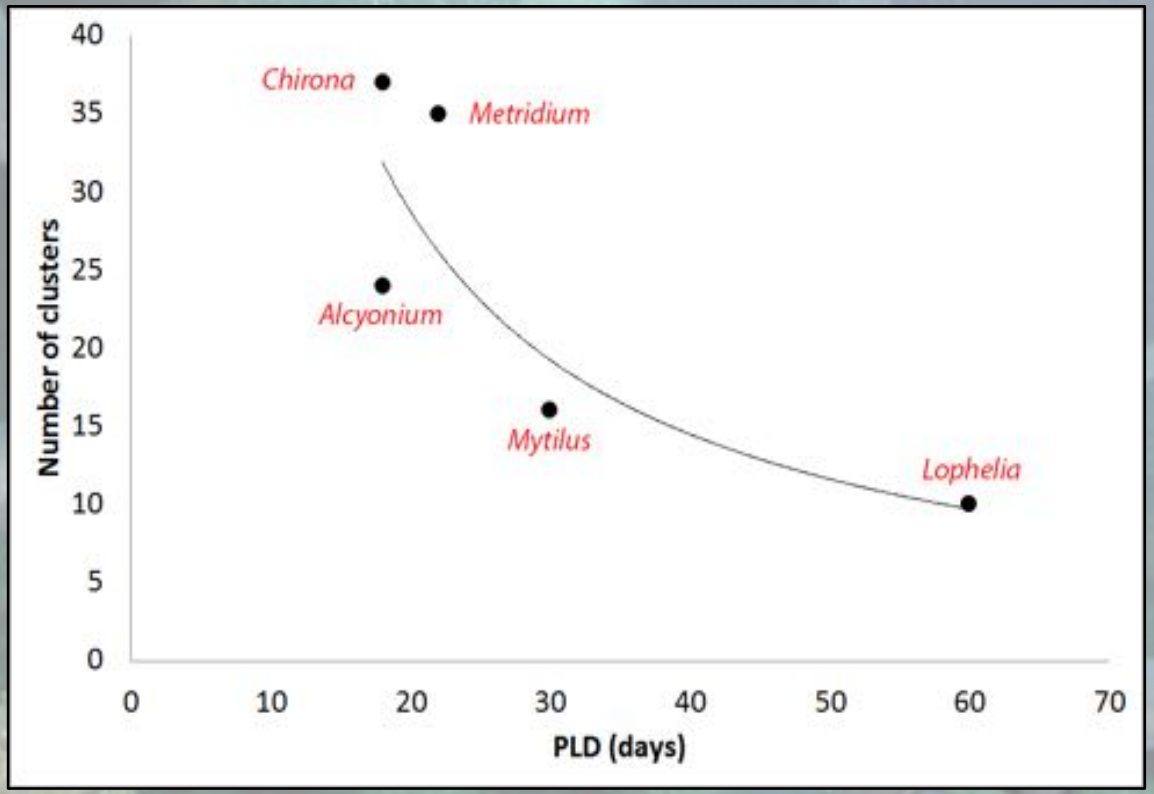
Stony coral
Lophelia pertusa

Anemone
Metridium senile

Blue mussel
Mytilus edulis

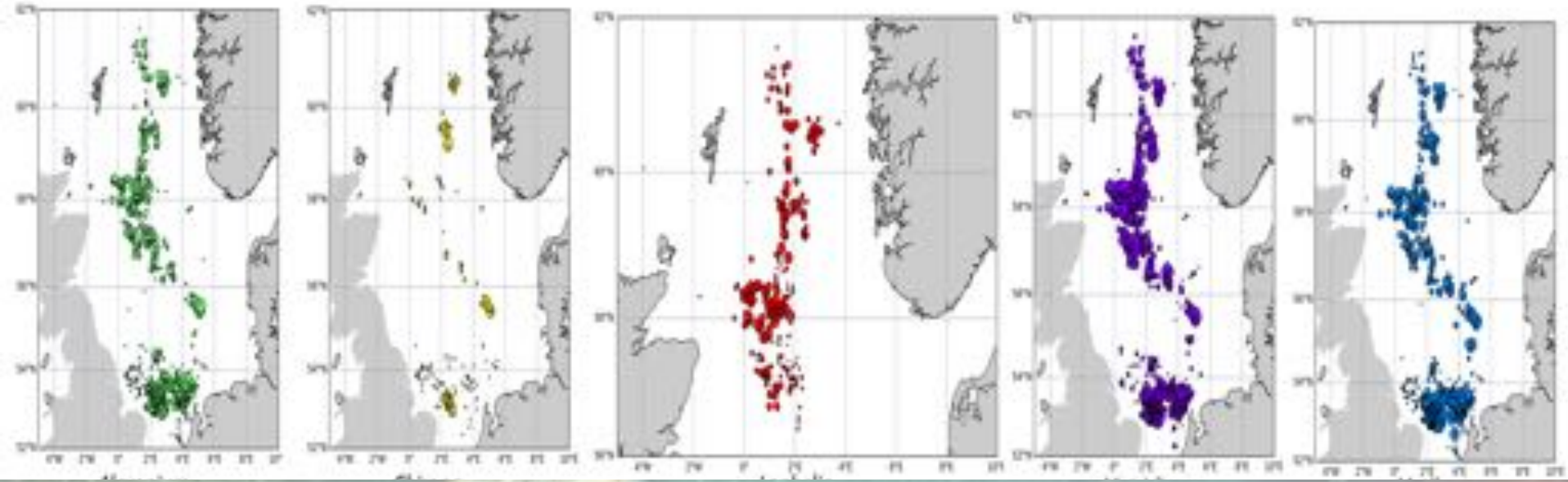
“Betweenness” – structures that act as bridges linking clusters:
Important for the soft and hard coral species

Major Findings - Connectivity



SCIENCE GAP: Spawning season & planktonic larval duration will vary with climate change

Major Findings - Connectivity



Soft coral
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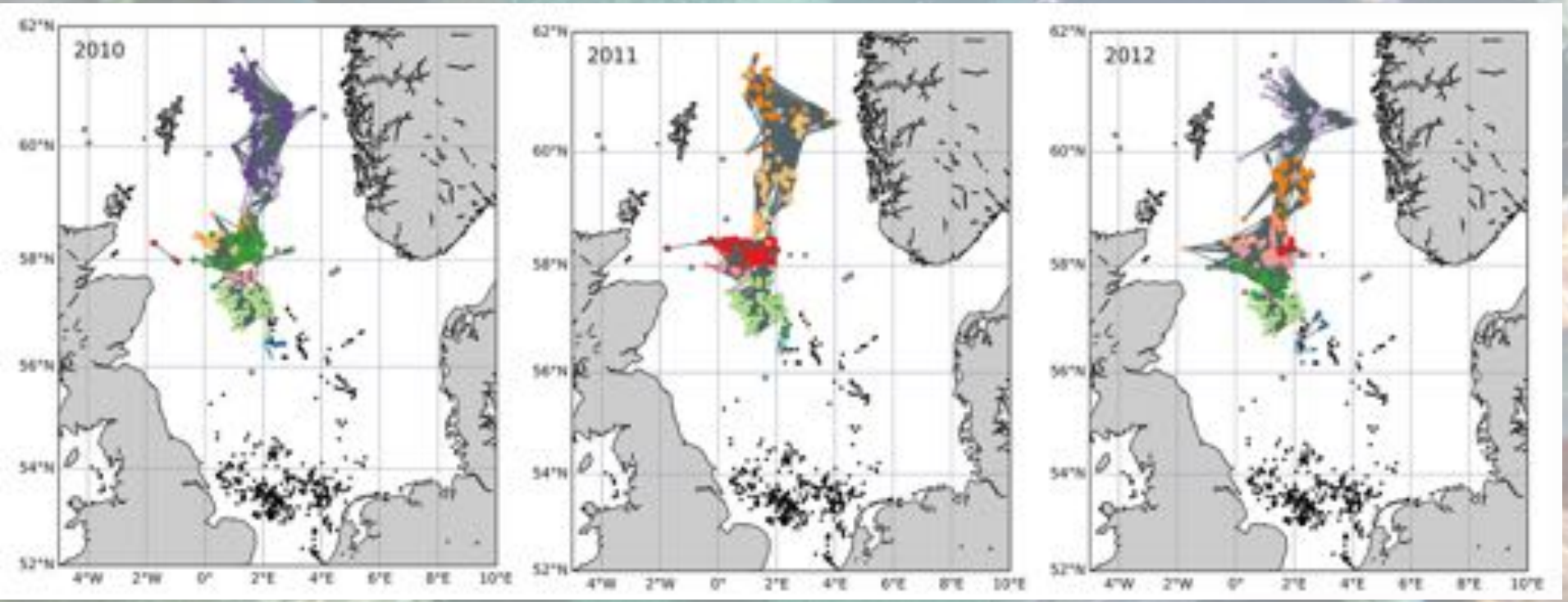
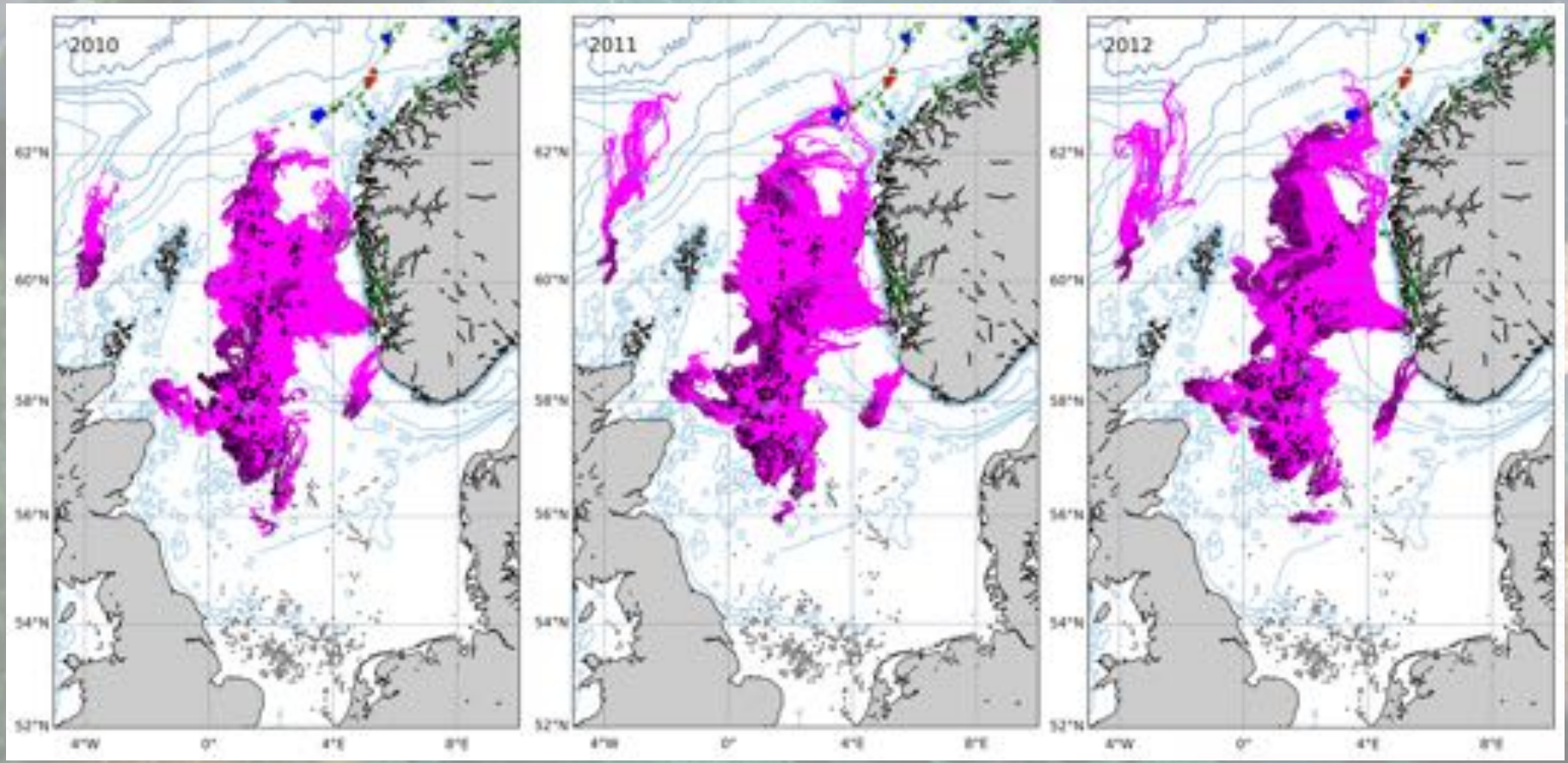
"Out-degree" – importance of structure as a larval source:
Generally, offshore structures were more important than those closer to land

Major Findings - Connectivity

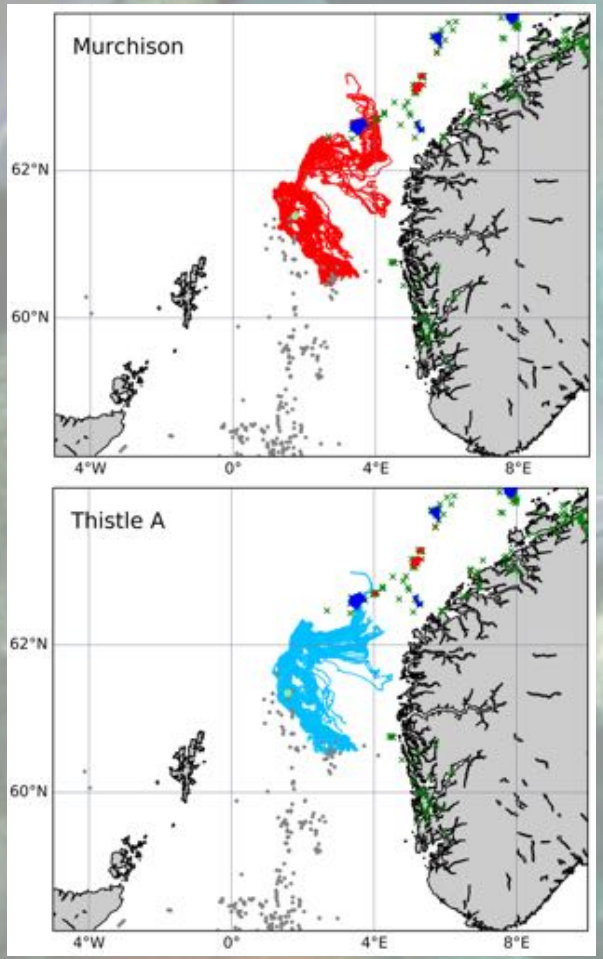


Lophelia **remains fairly well-connected as circulation patterns changed (2010-2012), but connectivity was lower in 2010 when Atlantic inflow and wind-driven currents would have been weaker**

Major Findings - Magnitude



Major Findings - Magnitude



Murchison now decommissioned:

jacket footings remain at 108m (derogation height), sufficient to keep supplying larvae to the Aktivneset MPA

Major Findings - Magnitude

Platform ecosystems have evolved to mimic those in the wild:

these are as biodiverse and morphologically similar as natural coral ecosystems, & **also host the same characteristic coral-worm symbiosis**

1st record of coral-worm (*Lophelia-Eunice*) symbiosis from man-made structures

Products

- Anonymised marine growth data (agreements to share in progress)
- Bespoke species connectivity maps of assets for all INSITE Foundation Phase sponsors
- Connectivity data for any particular offshore oil and gas structure in the North Sea e.g., data can be used for any regulatory/permitting requirement if desired or just to scope out connectivity

ANChor's Next Steps

- Consensus on clusters & important structures for connectivity
- **SCIENCE GAP:** like *Lophelia*, do man-made structures potentially support other iconic North Sea species
- **SCIENCE GAP**: Continue to ground-truth data (collection of samples for genetics; ROV inspection surveys)
- Scenario-test impact of structure removal under OSPAR 98/3 on connectivity


SCIENCE GAP 1:
Relevant larval biology studies
SCIENCE GAP 2:
Spawning season & planktonic larval duration will vary with climate change
SCIENCE GAP 3:
ground-truth data
SCIENCE GAP 4:
other iconic North Sea species


What do we Want?
EVIDENCE BASED SCIENCE
When do we Want It?
AFTER PEER REVIEW

Thank you

INSITE Sponsors
Richard Heard
INSITE ISAB
Eileen Rogerson
Other INSITE project teams
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