Summary of Research within Lamlash Bay No-Take Zone

- Science report for COAST July 2013 -

**Picture of a spider crab (Macropodia spp) inside a plumose anemone. Taken within Lamlash Bay No-Take Zone by Leigh Howarth*

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INTRODUCTION

The Firth of Clyde gained considerable media attention after it was identified as one of the most degraded marine environments in the UK, primarily due to over a century of overfishing. Fishing in the Clyde has origins dating back to medieval times and has supported a large number of important commercial fisheries targeting a wide range of species, including: herring, cod, mackerel, whiting, haddock, turbot, skate and many others. However, due to unsustainable levels of exploitation, today these fisheries have all disappeared. In September 2008, Scotland's first No-Take Zone (NTZ) protected from all methods of fishing was established within the Firth of Clyde at Lamlash Bay, off the Isle of Arran, under the rationale that it will "help regenerate the local marine environment and enhance commercial shellfish and fish populations in and around Lamlash Bay". Lamlash Bay NTZ came after a decade of campaigning by the Community of Arran Seabed Trust (COAST) for better protection of their seas.

SURVEY METHODS

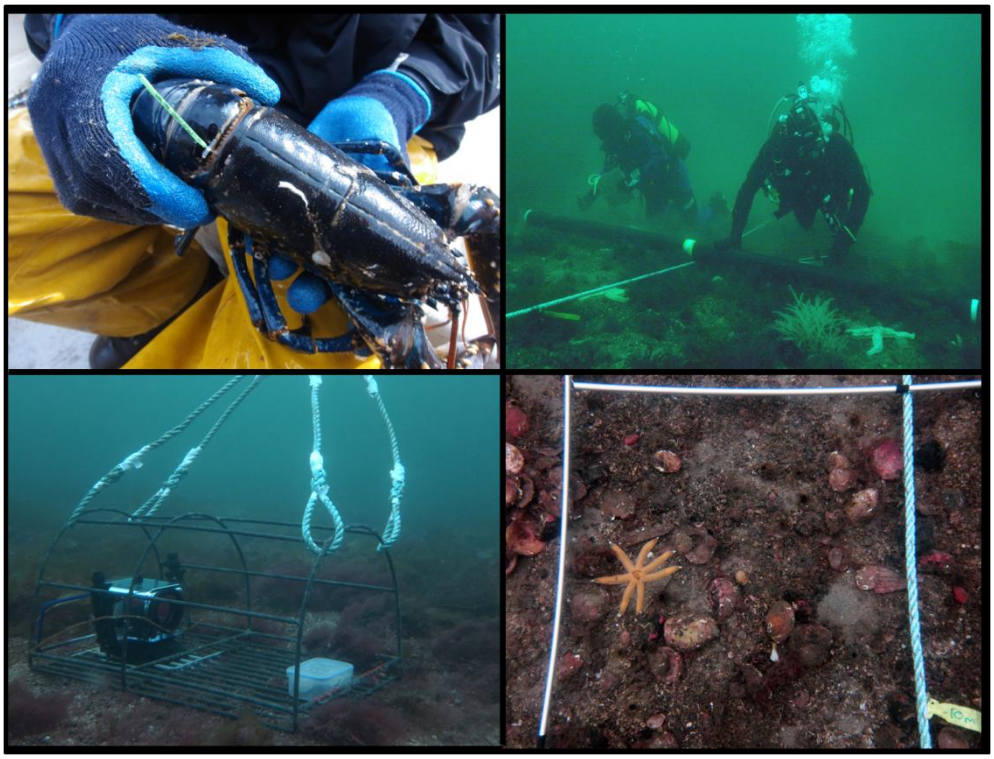
In 2010, the University of York in conjunction with the Community of Arran Seabed Trust (COAST), began conducting a series of underwater surveys to investigate how Lamlash Bay NTZ was responding to protection. What initially began as a series of basic SCUBA surveys has grown to become an extensive annual monitoring program utilising a number of different survey techniques. With each survey technique designed to gather data on the different ecological components that make up Lamlash Bay. These are:

Diver surveys - Every year, a team of two divers work along a number of 50m x 3m transects in and outside the NTZ, recording the number of organisms they encounter. In addition, every scallop encountered is collected and taken back to the surface where they are measured and aged, before being returned to the sea. A small sub-sample of scallops is however retained for the dissection of their meat and reproductive organs.

Photoquadrats - Over a thousand high resolution photographs are taken of the seabed every year in Lamlash Bay. Special software is then used to identify and count every organism within the photo and allows researchers to investigate whether the seafloor within Lamlash Bay NTZ is recovering.

Baited underwater video cameras - Exploring how fish populations respond to the reserve is vital if we are to understand how protecting an area of the sea may lead to the recovery of overexploited fish stocks. The use of a baited underwater video camera allows researchers to count and measure fish popualtions around Lamlash Bay without the need to dive to the seafloor.

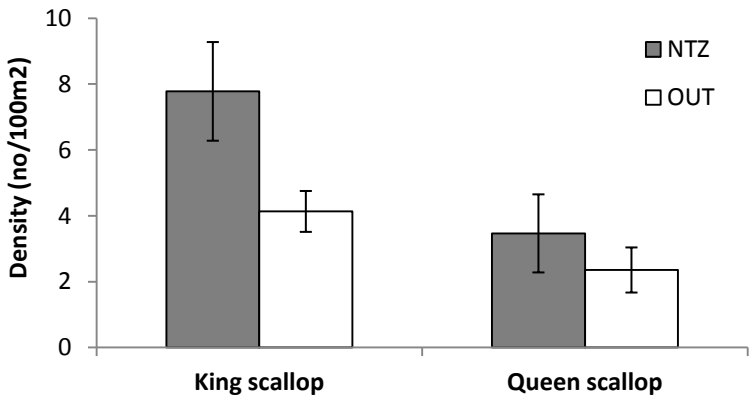
Crustacean surveys - With the help and expertise of local fishermen, researchers have been catching lobsters and crabs in and around Lamlash Bay. Every individual caught is measured and sexed before being returned to the sea. In addition, lobster and crab are also tagged with a unique number so their growth and movements can be monitored.



Images | Top left: A lobster after being measured and tagged. Top right: Two divers counting all the organisms they encounter along a 50m survey line. Bottom left: The baited underwater video camera within a protective cage. Bottom right: A photoquadrat of the seafloor within Lamlash Bay, the image shows a 7-armed starfish on a bed of shells.

RESULTS

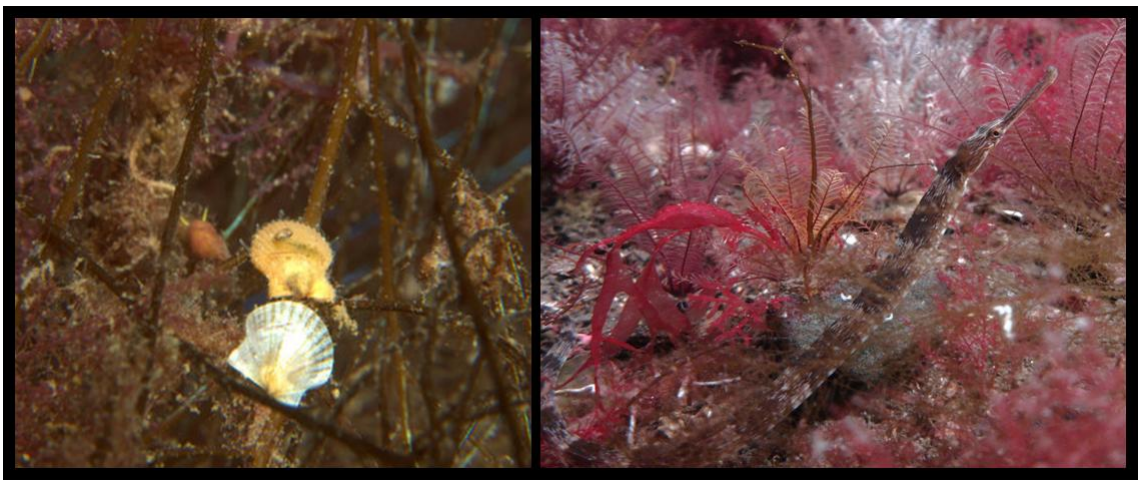
Scallops: Of all the organisms monitored within Lamlash Bay, none have responded quite as positively as scallops have. For the past three years running, scallops have been significantly more abundant, larger and older within the NTZ than outside. In 2012, king scallops were 50% more abundant within the NTZ, and queen scallops 45% more abundant. Although, in some years, queen scallop density has reached as high as 300% more abundant within the NTZ.



Graph | Density of king and queen scallops in 2012. Error bars represent ± 1 Standard Error (SE).

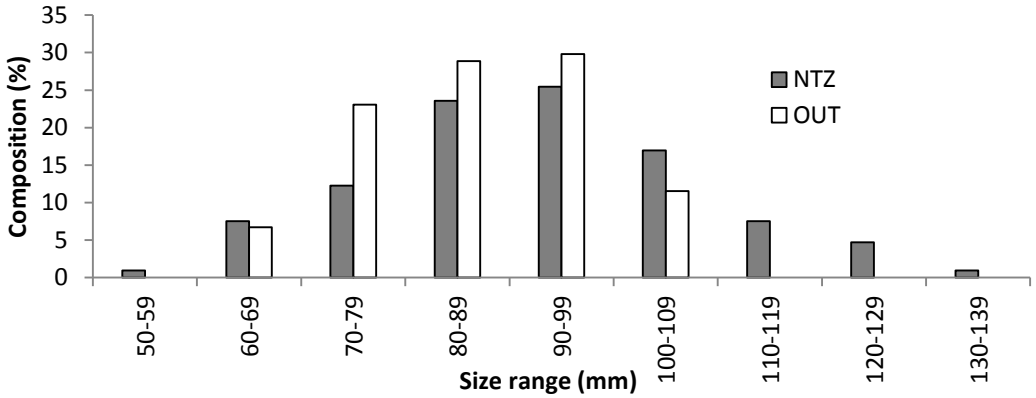
So it does indeed appear that the marine reserve is protecting those scallops within its boundaries, allowing them to reach older, larger sizes and to build up to greater population density. Not only this, but dissections reveal that scallops within the NTZ have significantly greater reproductive biomass. This should mean that scallops within the reserve are producing more eggs and larvae, which will then enter the water column and disperse, thereby boosting populations well outside the boundaries of the NTZ.

Seafloor recovery: Photoquadrats already suggest strong signs that the seafloor within Lamlash Bay NTZ is recovering. In fact, the animals and plants that attach to the seabed (such as maerl, seaweed, hydroids, bryozoans, and sponges) have all be found to be two times more abundant within the NTZ than outside. Such organisms are important because they provide the seafloor with structural complexity, thereby providing shelter for juvenile fish, scallops and other animals.



Images | Animals and plants that attach to the seafloor provide structure and shelter for juvenile scallops (left) and other organisms such as pipe fish (right). Such 'nursery habitats' have been found to be two times more abundant within Lamlash Bay NTZ, suggesting the seafloor may be recovering.

Lobsters: Similar to scallops, lobsters have been found to be substantially larger within Lamlash Bay NTZ. The size composition graph below clearly shows that large lobster are entirely absent outside the boundaries of the NTZ. These larger individuals are likely having a great impact on lobster reproduction in the area as large lobsters have much greater reproductive potential.



Graph | The size composition of lobsters in 2012. The graph reveals that large-bodied lobsters are entirely absent outside the boundaries of Lamlash Bay NTZ.

Biodiversity: Evidence suggests that the total number of individuals, number of species and overall biodiversity (Shannon Index) are all significantly higher within Lamlash Bay NTZ across all habitats. However, all sites, regardless of their level of protection, were dominated by bottom-dwelling, low-level, opportunistic invertebrates such as crabs and starfish. This suggests that there may still be some recovery to go.

CONCLUSION

After three years of surveying Lamlash Bay, using a wide variety of techniques and statistical analyses, the majority of evidence appears to be pointing in the same direction; that after just four years since its establishment, Lamlash Bay No-Take Zone appears to be promoting the recovery of scallops, lobster, fish and seafloor habitats.

IMPACTS

The research conducted in Lamlash Bay by the University of York has had a global impact. Their findings are regularly commented on by local and national newspapers, and both the University of York and COAST have made several appearances of national and international documentaries.

Researchers from the University of York have also presented their results at several international conferences and have so far published two scientific peer-reviewed papers on their research within Lamlash Bay, with a further two more papers to be released soon. The work in Lamlash Bay has also been mentioned in both EU and governmental reports as evidence for the support of establishing more marine protected areas in the UK and Europe.

FURTHER READING

Heath, M. R., & Speirs, D. C. (2011). Changes in species diversity and size composition in the Firth of Clyde demersal fish community (1927-2009). *Proceedings of the Royal Society B* doi:10.1098/rspb.2011.1015

Howarth, L. M., Roberts, C. M., Thurstan, R. H., & Stewart, B. D. (2013). The unintended consequences of simplifying the sea: making the case for complexity. *Fish and Fisheries*, DOI: 10.1111/faf.12041

Howarth, L. M., Wood, H. L., Turner, A. P., & Beukers-Stewart, B. D. (2011). Complex habitat boosts scallop recruitment in a fully protected marine reserve. *Marine Biology*, *158* (8), 1767–1780

Thurstan, R. H., & Roberts, C. M. (2010). Ecological meltdown in the Firth of Clyde, Scotland: two centuries of change in a coastal marine ecosystem. *PloS one*, *5* (7), e11767