

Institution: University of Essex		
Unit of Assessment: 5 – Biological Sciences		
Title of case study: Restoring European Native Oysters through evidence-based establishment and management of a nationally unique marine conservation zone.		
Period when the underpinning research was undertaken: 2011-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Thomas Cameron	Senior Lecturer of Ecology	2014 - present
Graham J. C. Underwood	Professor of Marine and Freshwater Biology	1992 - present
Period when the claimed impact occurred: Nov 2013 to Dec 2020		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact		
<p>The European Native Oyster, and the Essex oyster fisheries, established since Roman times, had declined to the point of commercial extinction. University of Essex research provided the crucial evidence for the designation of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (BCRC MCZ). The BCRC MCZ is nationally unique, it was the first, largest (284km²), and only MCZ specifically designated to conserve native oysters and their habitat. Essex research, including new population models, directly contributed to the development and implementation of policies by U.K. Government Agencies to ensure the recovery of the native oyster and associated heritage fisheries and provided evidence and tools to support nationally important and relevant decisions on coastal development and marine planning by Natural England and DEFRA. These include:</p> <ul style="list-style-type: none"> • new definitions of an “oyster bed” in the context of the MCZ • a new flexible Oyster fishing Permit Byelaw (2018) and adaptive harvest management plan • a renewed Several Order supporting the shellfish industry (2019) • adoption of oyster population models by the Secretary of State for the Environment and the Bradwell B Power Station Marine Evidence Committee. 		
2. Underpinning research		
<p>In 2010, Essex Wildlife Trust’s Living Seas Co-ordinator developed a collaboration with local oystermen and Underwood at Essex to identify the current state and importance of populations of the critically endangered European oyster on the Essex coast. This Essex-led research from 2011-2013 [R1], found three important subpopulations of oysters remaining in the greater Blackwater estuary area; determined the sediment characteristics associated with surviving populations; showed that some populations had significantly declined and were not recruiting new individuals; and illustrated that catches per sampling dredge effort were among the highest reported in natural reefs, both in the UK and Europe [R1]. This research provided the crucial underpinning evidence for the designation of the BCRC MCZ. Importantly, Essex research showed that close to half of remaining oyster stocks were associated with the activities of remaining heritage fisheries [R1, R2]. This contradicted the established view that all bottom-extraction activities (dredging) are detrimental to conservation efforts.</p>		

In 2014, the Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) – tasked with management and recovery of the native oyster in the newly established BCRC MCZ – approached Cameron, due to his research on invertebrate population dynamics and involvement with fishery stakeholders [R3], to co-design a survey to investigate status and trends of native oyster populations across the MCZ [R2], and to develop a useable management model to engage with fishery and public stakeholders and develop management scenarios. Cameron implemented bespoke field research in 2015 that provided, on a biannual basis, internationally important data on individual oyster survival, growth and reproduction rates. These were used to build a management model for predicting the recovery time for oyster populations under different management scenarios [R4].

Research, where Cameron demonstrated the importance of local ecological knowledge gained from working with fishery stakeholders (e.g. [R3]) as well as associated work identifying key information and implementation gaps that limit native oyster restoration attempts [R5], has contributed to the establishment and development of a European Native Oyster Restoration Alliance (NORA). NORA is an association of biologists, fishermen, conservationists and social scientists integrating Oyster restoration science and policy across Europe. Building on this body of research, Cameron has recently published (outside the REF2021 window) further work on oyster densities, associated species and function that Natural England will use to legally define an oyster “bed” or “reef” in a national context.

3. References to the research [can be supplied by HEI on request]

R1 Allison S, Hardy M, Hayward K, Cameron TC, Underwood GJC (2020). Strongholds of *Ostrea edulis* populations in estuaries in Essex, SE England and their association with traditional oyster aquaculture: evidence to support a MPA designation. *Journal of the Marine Biological Association of the United Kingdom* **100**; 27 - 36. <https://doi.org/10.1017/S0025315419001048>

R2 Cameron, TC. Smart, R., Lown, AE. Pullen, J. (2018) Tollesbury & Mersea Oyster Company Blackwater estuary Several Order survey 2018: an estimate of total stock size and distribution for European Flat oyster (*Ostrea edulis*) (Consultancy report).

R3 Pogoda, B, Boudry, P, Bromley, C, Cameron TC. et al. (2020) NORA moving forward: Developing an oyster restoration network in Europe to support the Berlin Oyster Recommendation. *Aquatic Conserv: Mar Freshw Ecosyst.*; 30: 2031– 2037. <https://doi.org/10.1002/aqc.3447>

R4 Lown, AE, Hepburn, LJ, Dyer, R, Cameron, TC. (2020) From individual vital rates to population dynamics: An integral projection model for European native oysters in a marine protected area. *Aquatic Conserv: Mar Freshw Ecosyst.* 2020; 30: 2191– 2206. <https://doi.org/10.1002/aqc.3445>

R5 zu Ermgassen, PSE, Bonačić, K, Boudry, P, Bromley, CA., Cameron, TC et al. (2020) Forty questions of importance to the policy and practice of native oyster reef restoration in Europe. *Aquatic Conserv: Mar Freshw Ecosyst.*; 30: 2038– 2049. <https://doi.org/10.1002/aqc.3462>

4. Details of the impact

Shaping the establishment of a nationally unique MCZ to protect native oysters and their

habitats

The Blackwater, Crouch, Roach and Colne Estuaries were designated a UK Marine Conservation Zone (MCZ) on 21 November 2013 [S1] on the basis of Essex research that determined the population densities of native oysters in the area and highlighted their decline in local seas in the years leading up to 2012, and determined the area still retained the highest remaining oyster densities in the UK – the only high density semi-natural “beds” in England [R1]. The data, subsequently published in [R1], were submitted with collaborators at Essex Wildlife Trust to the DEFRA open consultation in 2013 for the creation of Marine Conservation Zones in the UK [S2, S3]. The Essex data [R1] resulted in the designation case to DEFRA for the BCRC MCZ changing from only *intertidal* (e.g. *Clacton Cliffs and Foreshore - geological feature*) to *extensive subtidal native oyster beds* ([S2, S3] testimonial from Natural England). Notably this designation was supported by the local oyster fishing communities, even though it resulted in the fishery being temporally closed to them, as they wished to protect “their” oysters from unmanaged exploitation, and ensure the long term survival of their industry and cultural heritage [S4].

DEFRA adopted this designation proposal in Nov. 2013, creating the BCRC MCZ as one of the UK’s largest MCZs at 284 km² and nationally unique, being the first to protect native oysters and their habitats from uncontrolled non-quota exploitation with a designation set to “recovery” [S1, S3]. Less than 11% of all MCZ protected areas are selected for *recovery* status. Enacted under UK legislation (Marine and Coastal Access Act 2009), MCZs are the final link in a network of marine protected areas required by EU law (Habitats Directive 1992). Natural England state [S3] “*The research undertaken by Professor Underwood in collaboration with the Essex Wildlife Trust has been vital in our determination of the extent and abundance of native oyster populations in local seas*” They continue, “*Specifically the data....was submitted by Essex Wildlife Trust as evidence for consideration to DEFRA’s consultation on a new Marine Conservation Zone for the Blackwater, Crouch, Roach and Colne. DEFRA’s designation of this MCZ in 2013 and setting of the conservation objective of “recovery” for both the Native Oyster and Native Oyster bed features on the advice of NE could not have happened without the authoritative research undertaken by the University of Essex*”. The Essex Wildlife Trust’s Testimonial [S2] confirms the significance of this contribution: “*The success of the MCZ bid would have been highly unlikely without the academic rigour provided by the University of Essex, in the design of the collection and subsequent analysis of these key data.*”

Subsequently the Essex Wildlife Trust, local oystermen, Zoological Society of London and other NGOs, Natural England and the University of Essex established the Essex Native Oyster Restoration Initiative (ENORI, 2013-present) to aid and guide the Kent and Essex Inshore Fishery and Conservation Authority (KEIFCA), the DEFRA Agency responsible for delivery of the new MCZs objectives, to restore native oysters and the management of traditional small scale fishing to the MCZ. The Chair of ENORI states [S5] “*This [R1] was a very important piece of research – not only because MCZ designation would not have been possible without it – but because it brought the oystermen, the Wildlife Trust, and the University together in a close partnership and a commitment to work together to achieve the consequent MCZ conservation objectives.*”

Contributing to the development of the Flexible oyster Fishing Permit Byelaw and its management plan

From 2015-2019, Essex research, in collaboration with KEIFCA and the wider stakeholder community, estimated the total population size and population trends of the native oyster in the BCRC MCZ [R2, R4] and developed a population model to assess how oysters would respond to different management, restoration and fishing mortality scenarios [R4]. The population size and

structure data became the new baseline for defining the concept of an oyster bed and for oyster population management in the MCZ [S6]. The model was used at stakeholder workshops to demonstrate realistic non-intervention and intervention management scenarios [S6]. This Essex oyster model [R4] and Cameron's participation and engagement at stakeholder workshops, where he drew on his underpinning research, made a **significant contribution to the development of the Flexible oyster Fishing Permit Byelaw [S6, S7] and its associated management plan [S8]**. The KEIFCA Lead Scientific & Conservation Officer states [S6] *"Through attendance at our workshops and through published work [R1, R4], Dr Cameron's research has enabled us to set initial oyster bed density thresholds that are an integral part of the adaptive management in the KEIFCA Native Oyster Fishery Flexible Permit Byelaw, which has now been signed into Law by the Secretary of State (2018)"*. Cameron is working in collaboration with Natural England, further drawing on his body of underpinning research and recent published findings (outside the REF2021 window) on oyster densities, associated species and function, to legally define an oyster "bed" or "reef" in a national context [S3].

Informing the MCZ management plan, supporting the recovery of the native oyster

Essex research on estimation of native oyster densities [R2, R4], has **informed the development of adaptive management harvest rules for the MCZ management plan [S6, S7, S8]**. Senior Programme Manager UK & Europe for Estuaries & Wetlands; Chair, Essex Native Oyster Restoration Initiative; Co-Founder Native Oyster Network – UK & Ireland from the Zoological Society London said the following about the University of Essex research led by Dr Tom Cameron [S5] *"his research on oyster restoration in our nationally unique "restoration box project" has addressed several knowledge gaps vital for our objectives to recover native oysters in the MCZ"*. Discussing his research methods they note *"These methods have given our Essex project estimates of survival of free-living native oysters which helps us demonstrate the success or otherwise of our conservation interventions – some have since been adopted by other restoration projects in the UK, e.g. the Solent oyster restoration project"*. The BCRC MCZ now hosts ENORI's nationally unique 'restoration box project'. Cameron's research here addressed knowledge gaps vital for ENORI's native oyster recovery objectives in the MCZ, allowing determination of key factors for their restoration efforts [S5].

Supporting the Essex oyster fisheries and cultural heritage

Adjacent to 'restoration box project' is the Tollesbury and Mersea Native Oyster Fishery's ground. Their chairman [S4] explains how Essex's research was *'instrumental'* to their and ENORI's progressing *"regeneration of the native oyster which is a vital component of the social fabric and economic activity of the Essex coastal towns"* [S4]. For instance, [R2] enabled their identification of areas to harvest to prevent disease [S4]. They emphasise *"The benefits outlined here to The Company, and for the continuation of a traditional and culturally-valuable fishery, particularly the designation of this unique Marine Conservation Zone and its evidence led policy development for management, would not have been achieved without the research undertaken in collaboration with the School of Life Sciences at the University of Essex"* [S4]. Indeed, Essex research [R2] has **supported the local shellfish industry by providing evidence they required for Defra to renew the licence allowing the heritage fishing activities within the MCZ to continue from 14th July 2019 onwards to 2039 (the Several Order 2019 [S9], [S3, S4])**. This licence is crucial for the maintenance of the oyster fisheries, the associated economic and cultural impact, and the provision of adult oyster stock, with which the MCZ restoration is made possible. The Chairman of the Tollesbury and Mersea Native Oyster Fishery said [S4] *"The Company is reliant on the Several Order to remain in business and provide work for a dozen local oystermen. With the assistance of the research undertaken by Essex University, we have been able to identify other areas of our*

ground on which to culture shellfish. This has proved very beneficial financially for the Company and in turn provides us with funds to maintain the ground.”

Contributing to the work of the UK Government on nationally important infrastructure

Cefas, an executive agency sponsored by DEFRA, are the UK government’s marine and freshwater science experts. They describe Cameron’s research on aquatic environment, biodiversity and fisheries undertaken at Essex as “**crucial to our work**” and explain they have worked with Cameron since 2019 to develop a model of the native oyster population in the Blackwater Estuary [S10]. Highlighting the population’s national importance, Cefas confirm “*This model, underpinned by the research conducted at the University of Essex by Dr Cameron (subsequently published as [R4]) was selected by Cefas in June 2019 to provide the critical evidence for supporting the Secretary of State’s environmental assessment of the acceptability of a nationally significant infrastructure project, the proposed Bradwell B new nuclear power station at Bradwell, Essex*” adding “*Dr Cameron’s previous research and expertise has also helped to shape the marine evidence planning strategy for this project by providing authoritative, evidence based advice such as ecological data for the Blackwater Estuary i.e. Oyster distribution data and fish community data, which has directly influenced the evidence strategy for the project enabling it to be focused on ecological knowledge gaps.*” [S10].

5. Sources to corroborate the impact

S1 Department for Environment, Food and Rural Affairs, 2013. *Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone Designation Order 2013*. Available at: http://www.legislation.gov.uk/ukmo/2013/3/pdfs/ukmo_20130003_en.pdf [Accessed: May 2019].

S2 CEO and Living Seas Coordinator, Essex Wildlife Trust

S3 Senior Marine Advisor, Natural England

S4 Chairman, Tollesbury and Mersea Oyster Fishery Company.

S5 Chair of ENORI, Co-Chair Native Oyster Network UK & Ireland, Zoological Society of London.

S6 Lead Science and Conservation Officer, Kent & Essex Inshore Fisheries and Conservation Authority (KEIFCA)

S7 Kent & Essex Inshore Fisheries and Conservation Authority: Marine and Coastal Access Act 2009 (c.23) <https://www.kentandessex-ifca.gov.uk/wp-content/uploads/2018/05/Native-Oyster-Flexible-Permit-Byelaw.pdf>

S8 MCZ Oyster Management Plan <https://www.kentandessex-ifca.gov.uk/wp-content/uploads/2018/05/Native-Oyster-Management-Plan.pdf>

S9 Explanatory Memorandum to the Tollesbury and Mersea (Blackwater) Fishery Order 2019 2019 No. 974 https://www.legislation.gov.uk/uksi/2019/974/pdfs/uksiem_20190974_en.pdf

S10 Principal Investigator, Energy Portfolio, Cefas, on behalf of the Secretary of State.