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| **Institution:** Bangor University, 10007857 |
| **Unit of Assessment:** 07 Earth Systems and Environmental Sciences |
| **Title of case study:** Development of Marine Protected Area System, Cayman Islands |
| **Period when the underpinning research was undertaken:** April 2010 – September 2014. |
| **Details of staff conducting the underpinning research from the submitting unit:** |
| **Name(s):**1) John Turner2) Rhiannon Meier3) Laura Richardson4) Charlotte Mortimer 5) Croy McCoy  | **Role(s) (e.g. job title):**1) Professor of Marine Biology, PI2) Field Support Officer3) Project Support Officer 4) Project Support Officer5) Off campus PhD candidate and Senior Research Officer at Department of Environment, Cayman Islands and Co-I | **Period(s) employed by submitting HEI:**1) 1988 – ongoing2) Feb 2011– April 20113) April 2011 – March 20134) April 2013-September 20145) April 2010 - July 2018 (PT PhD) |
| **Period when the claimed impact occurred:** 2015 - 2019 |
| **Is this case study continued from a case study submitted in 2014?** N |
| 1. **Summary of the impact** (indicative maximum 100 words) This section should briefly state what specific impact is being described in the case study.

Change in Government policy (approved March 2019) driven by societal support of scientific evidence gathered by Bangor University to expand Marine Protected Areas in the UK Overseas Territory of the Cayman Islands. The area of no-take protection was increased from 14% of coastal waters to 45.2%, exceeding the Convention on Biological Diversity\* target of 10% protection of coastal and marine areas by 2020. Further it fulfils the call made by the UK at the UN General Assembly 2018 for governments to designate 30% of oceans as Marine Protected Areas by 2030 and piloted good practice for the Caribbean region.\* Aichi Biodiversity Target 1199 words |
| 1. **Underpinning research** (indicative maximum 500 words)

This section should outline the key research insights or findings that underpinned the impact, and provide details of what research was undertaken, when, and by whom. This research may be a body of work produced over a number of years or may be the output(s) of a particular project. References to specific research outputs that embody the research described in this section, and evidence of its quality should be provided in the next section. Details of the following should be provided in this section: • The nature of the research insights or findings which relate to the impact claimed in the case study. • An outline of what the underpinning research produced by the submitted unit was (this may relate to one or more research outputs, projects or programmes). • Dates of when it was carried out. In intro box• Names of the key researchers and what positions they held at the institution at the time of the research (where researchers joined or left the HEI during this time, these dates must also be stated). In intro boxes• Any relevant key contextual information about this area of research.Bangor University has had significant global impact through scientific assessments underpinning Marine Protected Area (MPA) creation and management for 50 years. This extends from the 1969 BU Expedition to Watamu Marine National Park, Kenya (one of the oldest MPAs in the world and now a UNESCO Man and Biosphere Reserve), through MPA implementation in Socotra, Yemen (now a Man & Biosphere Reserve 2003, Ramsar Site 2007 and World Heritage Site 2008), and community based MPAs in Rodrigues and Kingdom of Tonga. Current initiatives focus on the UK Overseas Territories by research supporting the Chagos Marine Protected Area in the British Indian Ocean Territory, and enhancing the MPA system of the Cayman Islands, Caribbean Sea. The Cayman Islands MPA system has existed since 1986, but local overconsumption, tourism growth, coastal development, invasive species and climate change has threatened biodiversity and ecosystem services rendering it unfit for purpose (Turner et al., 2013). Bangor University and The Nature Conservancy collaborated with the Department of the Environment, Cayman islands Government (DoE) to design a new MPA system for the Cayman Islands between 2010 and 2014. The aim was to enhance coral reef ecosystem resilience to climate change by reducing local human impacts across 30-50% of the coastal zone. This was achieved by integrating scientific evidence of the benefits of MPAs to reef resilience in Cayman, an assessment of options for protected area enhancement, a mechanism for stakeholder engagement and public consultation, to underpin the design of an increased MPA system. Our research showed that no take zones enhanced local reef resilience around Cayman by increasing reef-building coral cover and promoting coral recruitment, reducing competitive fleshy algae cover that compete with corals for space, and reducing coral disease prevalence (Turner et al., 2013b). These zones also demonstrated ‘overspill’ of fish replenishing surrounding waters where they can be caught legally (Dromard et al., 2011). The incentives of both legal and illegal fishers were captured through structured interviews (fishing is an important part of Caribbean culture) and assessing enforcement prosecution records (Meier et al., 2011). A campaign of public awareness, education and consultation followed, increasing support for the new MPA system and included 81 stakeholder meetings, an exhibition, 43 press articles, 54 TV and 8 radio programmes, 16 online news items, and 10 other outputs (e.g. education packs). Issues that could undermine the success of the new MPA system were identified in these consultations and further Bangor University research collaboration informed effective solutions (Turner et al., 2015), specifically: * DoE operated culling of invasive lionfish that threaten reef fish populations.
* New legislation to protect overexploited reef fish spawning aggregation sites (Egerton et al., 2016, Waterhouse et al., 2020).
* Line-fishing zones were incorporated between no take zones to allow local sustainable fishing.
* Development of an innovative solution to ensure MPA effectiveness over a larger area without increasing enforcement personnel. A System for Incident Reporting and Enforcement (SIREN) linked Enforcement Officers in the field to a central database via tablets and engaged the general public via a smart phone application, allowing anonymous reporting of transgressions, sightings and access to MPA regulations.

511 words |
| **3. References to the research** (indicative maximum of six references)This section should provide references to key outputs from the research described in the previous section, and evidence about the quality of the research. Underpinning research outputs may include the full range of types listed in the output glossary (Annex K) and are not limited to printed academic work. All forms of output cited as underpinning research will be considered equitably, with no distinction being made between the types of output referenced. Include the following details for each cited output: * author(s)
* title
* year of publication
* type of output and other relevant details required to identify the output (for example, DOI, journal title and issue)
* details to enable the panel to gain access to the output, if required (for example, a DOI or URL), or stating that the output is listed in REF2 or can be supplied by the HEI on request.

All outputs cited in this section must be capable of being made available to panels. If they are not available in the public domain or listed in REF2, the HEI must be able to provide them if requested by the REF team. Evidence of the quality of the research must also be provided in this section. Guidance on this is provided in the ‘Panel criteria’. Where panels request details of key research grants or end of grant reports, the following should be provided: * who the grant was awarded to
* the grant title
* sponsor
* period of the grant (with dates)
* value of the grant.

1. Turner, J.R., McCoy, C., Cottam, M, Olynik, J., Austin, T, Blumenthal,J. Bothwell, J., Burton, F.J., Bush, P., Chin, P., Dubock, O., Godbeer, K.D., Gibb, J., Hurlston, L., Johnson, B.J., Logan, A., Parsons, G., Ebanks-Petrie, G. (2013a). Biology and ecology of the coral reefs of the Cayman Islands. Chapter 7, P. 69-88 in Sheppard, C.R.C., (ed*). Coral reefs of the United Kingdom Overseas Territories. No.4 Coral Reefs of the World*. Springer. DOI 10.1007/978-94-007-5965-7.2. Final Reports:  (a) Turner, J. McCoy, C.M., Richardson, L., Mortimer, C. (2013b). *Darwin Initiative Final Report 18-016.* 93p. Darwin Initiative. <http://www.darwininitiative.org.uk/documents/18016/23622/18-016%20FR%20-%20edited.pdf>. *Quality of the research:* * *The Project scored Grade A (outcome met expectation) in the Defra Darwin Final Report Review FRR18-016: ‘There has been high quality research carried out under this Project, with a high level of knowledge transfer and expertise applied throughout.’*
* *‘The Project has succeeded in enhancing the existing MPA system in the Cayman Islands, based on sound scientific research, with local stakeholder buy-in and public support. Of particular note is the integration of fisheries into planning, with consultation with local fishers.’*
* *‘It’s an excellent example of the long-term benefits of MPA systems, in the face of increasing pressures on marine environments, and can be used as a successful model by other island states in the Caribbean region’*

(b) Turner, J. McCoy, C.M., Richardson, L., Mortimer, C. (2015). Darwin Initiative Final Report. EIDPO045. *Assuring engagement in Cayman’s enhanced marine protected area system* 70p. Darwin Initiative. <https://doe.ky/wp-content/uploads/2015/01/DarwinPP_Annual_Report-_2014_EIDP0045_.pdf>. (note links to annual report do not take you to final report at present – need to get LTS Darwin Initiative (Eilidh Young) to correct. We have copy of report. *Quality of the research:* * *This project also scored Grade A (outcome met expectation) in the Defra Final Project Report Review (FRR EIDPO045): ‘The project has worked closely with the Government Department of Environment in the Cayman Islands to develop an enhanced MPA system, with stakeholder and public engagement in order to protect essential marine resources. The design of the MPAs and activities of the enforcement officers and supporting policies is based on high quality evidence-based scientific research. This project is an excellent model for other islands in the Caribbean in designing an efficient MPA network.’*
1. Dromard, C.R., McCoy, C., Turner, J. R. (2011). Measuring the performance of Marine Protected Areas: the case of Little Cayman and Cayman Brac, Cayman Islands. *Proceedings (refereed) of the 63rd Annual Gulf and Caribbean Fisheries Institute, San Juan, Puerto Rico*. Volume 63: P. 246-253. <http://proceedings.gcfi.org/proceedings/measuring-the-performance-of-marine-protected-areas-the-case-of-little-cayman-and-cayman-brac-cayman-islands/?_sf_s=Turner&sf_paged=2>
2. Meier, R.E., McCoy, C., Richardson, L. & Turner, J.R. (2011). Quantifying the impact of recreational and artisanal fisheries in the Cayman Islands, through the use of socio-economic questionnaires. *Department of Environment, Cayman Islands Government Report*. 104p. <http://www.darwininitiative.org.uk/documents/18016/22226/18016%20Fisheries%20impact%20interim%20report.pdf>.
3. Egerton, J., Johnson, A. F., Le Vay, L., McCoy, C. M., Semmens, B. X., Heppell, S. A. & Turner, J., (2017). Hydroacoustics for the discovery and quantification of Nassau grouper (*Epinephelus striatus*) spawning aggregations. *Coral Reefs*. 36, 2, p. 589-600 12 p. DOI 10.1007/s00338-017-1542-4. [https://link.springer.com/article/10.1007%2Fs00338-017-1542-4/](https://link.springer.com/article/10.1007/s00338-017-1542-4/)
4. Waterhouse, L., Heppell, S.A, Pattengill-Semmens, C.V., McCoy ,C.M., Bush, P., Johnson, B.C., Semmens, B.X. (2020). Recovery of critically endangered Nassau grouper (*Epinephelus striatus*) in the Cayman Islands following targeted conservation actions. *Proc Natl Acad Sci U S A*. 2020 Jan 21;117(3):1587-1595. doi: 10.1073/pnas.1917132117. <https://www.pnas.org/content/117/3/1587.long>
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| **4. Details of the impact** (indicative maximum 750 words)This section should provide a narrative, with supporting evidence, to explain: * how the research underpinned (made a distinct and material contribution to) the impact;
* the nature and extent of the impact.

The following should be provided: * A clear explanation of the process or means through which the research led to, underpinned or made a contribution to the impact (for example, how it was disseminated, how it came to influence users or beneficiaries, or how it came to be exploited, taken up or applied).
* Where the submitted unit’s research was part of a wider body of research that contributed to the impact (for example, where there has been research collaboration with other institutions), the case study should specify the particular contribution of the submitted unit’s research and acknowledge other key research contributions.
* Details of the beneficiaries – who or what community, constituency or organisation has benefitted, been affected or impacted on.
* Details of the nature of the impact – how they have benefitted, been affected or impacted on.
* Evidence or indicators of the extent of the impact described, as appropriate to the case being made.
* Dates of when these impacts occurred.

**Process through which research led to impact:*** Bangor University (BU) increased capacity within the Cayman Islands Government by providing an embedded Project Support Officer for 5 years to facilitate project delivery in country, and by leadership of field and awareness campaigns, and stakeholder consultations (S1).
* The DoE’s Geographical Information System (GIS) allowed monitoring data assessment annually by BU/DoE team to record various coral reef health metrics.
* The Nature Conservancy led an Ecological Gap Analysis to assess the extent to which the existing MPAs met protection goals, and formulate a risk surface layer in the GIS based on multi-sectoral use of the environment (S2). Marxan with Zones conservation planning software was used to identify priority areas for the new MPA zones based on habitat maps superimposed with the above data.
* Surveys of fishers by BU/DoE revealed greater reef fishing pressure than previously recognised (>20,000 fish extracted per month of which 90% were reef fish) highlighting the need to enlarge no take zones. An independent assessment subsequently valued total reef-related catch to be worth US$2.3m annually to the local economy (S3).
* BU research showed invasive lionfish culling by DoE trained stakeholders protected reef fish populations and this activity engaged local people in active reef management.
* 27 fish species were identified by BU/DoE to use spawning aggregation sites throughout the year, and legislation was introduced by DoE to protect these sites in 2016 under the National Conservation Laws (S4).

**How users were influenced:*** In 2011, 7 district public meetings were organised by BU/DoE across the islands, to explain threats and to present evidence demonstrating that existing MPAs are effective, and to capture the public’s vision for the Caymanian marine environment (S5). Stakeholders were re-consulted in 2012 and invited to comment on the MPA plans on which further revisions were based.
* Public concerns over access to fishable areas and whether effective enforcement of a 200% larger protected area could be achieved were answered through assessments demonstrating fishing effort and overspill and the SIREN System for Incident Reporting and Enforcement (S6). SIREN recorded 246 incidents in the first 6 months of use and was adopted by the Cayman Islands Tourist Association. Ownership of the application was transferred to DoE from BU.
* Public perception of the value of the MPA system changed from scepticism to support following two further consultations and a programme of public outreach and awareness (S7). An independent analysis (S3) showed that the enhanced MPA is a low- cost and low-risk investment with the opportunity to substantially improve overall wellbeing in the Cayman Islands, increasing economic value (currently US$ 179m) by 7%. The MPA enhancement plans were supported by 58%-85% (varies by island) populations, with households collectively willing to pay US$5.6m per year for enhanced MPAs.

**Outcome & Reach:*** The enhanced MPA plan designated protection through Marine Reserves, Fish spawning aggregation sites, Environmental zones (protecting mangrove habitat), Wildlife interaction zones, Line fishing and No dive zones. In 2016, the plan was accepted by the National Conservation Council (S8), nominated to the Minister for adoption (S9) and submitted to Government. The expansion of the MPA system was finally approved by Cabinet, and announced during the visit of HRH Prince of Wales on 28th March, 2019. (S10). The Environment Minister stated*: “This expansion will serve to protect our local marine stocks, as well as the crucially important coral reef network … for generations to come.”* The Prince of Wales highlighted*: ‘’The Cayman Islands could become a shining example of best practice…Such an integrated approach is not only essential to protect our eco-systems, but also particularly in the Cayman Islands case to protect the long term viability of economic sectors.”*
* The aims were met; no-take protection was raised from 14% to 45.2% (50% of targeted representative habitats) with public support, far exceeding the Convention on Biological Diversity target of 10%. Marine Conservation Laws are being drafted and new signage prepared for launch of the MPAs in 2020.
* Bangor University’s research programme was demonstrated across the Caribbean region to promote good practice through The Nature Conservancy’s Caribbean Challenge\* recognising Cayman as a world leader in marine conservation. The project was presented as a successful case study at the UKOT Blue Belt Symposium 2019 and UK Overseas Territories Workshop on Improving Marine Management in the Caribbean (facilitated by Marine Conservation Society for FCO) and has spurred Cayman to investigate Blue Belt protection for the nation’s Economic Exclusive Zone (EEZ) of 119,137 km2.

\* Note: despite Cayman not being a signatory to this Challenge because it is a UK OT.Words 734  |
| 1. **Sources to corroborate the impact** (indicative maximum of ten references)

S1. Letters/statements detailing collaboration from Director & deputy Director (Research) Department of Environment, Cayman islands Government and from Director, Strategy and Policy, The Nature Conservancy Florida Chapter. To be submitted.S2. Olynik, J., Richardson, L., Schill, S. (2012). *Marine Ecological Gap Analysis Methodology for the Darwin Initiative to enhance an established marine protected area system in the Cayman Islands.* Report prepared by The Cayman Islands Department of Environment, Bangor University and The Nature Conservancy, 41pp. <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&ved=2ahUKEwjx0qGamczkAhUGTBUIHQxRBuQQFjAFegQIBxAC&url=http%3A%2F%2Fwww.conservationgateway.org%2FConservationByGeography%2FNorthAmerica%2FCaribbean%2Fscience%2Fplanning%2FDocuments%2FCayman_Marxan%2520Methodology%2520FINAL_v2.docx&usg=AOvVaw17ef5jlS9IeqVxK2mcMNME>.S3. Independent policy brief on economics of enhancing the MPA of the Cayman islands: Guzmán, A., Schep, S., van Zanten, B., van Beukering, P., Palacios Nieto, E., Hoogeven, R., Luna Strangl, A., Schutter, M., Ebanks-Petrie, G. And Austin, T. (2017). *The Economics of Enhancing the Marine Protected Areas of the Cayman Islands*. Wolfs Company, IVM VU University Amsterdam. <https://www.wolfscompany.com/wp-content/uploads/2018/03/Cayman-Islands-Policy-Brief-final.pdf> S4. The new National Conservation Regulations 2016: <http://www.gov.ky/portal/pls/portal/docs/1/12326595.PDF>S5. Public information booklet and invitation to District public meetings for first consultation: <http://doe.ky/wp-content/uploads/2015/01/MP-Review-Booklet-for-online-viewing-or-download.pdf>S6. SIREN System for Incident Reporting and Enforcement iphone and Android phone apps: <http://doe.ky/resources/doe-phone-apps/> (links to itunes and Google play resources) S7. Enhanced Marine Parks Proposals 2015 consultation Report: <http://doe.ky/wp-content/uploads/2017/02/3-Marine-Parks-2015-Consultation-Report-1.pdf>S8. The enhanced MPA nomination <http://doe.ky/wp-content/uploads/2017/02/2-Enhanced-Marine-Parks-Nomination-11x17-1.pdf>S9. Letter from Chair, National Conservation Council to Minister: <http://doe.ky/wp-content/uploads/2017/02/1-NCC-Letter-to-Minister-2016-03-10-1.pdf>S10. Department of Environment brief on MPA expansion 2019: <http://doe.ky/caymans-marine-parks-system-expanded-enhanced/> and example press on same: <http://www.ieyenews.com/wordpress/cayman-islands-marine-parks-expansion-enhancement/> and <https://caymannewsservice.com/2019/04/marine-protection-plan/>   |

Where the sources are individuals who could be contacted or have provided factual statements to the HEI, the submitted case study should state only the organisation (and, if appropriate, the position) of the individuals concerned, and which claim(s) they can corroborate. Their personal details (name, position, contact details) must be entered separately on the REF submission system and not on REF3. Details of a maximum of five individuals may be entered for each case study; these data will not be published as part of the submission.

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| **Source:** | **Name** | **Position** | **Contact details** |
| **1** | Mrs Gina E banks Petrie | Director, Department of Environment, Cayman Islands Government | Box 10202, Grand Cayman KY1-1002, Cayman islandsTel (345) 949-8469Email doe@gov.ky |
| **2** | Timothy Austin | Deputy Director (Research) Department of Environment, Cayman Islands Government  | Box 10202, Grand Cayman KY1-1002, Cayman islandsTel (345) 949-8469Email doe@gov.ky |
| **3** | James Byrne  | Director of Strategy and Policy  | The Nature ConservancyFlorida Chapter55 South Beach RoadHobe Sound, Florida 33455jbyrne@tnc.org 305-393-5130 |
| **4** | Eilidh Young | LTS Defra Darwin Initiative Projects | LTS International Ltd. Pentlands Science Park, Bush Loan, Penicuik, EH26 0PL, ScotlandPhone: (+44) 131 440 5181Email: darwin-projects@ltsi.co.uk |
| **5** | Amílcar Guzmán Valladares | Environmental consultant,  | Bulevar Gobernador Nicolaas Debrot 31, Kralendijk, Bonaire, Dutch CaribbeanMauritskade 64, 1092 AD, Amsterdam, The Netherlands+3120 568 8711amilcar.guzman@wolfscompany.com |

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| **Additional contextual data** The fields in this section are mandatory, where applicable. The information will be used in post assessment evaluations and will **not** be routinely provided to panels.  |
| **Name(s) of funder(s):** DEFRA |
| **Name(s) of funding programme(s):** Darwin Initiative |
| **Grant number(s):** 18-06 project: *To enhance an established Marine Protect Areas system, Cayman islands*EIDP0045: *Assuring engagement in Cayman’s enhanced MPA system* |
| **Amount of grant (in GBP):** 18-06£273,914 and EIDP0045 £190,000 = £463,914The grant amounts indicated by RIIO did not match the awards. There is also Sustainable Management of Threatened Keystone Predators to Enhance Reef Resilience. DPLUS 036 £173.439 Heriot Watt: Turner Co-I) and Satellite drifter tagging: Mixed fish spawning on coral reefs in Cayman Guy Harvey Ocean Foundation to DOE McCoy PI and Turner Co-I US $25,000. The other grants RIIO added were not directly relevant to this project - but these grants could be added if we wanted to support projects in para 1: Darwin Initiative to strengthen the world’s largest Marine Protected Area, Chagos Archipelago 19 027 Turner PI £287,778, Coral Reef condition in the Chagos Archipelago Bertarelli Foundation Turner PI £999,258.  |
| **ORCID for each named researcher:** Turner: 0000-0003-3093-2039Meier: 0000-0002-7411-619Richardson: 0000-0002-1284-4011McCoy: 0000-0001-6433-6775  |
| **Name(s) of formal partner(s):** Department of The Environment, Cayman Islands GovernmentThe Nature Conservancy, USAIn addition on EIDP0045:Scripps Institution of Oceanography, USAReef Environmental Education Foundation, USA  |
| **Country/countries where the impact occurred\*\*:** Cayman Islands, UK Overseas Territory |

\*\* Where the impact occurred specifically within one country that is part of the UK (for example, Wales), this country rather than ‘UK’ should be specified in the country/countries field.