

# Wireless sensor networks



## Research Projects

Smart Environmental Monitoring and Analysis Technologies - SEMAT, University of Queensland, Ron Johnstone, 2009-2012, Partner Institution(s): Queensland State Government, Milan Foundation, Torino Foundation., Funding: Queensland Smart State

eAtlas, Australian Institute of Marine Science, Katrina Fabricius, 2009-2013, Partner Institution(s): JCU, GBRMPA, Funding: National Environmental Research Program (NERP) , Marine and Tropical Sciences Research Facility (MTSRF)

Automated detection and identification of marine organisms using sensor networks, University of Melbourne, Marimuthu Palaniswami, 2010-2011, Funding: ARC

CREON Thailand mooring, National Electronics and Computer Technology Centre, Scott Bainbridge, Mullica Jaroensutasinee, Piyawut Srichaikul, 2010-2011, Partner Institution(s): Australian Institute of Marine Science, Walailak University, Funding: National Electronics and Computer Technology Centre

Event detection and data management using cloud computing based systems for sensor network data, University of Melbourne, Marimuthu Palaniswami, 2010-2011, Funding: ARC

Drivers of juvenile shark biodiversity and abundance in inshore ecosystems of the Great Barrier Reef, James Cook University, Australian Institute of Marine Science, Michelle Heupel, Colin Simpfendorfer, Andrew Tobin, 2011-2014, Funding: National Environmental Research Program (NERP)

Next generation satellite tools for understanding change in coral reef ecosystems due to multiple global and local stressors, University of Queensland, Ove Hoegh-Guldberg, Sophie Dove, C. Mark Eakin, Ray Berkelmans, Scott Bainbridge, David Wachenfeld, 2011-2016, Partner Institution(s): University of Queensland, Australian Institute of Marine Science, Great Barrier Reef Marine Park Authority, NOAA, Funding: ARC Linkage Project

Space-based national wireless sensor network, University of South Australia, Jeff Kasparian, 2011-2015, Partner Institution(s): CSIRO, Defence Science and Technology Organisation, Australian Institute of Marine Science, Sage Automation, Funding: Department of Industry, Innovation, Science, Research and Tertiary Education

SeaDroid: low cost, real-time water temperature logging, National Oceanic and Atmospheric Administration, Jim Hendee, Tim Burgess, Scott Heron, Scott Bainbridge, 2011-2012, Partner Institution(s): Australian Institute of Marine Science, Funding: NOAA - National Oceanic and Atmospheric Administration

Maximising the benefits of mobile predators to GBR ecosystems: the importance of movement, habitat and environment, Australian Institute of Marine Science, James Cook University, Michelle Heupel, Colin Simpfendorfer, 2011-2014, Funding: National Environmental Research Program (NERP)

eReefs - hydrodynamic modelling validation, BOM Queensland Regional Office, Arthur Simanjuntak, 2013-2014, Partner Institution(s): CSIRO, AIMS, Funding: Bureau of Meteorology

eReefs DA - phase 2, Commonwealth Scientific Industrial Research Organisation, Emlyn Jones, 2014-2015, Partner Institution(s): BOM, AIMS

Building services for Australian marine data discovery, University of Tasmania, Roger Proctor, 2018-2018, Partner Institution(s): AAD, AIMS, CSIRO (O&A linkage + OBIS), CSIRO (ALA linkage + OBIS), Geoscience Australia, GreyBits Engineering, SIMS, TERN, Funding: Australian National Data Service (ANDS), National eResearch Collaboration Tools and Resources (NeCTAR), Research Data Cloud (RDS)

Oceanographic drivers of bleaching in the GBR: from observations to prediction (Project 4.2), Australian Institute of Marine Science, Craig Steinberg, 2018-2021, Funding: National Environmental Science Program (NESP), Australian Institute of Marine Science, CSIRO

**Research Projects 14**

## Postgraduate Research Projects

Honours degree, Seabirds and climate change: Can wedge-tailed shearwaters adapt to changing resource availability?, James Cook University; Fiona McDuie, 2009-2010, Supervisor(s): Brad Congdon

Doctor of Philosophy (PhD), Biodiversity, ecology and distribution of benthic foraminiferal assemblages from the southern Great Barrier Reef, Macquarie University, James Cook University; Erika Woolsey, 2010-2014, Supervisor(s): Andrew Baird, S Keith

**Postgraduate Research Projects 2**

## Book

**Book null**

## Book Chapters

Lough, JM, Bainbridge, S, Berkelmans, R, Steinberg, C 2010, Physical monitoring of the Great Barrier Reef to understand ecological responses to climate change, in Y You, A Henderson-Sellers (eds.), Climate Alert: Climate Change Monitoring and Strategy, Sydney University Press, Sydney, pp.66-110

**Book Chapters 1**

## Community White Papers / Technical Papers

Brainard, RE, Bainbridge, S, Brinkman, R, Eakin, CM, Field, M, Gattuso, J-P, Gledhill, D, Gramer, L, Hendee, J, Hoeke, RK, Holbrook, SJ, Hoegh-Guldberg, O, Lammers, M, Manzello, D, McManus, M, Moffitt, R, Monaco, M, Morgan, JA, Obura, D, Planes, S, Schmitt, RJ, Steinberg, C, Sweatman, H, Vetter, OJ, Wong, KB, Wilkinson, C; 2010, An International Network of Coral Reef Ecosystem Observing Systems (I-CREOS), Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol 2), Venice, Italy, September 2009, ESA Publication WPP-306, doi:10.5270/OceanObs09.cwp.09

Moltmann, T, Llewellyn, L; 2014, Research Vessels, Experimental Facilities, Observing Systems and e-Research, Comments: National Marine Science Plan Biodiversity Conservation and Ecosystem Health, Canberra, Australia

## Community White Papers/Technical Papers 2

### Conference Proceedings

Bainbridge, S, Rehbein, MA, Feather, G, Eggeling, D 2008, Sensor networks on the Great Barrier Reef - managing marine sensor data, Proceedings of the Environmental Information Management Conference 2009, Albuquerque

Bainbridge, S 2010, The design of a novel time series client for ocean data, Proceedings of Oceans 2010 IEEE, Sydney, Australia, May, 2010, Sydney, Presenter: Scott Bainbridge

Bainbridge, S, Eggeling, D 2010, Smart sensors - a new paradigm for marine management: an example from the Great Barrier Reef, Proceedings of Oceans 2010 IEEE, Sydney, Australia, May, 2010, Sydney

Bainbridge, S, Steinberg, C, Heron, M, Furnas, M 2010, Integrating observation systems: an example from the Great Barrier Reef, Proceedings of Oceans 2010 IEEE, Sydney, Australia, May, 2010, Sydney

Bainbridge, S 2010, GBROOS - an ocean observing system for the Great Barrier Reef, Proceedings of the 11th International Coral Reef Symposium, 2008, Fort Lauderdale, Presenter: Scott Bainbridge

Bainbridge, S 2011, A services based architecture for achieving interoperability of environmental observational data., Proceedings of the Environmental Information Management Conference 2011, Santa Barbara, Presenter: Scott Bainbridge

Bainbridge, S, Page, G, Jaroensutasinee, M, Jaroensutasinee, K 2011, Towards a services based architecture for real time marine observing data, Proceedings of Oceans 2011 MTS/IEEE, Kona, USA, September, 2011, Kona

Woolsey, E, Bainbridge, S, Kingsford, MJ, Byrne, M 2012, Impacts of Cyclone Hamish at One Tree Reef, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: Erika Woolsey

Skirving, WJ, Dove, SG, Hoegh-Guldberg, O, Berkelmans, R, Bainbridge, S, Wachenfeld, D, Iglesias-Prieto, R, Eakin, CM, Enriquez, S, Mason, R 2012, Next generation satellite tools: understanding environmental stress on coral reefs, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: William Skirving

Burgess, T, Hendee, J, Heron, SF, Bainbridge, S, Gramer, L 2012, SeaDroid: low-cost, real-time water temperature logging, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: Tim Burgess

Hendee, J, Jankulak, M, Shoemaker, M, Gramer, L, Burgess, T, Heron, M, Amornthammarong, N, Bainbridge, S, Skirving, WJ 2012, Wireless architecture for coral reef environmental monitoring, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: Jim Hendee

Jaroensutasinee, M, Jaroensutasinee, K, Bainbridge, S, Fountain, T, Chumkiew, S, Noonsang, P, Kuhapong, U, Vannarat, S, Poyai, A, Nekrasov, M 2012, Sensor networks applications for reefs at Racha Island, Thailand, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: Mullica Jaroensutasinee

Jaroensutasinee, K, Jaroensutasinee, M, Bainbridge, S, Fountain, T, Holbrook, SJ, Nekrasov, M 2012, CREON: integrating disparate sources of remote coral reef sensor data, Proceedings of the 12th International Coral Reef Symposium, Cairns, Presenter: Krisanade Jaroensutasinee

Page, G, Bainbridge, S, Gardner, S, Hahn, S 2014, Development of a coral reef observing system using 802.11 wireless at Heron Island, Great Barrier Reef, Proceedings of Oceans 2014 MTS/IEEE, Taipei, Taiwan, April, 2014, Taipei, Presenter: Geoff Page

Page, G, Bainbridge, S, Gardner, S, Hahn, S 2014, Implementation of low-cost, long-range microwave links on the Great Barrier Reef using evaporation duct transmission, Proceedings of Oceans 2014 MTS/IEEE, Taipei, Taiwan, April, 2014, Taipei, Presenter: Geoff Page

Conference Proceedings 15

## In Press

In Press null

## Journals

Bainbridge, S, Steinberg, C, Heron, M 2010, Integrating observations: an example from the Great Barrier Reef, lessons from the reef on why integration matters and why achieving integration is harder than it looks, *Sea Technology*, vol. 51, no. 8, pp. 33-38

Bainbridge, S, Eggeling, D, Page, G 2011, Lessons from the field - Two years of deploying operational wireless sensor networks on the Great Barrier Reef, *Sensors*, vol. 11, no. 7, pp. 6842-6855, doi:10.3390/s110706842

Hollier, W, Rau, G, Dicks, A, Bainbridge, S 2011, Reef climate adaptation research and technology, *International Journal of Climate Change: Impacts and Responses*, vol. 2, no. 4, pp. 127-142, doi: <https://doi.org/10.18848/1835-7156/CGP/v02i04/37082>

Woolsey, E, Bainbridge, S, Kingsford, MJ, Byrne, M 2011, Impacts of cyclone Hamish at One Tree Reef: integrating environmental and benthic habitat data, *Marine Biology*, vol. 159, no. 4, pp. 793-803, doi:10.1007/s00227-011-1855-8

Leahy, SM, Kingsford, MJ, Steinberg, C 2013, Do clouds save the Great Barrier Reef? Satellite imagery elucidates the cloud-SST relationship at the local scale, *PLoS One*, vol. 8, no. 7, doi:10.1371/journal.pone.0070400

Lukoschek, V, Cross, P, Torda, G, Zimmerman, R, Willis, B 2013, The importance of coral larval recruitment for the recovery of reefs impacted by Cyclone Yasi in the Central Great Barrier Reef, *PLoS One*, vol. 8, e65363, doi:10.1371/journal.pone.0065363

Woolsey, E, Byrne, M, Baird, A 2013, The effects of temperature on embryonic development and larval survival in two scleractinian corals, *Marine Ecology Progress Series*, vol. 493, pp. 179-184, doi:10.3354/meps10499

Phinn, SR, Tilbrook, B, Steven, A, Shaw, E 2014, Comparability of slack water and Lagrangian flow respirometry methods for community metabolic measurements, *PLoS One*, vol. 9, e112161, doi:10.1371/journal.pone.0112161

Woolsey, E, Keith, S, Byrne, M, Schmidt-Roach, S, Baird, A 2014, Latitudinal variation in thermal tolerance thresholds of early life stages of corals, *Coral Reefs*, vol. 34, pp. 471-478, doi:10.1007/s00338-014-1253-2

Vila-Concejo, A, Harris, D, et. al. 2014, Sediment transport and mixing depth on a coral reef sand apron, *Geomorphology*, vol. 222, pp. 143-150, doi:10.1016/j.geomorph.2013.09.034

Shaw, E, Phinn, SR, Tilbrook, B, Steven, A 2015, Natural in situ relationships suggest coral reef calcium carbonate production will decline with ocean acidification, *Limnology and Oceanography*, vol. 60, no. 3, pp. 777-788, doi:10.1002/lno.10048

Wolfe, K, Byrne, M 2017, Biology and ecology of the vulnerable holothuroid, *Stichopus herrmanni*, on a high-latitude coral reef on the Great Barrier Reef, *Coral Reefs*, vol. 36, no. 4, pp. 1143-1156, doi:10.1007/s00338-017-1606-5

Bainbridge, S 2017, Temperature and light patterns at four reefs along the Great Barrier Reef during the 2015–2016 austral summer: understanding patterns of observed coral bleaching, *Journal of Operational Oceanography*, vol. 10, no. 1, pp. 16-29, doi:10.1080/1755876X.2017.1290863

**Journals 13**

## Reports

**Reports null**

## Thesis

Woolsey, E 2014, Coral larval ecology and biogeography in a warming ocean, Doctor of Philosophy (PhD), Macquarie University, Sydney

**Thesis 1**

## Data Products

Coral Reef Environmental Observatory Network (CREON), (2008 - 2029) Database. <http://creon.sdsc.edu:8080/confluence/display/creon/Welcome>

GBR - Coral Reef Temperature Dashboard, (2013 - 2035) Climatology. <http://138.7.120.39:47080/coralwatch/index.html>

Lizard Island Observing System (LIOS), (2014 - 2035) Database. [kiosk.aims.gov.au:47080/lizard/index.html](http://kiosk.aims.gov.au:47080/lizard/index.html)

**Data Products 3**

## Public Seminars

Steinberg, C, Bainbridge, S, Heupel, M, Meekan, MG, Benthuysen, J, Williams, DK, Brinkman, R; Coastal and Ocean Observing at AIMS; AIMS Science Days, 11/03/2015 - 12/03/2015, Australian Institute of Marine Science, Townsville, Presenter(s): Craig Steinberg

Bainbridge, S; Computers and climate change - Q-IMOS, Queensland's ocean observing system; 2011 Rotary Meeting, Townsville, Presenter(s): Scott Bainbridge

**Public Seminars 2**

## Conferences, Symposia or Workshops

### Conference Oral Presentation

Bainbridge, S; A services based architecture for achieving interoperability of environmental observational data; Environmental Information Management Conference , 10/09/2008 - 11/09/2008, Albuquerque, Presenter(s): Scott Bainbridge

Bainbridge, S, Rehbein, MA, Feather, G, Eggeling, D; Sensor networks on the Great Barrier Reef - managing marine sensor data; Environmental Information Management Conference , 10/09/2008 - 11/09/2008, Albuquerque

Bainbridge, S, Feather, G, Eggeling, D; GBROOS - Application of sensor networks to coral reef systems; 9th International Conference on Southern Hemisphere Meteorology and Oceanography (ICSHMO), 09/02/2009 - 13/02/2009, Melbourne

Bainbridge, S; I-CREOS - Towards an international network of coral reef ecosystem observing systems; 5th International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 07/12/2009 - 10/12/2009, Melbourne, Presenter(s): Scott Bainbridge

Hollier, W, Dargaville, R, Bainbridge, S, Rau, G, Dicks, A; Reef climate adaptation research and technology; The Second International Conference on Climate Change, 08/07/2010 - 10/07/2010, University of Queensland, Brisbane

Bainbridge, S; The role of sensor networks in monitoring and managing coastal systems including ecological monitoring of coral reefs; Thailand National Science and Technology Development Agency (NSTDA) Annual Conference, 25/03/2011 - 25/03/2011, Bangkok, Presenter(s): Scott Bainbridge

Bainbridge, S; Sensor Networks - working towards smart monitoring of environmental systems; Taiwan-AU-NZ Conference on Marine Biology, Biodiversity and Ecosystem, 19/06/2011 - 24/06/2011, Keelung, Presenter(s): Scott Bainbridge

Bainbridge, S; Cloud-based service-orientated data system for ocean observational data - an example from the coral reef community; European Geosciences Union (EGU), 21/04/2012 - 27/04/2012, Vienna, Presenter(s): Scott Bainbridge

Bainbridge, S, Proctor, R; AODC-JF, IMOS, AODN, eMII: an ocean of acronyms; IODE First ODIP Workshop, 25/02/2013 - 28/03/2013, Oostende, Presenter(s): Scott Bainbridge

Heupel, M, Simpfendorfer, C; Importance of environmental and biological drivers in the presence and space use of a reef-associated shark; Australian Marine Science Association Conference, 07/07/2013 - 11/07/2013, Gold Coast, Presenter(s): Michelle Heupel

Vila-Concejo, A, Harris, D; Morphological stability and sediment transport processes on sand aprons; 88th Australian Coral Reef Society Conference, 27/08/2014 - 29/08/2014, Brisbane, Presenter(s): Ana Vila-Concejo

Steinberg, C, Benthuisen, J, Herzfeld, M, Tonin, H, et. al.; Responding to the 2016 mass coral bleaching event on the Great Barrier Reef: from observations to modelling; NZMSS and AMSA Sharing Ocean Resources - Now and in the future, 04/07/2016 - 07/07/2016, Wellington, Presenter(s): Craig Steinberg

Bainbridge, S; GBR Sensor networks; CREON (Coral Reef Environmental Observatory Network) 8, Santa Barbara, Presenter(s): Scott Bainbridge

### **Conference Poster**

Bainbridge, S, Steinberg, C, Heron, M, Rigby, P; The role of observation systems in coral reef monitoring and management; 2009 Joint Assembly, 24/05/2009 - 27/05/2009, Toronto

Bainbridge, S, Eggeling, D; Application of Wireless Sensor Networks to Coastal Observing Systems - An Example From the Great Barrier Reef; OceanObs'09 Conference, 21/09/2009 - 25/09/2009, Venice

Moltmann, T, Proctor, R, Donoghue, S; The Integrated Marine Observing System: observations to support research and applications in the coastal zone; Ocean Sciences Meeting, 23/02/2014 - 28/02/2014, Honolulu, Presenter(s): Tim Moltmann

### **Key Note Speaker**

Bainbridge, S; Sensor Networks in the real world - ten lessons from the Great Barrier Reef; 6th International Conference on Intelligent Sensors, Sensor Networks and Information Processing - ISSNIP 2010, 07/12/2010 - 10/12/2010, Queensland University of Technology, Brisbane, Presenter(s): Scott Bainbridge

### Meeting Presentation

Bainbridge, S; GBROOS - Sensor Networks on the Great Barrier Reef; CREON (Coral Reef Environmental Observatory Network) 6 Meeting, 13/09/2010 - 16/09/2010, Taipei, Presenter(s): Scott Bainbridge

Bainbridge, S, Eggeling, D, Page, G; Sensor Networks - integrate or perish; CREON (Coral Reef Environmental Observatory Network) 7 Meeting, 07/12/2010 - 10/12/2010, Brisbane, Presenter(s): Scott Bainbridge

Steinberg, C, Moltmann, T; Australia's Integrated Marine Observing System; Joint WMO-IOC Commission for Oceanography and Marine Meteorology DBCP PI-1, 04/05/2015 - 07/05/2015, Koror, Presenter(s): Craig Steinberg

Steinberg, C; Australia's Integrated Marine Observing System; GOOS Steering Committee 4, 24/05/2015 - 26/05/2015, Australian Institute of Marine Science, Townsville, Presenter(s): Craig Steinberg

### Session Chair

Workshop Chair - CREON workshop on the application of sensor networks to Coral Reef Systems: towards an International system of systems; 5th International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 07/12/2009 - 10/12/2009, Melbourne, Presenter(s): Scott Bainbridge

Session Co-Chairs - Advances in marine management; IEEE Oceans 2010, 24/05/2010 - 27/05/2010, Sydney, Presenter(s): Scott Bainbridge, Douglas Cato

Session Co-Chairs - DVIM Data visualization and information management; IEEE Oceans 2010, 24/05/2010 - 27/05/2010, Sydney, Presenter(s): Scott Bainbridge, Paulo de Souza

Session Co-Chair - Reef Climate Adaptation Research and Technology; The Second International Conference on Climate Change, 08/07/2010 - 10/07/2010, University of Queensland, Brisbane, Presenter(s): Scott Bainbridge

Meeting Co-Chair; CREON (Coral Reef Environmental Observatory Network) 6 Meeting, 13/09/2010 - 16/09/2010, Taipei, Presenter(s): Scott Bainbridge

Workshop Co-chair - Workshop on monitoring the impact of climate change on the environment; International Conference on Intelligent Robots and Systems (IROS 2010), 18/10/2010 - 22/10/2010, Taipei, Presenter(s): Scott Bainbridge

Meeting Co-Chair; CREON (Coral Reef Environmental Observatory Network) 7 Meeting, 07/12/2010 - 10/12/2010, Brisbane, Presenter(s): Scott Bainbridge

Workshop Co-Chair - ISSNIP-CREON workshop, Building coral reef sensor networks as systems of systems; 6th International Conference on Intelligent Sensors, Sensor Networks and Information Processing - ISSNIP 2010, 07/12/2010 - 10/12/2010, Queensland University of Technology, Brisbane, Presenter(s): Scott Bainbridge

### Symposium Presentation

Bainbridge, S; The Application of sensor networks to coastal monitoring: an example from the Great Barrier Reef; 6th China-Australia Symposium: Towards Sustainable Coastal and Deltaic Systems under Climate Change, 13/10/2009 - 15/10/2009, Guangzhou and Xiamen, Presenter(s): Scott Bainbridge

Gillibrand, P, Mongin, M, Cahill, M, Tilbrook, B, Steinberg, C; Wave- and wind-driven circulation over Heron Island Lagoon in the Southern Great Barrier Reef: A Model Study; AMSA-NZMSS (Australian Marine Sciences Association and New Zealand Marine Science Society) Conference, 01/07/2012 - 07/07/2012, Hobart

### Workshop Presentation

Bainbridge, S; Sensor networks and web services: opportunities for new infrastructure; Australia-EU Workshop on marine data information, 04/04/2011 - 05/04/2011, Brussels, Presenter(s): Scott Bainbridge

Bainbridge, S; Sensor networks and the internet of things; International Hack Event - the Internet of Things, 08/04/2011 - 08/04/2011, London, Presenter(s): Scott Bainbridge

Jones, EM, Brinkman, R, Gillibrand, P, Herzfeld, M, Margvelashvili, N, Mongin, M, Rigby, P, Sharman, C, Timms, GP, Tonin, H, Wild-Allen, K; Australian coastal modelling and information systems: assisting management decision making; Australian Coastal Ocean Modelling and Observations - ACOMO, 03/10/2012 - 04/10/2012, Canberra, Presenter(s): Emlyn Jones

Mancini, S, Bainbridge, S, Proctor, R; ODIP Prototype 3: establishing a prototype for a sensor observation service (SOS) for selected sensors (SWE) installed on research vessels and in real-time monitoring systems; Ocean Data Interoperability Platform (ODIP) Workshop, 03/12/2013 - 06/12/2013, Scripps Institution of Oceanography, San Diego, Presenter(s): Sebastien Mancini

Spillman, CM, Steinberg, C, Benthuyzen, J, et, al.; Monitoring and modelling this summer's extreme temperatures on the GBR leading to a mass coral bleaching event on the Great Barrier Reef; Australian Coastal and Oceans Modelling and Observations (ACOMO) Workshop, 11/10/2016 - 12/10/2016, Canberra, Presenter(s): Claire Spillman

**Conferences, Symposia or Workshops 36**