



ASPAB conference 2010

ROTTNEST ISLAND
WESTERN AUSTRALIA
15TH-18TH NOVEMBER

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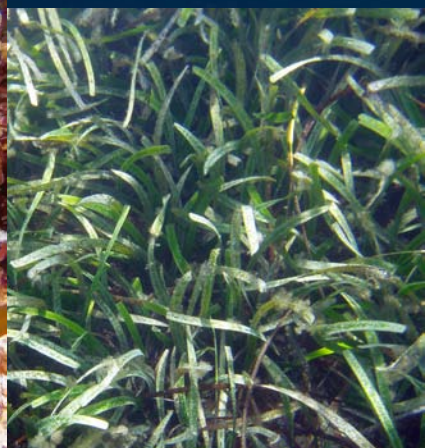
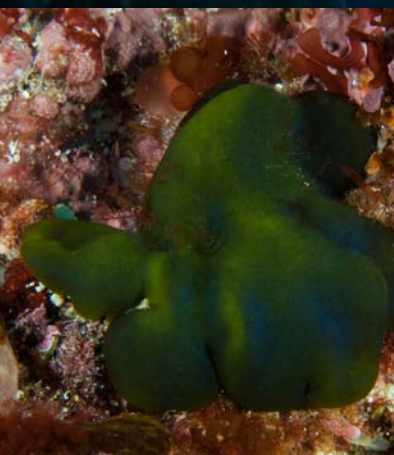
ASPAB



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ASPAB Annual Conference

Rottnest Island, 15-18 November, 2010

Welcome!

On behalf of the Australasian Society for Phycology and Aquatic Botany, welcome to Rottnest Island and to our annual meeting. Thanks for coming! We are delighted to see so many familiar faces and old friends, as well as delegates at their first ASPAB meeting. We hope those of you new to ASPAB enjoy the experience and are enticed to continue your association with the Society. Many of you have come a long way, including one of our Plenary speakers, Professor Gary Saunders, from Canada. A special welcome to our members from New Zealand, and other international visitors from Korea, Spain and Malaysia, who we are very pleased to have joining us. For those who have just ventured across from Perth, including our other Plenary speaker, Professor Gary Kendrick, thanks for coming.

Rottnest Island has been attracting phycologists and aquatic botanists since William Henry Harvey in 1854, and we hope you have a productive and inspiring time on an island with much to recommend it for scientists with our interests. ASPAB conferences are renowned for the quality of the interactions, so we encourage you to get to know all the participants over the next few days.

Enjoy your stay on Rottnest.

Di Walker

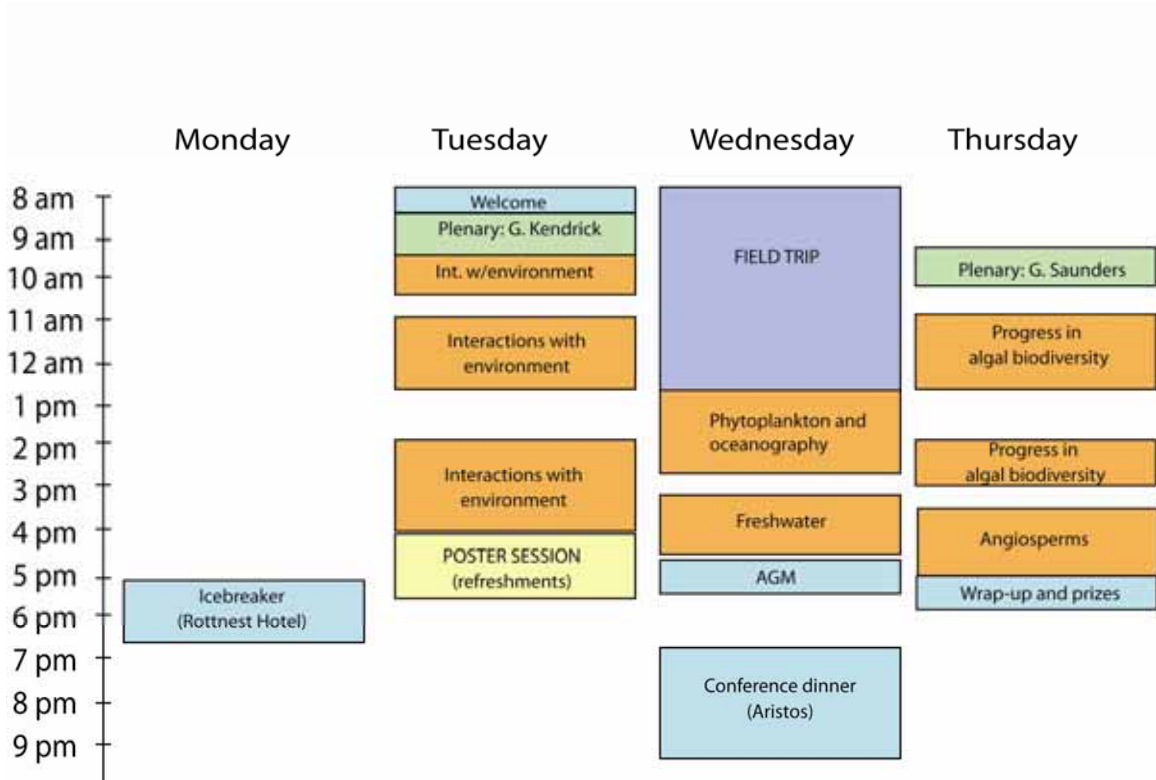
Organizing Committee

Di Walker (University of Western Australia), Kiernyn Kilminster (WA Department of Water), John Huisman (Murdoch University and DEC), Rainbo Dixon (Murdoch University)

Housekeeping

All presenters should submit their talks (on USB stick or CD) to RAINBO DIXON, at least one session prior to their scheduled talk, earlier if possible. Please inform Rainbo if the presentation was prepared on a PC or Mac. Oral presentations will be 15 minutes plus 5 minutes question time. Posters should be on view as early as possible, at the latest by lunchtime on Tuesday 16th.

Session Overview

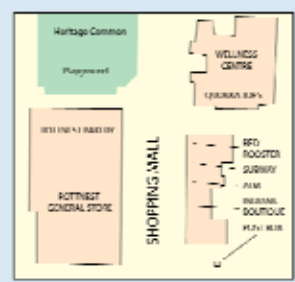
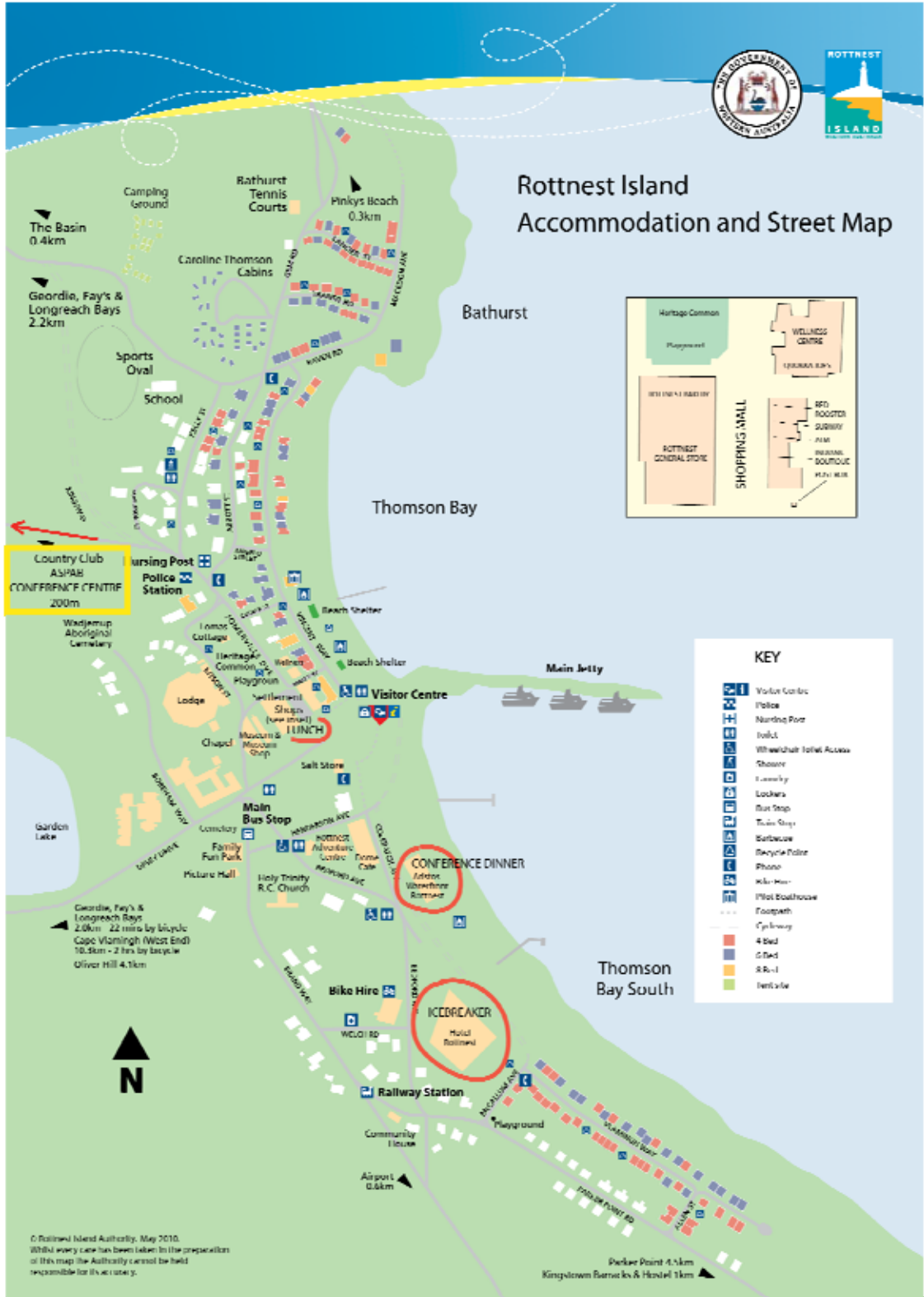


Map of Locations

The map on the following page provides details of each of the major venues for the conference. Directions towards the Country Club are shown in the yellow box, and social function locations highlighted with red circles.



Rottneet Island Accommodation and Street Map



KEY

- Visitor Centre
- Police
- Marina Pier
- Toilet
- Wheelchair Access
- Shower
- Luggage
- Lockers
- Bus Stop
- Tram Stop
- Barbecue
- Bicycle Parking
- Phone
- Kiosk
- First Aid
- Footpath
- Cycleway

Accommodation Unit Types:

- 4 Bed
- 2 Bed
- 2 B + 1
- 1 Bed + 1

© Rottneet Island Authority, May 2010.
 Whilst every care has been taken in the preparation of this map the Authority cannot be held responsible for its accuracy.

Programme

Presenting author indicated by *

(P) = Poster presentation

(S) = Student presentation

Monday 15th November

Registration and Icebreaker, Rottneest Island Hotel (5.00 p.m. onwards)

Tuesday 16th November

Walker, Diana: Welcome and housekeeping (8.15-8.30)

Plenary (8.30-9.30)

(Introduction: Di Walker)

Kendrick, Gary A.: Western Australia- a biodiversity hotspot for both seaweeds and seagrasses (8.30-9.30).

Session 1: Interactions with environment (9.30-10.30)

(Session Chair: Di Walker)

Diaz-Pulido, Guillermo*, **Dorothea Bender**, **Catalina Reyes-Nivia**, **Marine Gouezo & Kenneth R.N. Anthony:** Variability in the Effects of Ocean Acidification on Coral Reef Algae (9.30-9.50).

Bisset, Ramone: Assessment of the Giant kelp forests of the east and south coasts of Tasmania for listing as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (9.50-10.10).

Keesing, John, Dongyan Liu, Yajin Shi, Peter Fearn & Rodrigo Garcia: The world's largest macroalgal blooms: novel events caused by expansion of algal aquaculture in the Yellow Sea off China (10.10-10.30).

Morning Break: (10.30-11.00)

Session 2: Interactions with environment (11.00-12.40)

(Session Chair: Alecia Bellgrove)

Saunders, Megan I.*, **Anna Metaxas & Ramón Filgueira:** Causes and consequences of outbreaks of a nonindigenous epiphytic bryozoan in western North Atlantic kelp beds (11.00-11.20).

Martínez, Brezo*, **Rosa Viejo**, **Silvia Calvo & Francisco Carreño:** Habitat Model of *Himantalia elongata*: predictions in a warming scenario (11.20-11.40).

Cambridge, Marion: Is the increased occurrence of *Lyngbya majuscula* (Cyanobacteria) at Rottneest linked to higher nutrient loading? (11.40-12.00).

Kain (Jones), Joanna: Seasonal in situ growth rate of *Hormosira banksii* in southeast NSW rockpools (12.00-12.20).

Bearham, Douglas* & Mat Vanderklift: The influence of light intensity, temperature and water movement on changes in growth of *Ecklonia radiata* in Marmion Lagoon, Western Australia (12.20-12.40).

Lunch Break (12.40-2.00)

Session 3: Interactions with environment (2.00-4.00)

(Session Chair: Margaret Clayton)

Thomson, Damian*, Russ Babcock, Mat Vanderklift, Graham Symonds & Geordie Clapin: Patch dynamics on a temperate reef: patch size, wave exposure, herbivore abundance and patch age (2.00-2.20).

de Bettignies, Thibaut*, Thomas Wernberg, Paul Lavery & Mat Vanderklift: The importance of storms in driving export of organic matter (kelp wrack) from rocky reefs (2.20-2.40) (S).

Graham, Fiona*, Mat Vanderklift, Andy Revill & Rebecca Esmay: Biochemical analysis of degrading seagrass and macroalgae using litterbags (2.40-3.00).

Vanderklift, Mat*, Russ Babcock, Doug Bearham, Thibaut de Bettignies, Gary Kendrick & Thomas Wernberg: A single species, the kelp *Ecklonia radiata*, is disproportionately important in coastal marine ecosystems (3.00-3.20).

Wernberg, Thomas: Integrating biogeography, ecology and physiology to disentangle the effects of climate on Australian seaweeds (3.20-3.40)

Bellgrove, Alecia* & Masakazu N. Aoki: Attachment strength of different life-history stages of the intertidal red alga, *Chondrus verrucosus* (Gigartinaceae, Rhodophyta) (3.40-4.00).

Session 4: Posters (4.00-5.30)

(with refreshments)

de Bettignies, Thibaut*, Jeremie Godefroy, Thomas Wernberg & Mat Vanderklift: Changes in growth, erosion, productivity and morphology of *Ecklonia radiata* along a hydrodynamic gradient (S).

Neill, Kate, Tracy Farr*, Roberta D'Archino & Wendy Nelson: Soft sediment seaweed communities in two New Zealand harbours.

Gomez Bernardez, Maria Gabriela*, Dylan Korczynskyj & Tim Meagher: Documentation of coral reef habitat in Little Salmon Bay Snorkelling Trail, Rottnest Island (S).

Gedaria, Alice I.* & Matthew R. Hipsey: Seasonal patterns of phytoplankton populations in Swan River Estuary, Western Australia.

Han, Eun Gyu*, Mi Yeon Yang, Mi Kyung Choe & Myung Sook Kim: Systematics of the genus *Grateloupia* (Halymeniaceae, Rhodophyta) with an emphasis on two species from Korea.

Hart, Felicity: The taxonomy and pest potential of the genus *Codium* in Western Australia (S).

Hosja Wasele, Ashrafi Begum, Annabeth Kemp*, Alice Gedaria, Sarah Grigo & Rian Caccianiaga: *Lyngbya* occurrences Western Australia including Parker Point, Rottnest Island: Surveillance of potentially harmful algae in Western Australia.

Kim, Myung Sook*, Jeong Chan Kang & Mi Yeon Yang: A potentially undescribed species of *Haraldiophyllum* and *Symphyocladia* (Ceramiaceae, Rhodophyta) from Korea.

Koh, Young Ho*, Jeong Chan Kang, Jeong Hyeong Lee & Myung Sook Kim: Distribution and abundance of summer macroalgae at Marado of Jeju Island, Korea.

Lee, Hyung Woo*, Jeong Chan Kang & Myung Sook Kim: Marine benthic algal flora and community structure at U-do of Jeju Island, Korea.

Yang, Mi Yeon*, Jeong Hyeong Lee & Myung Sook Kim: Applying mt DNA COI barcoding to Korean Gracilariaceae (Rhodophyta).

Lee, Hyung Woo*, Ah Young Yu & Myung Sook Kim: Morphology and Molecular study of the Genus *Codium* (Chlorophyta) from Jeju, Korea.

Wednesday 17th November

Field Trip & Lunch Break (8.30-1.00)

Session 5: Phytoplankton and Oceanography (1.00-2.40)

(Session Chair: Tracy Farr)

Li, Yu*, Matthew Hipsey & Vardit Makler: Significance of microbial Loop in regulating Phytoplankton Succession in Lake Kinneret (Israel): A numerical Investigation using DYRESM-CAEDYM (1.00-1.20) (S).

Weller, David Ivor*, Cliff Law, Els Maas & Russell Frew: Marine microalgae: a major player in solving the methane paradox in the surface ocean (1.20-1.40).

Sävström, Christin*, Megan I. Saunders & Anya M. Waite: Phytoplankton productivity in the Leeuwin Current off Ningaloo Reef, Western Australia (1.40-2.00).

Hallegraef, Gustaaf, Ben Mooney, Kate Evans, Was Hosja, & Jeff Cosgrove*: The fish-killing dinoflagellate *Karlodinium veneficum* (D. Ballantine) J. Larsen in the Swan-Canning Estuary (2.00-2.20)

Noroozi, Mostafa*, Hishamuddin Omar, Soon Guan Tan & Suhaimi Napis: Genetic variation of green unicellular alga *Haematococcus pluvialis* (Chlorophyceae) obtained from different geographical locations using ISSR and RAPD (2.20-2.40)

Afternoon Break (2.40-3.10)

Session 6: Freshwater (3.10-4.30)

(Session Chair: Kieryn Kilminster)

Annan, Isaac* & Jacob John: *Nitella congesta*, a pioneer charophyte under the threat of eutrophication (3.10-3.30)

Trend, Felicity* & Jacob John: Survival strategies of the charophytes, *Lamprothamnium papulosum* and *Protochara inflata* in Perth wetlands under increasing salinity and climate change (3.30-3.50)

John, Jacob* & Peter Mioduszewski: Algal communities in Central Australia as indicators of water quality and climate change (3.50-4.10)

Alexander, Jennifer* & Jacob John: Are the thrombolites in Lake Clifton (Western Australia) dead? (4.10-4.30)

ASPAB AGM (4.30-5.30)

(Chair: Alecia Bellgrove)

Conference Dinner (7.00 onwards)

Aristos Restaurant

Thursday 18th November

Plenary (9.30-10.30)

(Introduction: John Huisman)

Saunders, Gary W.: ALGA – iBOL’s Algal Life Global Audit: muddled morphologies & molecular mayhem in the topsy-turvy world of algal floristics (9.30 – 10.30).

Morning Break (10.30-11.00)

Session 7: Progress in Algal Biodiversity (11.00-12.40)

(Session Chair: John Huisman)

Dixon, Rainbo* & John Huisman: Species boundaries within *Sargassum* (Fucales, Phaeophyceae) in Western Australia (11.00-11.20) (S).

Scott, Fiona*, Graham Edgar, James Kirkpatrick & Neville Barrett: Rare marine macroalgae and Marine Protected Area planning (11.20-11.40) (S).

Mohring, Margaret*, Thomas Wernberg & Gary Kendrick: Reproductive ecology of the kelp *Ecklonia radiata* (11.40-12.00) (S).

Hurrey, Lucy*, Clifford Roland Pitcher, Catherine Lovelock & Susanne Schmidt: Macroalgal species richness and assemblage composition of the Great Barrier Reef seabed (12.00-12.20) (S).

Dixon, Kyatt*, Gerald Kraft & Gary Saunders: *Ramicrusta* and *Incendia* gen. nov., two peyssonnelioid genera with secondary pit connections from Vanuatu and Australia (12.20-12.40).

Lunch Break (12.40-2.00)

Session 8: Progress in Algal Biodiversity (2.00-3.00)

(Session Chair: Kyatt Dixon)

Huisman, John M.*, Olivier De Clerck, Willem F. Prud’homme van Reine & Michael A. Borowitzka: *Spongophloea*, a new genus of red algae based on *Thamnoclonium* sect. *Nematophorae* Weber-van Bosse (Halymeniales) (2.00-2.20)

Broom, Judy*, Svenja Heesch & Wendy Nelson: Little Green Things – Marine Prasiolales from New Zealand and the Balleny Islands (2.20-2.40).

Farr, Tracy*, Neill Barr, Roberta D’Archino, Kate Neill, Sheryl Miller, Wendy Nelson, Rob Stewart & Judy Broom: Red rocks: rhodoliths in New Zealand (2.40-3.00).

Afternoon Break (3.00-3.30)

Session 9: Submerged Angiosperms (3.30-5.10)

(Session Chair: Gary Kendrick)

Hovey, Renae*, Marion Cambridge & Gary Kendrick: Effects of sediment nutrient additions and season on root architecture of the temperate seagrasses, *Posidonia australis* and *Posidonia sinuosa* (3.30-3.50).

Kilminster, Kieryn: Seagrasses as bioindicators of point source pollution in the Leschenault Estuary (3.50-4.10).

Ruiz-Montoya, Leonardo*, Ryan Lowe, Kimberly Van Niel & Gary Kendrick: The role of ocean dynamics in seagrass seed dispersal and recruitment in Western Australia (4.10-4.30).

McMahon, Kathryn*, Paul Lavery, Carolyn Oldham, Adam Gartner & Candace Willison: Seagrass wrack mass balance, generation and transport (4.30-4.50).

Walker, Di: Investigating effects of climate change in a very large seagrass-dominated ecosystem – Shark Bay (4.50-5.10).

Wrap-up and Prize Presentation (5.10-6.00)

(Alecia Bellgrove, ASPAB President)

ABSTRACTS

Listed alphabetically by first author

Are the thrombolites in Lake Clifton (Western Australia) dead?

Alexander, Jennifer* and Jacob John

Dept of Environmental and Aquatic Sciences, Curtin University, GPO Box U 1987, Perth WA 6845 Australia

Author contact:

Lake Clifton is well known for the largest array of living Thrombolites (a type of Microbialites similar to Stromatolites) in the southern hemisphere. They were first described in 1980s when the lake ranged in salinity between 7 and 35 ppt. Within the last 25 years the salinity in the lake has doubled with increase in nutrients. In 2002, 2005, 2007 and 2010 there has been massive break down of thick microbial mats from the bottom of the lake and floating in the lake. In Spring and summer the thrombolites are smothered with Cladophora – a sign of eutrophication. The microbial mats in the lake including those responsible for the growth of thrombolites have been investigated in conjunction with the environmental factors. The results indicate that the system is becoming eutrophic and hypersaline. The paper traces the origin of the floating algal mats and provides an explanation for the break up of the benthic algal mats in the context of salinity and nutrient increases related to climate changes and change in land use in the catchments. The current conditions are unlikely to support thrombolite growth.

***Nitella congesta*, a pioneer charophyte under the threat of eutrophication**

Annan, Isaac* and Jacob John

Dept of Environmental and Aquatic Sciences, Curtin University of Technology, GPO Box U1987, Perth, WA 6845.

Author contact:

The disappearance of submerged macrophytes in shallow lakes is one of the most critical problems caused by eutrophication. The impact of increased phosphorus concentration on the establishment of *N. congesta* as a suitable macrophyte was studied in a laboratory experiment. *N. congesta* was cultured in aquarium tanks in eutrophic and mesotrophic media alongside control (oligotrophic) setup and its growth was monitored. It was observed that eutrophication had an adverse impact on growth, morphology and life cycle of *N. congesta*. In addition to showing profuse vegetative growth, *N. congesta* produced no fruiting bodies in the eutrophic medium whereas an approximate ratio of 1:1 male to female sex bodies was recorded in the mesotrophic and control experimental setup but with reduced vegetative growth. Higher biomass of *N. congesta* and other filamentous algal was also recorded in the eutrophic treatments. Filamentous algal biomass was found to correspond with the nutrient concentration and the biomass of *N. congesta*.

The influence of light intensity, temperature and water movement on changes in growth of *Ecklonia radiata* in Marmion Lagoon, Western Australia.

Bearham, Douglas* and Mat Vanderklift

CSIRO Marine and Atmospheric Science, CELS Building, Underwood Avenue Floreat WA 6014

Author contact: Douglas.Bearham@csiro.au

The productivity of macroalgae such as *Ecklonia radiata* is primarily affected by light, water movement, and temperature. This study investigated seasonal changes in growth rates of *E. radiata* between reefs with differing physical characteristics near Perth, Western Australia and determined the individual influence of water movement, temperature and light penetration on these changes. The growth rates of 739 *E. radiata* from nineteen sites around Marmion Lagoon, Western Australia were calculated using a hole punch method in summer, winter and spring. Average bottom temperature and light intensities for each site was calculated using Hobo™ loggers and measurements for water movement were obtained from a Swan model for Marmion Lagoon. The growth data was compared to the environmental data using multiple regressions. Temperature had the most significant effect on the growth of *E. radiata* during summer (adjusted $R^2 = 0.60$) where growth was lower in warmer, shallower sites close to shore. Temperature also had a significant role in the models produced for winter growth. Depth and Light intensity were the most important factors affecting growth during winter (adjusted $R^2 = 0.71$). Water movement was found to have a significant effect during the high growth periods such as spring that when combined with light produced a model with an adjusted R^2 of 0.55. These results suggest atmospheric warming may also have an effect on the growth (and therefore distribution) of *E. radiata*. If atmospheric warming causes a rise in sea temperatures then the productivity of *E. radiata* may be altered especially in shallower reef sites towards the northern end of its range.

Attachment strength of different life-history stages of the intertidal red alga, *Chondrus verrucosus* (Gigartinaceae, Rhodophyta).

Bellgrove, Alecia*¹ and Masakazu N. Aoki²

¹School of Life & Environmental Sciences, Deakin University, PO Box 423, Warrnambool, Vic 3280, Australia.

²Shimoda Marine Research Center, University of Tsukuba, 5-10-1 Shimoda, Shizuoka 415-0025, Japan.

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For macroalgae living on wave-exposed coasts, dislodgment of thalli by water motion is a common occurrence. Rather than always being a negative impact on individuals however, it has been suggested that dislodgement of fertile thalli may facilitate long-distance dispersal for many macroalgal species. Many species within the Gigartinaceae have differences in carrageenans between life-history phases, with gametophytes possessing the mechanically superior, gelling κ -carrageenan and tetrasporophytes possessing the weaker, non-gelling λ -carrageenan. Using field experiments, we tested the model that weaker mechanical strength of tetrasporophytes of the Japanese *Chondrus verrucosus* Mikami, combined with tissue damage of reproductive portions of the thalli, may lead to greater dislodgement of fertile tetrasporophytes (relative to fertile gametophytes or vegetative thalli of this species), facilitating long-distance dispersal and compensating for previously-hypothesised, poor tetraspore dispersal. Results showed that break stress of tetrasporophytic fronds was less than that of gametophytic fronds, but there were no further effects of fertility or tissue damage. Most fronds were dislodged at the stipe-holdfast junction or at the holdfast, with very few breaking further up despite tissue damage. The significance of these results to the dispersal dynamics of this species will be discussed.

Assessment of the Giant kelp forests of the east and south coasts of Tasmania for listing as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

Bisset, Ramone

Ecological Communities Section, Approvals and Wildlife Division, Department of Sustainability, Environment, Water, Population and Communities, GPO Box 787, Canberra ACT 2601, Australia.

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Australia's national environmental law, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), protects matters of national environmental significance including listed threatened ecological communities (ECs). ECs are nominated through an annual process open to the general public and subsequently undergo assessment by the national Threatened Species Scientific Committee (TSSC). Although the national list of threatened ECs contains predominantly terrestrial vegetation-based communities, ECs can represent any part of the Australian environment. There are no marine ECs yet included in the list. However, there has been recent interest in the benefits that EPBC Act listing may bring for some threatened marine ECs, such as national recognition and additional protection. In late 2009 an expert workshop examined how marine ECs might be defined and assessed under the EPBC Act. The workshop outcomes highlight the complex challenges in assessing marine ECs. The Giant Kelp Forests of the East and South Coasts of Tasmania ecological community was publicly nominated and prioritised for assessment in 2009. The assessment of this community is now underway and, if successful will become the first marine EC listed under the EPBC Act. EPBC listing is unlikely to change current uses in the area of the EC but new or changed activities in the future may require referral and approval if they might have a significant impact. EPBC protection may not be able to ameliorate the threat of climate change but could assist with access to funding opportunities for conservation and research programs on the EC. Expert consultation on the Giant kelp assessment will soon begin and this is where ASPAB members can help. Questions regarding the extent of the foundation species, *Macrocystis pyrifera* (Linnaeus) C. Agardh, in the Australian context, how to accommodate for its characteristic fluctuations over time and identification of other species included in the community require clarification in order to complete the assessment. I invite ASPAB members to become involved in this exciting opportunity to protect a valuable and distinctive Australian marine habitat by providing expert input to the assessment of the Giant Kelp Forests of the East and South Coasts of Tasmania EC.

Little Green Things – Marine Prasiolales from New Zealand and the Balleny Islands

Broom, Judy*¹, Svenja Heesch² and Wendy Nelson³

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² Scottish Association for Marine Science (SAMS), Oban, Scotland PA37 1QA.

³ National Institute for Water & Atmospheric Research (NIWA), Private Bag 14901, Kilbirnie, Wellington 6241

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Green algae from the order Prasiolales (Trebouxiophyceae, Chlorophyta) are found worldwide from marine, freshwater and terrestrial habitats. Marine taxa are typically found in the high intertidal zone, often associated with guano deposits, and terrestrial taxa are found in habitats such as on bark, soil and urban walls as well as growing on sloths. Two genera, *Rosenvingiella* P.C.Silva and *Prasiola* Meneghini are known to be present in New Zealand. Currently three species of *Rosenvingiella* and 29 species of *Prasiola* are recognised worldwide. In this study we report molecular systematic studies of selected marine populations of Prasiolales in the New Zealand archipelago (29 – 54° S) and the Balleny Islands (66°15' to 67°10'S). Our studies, limited to habitats close to the sea (eulittoral to supralittoral), show the presence of at least four species of *Prasiola*, including an undescribed species, and two species of *Rosenvingiella*, neither of which corresponds to the concept of *R. polyrhiza* (Rosenvinge) P.C.Silva, a cosmopolitan species previously recorded from New Zealand.

Is the increased occurrence of *Lyngbya majuscula* (Cyanobacteria) at Rottnest linked to higher nutrient loading?

Cambridge, Marion

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Lyngbya majuscula, also known as “fireweed,” is a filamentous cyanobacterium, which sometimes occurs in a toxic form. It is found worldwide in tropical and sub-tropical marine environments, and is normally present in trace amounts as fragments in the coastal marine sediments. Significant growths of *Lyngbya majuscula* have been found on seagrasses and corals at Parker Point, Rottnest Island on the West Australian coast near Perth. Are the blooms of filamentous *Lyngbya* on seagrass leaves, fibre and coral recorded in summer, 2008 and 2009 the result of nutrient addition? The area is an important tourist site on Rottnest with many hundreds of visitors attracted to the clear, sheltered waters of the *Pocillopora* coral reef adjacent to temperate seagrass meadows (*Posidonia* and *Amphibolis*). Water circulation and replacement rates from wind and wave action have a major influence on the outcome of nutrient loading in shallow coastal bays. The heaviest recreational and boating use of the area coincides with high temperatures and calm waters in mid-summer when conditions are most favorable for algal growth. Preliminary surveys of nutrient concentrations in the water column, sediments and seagrass, and nitrogen isotope ratios of seagrass have identified potential sources of nutrient loading. The levels of algal growth on this iconic coral and seagrass community are cause for concern and further studies on the sources and effects of nutrient loading are being undertaken.

Changes in growth, erosion, productivity and morphology of *Ecklonia radiata* along a hydrodynamic gradient (P)

de Bettignies, Thibaut*¹, Jeremie Godefroy², Thomas Wernberg^{1,3} & Mat Vanderklift⁴

¹Centre for Marine Ecosystems Research, Edith Cowan University, 270 Joondalup Drive, Joondalup WA 6027

²Université de la Rochelle, 23 avenue Albert Einstein, 17071 La Rochelle, France

³School of Plant Biology & Australian Institute of Marine Science, Ocean Institute. The University of Western Australia, 39 Fairway, Crawley WA 6009

⁴CSIRO Marine & Atmospheric Research, Private Bag 5, Wembley, WA, 6913

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Kelps release particulate organic matter through distal fragmentation of their fronds. This erosion plays a significant role in the cycling of organic matter in the coastal zone. The commencement of winter, when storms are frequent, and parameters influencing kelp growth are changing, is a critical period for frond erosion. I will examine the magnitude of this process and its relationship with wave exposure over this key period. This was done by measuring productivity, growth, erosion and morphology of kelps for 9 subtidal reefs along a hydrodynamic gradient. A reduction of biomass of 37, 40 and 48% occurred respectively at the low, medium and high exposed sites during 2 months (April-June), which represents an average loss of 4.5g fresh weight.day⁻¹ per plant and around 40g.m⁻².day⁻¹. This loss was not only explained by the distal erosion (~ 2g.day⁻¹) but also by an overall erosion of the laterals for the whole thallus (~ 2.5g.day⁻¹). Interestingly, along with other work, this severe decrease in thallus area makes *E. radiata* able to withstand intense hydrodynamic forces during storms and may increase their survival.

The importance of storms in driving export of organic matter (kelp wrack) from rocky reefs

de Bettignies, Thibaut*¹, Thomas Wernberg^{1,2}, Paul Lavery¹ and Mat Vanderklift³

¹Centre for Marine Ecosystems Research, Edith Cowan University, 270 Joondalup Drive, Joondalup WA 6027

²School of Plant Biology & Australian Institute of Marine Science, Ocean Institute, The University of Western Australia, 39 Fairway, Crawley WA 6009

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Kelps are dominant primary producers in most temperate marine ecosystems. Their high productivity and susceptibility to dislodgment by waves and currents provide a strong opportunity for subsidy of biomass to adjacent low-productivity habitats (e.g. beaches, surf zone). This study examined the importance of individual storms in driving this delivery, and the underlying mechanisms that determine the magnitude of delivery (i.e. the drag and biomechanical properties of the kelps). Break forces (F_{break}) were determined for kelp from different wave exposures and hydrodynamic forces (and resulting hydrodynamic drag, F_{drag}) were measured over a severe July 2010 storm. Having established F_{drag} and F_{break} , break velocity (U_{break}) and probability of dislodgment as a function of water motion were estimated for this storm. The dislodgement rate of kelp was 7%, representing an export of 250g fresh weight.m⁻². These empirical data will be compared against predicted loss based on the probability of dislodgment for 9 reefs along a hydrodynamic gradient in Marmion Lagoon (Perth, Western Australia). Finally, we will test the importance of whole-plant dislodgment relative to erosion of distal tissue, another common process likely to contribute significantly to the export of organic matter from reefs.

Variability in the Effects of Ocean Acidification on Coral Reef Algae

Diaz-Pulido, Guillermo*¹, Dorothea Bender², Catalina Reyes-Nivia², Marine Gouezo², Kenneth R.N. Anthony².

¹Griffith School of Environment, Australian Rivers Institute and ARC Centre of Excellence for Coral Reef Studies, Nathan Campus, Griffith University, 170 Kessels Road, Brisbane, Nathan, QLD 4111, Australia

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Ocean acidification due to increased atmospheric carbon dioxide (pCO₂) is a major threat to coral reef ecosystems. Coral reef algae play important roles in the ecology of coral reefs, yet, there is little known about the impacts of increased pCO₂ on physiological and ecological processes of the algae. Here, we present results from manipulative pCO₂ and temperature experiments at Heron and Lizard Islands in the Great Barrier Reef. Experimental taxa included upright red (*Amphiroa*, *Delisea*, *Hypnea* and turfs), brown (*Lobophora*, *Sargassum*) and green (*Avrainvillea*, *Halimeda*) algae and crustose coralline algae (*Hydrolithon*, *Lithophyllum*, *Lithothamnion* and *Sporolithon*). Upright species showed variable growth responses to increased pCO₂ (560-1140ppm) including positive, negative and neutral effects while crustose coralline algae showed either negative or neutral response to increased CO₂ levels. Such variability might be related to carbon concentrating mechanisms, and in the case of calcareous algae to skeletal mineralogies and evolutionary history. These results indicate large variability in the growth and calcification responses of a range of fleshy and crustose calcareous algae suggesting the extent of impacts of ocean acidification on coral reef algae are more complex and diverse than previously thought.

***Ramicrusta* and *Incendia* gen. nov., two peyssonnelioid genera with secondary pit connections from Vanuatu and Australia**

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Within the family Peyssonneliaceae, secondary pit connections have only been recorded in the genus *Ramicrusta* Zhang Derui & Zhou Jinghua which was until recently known only from two species, the generitype *Ramicrusta nanhaiensis* Zhang Derui & Zhou Jinghua, endemic to the South China Sea, and *Ramicrusta textilis* Pueschel & Saunders from Jamaica. Collections made around the southern islands of Vanuatu revealed the presence of five species of *Ramicrusta*, including *R. textilis*, that all exhibit secondary pit connections and long unicellular rhizoids, two features that largely define the genus, but are distinguished by molecular and fine-scale anatomical characters. Female nemathecium were observed in two species, *Ramicrusta lateralis* sp. nov. and *Ramicrusta cruciata* sp. nov., the first records of sexual reproduction in the genus, the details of which are discussed. Two additional species, *Ramicrusta australica* sp. nov. and *Ramicrusta kimberleyensis* sp. nov. were discovered in southeastern Australia and the Kimberley region of Western Australia respectively, these representing the first records of the genus from Australia. A second group of plants bearing secondary pit connections but otherwise anatomically distinct from *Ramicrusta* were collected from Vanuatu and northern Western Australia, these representing the genus *Incendia* gen nov. Analyses of *COI*, *EF2* and *rbcL* loci link the Australian and Vanuatuan species of *Ramicrusta* to *R. nanhaiensis*, show that *Incendia* is genetically distinct from *Ramicrusta* as well as peyssonnelioid genera without secondary pit connections, and suggest an early divergence of peyssonnelioid taxa with secondary pit connections from the remaining members of the family.

Species boundaries within *Sargassum* (Fucales, Phaeophyceae) of Western Australia

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A genus dominating the brown algal flora of most tropical areas, *Sargassum* C.Agardh, has long been a challenge for taxonomists in terms of species delimitation and sub-generic assignment. In Australia, where more than a quarter of all species have been recorded, *Sargassum* species provide habitat, structure and food for a wide range of animals and plants. Thalli are usually large and brown, and physically differentiated into stem, leaves, vesicles and reproductive branches. Despite this suite of features available for identification, the task of taxonomic assignment is complicated by within-species variation due to morphological plasticity, seasonality and developmental forms. In this study, *Sargassum* species sampled from Esperance, W.A. to the Kimberley, W.A. over 3 years were sequenced for the nuclear ITS-2, mitochondrial *cox3* and chloroplast *rbcL-S* spacer regions. The three current Australian subgenera are supported by this study, *Phyllotrichia* J.Agardh, *Arthrophyucus* J.Agardh and *Sargassum* J.Agardh and a fourth is proposed. Fifteen genetic species were found, including two new species, from 51 originally listed from WA shores. Many of the original records are now recognised as synonymies or misidentifications. In the subgenus *Phyllotrichia*, all previous species remain current except *Sargassum peronii* C.Agardh which is now synonymised with *S. decurrens* (R.Brown ex Turner) C.Agardh. In subgenus *Arthrophyucus*, only two distinct genetic species are obvious from all Australian collections, necessitating a clearer revision of the subgenus. A North West species, most closely conforming to the description of *Carpophyllum nothum* Grunow, which has long been synonymized with *Cystoseira trinodis* (Forsskål) C.Agardh, will now be moved to *Sargassum*. It shares morphological similarity to both subgenus *Arthrophyucus* and *Sargassum* and is a clear intermediate between the two subgenera, an observation supported by molecular data. In Subgenus *Sargassum* at least 10 species appear distinct with many new synonymies proposed or validated from recent work on the group. This study further shows the usefulness of molecular techniques in taxonomic delineation of morphologically plastic species, and provides greater insight into the true species richness of *Sargassum*, an ecologically and economically important genus of macroalgae.

Red rocks: rhodoliths in New Zealand

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Rhodoliths – literally “red rocks” – are free-living calcified red algae that occur in localised habitats worldwide, over wide latitudinal and depth ranges. Within rhodolith beds, complex thallus morphologies provide highly heterogeneous habitats, with thalli forming fragile, structured biogenic matrices. Internationally, rhodolith beds have been identified as critically important biodiversity hotspots. Recent studies show that these algae are at risk from the impacts of a range of environmental stressors, including ocean acidification. The taxonomy of rhodoliths in New Zealand is well defined through our two studies documenting the common coralline algae of central and northern New Zealand. We discuss the common species of rhodolith-forming non-geniculate coralline algae in New Zealand, and the range of different forms and sizes in which they occur. While limited information exists about the extent or ecosystem functioning of rhodolith beds in New Zealand, we have secured new funding to study rhodolith beds in the Bay of Islands to characterise their extent and physical characteristics, and the associated biodiversity of macroalgae, invertebrates and fishes. Rhodolith growth rates are being measured in situ and in culture, and the vulnerability of rhodoliths to specific environmental stressors is being assessed. We present preliminary data from this project.

Seasonal patterns of phytoplankton populations in Swan River Estuary, Western Australia (P)

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Estuaries are highly dynamic ecosystems and are known to support complex patterns of microbial populations. Anthropogenic activities have led to profound changes in the export of nutrients, sediment and organic matter to estuaries, and blooms of nuisance phytoplankton and the associated conditions of high organic loads and hypoxia are increasingly common. Here we report on the phytoplankton patterns in the Swan River Estuary, where major blooms of *Microcystis aeruginosa* (blue green algae) and *Karlodinium micrum* (syn. *veneficum*) (dinoflagellate) have occurred and caused water discoloration and massive fish kills. To better understand the phytoplankton dynamics in relation to various physico-chemical factors which vary considerably throughout the year due to strong seasonality in riverine flows, we have quantified and identified various groups of phytoplankton across the full range of size classes. Pico and nano phytoplankton were quantified using flow cytometric analysis while larger phytoplankton were analysed using microscopic analysis. Though there has been a routine phytoplankton monitoring program in the estuary for some time, this is the first time that the spatial and temporal trends in the complete spectrum of phytoplankton populations has been characterised. In addition, the effects of various physical and chemical properties on their abundance have been determined to better understand environmental controls on the observed phytoplankton patterns.

Documentation of coral reef habitat in Little Salmon Bay Snorkelling Trail, Rottnest Island (P)

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A procedure to document the benthic habitat of Little Salmon Bay snorkelling trail, Rottnest Island, was trialled. The research aimed at developing methodology that assessed impact on the coral reef environment which could be utilised in future studies. Photodocumenting was the most suitable technique to capture images of the benthic community in the treatment (Little Salmon Bay) and control sites (Jeannie's Pools), with the images obtained analysed with Coral Point Count Software. Results showed variation between sites with respect to the coverage of Pocillopora coral and the amount of dead and broken coral. Results are intended to assist with management decisions in regards to the protection of Rottnest Island's marine habitat.

Biochemical analysis of degrading seagrass and macroalgae using litterbags

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In the coastal waters of Perth, Western Australia, large areas of reef are dominated by the kelp, *Ecklonia radiata*. In shallow areas, these reefs are often surrounded by dense meadows of seagrass, with high species diversity. However, little is known of how these algae contribute to detrital food chains once they become dislodged, through storm action or herbivory, and enter the water column. In order to gain some insight into how these dislodged algae may flow as energy through food chains we conducted a study to look at how we can use stable isotopes to infer the provenance of detritus. We completed a six month field based litter bag experiment with two locally occurring macroalgae, *Ecklonia radiata* and *Sargassum* sp and two seagrass species *Amphibolis griffithii* and *Posidonia sinuosa*. Litterbags were deployed in *Posidonia sinuosa* meadows in Buchanan Bay, Garden Island between March and August 2010. We collected monthly samples to investigate how the biochemical composition of the macroalgae and seagrass changes over time as they decay. Additionally we included a mixed treatment of *E. radiata* and *P. sinuosa* in an attempt to resolve the species composition of mixed detritus. All samples are currently being analysed for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$, compound specific isotopes and fatty acids and results will be presented at the conference.

The fish-killing dinoflagellate *Karlodinium veneficum* (D.Ballantine) J.Larsen in the Swan-Canning Estuary

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In recent years blooms of the ichthyotoxic dinoflagellate *Karlodinium veneficum* (D.Ballantine) J.Larsen have become more prominent in Australian estuaries as well as overseas. The Swan Canning Estuary in Western Australia experienced extensive fish-killing blooms of this species for the first time in April-June 2003; with the mortality of 7.8 tonnes of fish. Seasonal blooms of *K. veneficum* have become semi-regular, however fish mortality rates have been unpredictable. Bloom dynamics of *K. veneficum* in the Swan-Canning Estuary will be described alongside results of recent research into the local genetic diversity, toxicity and mixotrophic feeding rates of this species. Swan River *K. veneficum* was found to have a fast growth rate compared to other similar gymnodinoid dinoflagellate species. Mixotrophic feeding rates were low compared to strains from other locations and appeared to have no effect on growth rate. However, mixotrophy resulted in extended periods of exponential growth and higher overall cell biomass. Swan River Strains (six) were genetically identical and all were found to produce karlotoxins. This implies that all *K. veneficum* blooms in the Swan-Canning Estuary have the potential to kill fish. Cell lysis appears to be critical for fish-kills to occur.

Systematics of the genus *Grateloupia* (Halymeniaceae, Rhodophyta) with an emphasis on two species from Korea (P)

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The marine red algae *Grateloupia* is the largest genus in the family Halymeniaceae. This is widely distributed in tropical to warm temperate water and known an ecologically important genus. In order to assess taxonomic and phylogenetic relationships within this genus, we analyzed 96 samples of *Grateloupia* based on the chloroplast-encoded *rbcL* sequences. In addition, detailed comparative morphological studies focused on two species: *Grateloupia elliptica* and *G. lanceolata* from Korea. The genus *Grateloupia* is characterized by terete to bladelike thalli that range from gelatinous to cartilaginous in texture, gonimoblasts borne on a small fusion cell and cruciately divided tetrasporangia. Molecular analyses revealed the occurrence of seven species in Korea: *Grateloupia angusta*, *G. asiatica*, *G. elliptica*, *G. imbricata*, *G. kurogii*, *G. lanceolata* and *G. turuturu*. As morphological results, *G. elliptica* and *G. lanceolata* are distinguished by several different characteristics: *G. elliptica* is having holdfast on the undersurface of the thallus and elliptical frond with 18-20 cortical cell layers, whereas *G. lanceolata* is having stipitate at the base of lanceolate blade and 10-20 cortical cells. Further sampling will provide a correct systematics of the genus *Grateloupia* from Korea.

The taxonomy and pest potential of the genus *Codium* in Western Australia

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The green macroalgal genus *Codium* (Chlorophyta, Codiales) is one of the most diverse genera in the world, comprising approximately 125 globally distributed species. Taxonomic studies on the *Codium* species found on the Western Australian coastline are mostly lacking. The genus displays a variety of morphologies, from globular to frond-like to erect and dichotomously branching. One subspecies, *C. fragile* subspecies *fragile* (Suringar) Hariot, is one of the most invasive seaweeds in the world, and is a major ecological and economic threat to the invaded habitat. It is a somewhat cryptic subspecies as it has a global distribution that overlaps morphologically similar native subspecies. This invasive alga was recently discovered in Princess Royal Harbour, Albany, Western Australia. Seventeen *C. fragile* ssp. *fragile* plants were collected from the Albany tug pen, and housed in a holding tank at 21° C. Two individual thalli were cultured at 20°C, 25°C and 28°C to determine their tolerance to increased water temperatures, and to gain insight into the subspecies potential spread in W.A. Culturing results indicate that at increased temperatures (> 25°C), the growth of *Codium fragile* ssp. *fragile* is strongly inhibited, indicating that its potential spread in W.A. may be temperature limited. To prepare a taxonomic account of the species occurring in W.A., specimens of *Codium* housed at the W.A. Herbarium (PERTH) were examined. Small portions of plants were removed and rehydrated in freshwater, and the utricles were excised and observed under a microscope to obtain anatomical measurements. On the basis of the PERTH collections, nineteen species of *Codium* occur on the coast of W.A. Thirteen of these have been documented previously, whilst five are, for the first time, described in detail based on W.A. specimens: *C. arabicum* Kützinger, *C. dwarkense* Børgesen, *C. fragile* subspecies *fragile* (Suringar) Hariot, *C. geppiorum* O.C. Schmidt and *C. platyclados* R. Jones & Kraft. One species, from Nornalup Inlet on the south coast, appears to represent a new species, based on its morphology and analyses of its anatomical details. For all nineteen species, morphological and anatomical descriptions and illustrations are given, in addition to information on their local and worldwide distribution and habitat.

***Lyngbya* occurrences Western Australia including Parker Point, Rottnest Island: Surveillance of Potentially Harmful Algae in Western Australia (P)**

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Lyngbya is a filamentous cyanobacterium found in a variety of environments. One marine taxon *Lyngbya majuscula*, is a documented producer of aplysiatoxin and lyngbyatoxin, with a distribution in tropical and temperate regions of Australia. In recent years, blooms of *Lyngbya* cf. *majuscula* (identified by light microscopy) have occurred in Parker Point, Rottnest Island, a popular swimming, snorkelling and diving destination. Because *L. majuscula* can potentially produce severe dermatitis via contact, the Rottnest Island Authority with assistance from the Department of Water is developing a *Lyngbya* management plan for Rottnest Island. Elsewhere in Western Australia, different *Lyngbya* species have been recorded from Swan River Estuary, Peel-Harvey Estuary, Serpentine River, Scott and Blackwood Rivers, Princess Royal Harbour, Oyster Harbour and Roebuck Bay. Despite this, little is known about the toxicity of these local *Lyngbya* species, though occasional toxin testing was conducted. This paper summarises current information about *Lyngbya* in Western Australia, the distribution and known frequency of blooms, and presents findings from the harmful algal bloom surveillance currently being undertaken in the state. The Department of Water co-ordinates the surveillance of harmful algal species in a number of Western Australian lakes, rivers and estuaries. It is through this program harmful algal bloom occurrences in the state are monitored and documented.

Effects of sediment nutrient additions and season on root architecture of the temperate seagrasses, *Posidonia australis* and *Posidonia sinuosa*.

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We examined the root systems of two temperate marine seagrasses, *Posidonia australis* and *P. sinuosa*, over summer and winter in order to test (i) if variations in architecture and morphology of root systems reflect localised additions of N and P, (ii) if season had an effect on root architecture or the root response to nutrient additions and (iii) if two closely related species show similar root responses to nutrient additions and season. Difficulties with sampling complete root systems of these submerged plants were overcome by growing seagrass in pots containing a standardised sand medium and a localised nutrient supply. Root morphology differed between the species. *Posidonia australis* produced a larger root system overall with most of root length consisting of laterals. Root hairs were not observed in either species. Root architecture for both species was significantly affected by the combined addition of N and P but not separate additions. Lateral root density increased in plants with N and P addition, resulting in a more complex branching pattern that was reflected in the lower topological index (TI). There was, however, no significant change in total root length, root surface area or specific root length. There was also no response in lateral root length with localised nutrient additions. Root architecture was more complex in summer than winter for both species. In summer there were more higher order laterals (TI: 0.73 ± 0.02) resulting in a more “dichotomous” pattern, whereas in winter there were fewer laterals resulting in a “herringbone” structure (TI: 0.86 ± 0.01). There were also significant differences in root morphology between summer and winter, particularly *P. australis* transplants, which had twice the root total length in summer compared to winter, mostly due to increases in lateral root number and length, and higher specific root lengths. This study demonstrates that these seagrass species produce substantial roots systems and display some architectural and morphological plasticity, in response to season and to a lesser extent sediment nutrient availability.

***Spongophloea*, a new genus of red algae based on *Thamnoclonium* sect. *Nematophorae* Weber-van Bosse (Halymeniales)**

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The red algal order Halymeniales contains a relatively high percentage of sponge-associated taxa. These species are predominantly classified in two genera, *Thamnoclonium* and *Codiophyllum* (and to a lesser extent, *Carpopeltis*), and are chiefly distributed in temperate waters along the South African and Australian coasts. Three rare species of *Thamnoclonium* (*T. tissotii*, *T. treubii*, and *T. procumbens*), however, were originally described by Weber-van Bosse from tropical localities in Indonesia, the Philippines, and northern Australia. These formed her new *Thamnoclonium* sect. *Nematophorae* and differ from typical *Thamnoclonium* in having a pseudoparenchymatous medulla in vegetative tissue and in the production of moniliform chains of cells from the cortex. Recent collections of *T. tissotii* from Western Australia included tetrasporangial and cystocarpic specimens, the latter previously unrecorded for the section. Phylogenetic analyses of rbcL sequence data generated from these and other specimens revealed that the genus *Thamnoclonium* is presently polyphyletic. Although the phylogenetic tree was not completely resolved, sponge-algal associations in the Halymeniales seem to have evolved independently at least four times. Specimens of *T. tissotii* formed a sister relationship with *Codiophyllum*. Thus, both morphological and DNA sequence analyses support the segregation of *Thamnoclonium* sect. *Nematophorae* as a new genus, for which the name *Spongophloea* is proposed, in recognition of its seemingly obligate relationship with the sponge that coats the thallus surface.

Macroalgal species richness and assemblage composition of the Great Barrier Reef seabed

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Macroalgae are significant primary producers in the Great Barrier Reef but floristic studies are confined to intertidal and reef zones. Knowledge of the macroalgal communities of the GBR seabed, which constitutes ~95 % of the GBR Marine Park region, is even more limited. Recognising the lack of knowledge of the deeper seabed in the region, the GBR Seabed Biodiversity Project was conducted from 2003-2006 to map habitats and their associated biodiversity. We examined a unique database consisting of 1195 epibenthic sled samples collected during the Project, of which 639 contained macroalgae. Algal species richness, calculated simply as the number of taxa sampled by the sled at each site, was mapped to show diverse and depauperate areas. We identified a total of 370 individual taxa, 250 taxa not previously found on the GBR. Patterns of species composition, or "assemblages", were investigated using the clustering method "partitioning around medoids" and also mapped. Multivariate regression trees were used to indicate how many assemblages may be predictable from the physical variables. Classification Random Forests were used to identify which physical factors appeared to be most influential for each of the algal assemblages. Five algal assemblages were distinguished. Assemblages grouped taxonomically (the Bryopsidales assemblage), by functional form (the red foliose assemblage) or were characterised by single species (the *Halimeda gracilis* assemblage). Substrate and light availability were found to have the greatest influence on both species richness and assemblages. This study provides the first account of the distributional patterns of the macroalgae of the Great Barrier Reef shelf seabed.

Algal communities in Central Australia as indicators of water quality and climate change

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Almost 70% of the land area of Australia is arid with an annual evaporation up to 10 times than the condensation. The vast land of red earth and short trees, shrubs and waterholes supported several tribes of wandering aboriginals for thousands of years. It is not surprising this region was the last to be colonised by Europeans. Establishments of farms and human settlements deprived the original inhabitants of the waterholes. A study was conducted recently on the diatom flora of the red centre of Australia and the MacDonnell ranges – east and west. Underground springs cutting through the mountain ranges and springs surrounding the gigantic rock formations harbour a host of diatom assemblages, desmids, chrysophytes and charophytes dominated by high diversity of diatoms- *Pinnularia*, *Eunotia* and *Encyonema* which are normally abundant in the wet and dry tropical parts of Australia. Several of these springs are also impacted by farming practices and settlements, as well as basic geological factors as informed by the assemblages of *Amphora*, *Nitzschia*, *Hantzschia*, *Navicymbula* and *Craticula* species. The diversity of diatoms and desmids in these gorges is interpreted in the context of climate change and recent human history.

Seasonal *in situ* growth rate of *Hormosira banksii* in southeast NSW rockpools

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Monitoring the growth of individuals is usually accomplished by tagging. In *Hormosira banksii* (Turner) Decaisne, however, this would be likely to increase the risk of breakage so a non-invasive method of recognition was adopted. Individual branches of plants were photographed in their rockpools, against a white plastic background, one branch per plant. A key photograph was taken of the pool, showing the plants' positions. After up to 3 months, armed with the original images, a search was made for the appropriate branch on each plant and, if found, it was photographed again. The variability of branch pattern and vesicle shape allowed reliable recognition. The diameter of the apical 3 vesicles that showed the most growth was measured digitally on each pair of images. The square of the diameters of the first and second vesicle were taken as the proportion of that of the third (mature) vesicle or, when possible, the later mature sizes of the same ones. From these was calculated the increase in vesicle number attributable to that apex. In pools mid-reef at 1.3-1.7 m above lowest astronomical tide (LAT), protected from swell at low water, the mean growth rate was over 2 vesicles/quarter in autumn but 1.2-1.4 vesicles per quarter in all the other seasons last year. In winter this year the growth was slightly but significantly higher, perhaps due to the fact that seawater temperature was higher. In pools on the edge of the reef at 1.0-1.4 m LAT and more exposed to swell, the growth rate in both summers was significantly higher than on mid-reef. This could be due to water movement aiding nutrient (low in summer) supply. There was no significant difference between the groups of pools in autumn and winter. The slow growth in the mid-reef pools in winter and spring might be caused by low temperature and that in the summer by low nutrient supply. Mortality of branches (measured as failure to find them) was significantly highest in summer and second highest in spring. This reflects the risk of drying resulting from the coincidence of low high water neap tides and low swell.

The world's largest macroalgal blooms: novel events caused by expansion of algal aquaculture in the Yellow Sea off China

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Recurrent green tides or macroalgal blooms of *Ulva prolifera* occurred in the Yellow Sea off China in June/July 2008 and 2009. At their peak they covered more than 4,000 km² and affected 40,000 km². Smaller blooms also occurred in 2010 and 2007, but not earlier. The bloom that washed ashore in late June 2008 affected an area of 600 km² along the coast of Qingdao, and threatened to disrupt the Olympic sailing regatta. The resultant cleanup involved more than 10,000 people and removed over one million tonnes of algae. We used remotely sensed ocean colour products to back-track the source of the 2008 bloom to an area along the Jiangsu Province coastline, over 200 km south from Qingdao, where there had been rapid expansion of *Porphyra* aquaculture since 2006. *Porphyra* is grown on rafts which can become heavily fouled with *U. prolifera* which is disposed into the sea when the *Porphyra* is harvested. We hypothesised that the favourable, but typical oceanographic conditions caused rapid growth of the discarded algae and transportation of the bloom north into the Yellow Sea. We suggested that further green tides would occur unless mitigation measures such as improved hygiene in aquaculture practices were taken. Subsequently, a second very large bloom formed in the Yellow Sea in June 2009. We tracked this bloom from its inception in May 2009 close to the Jiangsu Province coastline until it washed ashore as a green tide on the Shandong Peninsula. We also measured biomass accumulation of *U. prolifera* on the aquaculture rafts and estimated a total biomass accumulation of 5,000 tonnes which is sufficient to initiate the macroalgal blooms observed in 2008 and 2009. Phylogenetic analysis of *U. prolifera* collected in 2009 from the *Porphyra* rafts matched almost identically (99.6%) DNA sequences obtained from *U. prolifera* collected from the 2008 Qingdao green-tide. These observations add weight to the validity of the hypothesis that expansion of coastal *Porphyra* aquaculture provides the source biomass of floating *U. prolifera* for green tides in the Yellow Sea.

Western Australia- a biodiversity hotspot for both seaweeds and seagrasses

Kendrick, Gary A. (Plenary)

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Western Australia has been recognised as a global hotspot for diversity and high levels of endemism of marine flora and fauna. The processes that underpin the evolution of biota in the marine as well as the terrestrial environment are poorly understood. Recently the diversity of the SW terrestrial flora was explained as a product of 'Old Climatically Buffered Infertile Landscapes' (OCBIL). A similar mode; for the evolution of the marine biota may apply to the diverse marine biota, which evolved in nutrient poor waters, climatically buffered from past glaciation combined with millennial persistence of the Leeuwin Current. The major difference between the terrestrial model and the marine is that evolution on land is defined by a strong plant physiological imperative for persistence of species within highly specific micro-niches. From my perspective this is not the case in the seaweeds and seagrasses, where most species have broad niches, large reproductive outputs and potential connectivity over 10s to 1000s of kilometers. A more appropriate model seems to be where the spatial and temporal distributions of species at a specific location are drawn from a pool of recruiting species. This is clearly a non equilibrium model for the evolution of the marine flora, where apparent stability is an emergent property of the species-environment interactions across the marine landscape. So what are the mechanisms that maintain high species diversity in an endemic flora where micro-niche models appear inappropriate? This presentation will explore existing mechanisms of seagrass and seaweed species distribution in Western Australia by studying both patterns in distribution of species and the underlying drivers, or processes that influence these distributions. My goal is to summarize our existing knowledge into a working hypothesis for the evolution and persistence of our diverse and endemic marine flora.

Seagrasses as bioindicators of point source pollution in the Leschenault Estuary

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Within coastal Western Australia there is an estimated 16 000 km² of shallow acid sulfate soils. Seagrasses could be useful as bioindicators of aquatic impact from acid sulfate soils, since aquatic plants may act as a sink for the contaminants signals derived from acidic drainage waters. Acidic drainage typically occurs in pulses associated with rainfall, and may be easily missed with irregular or routine water quality monitoring. Drainage from acid sulfate soil typically contains high concentrations of metals, acidity and sulfate (from oxidised pyrite). The sulfur within pyrite has a more negative isotopic signature than sulfate in seawater, therefore isotopic measurement may inform on sources of sulfur to seagrasses. This study investigated trace metal accumulation (Fe, Al, Cu, Mn, As, Zn, Ni, Cd), total sulfur and sulfur stable isotopes within tissues of *Ruppia megacarpa* and *Halophila ovalis* along a transect in close proximity to a drain in the northern Leschenault Estuary, south-west Western Australia. A water sample taken from this drain in the winter of 2007 suggested that the drain was discharging water from disturbed acid sulfate soils. Sampling of seagrasses was undertaken in February 2008. Typically [Fe]>[Al]>[Mn]>[Cu]≈[Zn]>[As]>[Ni]>[Cd] for both plant species. Copper and manganese showed highest concentrations closest to the drain for both plant species. *R. megacarpa* closest to the drain had the highest concentration of sulfur and most negative $\delta^{34}\text{S}$, signals which were most likely related to drainage from acid sulfate soils.

A potentially undescribed species of *Haraldiophyllum* and *Symphyocladia* (Ceramiiales, Rhodophyta) from Korea (P)

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A potentially undescribed species of *Haraldiophyllum* and *Symphyocladia* are reported based on the morphology and molecular evidence. *Haraldiophyllum* sp. was collected at 12m deep in sublittoral zone of Udo, Jeju Island, Korea. Blade is a greenish red-brown in color, 10-20cm high and 5cm broad, consisting of one or more blades attached by a small solid holdfast accompanied with a few fibrous roots. Blade on a short cylindrical stipe is thin, veinless, monostromatic above and polystromatic toward the base and in fertile areas. Marginal cells divide anticlinally or obliquely for growing marginal meristems without distinct apical cells. Tetrasporangial sori are ovate, scattered, protruding on either side of the blade, with tetrasporangia in 2 layers between both surface cells, divided tetrahedrally. *Symphyocladia* sp. was collected at the lower intertidal zone of Chuja Island, Korea. Thalli are erect, polysiphonous, bilaterally compressed and with some branches congenitally fused attaching to substratum by rhizoids cut off from pericentral cells on lower side, each forming multicellular plates. The center of thallus is developing indistinct midrib or veins. Molecular phylogenetic analysis on the basis of *rbcL* sequences showed that two species formed a robust clade further confirming its novelty.

Distribution and abundance of summer macroalgae at Marado of Jeju Island, Korea (P)

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Marado is an islet located at the southernmost part of Korea and affected by Kuroshio ocean current for the first time. We are currently in the two year of a biodiversity survey of Jeju Island, hence this is a preliminary data among multiple seasons of collecting at the Marado of Jeju Island, Korea. We investigated macro algal flora, vertical distribution and abundance using random quadrat method ranged from upper intertidal to 18m depth of subtidal zone during summertime. Field work was conducted at the northern and southern parts of Marado for intertidal zone, and at the eastern and western parts for subtidal zone. We found a total of 138 species of macroalgae; 19 belonged to chlorophyta, 39 to Phaeophyta and 80 to Rhodophyta. The highest biomass was 6371.89 g w.weight/m² at 2~6m depth level and the lowest was 1262.17g at the upper intertidal zone, though mean biomass was 3612.96g. The dominant species based on coverage, frequency and biomass were *Ecklonia cava*, *Laurencia yendoi*, *Amphiroa galapagensis*, *Sargassum macrocarpum* and *Cladophora wrightiana*. The vertical distribution of summer macroalgae was characterized by *Ishige okamurai*, *Laurencia yendoi*, *Amphiroa galapagensis* and *Ecklonia cava*. Continuously, we will investigate more three season and estimate variation of species composition and community structure. This study will provide a baseline data as indicator seaweeds in relation to the climate change in Jeju Island, Korea.

Marine benthic algal flora and community structure at U-do of Jeju Island, Korea (P)

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U-do is located at the easternmost part of Jeju Island, Korea. We investigated macroalgal flora and community structure at the northern and southern part of rocky shore in U-do. We conducted the collections using quadrat method on line-transect ranged from upper intertidal to 9m depth of subtidal zone during a year. A total of 232 species was confirmed: 27 green, 56 brown and 149 red. The highest value of biomass was 6374.16 g w.weight/m² recorded at middle intertidal zone during winter season, whereas in summer the lowest was 227.13g at upper intertidal level. The several dominant species based on coverage, frequency and density were *Sargassum fusiform*, *Ishige okamurai*, *Ecklonia cava*, *Plocamium telfairiae* and *Corallina pilulifera*. The representative alga by mean biomass was *Ecklonia cava* and the value was 874.89g. The vertical distribution of macroalgae at U-do was characterized by *Ishige okamurai*, *Sargassum fusiform*, *Corallina pilulifera*, *Plocamium telfairiae* and *Ecklonia cava*. ESGII (ecological state group) as an opportunistic species including sheet form, filamentous form and coarsely branched form occurred 77.5% by species number, but by importance value was 38.7% in the intertidal and subtidal zones of seaweeds. Although the number of cold water macro algal species tend to be decrease, diversity index (H') and dominance index (DI) indicate that the seaweed community structure at U-do of Jeju Island, Korea is still stable.

Morphology and Molecular study of the Genus *Codium* (Chlorophyta) from Jeju, Korea (P)

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The green algal genus *Codium* occurs in all marine waters except the Arctic and Antarctic Oceans. The distinct characteristics of *Codium* are thallus composed of numerous utricles and medulla entangled structures of siphons, though their shape and habitat are various. The total of 16 species has been reported in Korea, including two new species from Jeju Island. To describe morphological features and to reveal phylogenetic relationships for Korean species of *Codium*, we have investigated 5 species of *Codium*; *C. contractum*, *C. fragile*, *C. hubbsii*, *C. subtubulosum* and 1 unrecorded species from Jeju Island. For morphological features, we observed vegetative features and reproductive structures of utricles. Also, to analyze the phylogenetic relationships, we amplified and sequenced *rbcL* regions of each *Codium* species. As the results, the important characters to distinguish *Codium* species morphologically are the shape, size and composition of utricles; *C. contractum* with clavate and long utricles, *C. fragile* with clavate and mucronate utricles, *C. hubbsii* with an alveolate ornamentation at the apex of utricles, *C. subtubulosum* with cylindrical and slightly clavate utricles, and the unrecorded species of *Codium* with sub-pyriform and head tumid utricles. Molecular analyses using *rbcL* sequence data indicate that 4 species of *Codium* are identical with those species from Japan and an unrecorded species is corresponded with *C. tenuifolium* from Japan.

Significance of microbial Loop in regulating Phytoplankton Succession in Lake Kinneret (Israel): A numerical Investigation using DYRESM-CAEDYM

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Compared with other microbial interactions in aquatic ecosystems, the microbial loop has received little attention but increasingly researchers are documenting that the microbial loop plays an important role in nutrient cycling in freshwater and marine ecosystems. In this paper, we examine the significance of key microbial loop processes on the Lake Kinneret ecosystem by applying a one dimensional coupled hydrodynamic-ecosystem model (DYRESM-CAEDYM). A range of alternative microbial loop configurations are presented, including a) direct organic matter mineralization (no bacteria state variable, NOBAC), b) bacteria included but without dissolved inorganic nutrient uptake (BAC-DIM), and bacteria with dissolved inorganic nutrient supplementation (BAC+DIM). The model simulations are compared against a comprehensive dataset (1997-2001) and, through comparison of the simulations, insights into the nutrient flux pathways between bacteria, phytoplankton and zooplankton are reported. The results are analysed from a stoichiometric point of view and used to understand how significant these pathways are in shaping the algal succession within the lake. Considerable variation in algal stoichiometry of five species of phytoplankton and Dissolved Organic Matter (DOM) demonstrated the predicted model results are highly sensitive to assumptions made in the microbial loop formulations, and suggested that Dissolved Organic Phosphorous (DOP) is the key driver of microbial loop when bacterial growth is P-limited. Nutrient limitation functions for the five simulated phytoplankton groups of the BAC-DIM and BAC+DIM simulations were compared to confirm that bacterial competition for nutrients can switch the nutrient that limits algal growth and change the algal composition. The analysis therefore concludes that it is crucial to understand the role that the microbial loop plays in nutrient cycling as a potentially important model component that must be carefully parameterized when simulating phytoplankton and water quality dynamics in lakes.

Habitat Model of *Himanthalia elongata*: predictions in a warming scenario.

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Traditional models explaining macroalgae distribution are based on ocean temperature (August and February Isotherms). The predictive power of this approach is restricted because it lacks a mathematical expression, and omits factors relevant for intertidal seaweeds distribution, particularly atmospheric temperature. We aimed to improve our understanding about the role of other factors in seaweed biogeography using a niche-based approach suitable to make projections. Presence and absence records of *Himanthalia elongata* (Linnaeus) S.F.Gray from cells selected on a grid along the NW Iberian Peninsula were related using GLMs to the variables that potentially influence this species distribution: August and February SSTs, maximum and minimum air temperature, kind of substrate, wave height, and cloudiness. In the NW Iberian Peninsula has been reported a warming of the sea surface between 0.1 and 0.5 °C per decade. This has been associated to an ongoing reduction of North Atlantic cold temperate flora in the Cantabrian Sea i.e. southern limit, including *Himanthalia elongata*, which its boundary have shifted W towards the coldest area. Atmospheric temperatures have also increased at a higher rate (0.3 to 0.6 °C per decade). This is the first attempt to formally include this parameter into a predictive equation for intertidal macroalgae distribution. Three variables were included in the final equation: 1. presences were restricted to places with hard substrate for fixation, 2. absences were found in sites with high August SST at the mid Cantabrian Sea, 3. hot conditions during low tide i.e. maximum august atmospheric temperature, restricted presences at the south. The equation was applied to two warming scenarios suggesting *Himanthalia elongata* extinction from the Iberian Peninsula in few decades in response to both increasing ocean and atmospheric temperatures. The traditional isotherm model pointed to a southern limit associated to the 20°C August isotherm but omitted atmospheric temperature. We propose a methodology to investigate coastal species biogeography and forecast changes in response to the warming.

Seagrass wrack mass balance, generation and transport.

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Wrack is an important feature of coastlines as it can play a major role in subsidising terrestrial production and supporting marine food webs. However, with human alteration of beaches such as groynes, the build-up of wrack can create significant management issues. An understanding of the mass balance of wrack pools including generation, transport and degradation of wrack is required to inform management solutions. This study developed an annual wrack budget in Geographe Bay, a large embayment in Western Australia and quantified the key processes that determine the fate of wrack. From ~ 8725 ha of seagrass meadow it was estimated that 32600 – 35250 tonnes of seagrass wrack was produced annually through natural shedding of leaves and removal of plants during storm events. In May following peak seagrass production up to 98% of the seagrass wrack was present in off-shore areas (seagrass meadows: 13895 tonnes, unvegetated sediments: 7939 tonnes) with less than 2% on the beach (1 tonne). In winter during storms, wrack was suspended in the water column as individual particles and transported from these habitats, with 54% of the wrack ending up on beaches (7500 tonnes) and 46% degraded or transported out of the system (9901 tonnes). Around 2116 tonnes remained in the seagrass meadow and 2319 on unvegetated sediments. Wrack accumulations on beaches were generally dynamic, moving on and off beaches with further storm events and when water levels were high, and were transported alongshore by currents. However, by the end of July, the majority of wrack on beaches (97%) was trapped next to a large groyne, unable to be transported by the long-shore current. This understanding of the mass balance, generation and transport of wrack has been incorporated into a hydrodynamic and particle transport model to provide recommendations for wrack management at the Port Geographe groyne, and highlights the potential for seagrass wrack as a spatial subsidy in habitats adjacent to seagrass meadows.

Reproductive ecology of the kelp *Ecklonia radiata*

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The dominant habitat-forming species on shallow subtidal reefs in temperate Australia is the kelp *Ecklonia radiata*. Despite *E. radiata*'s critical role in the ecological functioning of temperate reef communities, surprisingly little is known about its reproductive ecology. The exact time when *E. radiata* plants produce and release spores is currently unknown. Every week for one year *E. radiata* plants will be treated to induce sporulation, so that the timing of spore production and release can be determined. Spore production will also be quantified over a range of spatial (kilometres to thousands of kilometres) and temporal levels. In order to understand how climate influences juvenile growth, *E. radiata* spores will be settled on microscope slides and treated under a range of conditions. The gametophytes will be subjected to different temperature and light levels, and densities and growth rates will be determined. Other experiments will be designed to examine natural settlement rates, recruitment, and fertility of dislodged wrack. Together these experiments will provide an understanding of the reproductive ecology of *E. radiata* and how it is affected by environmental conditions.

Soft sediment seaweed communities in two New Zealand harbours (P)

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Macroalgal diversity and community structure in soft sediment habitats is largely overlooked in comparison to rocky reef habitats. Under current Biodiversity funding from New Zealand Ministry of Fisheries, we are assessing macroalgal communities within a northern and a southern harbour in New Zealand. In Whangarei Harbour (northern North Island) and Otago Harbour (south-eastern South Island) we are working in several soft sediment habitat types to assess their seaweed communities at different depths (intertidally and subtidally), and seasons (spring and summer/autumn). Within each habitat type, we are investigating macroalgal diversity, biomass, and percentage cover. We are also comparing collection methods: quantitative collection from quadrats within transects, vs opportunistic collection by experts across a site. This presentation summarises the work completed to date and discusses ongoing work.

Genetic Variation of Green Unicellular Alga *Haematococcus pluvialis* (Chlorophyceae) Obtained from Different Geographical Locations using ISSR and RAPD

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Haematococcus pluvialis (Flotow) is a unicellular green alga, which is considered to be the best astaxanthin producer organism. Molecular markers are suitable tools for the purpose of finding out genetic variations in organisms; however there is no study conducted on ISSR or RAPD molecular marker regarding this organism. In this research, DNA was extracted from 10 different strains of *H. pluvialis* (four strains from Iran, two strains from Finland, one strain from Switzerland and three strains from USA) using the Dellaporta method. Genetic similarity study was carried out using 14 ISSR and 12 RAPD primers. Moreover, the molecular weights of the bands produced ranged from 3.4 to 0.14 Kb. The NTSYS pc, POPGENE and GenAIEx software were used to analyze the data and a dendrogram was generated to obtain the relationship among the strains. The PCA and dendrogram clustered the *H. pluvialis* strains into various groups according to their geographical situation. The lowest genetic similarity was between the Iran2 and USA1 strains and the highest genetic similarity was between Finland1 and Finland2. The results showed that ISSR and RAPD markers are useful for genetic diversity studies of *Haematococcus* as they showed similar geographical result.

The role of ocean dynamics in seagrass seed dispersal and recruitment in Western Australia

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Seagrasses are very important ecosystems providing several ecological services. Compared to work on their reproduction by vegetative growth, much less is known about seagrass sexual reproduction via seed dispersal, and its importance in maintaining, consolidating and creating new meadows. This project aims to improve our process understanding of the dynamics of seed dispersal of three very different species, through quantifying the physical properties of their seeds and incorporating them into a numerical ocean model of the southwest coast of Australia. This approach will ultimately provide new insight into the role that seed dispersal plays in seagrass ecology and evolution along this coast. Fruits and seeds of *Halophila* and *Posidonia* were collected in the field during summer and seed properties were measured in the laboratory using a variety of techniques; video particle tracking a transparent settling tube was used to measure seed settling velocity, while varying flow imposed in a flume with a sandy bed was used to calculate the critical shear stresses required to suspend the seeds. These among other measured seed characteristics (e.g., drag coefficient and buoyancy) suggest that *Halophila* has a limited dispersal capability, whereas *Posidonia* seeds have the potential for long distance dispersal, spending their initial stage within a floating fruit. These physical seed properties are now being incorporated within a numerical circulation model of the Perth coastal region, driven by winds, tides and surface waves.

ALGA – iBOL’s Algal Life Global Audit: muddled morphologies & molecular mayhem in the topsy-turvy world of algal floristics.

Saunders, Gary W. (Plenary)

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This presentation will highlight successes and challenges to date in our DNA barcoding effort to generate a complete floristic account of marine macroalgae on a global scale. With ca. 15000 barcodes completed at the time of writing this abstract, we have uncovered literally hundreds of cryptic/overlooked species. In addition to altering radically our perspectives on actual species diversity, we are uncovering a bewildering array of tales including: challenges to widely accepted morphological species concepts; introduced species; new perspectives on algal distribution at both ecological and geographical scales; rewriting phylogeographical hypotheses; resolving the dynamic nature of speciation and various hybrid populations; and uncovering key examples of niche exclusion with a corresponding restriction in phenotypic plasticity. I will present an overview of some of the highlights of our work with the aim of sharing the power of molecular-assisted alpha taxonomy in resolving species-level conundrums for a group of organisms that are notoriously difficult to identify using conventional approaches. I will also explore the problem of matching contemporary species to available names under the type-based system of taxonomy.

Causes and consequences of outbreaks of a nonindigenous epiphytic bryozoan in western North Atlantic kelp beds

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In rocky subtidal ecosystems of the western North Atlantic, the nonindigenous epiphytic bryozoan *Membranipora membranacea* facilitates the introduction of other nonindigenous benthic algae by defoliating kelps. Susceptibility to infestation by the bryozoan varies among kelp species, although the causes of this variability are not known. We monitored the percent cover of bryozoan on the kelps *Saccharina longicruris*, *Laminaria digitata*, and *Agarum clathratum*, at 2-3 depths within 3 sites in Nova Scotia, Canada, over 15 months. To infer mechanisms of observed differences in bryozoan cover, we examined patterns of colony settlement and abundance, size-frequency distributions, and the proportion of plants with overwintering bryozoan, on the respective kelp species. We also quantified the distributions and abundances of kelps before and after a major defoliation event in fall 2006. Our results suggest that differences in the abundance of this introduced species among its algal hosts arise as a result of both differential settlement and survival. In turn, differential susceptibility among hosts to infestation may result in alteration of the algal community structure. Results from an individual-based model incorporating temperature-dependent parameters for colony settlement, growth, and mortality, suggest that outbreaks of this bryozoan will increase in frequency and intensity as a result of warming temperatures attributable to climate change. Through the associated loss of kelp, this will have profound consequences for the productivity of rocky subtidal ecosystems in the western North Atlantic.

Phytoplankton productivity in the Leeuwin Current off Ningaloo Reef, Western Australia

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Phytoplankton productivity off the coast of Western Australia is potentially an important driver of the food supply of commercially important species, such as the western rock lobster. In this region, dynamics of the poleward flowing Leeuwin Current play a critical role in determining nutrient supply and productivity off the continental shelf. Given that the flow of the Leeuwin Current is strongest in autumn, we conducted an oceanographic research cruise in May 2010 onboard the RV Southern Surveyor, to quantify spatial patterns in phytoplankton productivity. Sampling was conducted along a set of 7 transects spanning the coast off Ningaloo Reef, WA, between the 50 and 1000 depth contours. Size-fractionated (cells < 5 and $> 5 \mu\text{m}$) productivity was estimated using uptake rates of ^{14}C and concentrations of chlorophyll *a*. Water mass characteristics, including temperature, salinity, nitrate, CDOM, oxygen, and backscatter, were measured concurrently using CTD casts and towed instruments. In general, productivity decreased with increasing distance from shore, and was higher at the southern end of the study area than farther north. Furthermore, uptake rates of ^{14}C were considerably higher for the $< 5 \mu\text{m}$ size fraction, suggesting that a large proportion of productivity is derived from picoplankton in these oligotrophic waters.

Rare marine macroalgae and Marine Protected Area planning.

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Ideally, an effective marine reserve should be designated after considering relevant aspects of biology and ecology, within the social and political context. But is this effective for preserving biodiversity, particularly rare species? To determine if there are areas of temperate Australia where rare or little-known marine macroalgae are concentrated, I have examined herbarium records and published data. Currently, 142 Australian endemic species fit my nominated criteria of having 5 or fewer verifiable records, and mapping the records has revealed 7 localities where 10 or more of these species co-occur. To investigate biases associated with historical collecting effort, the reality and underlying physical causes of these possible “centres of rarity” will be tested using spatial autocorrelation analysis. To expand information on geographical distributions of rare species, field surveys are underway to investigate the actual distributions and habitat requirements of species occurring in Tasmania. The results will help determine the benefits of marine protected areas in safeguarding genuinely rare macroalgae, and recognise those species that meet the IUCN Red List extinction-risk categories.

Patch dynamics on a temperate reef: patch size, wave exposure, herbivore abundance and patch age.

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Kelp canopies are widely recognised for their influence on the structure of sub tidal algal assemblages in southern Australia. Indeed, algal and sessile invertebrate assemblages are often characterised by their association with (canopy) or without (open-gap) kelp. Despite this, the influence of physical versus biological processes in the creation and maintenance of these two habitat types is poorly understood. By sampling a subtidal reef near Perth, we were able to test whether the length and proportion of open-gap habitat patches were related to wave energy, herbivore density (urchins and herbivorous fish) and (or) the abundance of large sessile invertebrates (sponges and corals). In addition, we monitored the recovery of experimentally cleared plots to determine if the recovery of canopy and open-gap habitats followed similar successional paths. We found the length and proportion of open-gap patches were positively correlated with wave exposure, supporting the hypothesis that open-gap size is a function of wave disturbance. However, strong associations between some mobile herbivores and open-gap habitats suggest that in areas of low wave exposure, the influence of biological processes may be particularly important. Recovery of experimentally cleared patches indicated that in the short-term patches were more likely to revert to their original habitat type than undergo succession toward a climax habitat type; however, additional monitoring is required. We conclude that future predictive models should incorporate stochastic and priority effects if they wish to explain habitat mosaics and proportions of kelp in kelp habitats.

Survival strategies of the charophytes, *Lamprothamnium papulosum* and *Protochara inflata* in Perth wetlands under increasing salinity and climate change

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Charophytes are adapted to temporary wetlands and their life cycle is completed before the dry phase. As draw down commences, they sexually reproduce and leave their oospores in the sediment. As Perth wetlands experience prolonged period of desiccation, acidification, eutrophication and secondary salinisation, the sensitive species are becoming rarer leading to their disappearance. *Protochara inflata* is a rare species of charophyte observed along with *Lamprothamnium papulosum* which is known to be highly tolerant to salinity. A *Melaleuca* swamp in the nature conservation reserve—the Brown mans swamp in Hansen and Claremont lakes are two wetlands in which these two species coexist. Both these temporary wetlands have been undergoing prolonged desiccation and salinisation in recent years. The life cycle and population dynamics of these species were studied in laboratory cultures as well as natural habitats. The results indicate that *Protochara inflata* has declined drastically in these wetlands and the more salt tolerant *Lamprothamnium* species appeared to be on the increase. Salinity and climate change may play a vital role in the survival of these species.

A single species, the kelp *Ecklonia radiata*, is disproportionately important in coastal marine ecosystems

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The kelp *Ecklonia radiata* is a dominant component of rocky surfaces in shallow marine habitats around southern Australia. It has been the focus of much research in south-western Australia in particular in the last 30 or so years. I will present data drawing on results of several large and small studies spanning more than a decade, and will examine spatial and temporal dynamics of biomass and production, the factors that influence these dynamics, and the fate of kelp production, including incorporation into coastal food webs. I will also highlight where some of the key knowledge gaps remain.

Investigating Effects of Climate Change in a Very Large Seagrass-Dominated Ecosystem – Shark Bay

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Shark Bay is one of only twenty World Heritage sites in the world to have been listed under all four natural criteria categories for nomination. Salinity gradients in the inner gulfs of Shark Bay drive globally unique biological and geological phenomena, such as the stromatolites, seagrass beds and shell beaches. Rising Sea Level, as predicted under climate change scenarios, would significantly influence critical world Heritage Values. The Wooramel river drains into Shark Bay, but its flow is intermittent and runoff is low except during extreme events, such as during cyclones. Changes to the rainfall events can have a major influence through input of freshwater, sediments and nutrients. In addition, changes to evaporation and sea levels increasing sea level, could change the water circulation within the Bay, altering the steep salinity gradients that drive the World Heritage Property Values (WHPV). Increased rainfall through major cyclonic events will cause increased erosion of the catchment with consequential increases in nutrient and sediment inputs to the coastal ecosystems. Freshwater inputs through these events can also change the salinity structure within the Bay. These factors suggest that the WHPV associated with the Faure Sill are threatened by the effects of climate change, and their interactions with the Wooramel River catchments. In combination, increases in extreme rainfall events and sea level together with changes to evaporation regime are critical threats to core WHPV, including the seagrass meadows of Wooramel Bank, and the hypersaline ecosystems of Hamelin Pool, location of the globally unique stromatolites, and have significant potential to cause landscape scale changes to the gradients in salinity that drive the Shark Bay marine environment and distribution and abundance of seagrasses that are the foundation of much of the ecosystem. This talk will describe a new project that will concentrate on the prediction and management of rising sea level effects on the Faure Sill, significant components of the marine environment (e.g. shell deposits, and hypersaline environments), benthic habitats as indicators of change (e.g. seagrass meadows), and superlative natural phenomena and features (e.g. stromatolites).

Marine microalgae: a major player in solving the methane paradox in the surface ocean

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Methane is twenty times more of a potent greenhouse gas than carbon dioxide. The oceans emit 5-15M tonnes of methane to the atmosphere, some of which originates from sediment in coastal regions and some from a surface layer source in the open ocean. Methane is a reduced gas that is produced under anoxic conditions by methanogenic bacteria that are obligate anaerobes, and so the elevated methane throughout the surface ocean is counter-intuitive. A dissolved methane maximum at depths of 40-150m is a widely recognised phenomenon, yet the “oceanic methane paradox” had remained unexplained for many decades. Recently, however, Karl and co-workers identified an aerobic phosphonate pathway in methanogenesis in the surface ocean. The interaction between microalgae and their associated bacterial consortia plays a vital role in nutrient remineralisation where compounds exuded by algae may be used by aerobic bacteria and biofilms to produce the precursor molecules necessary for methane production by potential methanogenic archaea thriving in “anaerobic nests”. Precursors such as DMS, DMSP and halogenated carbons (eg. methyl bromides or methyl chlorides) produced by specific microalgae such as *Emiliana huxleyi* and *Phaeocystis* spp. contain methyl groups that may undergo further chemical reduction and so represent potential substrates for methane production. Gas chromatography was used to investigate differences in methane production in laboratory cultures of 13 various microalgal species, including groups such as the coccolithophorids, diatoms, dinoflagellates, cyanobacteria, flagellates and green microalgae and their associated bacterial consortia. The culture containing the oceanic coccolithophorid, *Emiliana huxleyi* was the highest methane producer, with methane concentrations of up to 8nM over a 6-day incubation period. The effect of algal morphology, algal growth phase and environmental parameters such as light intensity was examined in selected groups. In providing insight into the oceanic methane paradox, this novel research addresses both the role of microbial consortia in marine elemental cycling in the surface ocean and its responsiveness to climate change.

Integrating biogeography, ecology and physiology to disentangle the effects of climate on Australian seaweeds

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Ecological impacts of global climate change have been extensively documented in terrestrial ecosystems, but substantially fewer examples exist from the marine biome – not because it has not been affected, but because of limited time series and broad-scale data sets. Australian herbarium records documents the profound influence of ocean climate on the distribution of seaweeds, and suggests that changes have occurred over the past ~50 years. Forecasting further changes will require a mechanistic understanding of the underlying drivers of change, which can best be achieved through experiments. A review of marine climate change experiments reveal an under-representation of studies on macrophytes and a lack of field studies. This is worrying given the ecological importance of seaweeds as food, habitat and ecosystem engineers, and because laboratory and mesocosm experiments are highly artificial and often suffer problems of scale. An alternative approach is the comparative experimental approach, where identical experiments are conducted in different locations characterised by different ‘climates’. I will show how physiological adjustment to warmer water along a latitudinal gradient in ocean temperature, was linked to reduced ecological performance of Australian kelp beds. Studying the links between physiological and ecological processes along latitudinal gradients is particularly relevant in relation to climate change because the responses of many organisms are likely to include distribution shifts along these gradients.

Applying mt DNA COI barcoding to Korean Gracilariaceae (Rhodophyta) (P)

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The red algal family Gracilariaceae has high commercial value used for biotechnology and microbiology research as a phycocolloid agar. *Gracilaria* species are difficult to identify based on morphological features alone and the taxonomy of the Gracilariaceae occurring in Korea has remained a gap in our knowledge. We test the effectiveness of DNA barcoding for the identification and discovery of species of Gracilariaceae in Korea. We analyzed cytochrome c oxidase 1 (COI) sequences from 72 specimens and found total 5 species, 4 of *Gracilaria* and 1 of *Gracilariopsis*: *Gracilaria textorii*, *G. incurvata*, *G. parvispora*, *G. vermiculophylla* and *Gracilariopsis chorda*. These findings prompt for further taxonomic studies of Gracilariaceae using more extensive specimen sampling from the known distributional areas in the Asian-Pacific region for better understanding of species diversity. The results indicated that the utility of mtDNA COI sequence characters is valid for revealing the species identification in marine biomonitoring of Gracilariaceae and thus also for the understanding of species boundaries of this group. We presume that DNA barcoding will significantly provide an efficient method for species-level identifications and contribute powerfully to taxonomic and biodiversity research.

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