Journal of the Marine Biological Association of the United Kingdom, 2010, 90(6), 1073–1077.
doi:10.1017/S0025315410000627

FOREWORD

Frederick Stratten Russell, FRS (1897–1984): a distinguished scientist and stimulating leader

GERALD T. BOALCH

Marine Biological Association of the United Kingdom, The Laboratory, Citadel Hill, Plymouth PL1 2PB, UK

Frederick Stratten Russell, a self portrait

This issue of the *Journal of the Marine Biological Association of the United Kingdom* (*JMBA*) is dedicated to Sir Frederick Stratten Russell, FRS, on the occasion of the 125th anniversary of the foundation of the Marine Biological Association of the United Kingdom (MBA). The year 2010 also marks the occasion of the 350th anniversary of the foundation of the Royal Society, London. As part of their celebrations the Royal Society has selected Frederick Russell as one of their Local Heroes for 2010, to bring to the attention of the general public his considerable scientific achievements.

For 20 years, from 1945 whilst Director of the MBA, Frederick Russell was also the Editor-in-Chief of the *JMBA*. Whenever possible, he liked to look at the final proofs before each issue went to press. During his scientific career, F.S. Russell developed a variety of scientific interests, including the distribution of invertebrate zooplankton, the identification, spatial and diel distribution and seasonal occurrence of young fish (eggs, larvae and post-larvae), medusae and long-term cycles in the marine ecosystem. Papers on all these topics are included in this issue.

F.S. Russell was born in Bridport, Dorset on 3 November 1897 and moved to Newquay, Cornwall with his family when he was 6 years old. His father, a very gifted man, was a schoolmaster who ran private preparatory schools. Frederick was taught by his father and was encouraged to study natural history. Since they lived near the coast, and his father was a keen fisherman, Frederick developed an early interest in marine biology. His father was also an accomplished watercolour artist and taught Freddie to draw and to paint in watercolours. Father and son went on fishing and painting expeditions together.

Russell obtained a Scholarship to Oundle School, where he further developed his interest in science and, in 1915, won an Open Scholarship to Gonville and Caius College, Cambridge. However, although he thought of becoming a surgeon, he felt his first duty was to fight for his country. He delayed his Scholarship and volunteered for the Royal Naval Air Service. He was soon commissioned and taught to fly, but on his first solo flight stalled the aircraft and damaged his knee. He was told that he would need a long convalescence before he could continue training as a pilot but he could fly immediately as an observer. This he did, excelling at taking aerial photographs of the enemy lines and the Belgium coast, in the process being awarded the DSC, DFC and the French Croix de Guerre (with Palme), for gallantry. Perhaps it was his service as a photographer, having to adapt his apparatus to get the best results, which was later useful in enabling him to adapt and modify plankton sampling gear to open and close at set depths.

After the war, Russell took up his Scholarship at Cambridge and, after taking Part I in zoology, botany and physiology, he was persuaded by Professor Stanley Gardiner to think of a career in science. In Part II he concentrated on zoology, specializing in marine biology. During the long vacations Gardiner arranged for Russell to work at the Fisheries Laboratory in Lowestoft. In 1921 he attended the Easter course at the Plymouth Laboratory of the MBA. While Russell was in Plymouth, R.S. Clarke who had been with Shackleton to the Antarctic on 'Endurance' persuaded him to join the next Shackleton expedition. However, his tutor at Cambridge vetoed the idea and said he should first finish his degree. Russell passed Part II with honours and was offered two posts, one to work with J. Hjort in Norway and the other as Assistant Director of Fisheries in Egypt, to work on the eggs and early stages of Mediterranean fish. He chose the second and in 1922 came to Plymouth for intensive training for six weeks.

While in Plymouth, Russell met Gweneth May Evans and married her. He and Gweneth then moved to Egypt, where Russell began the studies that started his life-long interest in fish eggs and the early stages of the development of fish. The Russells did not stay in Egypt for very long, as the post of Assistant Naturalist at the MBA became vacant. The then Director at Plymouth, Dr E.J. Allen, was determined to have Russell on his staff. Although it meant a drop in salary, Russell accepted the post and moved to Plymouth with Gweneth in 1924. Russell spent the rest of his career, apart from a short spell on the Great Barrier Reef and service in the RAF during the Second World War, at Plymouth.

By 1925, Russell had started his extremely productive study of marine zooplankton, a field in which he became acknowledged as a world expert. He had the great ability to identify the most important problems and to devise ways of studying them. His numerous papers, on all aspects of zooplankton, were interspersed with papers describing the construction of nets for studying the vertical distribution of planktonic species. Full details of the 159 publications by Russell are given in Denton & Southward (1986). By the use of the new opening and closing nets, Russell was able to study the depth distribution of zooplankton. Sampling throughout a 24-hour period, he was able to demonstrate the vertical migration of some species and also to show that this migration was light dependant. Working with the marine chemists at the MBA, he also showed that some species, that he later called 'indicator species', were linked with particular water masses.

Russell became friendly with C.M. Yonge during his early research years. In the mid-1920s they decided to write a book about life in the sea, entitled *The seas* (Russell & Yonge, 1928). This book became the standard reading for all marine biologists as well as interested members of the wider public. It was written in a clear but concise style and was illustrated with many colour plates, including two watercolour illustrations prepared by Frederick's father. The book went into four editions and was last updated in 1975. It was, and in many respects still is, the best introduction a student could have to the study of life in the seas.

In 1928, Russell took part in a scientific expedition to the Great Barrier Reef. He had been suggested as the leader for this expedition, but as he could only be released from the MBA for six months, C.M. Yonge was appointed leader. This meant that Russell was able to spend his time on zooplankton research without administration worries. Gweneth accompanied him to the Barrier Reef and proved of great strength at a critical stage. Frederick, while swimming, was stung on the leg by a 'sea wasp', an extremely venomous jellyfish. He became unconscious and Gweneth was advised that the only certain way to save his life was to amputate the leg. Fortunately, Gweneth refused permission for this and Frederick eventually recovered fully. While on the Barrier Reef, Russell become ever more interested in the breeding cycles of invertebrates and seasonal changes in the plankton.

On his return to Plymouth, Russell began taking samples from a much wider area of the Western English Channel and was able to study the species characteristic of certain water masses, 'indicator species'. Russell showed that plankton species could indicate the origin of the water. Some of the main indicator species were those of the chaetognath *Sagitta*. It had been previously shown that two species occurred in the North Sea and, when examining samples collected in the English Channel, Russell found that there were also two species present, each associated with different water masses. He noted a change in relative abundance of the two species in the 1930s and linked this with a change in water mass and temperature. Later it was appreciated that this led to a considerable change in the ecosystem that affected commercial fisheries. Because of the great importance of his research, in 1938 Russell was made a Fellow of the Royal Society at the unusually young age of 40.

While making observations on the distribution of the plankton, Russell, who remained interested in the eggs and early stages of fish, began to accumulate information and drawings of the eggs and larvae of all the British fish species he could find. He had also developed an interest in medusae, since these were often good indicator species. As he studied different species, a number of which were new to science, he prepared beautiful watercolour drawings of each. Watercolours were the ideal medium for preparing illustrations of such delicately coloured species. As well as his scientific papers on plankton distribution and the life histories of fish and jellyfish, Russell also found time to write popular articles on various aspects of life in the sea.

In 1940, Russell again volunteered for military service and joined the Intelligence Service of the RAF. His past knowledge of aerial photography and his scientific approach proved most valuable and he prepared a *Handbook on the Organization of the German Air Force* that was acknowledged as one of the most valuable documents produced in the Intelligence Service during the war.

At the end of the war, Russell planned a long holiday, involving fishing and painting, before returning to his work at Plymouth. However, Stanley Kemp, the Director of the Plymouth Laboratory, died and the Council of the MBA asked Russell to take over as Director immediately. His sense of duty and attachment to the MBA was great and he reluctantly accepted. He had previously been asked to consider other senior appointments, but had turned them down because of his close attachment to the MBA Laboratory. Russell returned to Plymouth to find the building partly destroyed by bombing and a staff that had dispersed in war service. He had to draw his staff together and encourage them to carry out research, to the best of their ability, while the building was being rebuilt. His firm, but gentle, approach proved important at this time. He had a system whereby, unless he was otherwise engaged, the door of his office was open in the morning until the coffee break and anyone needing help or advice could drop in. Because he was also very good at obtaining financial support from funding bodies, he was able to gradually bring in more staff and build a coherent organization.

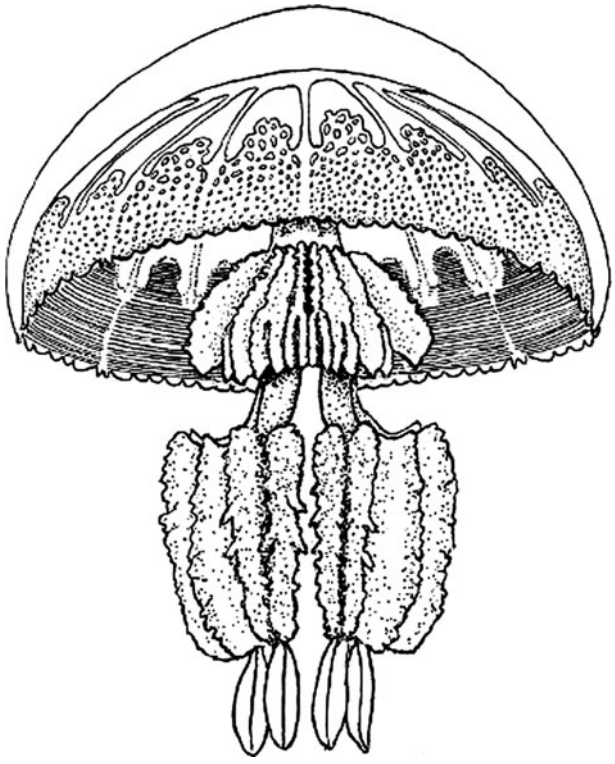
Each member of staff had a specific group or topic of marine life in which they were expected to become an expert. They could also work on other groups and collaborate with other members of staff and with visiting workers. Most members of staff were also given a field of responsibility in helping to run the Laboratory. At the time Russell was also carrying out his own research, sometimes also collaborating with other members of staff. Some of the groundbreaking papers on the distribution of plankton in relation to water chemistry and season were produced during this period. Russell encouraged other eminent scientists to come to work at Plymouth for long or short periods. He also strove hard to acquire funding to ensure that the MBA was well equipped with ships that could carry out all the sampling his staff and

https://doi.org/10.1017/S0025315410000627 Published online by Cambridge University Press

the visiting research workers required. The fleet he assembled consisted of 'Sarsia', a specially built trawler/research vessel capable of remaining at sea for three weeks or more, 'Sula', a day trawler for collecting live material and 'Gammarus', a small launch for inshore work. During the directorship of Russell (1945–1965) work was carried out at Plymouth that led to three visiting scientists being awarded Nobel Prizes and six staff researchers associated with him being made Fellows of the Royal Society. Russell had successfully overseen the rebuilding of the Laboratory and built up his staff to a high level of scientific achievement. Whilst fulfilling the arduous duties of Director, Russell kept up his interest in the plankton, all the time collecting descriptions and illustrations for two major works, one on the British medusae that would deal with every species recorded for the UK, and the other was a work describing the eggs and early stages of all the British marine fishes.

In 1953, Russell achieved one of his targets, publishing the first volume of *The Medusae of the British Isles* (Russell, 1953). This book was profusely illustrated with his watercolour illustrations and great care was taken by the publishers to ensure that the illustrations were produced as true to their original colour as possible.

When he retired as Director, Russell kept a room at the Laboratory and, although he kept a low profile, he continued his researches. To the delight of everyone who knew him, he was knighted in 1965. In 1970 the second volume of *The Medusae of the British Isles* was published (Russell, 1970), the culmination of a lifetime study. The two volumes of this work were the most comprehensive work ever published on British jellyfish. They have become classic reference books and received praise from all who used them, in part due to his detailed drawings of the species.



A drawing, by Russell, of *Rhizostoma octopus* from The Medusae of the British Isles Volume II Pelagic Scyphozoa (1970)

Russell continued his interest in the plankton and, while Director, he encouraged younger members of the staff at Plymouth to carry on long-term sampling so that the observations he and other members of staff had started would be continued. This resulted in the MBA having in its archive some of the longest time series of observations on plankton carried out under the same conditions. In the late 1960s, the younger members of staff carrying out these long-term studies noted a change in the relative abundance of species in the plankton. Russell drew all these observations together and realized that it was a reversal of what he had recorded in the 1930s. As a result, together with another zoologist, a botanist and a chemist, Russell published a letter in *Nature* (Russell *et al.*, 1971) recording these changes and pointing out the cyclic nature of changes in the English Channel. These cyclic changes were later named the Russell cycle.

Having completed his work on the medusae, Russell turned to another of his interests, one that started during his time in Egypt, the study of the eggs and early development of fish. His resulting book comprehensively described the eggs and young stages of British fish (Russell, 1976) and was copiously illustrated with many drawings made from material he had collected. Where he had not been able to draw from such specimens, he carefully traced from drawings made by other workers. In this book, all the illustrations are in black and white. Russell pointed out that, since most workers would be working with preserved material, the illustrations were prepared to show what would be seen in preserved material, in which most of the pale colours in the living specimens are lost and only the black of the melanophores remain. Once again this is a book to which those working in the field will continue to refer.

Sadly, on New Year's Day 1978, Gweneth died suddenly. Russell was very shaken by this event; he remained active by setting about tidying up his life's work and, in 1980, moved from Plymouth to a nursing home at Goring-on-Thames to be near his son and daughter-in-law in Reading. In Goring-on-Thames he was visited by his friends and he continued to show an interest in the MBA and the research being carried out there. He also continued with his watercolours, painting the changing scene outside his window at least once a month. He died on 5 June 1984.

My personal memories of Sir Frederick are very vivid. He was on both the examination board that awarded the Scholarship that financed my PhD research in London and the selection board that awarded an International Paints Research Fellowship to me for work at Plymouth in 1958. At the end of the Fellowship he appointed me to the staff of the MBA and I came to know him as a kind and helpful Director. Early in my research career at the MBA, after losing some valuable apparatus at sea, I had to stand in front of his desk and confess the loss. He asked me to describe what had happened. I told him how the apparatus had been torn off the wire when we were working in bad weather and he kindly said 'Well now you know the limit of the conditions in which you can work, I am sure we have replacement apparatus in the laboratory'.

As I came from East Devon, not far from Bridport, and had been brought up in a family linked to fishing, he would sometimes talk with me about fishing and life on the Devon and Dorset coast. He also knew I was attempting watercolour painting and this was another topic of conversation. I soon learnt that not only was he a helpful Director but also a very kind friend. I remember accidentally meeting him as he

https://doi.org/10.1017/S0025315410000627 Published online by Cambridge University Press

came into the MBA on the day his knighthood was announced and I said to him, 'Now I have good reason to call you "Sir"', and he replied 'Yes, but I hope you will find me no different'. When he finally left Plymouth, due to failing health, he gave me all his spare watercolour paper and paints.

In May 1984, on the way to catch a flight from Heathrow, I allowed time to visit Sir Frederick en route. As soon as I arrived he said, 'Oh I am so glad to see someone from Plymouth, the doctor has just left and he told me I only have about two weeks to live'. I was dreadfully shaken but he was quite calm and cheerful and wanted to talk about the MBA and the work that was going on there. Then he went on to discuss painting and he showed me the collection of paintings he had done of the changing scene outside his window. I sadly explained that my time was limited as I had a flight to catch and he happily said goodbye and saw me to the door. By the time I returned to England he was dead. He was an inspirational leader and Director, a stimulating colleague and a great friend.

This issue contains papers that reflect the research interests of Frederick Russell, including six papers on medusae. Benfield & Graham (2010) describe the global distribution and habitat of *Stygiomedusa gigantea* along with *in situ* observations on the species using ROVs. The annual production of *Aurelia aurita* scyphopolyps in the northern Adriatic is described by Di Camillo *et al.* (2010) and a DNA microarray technique (not available in Russell's time) is described for distinguishing *Aurelia* from *Chrysaora* by Ki *et al.* (2010).

New technologies are also being used to find and collect new species of medusae. Pugh & Haddock (2010) give a description of three new species of remosiid siphonophores collected by ROV off Monterey Bay, California and by a submersible off the Bahamas. The gonad morphology and gametogenesis of *Atolla wyvillei* and *Periphylla periphylla* are described by Lucas & Reed (2010) while Puce *et al.* (2010) describe the morphology of the early developmental stages of an Indonesian species of *Stylaster*.

The interests of Russell, in long-term changes in the sea, are reflected well in the paper by Lynam *et al.* (2010) describing how changes in the water masses entering the North Sea, that can be related to the North Atlantic Oscillation Index, influence the abundance of gelatinous zooplankton in the North Sea. Changes in the benthos since 1895, around the Eddystone lighthouse in the Western English Channel, are discussed by Capasso *et al.* (2010). These authors concluded that the changes in species abundance were attributable to the effects of demersal fishing, rather than to changes in the water masses entering the Channel. This contrasts with changes in the pelagic zone where water mass changes profoundly affect the composition of the pelagic community.

Russell was one of the early pioneers of studies into plankton around the Great Barrier Reef in Australia (Russell & Colman, 1934). Sorokin & Sorokin (2010), in a detailed follow-up to these early studies, describe a survey of labile organic matter, microplankton and mesozooplankton around the Reef. They quantify the plankton production over the reef and conclude that organic matter exported from the mangroves and the benthic reef communities largely supports the heterotrophic plankton in the deep lagoon, rather than local primary production. Vargas *et al.* (2010) also examine zooplankton production in coastal waters and show how diatom abundance and nutritional quality affect the growth of copepods. Similarly, Drira *et al.* (2010), working in the Ionian Sea, relate the composition of the phytoplankton community to the role of ciliates in the food supply to copepods and show how water masses with different nutrient levels impact on the species composition of the plankton. Another study, on the changes in phytoplankton composition and the consequences for components of the zooplankton, is presented by Gaonkar & Anil (2010). These authors show, in Dona Paula Bay, Goa, the effects of seasonal changes in phytoplankton composition on the survival, as judged by settlement success, of barnacle nauplii.

Many of Russell's early studies on zooplankton focused on their spatial distribution and diurnal movements. In this issue, Sorokin & Sorokin (2010) report an increase in zooplankton abundance, from two up to three orders of magnitude, near the Great Barrier Reef, due to organisms leaving the benthos at night. In a different setting, around St Paul's Rocks, Brazil, Koettker *et al.* (2010) show diel variations in the composition of decapod larvae in the plankton. Both these studies also report major spatial changes in species composition. Similarly, Landeira *et al.* (2010) have studied the distribution of invertebrate larvae around the Canary Islands and show the importance of eddies in retaining larvae in a region to the south of the Islands. The effects of light on O-group *Solea solea* are described by Durieux *et al.* (2010), who show clear evidence for a circadian rhythm in swimming activity.

Finally, Russell's interests in the early planktonic stages of fish are reflected in this issue in three studies. Faria *et al.* (2010) compare the developmental stages of *Parablennius gattorugine* and *P. ruber*, showing how the larval stages of these species can be distinguished. In the North Pacific, Sassa (2010) has studied the post-larvae of *Symbolophorus californiensis*, a major component of the ichthyoplankton and it has shown how the diet changes during ontogeny.

The papers in this issue demonstrate that the areas of research pioneered by Frederick Russell continue to be active today and that, as in Russell's time, the use of new techniques and technology are leading to major advances in marine biology and our understanding of the behaviour of pelagic organisms.

REFERENCES

Benfield M.C. and Graham W.M. (2010) *In situ* observations of *Stygiomedusa gigantea* in the Gulf of Mexico with a review of its global distribution and habitat. *Journal of the Marine Biological Association of the United Kingdom* 90, 1079–1093.

Capasso E., Jenkins S.R., Frost M. and Hinz H. (2010) Investigation of benthic community change over a century-wide scale in the Western English Channel. *Journal of the Marine Biological Association of the United Kingdom* 90, 1161–1172.

Denton E.J. and Southward A.J. (1986) Frederick Stratten Russell 1897–1984. *Biographical Memoirs of Fellows of the Royal Society* 32, 463–493.

Di Camillo C.G., Betti F., Bo M., Martinelli M., Puce S. and Bavestrello G. (2010) Contribution to the understanding of seasonal cycle of *Aurelia aurita* (Cnidaria: Scyphozoa) scyphopolyps in the northern Adriatic Sea. *Journal of the Marine Biological Association of the United Kingdom* 90, 1105–1110.

Drira Z., Hamza A., Bel Hassen M., Ayadi H., Bouain A. and Aleya L. (2010) Coupling of phytoplankton community structure to nutrients, ciliates and copepods in the Gulf of Gabès (South Ionian Sea, Tunisia).

https://doi.org/10.1017/S0025315410000627 Published online by Cambridge University Press

Journal of the Marine Biological Association of the United Kingdom 90, 1203–1215.

Durieux E.D.H., Le Duigou M., Millot S., Sasal P. and Bégout M.-L. (2010) Sedentary behaviour establishment in O-group common sole *Solea solea*: a laboratory video-tracking study. *Journal of the Marine Biological Association of the United Kingdom* 90, 1257–1262.

Faria C., Gil F., Santos R.S. and Almada V.C. (2010) A comparison between the ontogeny of two related blenniid species *Parablennius gattorugine* and *Parablennius ruber* (Pisces: Blenniidae). *Journal of the Marine Biological Association of the United Kingdom* 90, 1263–1268.

Gaonkar C.A. and Anil A.C. (2010) What do barnacle larvae feed on? Implications in biofouling ecology. *Journal of the Marine Biological Association of the United Kingdom* 90, 1241–1247.

Ki J.-S., Hwang D.-S. and Lee J.-S. (2010) Simultaneous detection of *Aurelia* and *Chrysaora* scyphozoan jellyfish on a DNA microarray. *Journal of the Marine Biological Association of the United Kingdom* 90, 1111–1117.

Koettker A.G., Freire A.S. and Sumida P.Y.G. (2010) Temporal, diel and spatial variability of decapod larvae from St Paul's Rocks, an equatorial oceanic island of Brazil. *Journal of the Marine Biological Association of the United Kingdom* 90, 1227–1239.

Landeira J.M., Lozano-Soldevilla F., Hernández-León S. and Barton E.D. (2010) Spatial variability of planktonic invertebrate larvae in the Canary Islands area. *Journal of the Marine Biological Association of the United Kingdom* 90, 1217–1225.

Lucas C.H. and Reed A.J. (2010) Gonad morphology and gametogenesis in the deep-sea jellyfish *Atolla wyvillei* and *Periphylla periphylla* (Scyphozoa: Coronatae) collected from Cape Hatteras and the Gulf of Mexico. *Journal of the Marine Biological Association of the United Kingdom* 90, 1095–1104.

Lynam C.P., Attrill M.J. and Skogen M.D. (2010) Climatic and oceanic influences on the abundance of gelatinous zooplankton in the North Sea. *Journal of the Marine Biological Association of the United Kingdom* 90, 1153–1159.

Puce S., Bo M., Di Camillo C.G., Paoli L., Pica D. and Bavestrello G. (2010) Morphology and development of the early growth stages of an Indonesian stylaster (Cnidaria: Hydrozoa). *Journal of the Marine Biological Association of the United Kingdom* 90, 1145–1151.

Pugh P.R. and Haddock S.H.D. (2010) Three new species of remosiid siphonophore (Siphonophora: Physonectae). *Journal of the Marine Biological Association of the United Kingdom* 90, 1119–1143.

Russell F.S. (1953) *The Medusae of the British Isles Volume I: Anthomedusae, Leptomedusae, Limnomedusae, Trachymedusae, and Narcomedusae*. Cambridge: Cambridge University Press.

Russell F.S. (1970) *The Medusae of the British Isles. Volume II—Pelagic Scyphozoa, with a supplement to Volume I*. Cambridge: Cambridge University Press.

Russell F.S. (1976) *The eggs and planktonic stages British marine fishes*. London, Academic Press.

Russell F.S. and Colman J.S. (1934) The zooplankton II. The composition of the zooplankton of the Barrier Reef Lagoon. *Scientific Reports of the Great Barrier Reef Expedition 1928–29* 2, 159–176.

Russell F.S., Southward A.J., Boalch G.T. and Butler E.I. (1971) Changes in biological conditions in the English Channel off Plymouth during the last half century. *Nature* 234, 468–470.

Russell F.S. and Yonge C.M. (1928) *The seas: an introduction to the study of life in the sea*. London, Frederick Warne & Co.

Sassa C. (2010) Feeding ecology of *Symbolophorus californiensis* larvae (Teleostei: Myctophidae) in the southern transition region of the Western North Pacific. *Journal of the Marine Biological Association of the United Kingdom* 90, 1249–1256.

Sorokin Yu.I. and Sorokin P.Yu. (2010) Plankton in waters of the central Great Barrier Reef: abundance, production and trophodynamic roles. *Journal of the Marine Biological Association of the United Kingdom* 90, 1173–1187.

and

Vargas C.A., Martínez R.A., Escribano R. and Lagos N.A. (2010) Seasonal relative influence of food quantity, quality, and feeding behaviour on zooplankton growth regulation in coastal food webs. *Journal of the Marine Biological Association of the United Kingdom* 90, 1189–1201.