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Scientific contributions of the Mangrove Macrobenthos and Management (MMM) conference series, 2000–2019

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ABSTRACT

The conservation of mangrove forests has become an important international policy priority in recent decades, and is mirrored by a large increase in research interest. Multiple disciplines now use mangroves as a study system, from molecular biology to social science. The variety of research conducted in mangroves is exemplified by the Mangrove Macrobenthos & Management (MMM) conference series, the world's largest gathering of researchers and practitioners dedicated to the science and conservation of the mangrove ecosystem. Established in 2000, MMM is a useful barometer with which to identify and measure research trends over the last 20 years. This study describes the history of the MMM conference series, and analyses the research presented in this series as a potential proxy of how the broader mangrove research field has changed through time. Presentations in early MMM conferences were dominated by macrobenthos studies, reflective of the origins of MMM as a forum specifically for mangrove macrobenthos research. However, later conferences have come to reflect the broader interests of the mangrove research field, and have tracked the emergence of blue carbon and other ecosystem services. Mangrove forests continue to be a rich and diverse ecosystem of study, and future MMM conferences will continue to provide a platform for impactful research and management.

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1. Introduction

Intertidal mangrove forests have long provided opportunities for diverse fields of scholarly research. Since at least the early 20th century researchers have been describing the physiology and ecology of mangrove tree species (Bowman, 1917), propagule dispersal (Van Welsem, 1920), geomorphic controls on vegetation species distribution (Watson, 1928; de Haan, 1931), and later the systems ecology of mangroves (Davis, 1940; Walsh et al., 1975; Clough, 1982) and diversity of mangrove fauna (Macnae, 1969; Warner, 1969). Contemporary mangrove research has built upon and expanded from these scientific foundations, and their biodiversity and functioning have now been heavily researched (Tomlinson, 1986; Cannicci et al., 2008). Mangroves are now well known as a key model study system (Feller et al., 2010) through which to investigate geological, geomorphological and geographical processes (e.g., Krauss et al., 2014, Woodroffe et al., 2016), and the influence of such physical processes on physiology, genetics, connectivity, ecology and biogeography (e.g., Duke, 1992, 2017; Duke et al., 1998; Van der Stocken et al., 2019). The role that mangroves play in supporting coastal communities means there has also been increasing interest in mangroves as a socio-ecological system (Walters et al., 2008; Quinn et al., 2017; Santos et al., 2017), and particularly their role in the production of ecosystem services (Vo et al., 2012; Lee et al., 2014). Mangroves have been suggested as a model ecosystem for trans-disciplinary research (Dahdouh-Guebas and Koedam, 2008), precisely because a holistic understanding of the complex mangrove system requires knowledge of the physical, biological, environmental and social sciences.

Like many fields, contemporary mangrove research is subjected to, and influenced by multiple factors that determine policy priorities, funding and student research interest. Research funding sources can influence the type of research conducted and the impact it may have (Gök et al., 2016), and research is also influenced by underlying public policy requirements (Cáceres et al., 2016; Glaser and Laudel, 2016) or the influences of other stakeholders (Mace, 2014). The mangrove research field has itself been influenced by such factors. Mangrove forests have experienced rapid loss, particularly in the late 20th century, though substantial mangrove conservation efforts have slowed rates of deforestation over the last 20 years (Friess et al., 2020). However, hotspots of mangrove deforestation and degradation still remain, particularly in parts of Southeast Asia (Hamilton and Casey, 2016), so mangrove loss still commands substantial management and policy attention. Mangrove rehabilitation gained huge research and applied attention in the aftermath of the 2004 Southeast Asian tsunami (Wetlands International, 2009; Kodikara et al., 2017), and as much as 800 000 ha may ultimately be biophysically suitable for rehabilitation globally (Worthington and Spalding, 2018). More recently, the ability of coastal ecosystems to store high densities of carbon has attracted strong interest from national and international policy makers (Mcleod et al., 2011), and has driven a large amount of research into the role of mangroves in carbon cycling (Alongi, 2014).

Analyses of research trends are useful to understand how a research field is influenced by changes in attention or philosophy, and may provide an insight into predicting emerging research trends in the future. This study provides a commentary on recent trends in mangrove research, using the example of the world's largest gathering of mangrove researchers: the Mangrove Macrobenthos & Management (MMM) conference series (previously the Mangrove Macrobenthos Meeting). MMM has come to represent the largest and most diverse collection of mangrove specialists working across disciplines, from benthic invertebrates and soil biogeochemistry to macroclimatic drivers and latitudinal limits of mangrove expansion. The authors represent many of the organizers of the five MMM conferences that have been held since 2000.

2. The MMM conference series

2.1. Key mangrove conferences and the history of the MMM series

Few conferences have been dedicated solely to the study of mangroves, though a formative meeting was held in Hawaii in 1974 (Walsh et al., 1975). The *First International Symposium on Biology and Management of Mangroves* was formed because the importance of mangroves was only beginning to be recognized. This symposium resulted in a statement being sent to the Secretary General of the United Nations urging the active promotion of research into this ecosystem (Walsh, 1975). Other regional and international meetings began to be held around this time, such as the *International Workshop in Mangrove and Estuarine Area Development for the Indo-Pacific Region* held in the Philippines in 1977, and the *Symposium on Mangrove & Estuarine Vegetation in Southeast Asia* and the *Asian Symposium on Mangrove Environment* both held in Malaysia in 1978 and 1980. Similar meetings attempted to consolidate information on mangrove forests at the national level, such as the Australian *National Mangrove Workshop* held in 1979, with the objective of reviewing existing and previously fragmented or unpublished knowledge of Australia's mangroves, and identifying areas where further research was needed (Clough, 1982).

These early mangrove conferences were broad in thematic focus, though the first MMM meeting had the primary goal of developing a more focused global community of practice around the ecology of mangrove macrobenthos, specifically referring to large macroscopic benthic fauna (Vannini et al., 2002). This meeting was convened in 2000 in Mombasa, Kenya, and was organized as a final scientific event for the EU funded INCO–DC project titled "Macrobenthos of Eastern African Mangroves: life cycles and reproductive biology of exploited species", a collaboration of three European universities and four African institutions between 1997 and 2000. The MMM series eventually developed a broader focus to encompass all aspects of mangroves, with subsequent meetings held across the tropics and sub-tropics (Table 1).

The MMM conference series rotates among continents to increase access to as many participants as possible and to reflect the broad diversity of participants involved in mangrove research. The most recent iteration – MMM6 – will represent Latin America and the Caribbean, and is due to be held on the Caribbean coast of Colombia in 2022. Generally, at least 50% of presenters at MMM have been from developing nations; 26 countries were represented at MMM3 in Sri Lanka, and most recently, MMM5 in Singapore had attendees from at least 38 different countries around the world.

The MMM conference series has brought together hundreds of participants from across the globe, and the number of participants continues to increase. MMM also sees substantial representation from non-

Table 1
Summary of the MMM conferences held around the world since 2000.

	Year	Location	Region	Key theme	# participants
MMM1	2000	Mombasa, Kenya	East Africa	Macrobenthos	80
MMM2	2006	Coolangatta, Australia	Australasia	Macrobenthos	41
MMM3	2012	Galle, Sri Lanka	South Asia	Ecology, functioning and management	180
MMM4	2016	St. Augustine, USA	North America	Climate change	267
MMM5	2019	Singapore, Singapore	Southeast Asia	Mangroves & people	335
MMM6	2022	To be held in Colombia	Latin America & the Caribbean	To be confirmed	–

governmental organizations, managers and rehabilitation practitioners (including on the organizing committees for MMM1, MMM4 and MMM5), so the conference is in a position to act as a conduit of knowledge between academic and applied stakeholders. This conference series is still ongoing, making MMM the world's longest running mangrove conference series. This conference is unique in that it is one of the few major international conferences to have a single session format, so that all participants from all disciplines and background (whether research, management or advocacy) listen to all presentations and learn from each other.

Groups of researchers attending MMM conferences have subsequently been established to formally cross the academic-policy maker divide; for example, the creation of the Mangrove Specialist Group of the IUCN Species Survival Commission was first raised at MMM3. This group has now become an expert commission tasked with producing the Red List for Threatened Species for mangroves, and has conducted high level visits to governments to advise on mangrove management problems. The group has conducted advocacy work such as a statement to the World Parks Congress in 2014 that advocated for increased mangrove protected area coverage, and contributed to motions for mangrove protection at the World Conservation Congress in 2020.

2.2. Scientific contributions of the MMM series

In addition to a conference, each MMM has produced specific scientific outputs, with the aim of reflecting the state of the art of mangrove research at that time. A number of journal Special Issues have been produced from research presented at the MMM conferences. Research presented at MMM1 was published in the journal *Wetlands Ecology and Management* in 2002, comprising 12 articles that have been cited more than 150 times by December 2019 in *Web of Science*. MMM2 led to a Special Issue in the *Journal of Sea Research* in 2008 (10 articles, cited >700 times), and an independent Special Issue involving a number of MMM2 participants was published in *Aquatic Botany* in the same year, titled *Mangrove Ecology – Applications in Forestry and Coastal Zone Management*. The latter comprised 12 review articles, and has had a major impact on the research field, having been cited >3050 times, or an average of 277 times per year. This special issue has been particularly highly cited because review articles are often cited at greater rates than empirical papers (Miranda and Garcia-Carpintero, 2018). Scientific outputs from MMM3 were hosted in *Biogeosciences* (remote sensing and spatio-temporal vegetation dynamics of mangrove forests, 9 articles, 250 citations) and *Acta Oecologica* (mangrove ecology, functioning and management, 4 articles, 73 citations). The special issue of *Hydrobiologia* dedicated to MMM4 focused on impacts of global change on the distribution, structure and function of mangrove communities; human interactions with and influences on mangrove ecosystems; the role of macrobenthic communities; mangrove management, restoration and rehabilitation; and valuation of mangroves and other coastal ecosystems to society. This Special Issue was published in 2017, with contributions already being cited approximately 150 times in the last 2 years. The MMM4 special issue was introduced by an agenda-setting article describing the state of the world's mangroves in the 21st century under climate change (Feller et al., 2017). MMM5 has produced this Special Issue in *Estuarine, Coastal and Shelf Science*, comprising articles on a range of topics around the theme of 'Mangroves and People: Impacts and Interactions'.

The MMM series has also produced a number of synthesis articles that have highlighted key aspects of mangrove management through small-scale workshops following the main MMM Conference (organized in the Daintree National Park in Australia in 2006, Chilaw Lagoon in Sri Lanka in 2012, the Florida Keys in USA in 2016 and Pulau Tioman in Malaysia in 2019). Many have focused on the threats that mangroves face globally. For example, MMM2 led to a high impact statement of the state of the world's mangroves (Duke et al., 2007) published in the journal *Science*. Titled '*A world without mangroves?*', this letter highlighted the rapid loss of mangrove forests in the 20th century. This letter helped place mangroves on the international conservation agenda and has been one of the most influential articles written on mangroves, having been cited over a thousand times. Discussions at MMM5 led to an article that reflected on the progress made in mangrove conservation since MMM2, and how mangroves may now be on a more optimistic global trajectory with decreased rates of deforestation and greater conservation attention (Friess et al., 2020). MMM has also produced articles on broader topics of interest to the mangrove community; for example, MMM3 led to a critical reevaluation of key paradigms in mangrove ecosystem services, with particular focus on carbon cycling, coastal protection and land building services (Lee et al., 2014).

3. The MMM series as a barometer of the broader mangrove research field

3.1. The role of keyword analysis

As the premier conference for mangrove researchers, practitioners and policy makers, it would be expected that the MMM conference series would reflect the state of the research field at that time. The MMM series gives us a unique opportunity to analyse such trends over a period of almost 20 years. Conference theme and abstract analysis has been used as a window into broader research trends within related fields such as coastal sciences (Seaman, 2002; Weinstein, 2009), limnology (Lapierre et al., 2020) and conservation (Elliott et al., 2014), as well as other fields as diverse as media studies (Rice, 2005), medical studies (Lunny et al., 2011), library studies (Fourie, 2012), information systems and technology (Moro et al., 2017), pharmaceuticals (Korf et al., 2017) and medical informatics (Jia et al., 2018).

To broadly understand how mangrove research priorities may have changed from 2000 to 2019, we first categorized the session themes for each MMM conference. 39 individual session titles from all conferences were iteratively grouped together into common themes. We then conducted a keyword analysis of all peer-reviewed oral presentation and poster abstracts accepted and included in the programme for all five MMM conferences. The titles and abstracts of all oral and poster presentations were extracted and compiled into a single database, separated by MMM conference. All extraneous information such as affiliations and session titles were removed. Each dataset was analysed using an online text analyser that calculated keyword density. The analysis discounted connecting words (such as 'and', 'or', 'the' etc) and other common words such as 'mangrove'. Since the analysis was interested in research themes, geographical words (such as countries and site names) were also not included in the analysis. Similar and pluralized words e.g., 'ecosystem' and 'ecosystems' were amalgamated into one word. The analysis was performed twice, firstly on the presentation titles, and secondly on the presentation titles and abstract text combined.

3.2. Key research trends identified from the MMM series

The session themes across all five MMM conferences can be grouped into ten broad themes (Fig. 1): macrobenthos and other fauna (25% of all MMM sessions); rehabilitation & management (12.5%); habitat, diversity and distribution (10.4%); biogeochemistry (8.3%); climate change (8.3%); loss and degradation (8.3%); plant and community ecology (8.3%); socio-ecology and ecosystem services (8.3%); blue carbon (6.3%); and genetics and connectivity (6.3%). Fig. 1 also shows that the proportion of these ten themes represented in each MMM conference has changed through time. Macrobenthos was the primary focus of MMM1, and while it was still a topic at all MMM conferences, its relative importance has decreased. Instead, a greater focus on flora has emerged from MMM3 onwards. Biogeochemistry presentations were incorporated from MMM2 onwards, but by MMM3 a subset of these presentations – "blue carbon" – has emerged as their own theme within the MMM conferences. Climate change was not discussed as an explicit

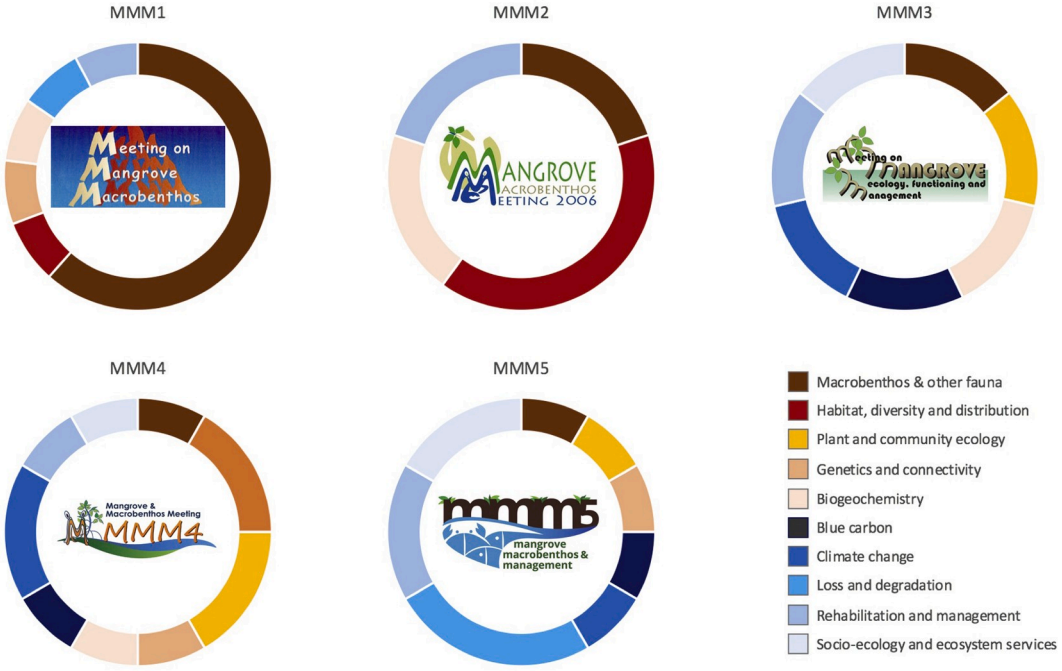

Fig. 1. *Change in dominant conference themes through time, from small-scale or ecological themes (brown) to larger scale themes related to global change and management (blue).* (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

session theme in MMM1 or MMM2. Genetics and connectivity have been presented at all MMM conferences, but by MMM4 onwards a critical mass of studies had emerged to enable their own session. All MMM conferences have held sessions on mangrove management and rehabilitation, though an explicit focus on drivers of mangrove deforestation and degradation in the session title has only emerged at MMM5.

An analysis of keywords used in the titles and abstracts of accepted MMM presentations allows us to define the broad topics of interest that were presented at each conference (Table 2). While each conference has a set theme, conference themes from MMM3 onwards were intentionally broad and abstracts on all aspects of mangroves were accepted. Keywords related to fauna, particularly macrobenthos, were prevalent in the titles and abstracts of research presented at MMM1 and MMM2, though seemed to decline in prevalence in subsequent conferences. From MMM2 onwards, larger scale concepts such as "climate", "ecosystem" and "estuary" appear more prevalent and important. Carbon is first mentioned in the titles and abstracts presented at MMM2, but increase rapidly in importance in MMM3 and MMM4. By 2019 (MMM5), carbon is the second most prevalent word used in both presentation titles and abstracts. Concepts relating to mangrove management and conservation are lower in prevalence during MMM1, though are more commonly discussed in subsequent conferences.

Taken together, these analyses suggest some broad shifts in the research focus of MMM participants in the 19 years between MMM1 and MMM5. A focus of MMM on macrobenthos is not surprising given the history of the series as a meeting place for macrobenthos researchers interested in mangrove habitats. While presentations on macrobenthos were still presented at all subsequent MMM conferences, this analysis suggests a broader shift in research topics presented, and their scale. This was in part an intentional broadening of the research suitable for inclusion at MMM; for MMM3 the conference name changed from *Mangrove Macrobenthos Meeting* to *Meeting* on *Mangrove ecology, functioning and Management*; a switch that has been supported by subsequent meetings (e.g., MMM5 = *Mangrove, Macrobenthos* and *Management*). A number of presentations at MMM4 also had marsh as a keyword, reflecting the conference location at the latitudinal limit of mangroves, where they are expanding northwards into saltmarsh-dominated areas

Table 2
Results of keyword analysis conducted on available MMM presentation and poster titles and abstracts.

Conference	Top 20 keywords in titles (ordered by frequency)	Top 20 keywords in titles and abstracts (ordered by frequency)
MMM1	crab; shrimp; tropical; distribution; juvenile; ecological; estuary; fauna; *Penaeus*; recruitment; *Rhizophora*; clam; ecosystem; habitat; management; pattern; prawn; reserve; *Scylla*; structure	*Abstract book unavailable*
MMM2	crab; dynamics; forests; ecosystem; macrobenthos; sediment; spatial; carbon; estuary; prawn; *Ucides*; benthic; coastal; colonization; degradation; diversity; intertidal; isotope; organic matter; tropical	crab; species; leaves; litter; sediment; habitat; ecosystem; feeding; carbon; food; management; organic; prawn; consumption; intertidal; benthic; distribution; fish; tidal; stable isotope
MMM3	forest; species; structure; crab; coast; change; estuary; climate; distribution; management; vegetation; *Avicennia;* ecosystem; *Rhizophora;* coastal; diversity; environmental; pattern; remote sensing; density	species; forest; coastal; ecosystem; tree; *Avicennia;* vegetation; water; carbon; distribution; *Rhizophora;* climate; sea; structure; data; density; management; ecological; local; environmental
MMM4	carbon; ecosystem; marsh; restoration; species; dynamics; *Avicennia;* community; impacts; assessment; crab; *Rhizophora;* structure; distribution; expansion; growth; sea level rise; climate change; vegetation; biomass	species; forest; coastal; ecosystem; carbon; habitat; soil; marsh; sediment; sea; structure; vegetation; climate; growth; restoration; tidal; data; water; distribution; elevation
MMM5	forest; carbon; ecosystem; species; management; conservation; *Avicennia;* crab; *Rhizophora;* restoration; community; global; soil; structure; assessment; dynamics; ecological; pattern; root; spatial	coastal; carbon; species; ecosystem; forest; change; management; data; conservation; sediment; soil; ecosystem services; water; area; local; communities; climate; global; sea; ecological

Table 3
Summary of keynote presentations delivered at the MMM conferences, and their themes. Note that MMM1 did not have keynote presentations.

Keynote presentation	Presenter	General theme(s)
MMM2		
Managing mangroves with benthic biodiversity in mind	Aaron Ellison, Harvard University	Macrobenthos, management
Resource utilization patterns of mangrove-associated fauna in different geomorphological settings and across various spatial scales: clues from stable isotope studies	Steven Bouillon, Vrije Universiteit Brussel	Macrobenthos
Mangrove crabs as potential ecosystem engineers; with emphasis on sediment processes	Erik Kristensen, University of Southern Denmark	Macrobenthos, geomorphology
Mangrove macrobenthos: assemblages, services and linkages	Shing Yip Lee, Griffith University	Macrobenthos, ecosystem function
MMM3		
Functions of macrobenthos in mangrove forests: >20 years of research lessons	Stefano Cannicci, University of Florence	Macrobenthos
Ecological functioning of mangroves under changing climatic conditions	Karen McKee, US Geological Survey	Ecosystem function, climate change
A lifetime of mangrove research, management and advocacy	Jurgenne Primavera, SEAFDEC	Management
MMM4		
Deserving of a better fate: mangroves and sea level rise	Catherine Lovelock, University of Queensland	Climate change
Using ecogeomorphology models to scale global estimates of biomass, productivity and carbon dynamics in mangrove ecosystems	Robert Twilley, Louisiana State University	Blue carbon
MMM5		
Lessons in mangrove rehabilitation in the Philippines over the decades	Jurgenne Primavera, ZSL Philippines	Rehabilitation
A world without functional mangroves?	Shing Yip Lee, Chinese University of Hong Kong	Ecosystem function, degradation
Mangroves, people and sea level rise: the past as a guide to the future	Kerrylee Rogers, University of Wollongong	Climate change

over time (Cavanaugh et al., 2019).

Carbon was a well-studied field in mangrove research even before MMM1 (Ong, 1993; Jennerjahn and Ittekkot, 2002; Bouillon et al., 2008). The potential export of large percentages of mangrove production to be processed by microbial enrichment, then utilized by offshore consumers was a central paradigm in mangrove ecology in the mid 20th century (Odum and Heald, 1972; Lee, 1995). This was evidenced by an early focus in Southwest Florida on understanding the role of basin mangroves on coastal carbon cycling (Twilley, 1985; Twilley et al., 1992). Carbon was discussed during MMM1 and MMM2 within the context of biogeochemical and nutrient cycling. However, the number of presentations specifically on carbon increased rapidly from MMM3 (2012) onwards. Presentations also shifted from a biogeochemical focus to broader aspects of carbon, including stock assessments and greenhouse gas emissions. The timing of this change in presentation focus coincides with key publications that began to frame mangrove carbon within the broader "blue carbon" concept, referring to the efficiency with which coastal ecosystems such as mangroves, saltmarshes and seagrasses store organic carbon (Macreadie et al., 2019) compared to terrestrial vegetated ecosystems. Blue carbon was introduced as a concept in 2009 (Lovelock and Duarte, 2019), and was supported by key articles that publicized the concept to academic audiences (Mcleod et al., 2011), highlighted the importance of mangroves for blue carbon (Donato et al., 2011), and roughly estimated the contribution of blue carbon habitat loss to climate change emissions (Pendleton et al., 2012). By 2012, MMM participants had quickly grasped the importance of the emerging blue carbon concept, and aligned their presented research accordingly. The proportion of presentations dedicated to blue carbon has continued to increase through successive MMM conferences. After a decade, blue carbon research now stands at a crossroads and requires a strong scientific framework (Macreadie et al., 2019); the MMM conferences suggest that mangrove researchers are increasingly well positioned to contribute to future debates in blue carbon science.

Ecosystem services, or the benefits that mangroves provide to human populations, has also been a theme that has increased in prominence since MMM1. This anthropocentric concept was most explicitly incorporated into the theme of '*Mangroves and People*' for MMM5, explaining its popularity in abstracts submitted to that conference. But the ecosystem services concept has shaped the MMM conference series since at least 2012, being the focus of a key synthesis paper from MMM3 (Lee et al., 2014). The increase in ecosystem services research presented in later MMM conferences mirrors the almost exponential increase in popularity of the ecosystem services concept in environmental research more broadly (Milcu et al., 2013; McDonough et al., 2017).

The scope of research presented at the MMM conferences has broadened from descriptive and fundamental macrobenthos research to larger scale relational research on ecosystem processes, including impacts and responses, and policy relevant research around management or socioecological systems. These conclusions are also reflected in the keynote presentations given at the MMM conferences; all four keynote presentations at MMM2 concerned aspects of macrobenthos, while keynote presentations at later MMM conferences largely represented broader topics related to climate change (particularly sea-level rise), management and rehabilitation (Table 3). Keynote presentations are aimed at representing either the current status or future needs of the research field, so are themselves an interesting tool to understand what the conference organizing and scientific committees consider are the key aspects of a research field.

The transition from natural history and species biology/ecology to larger scale global change research exemplified by the MMM series matches trends in ecology and conservation biology more broadly (Mace, 2014). An analysis of almost 85 000 ecological research articles published since 1980 showed a clear trend towards macro-scale research focused on climate change, population genetics and anthropogenic impacts (McCallen et al., 2019). Similarly, analyses of journal papers and conference proceedings suggest that the limnology research field is also moving to larger-scale themes related to global change (Lewis, 2005; Lapierre et al., 2020).

4. Conclusions

Academic and applied research has contributed to understanding the importance of the mangrove ecosystem, and learning how to manage and restore them in the face of multiple natural and anthropogenic

threats. The Mangrove Macrobenthos & Management conference series has provided an important platform for research to be communicated within the research community, and between researchers, NGOs and practitioners. As the largest and longest running conference dedicated to the mangrove ecosystem, MMM has also provided a unique opportunity to show how research priorities in the field have changed through time. Mirroring broader trends in ecology, MMM now showcases a wide range of geographical, biological and ecological research, compared to its beginnings as a conference predominantly dedicated to promoting research on macrobenthos. However, knowledge gaps remain; some are gaps in research areas that may be underrepresented at the MMM conferences but presented at other venues (e.g., pharmaceutical research derived from mangrove organisms), and other strands of research may need a further extension of the research field trajectory, such as a stronger consideration of connectivity between mangroves and adjacent coastal and terrestrial ecosystems. Understanding how and why research trends change through time is important in order for us to understand the foundations of our field, its evolution through time, and to predict such emerging trends in the future. As the largest international conference series dedicated solely to the mangrove ecosystem, future MMM conferences are well positioned to influence future research trends and provide the robust scientific basis needed for future local and global mangrove conservation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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