

Criteria for Evaluating the Design of Implementation Models for Integrated Coastal Management

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Despite the emphasis placed on the contextual nature of integrated coastal management (ICM) implementation in the literature, many uniformities are encountered in ICM implementation worldwide. In this article the tangled threads of ICM practice are unravelled and a theoretically founded set of criteria for evaluating the design of ICM implementation models is provided. First, paradigms in integrated environmental management (IEM) implementation, the broader domain within which ICM practice is nested, are characterized in terms of their key concepts. Next, the paradigms are used as a mechanism to distill uniformities in ICM practice as reported in review articles. Finally a set of fourteen building blocks against which the scientific credibility of contextual, country-specific ICM implementation models can be validated, is generated by translating the theory-based characterization into evaluation criteria readily accessible to practitioners.

Keywords environmental governance, ICM practice, integrated environmental management, management approach, manifestation in practice, paradigms, uniformities

Introduction

Integrated coastal management (ICM) can be viewed as “a simple and common sense approach to use, protect and conserve oceans and coastal waters” (DFO 2002, 9). This understanding of ICM differs substantially from coastal zone management (CZM) as it was first conceived in the early 1970s and later consolidated in the Coastal Zone Management Act passed in the USA in 1972 (Cummins, Mahon, and Connolly 2002; Tobey and Vlok 2002). In the 1980s, the term “integrated” was added when it became clear that effective management of coastal areas requires an inter-sectoral approach taking account of all of

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the sectoral activities that affect the coast and its resources and dealing with economic and social issues as well as environmental (ecological) concerns (Post and Lundin 1996). Today, the ICM approach aims to balance development and conservation, ensure multi-sectoral planning, and to facilitate participation and conflict mediation (Christie 2005).

Over the past two decades, many review articles on ICM highlight the key lessons learned, contributing to a wide body of knowledge on ICM implementation and a deep understanding of the variation and diversity in ICM practice worldwide (e.g., Sørensen 1993; Cicin-Sain and Knecht 1998; Olsen, Tobey, and Kerr 1997; Olsen 1998; Olsen, Lowry, and Tobey 1999; Olsen and Christie 2000; Lowry, Olsen, and Tobey 1999; Tobey and Vlok 2002; Stojanovic, Ballinger, and Lalwani 2004; Christie 2005; Christie et al. 2005; Shipman and Stojanovic 2007; Yao 2008). The majority of articles documenting the evolution of, and learning from, the ICM experience emphasize the contextual nature of ICM implementation and the importance of considering country-specific knowledge (e.g., Cicin-Sain and Knecht, 1998; Olsen, Tobey, and Kerr 1997; UNEP/GPA 2006). Indeed, the extensive literature on implementation frameworks and models for ICM (Pernetta and Elder 1993; GESAMP 1996; Post and Lundin 1996; Olsen, Tobey, and Kerr 1997; Cicin-Sain and Knecht 1998; European Commission 2002; DFO 2002; NRMCM 2006; UNEP/GPA 2006) reveals there is no international, generic blueprint that can be applied routinely to yield predictable and desirable outcomes. The Global Programme of Action to protect the marine environment from land-based activities (GPA) even states that “As needs and priorities vary greatly between countries, action has to be tailor-made” (UNEP/GPA 2006, i). However, in a review of ICM successes Stojanovic, Ballinger, and Lalwani (2004, 274) observe that “. . . it is interesting to note that a common goal behind these post-modern approaches to research is a desire to acknowledge that applications of ICM vary around the world with the variety of situations in which they are applied. Whilst this is an important point, it may be said that this is merely emphasising differences, as opposed to *uniformities* [own emphasis] that are found.” In this article, we depart from the usual practice-based assessment of ICM implementation and focus instead on a theoretically based identification of the uniformities or common elements underpinning ICM implementation.

We demonstrate that by examining the theoretical roots of ICM practice, the overwhelming complexity can be resolved into a set of criteria against which the scientific credibility of contextual, country-specific ICM implementation models may be validated. Whereas much of the ICM literature focuses on learning-by-doing, we choose to focus on distilling theory-based building blocks for constructing and evaluating ICM implementation models. We identify fourteen practically recognizable criteria for evaluating the design of ICM implementation models. In this, we go beyond the work of Stojanovic, Ballinger, and Lalwani (2004) who determined nine factors important for successful ICM on the basis of a grounded theoretical assessment, yet did not connect the factors to easily recognizable elements of ICM practice. By expressing our suite of theory-based criteria in terms of their manifestation in practice we seek to make the findings accessible to, and applicable for, ICM practitioners worldwide and so to contribute to enhancing the rooting of ICM design and implementation in theory.

Approach and Methods

Stojanovic, Ballinger, and Lalwani (2004) suggest that despite the highly contextual nature of ICM implementation there are uniformities that contribute to effective implementation worldwide. Following Stojanovic, Ballinger, and Lalwani (2004) we adopt a stance of

critical realism (Sayer 2000), and use paradigms as the frames to distill the uniformities. The analysis is undertaken in three steps. First, we cast the net widely to discover the theoretical paradigms that underpin the implementation of integrated environmental management (IEM), the broader domain encasing ICM. One can justify this initial, broad selection by understanding that the coastal marine environment is a component of the environment in general so that the generic paradigms applicable to IEM are also applicable to ICM, although some of these may not have been fully incorporated in ICM practice. We base our decision to use paradigms as the frames to distill the uniformities on Frantzeskaki et al. (2010), who distinguish paradigms as the underlying determinants of environmental management approaches. Next, the theoretical bases of the ten paradigms identified as underpinning IEM are explored by discussing the key concepts of each paradigm and then carefully identifying the characteristics by which they manifest in practice.

Second, the characteristics distilled from the paradigms are used to label uniformities in ICM implementation manifested over the past two decades. The literature on ICM is extensive and a selection of review articles, spanning the period from the early 1990s to the late 2000s (Sørensen 1993; Cicin-Sain and Knecht 1998; Olsen, Tobey, and Kerr 1997; Olsen 1998; Olsen, Lowry, and Tobey 1999; Olsen and Christie 2000; Lowry, Olsen, and Tobey 1999; Tobey and Vlok 2002; Stojanovic, Ballinger, and Lalwani 2004; Christie 2005; Christie et al. 2005; Yao 2008) form the secondary data considered appropriate to assess the evolution and learning from the ICM experience and to identify the uniformities encountered in practice. The articles reviewed are by no means exhaustive, but are considered to represent significant contributions which highlight the lessons learned over the past few decades. Additionally, the information on the future challenges to ICM practice, derived from the secondary data complemented by literature sources such as Weinstein et al. (2007), Crowder and Norse (2008), Norse (2008), and Foley et al. (2010), is used to specify possible new uniformities.

Third, after establishing that the paradigms underlying IEM do indeed underpin ICM practice in the second step of the analysis, we return to the characteristics of the paradigms and derive a common set of fourteen characteristics which we view as the building blocks of the uniformities in IEM and ICM implementation. Each of the fourteen characteristics is then translated into a clear statement or criterion for evaluating the design of ICM implementation models. In this way, the tangled threads of ICM practice are unravelled to expose its theoretical roots and the characteristics of these roots are used to construct criteria against which the scientific credibility of contextual, country-specific ICM implementation models can be validated.

Finally, the contribution of the research to ICM implementation is discussed and the potential to complement the strong theory-based environmental management perspective of this analysis by contributions deriving from the theory of fields such as economics, education, and public administration, is indicated.

Key Paradigms in Integrated Environmental Management

The ten key paradigms considered to inform IEM implementation are depicted in Figure 1. The theoretical bases of the ten paradigms are explored by discussing the key concepts of each paradigm and then distilling the characteristics of the paradigms (*italicized*) as they manifest in practice.

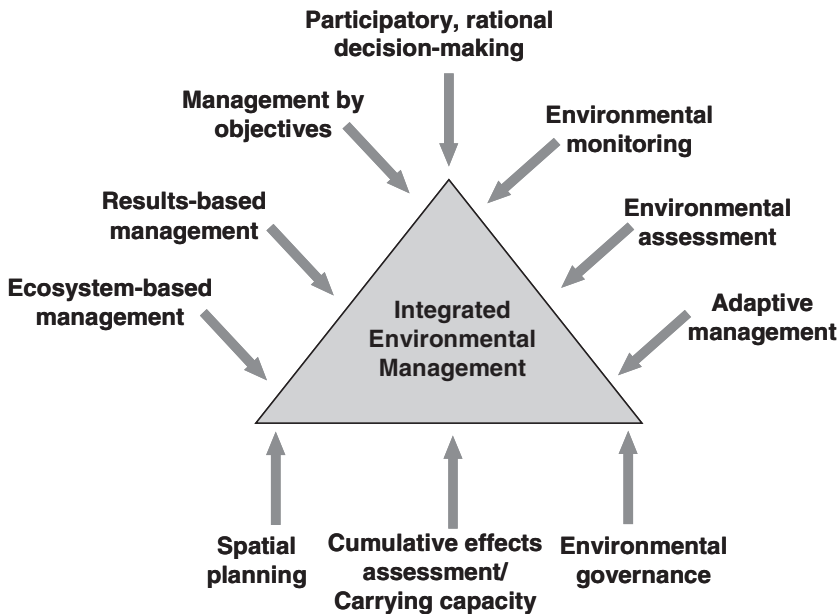


Figure 1. The ten key paradigms considered to inform IEM implementation.

Participatory, Rational Decision-Making

Participatory, rational decision-making evolved from the field of economics (Simon 1955). “Traditional economic theory postulates an ‘economic’ being who in the course of being ‘economic’ is also ‘rational’” (Simon 1955, 99). However, over the years it has become evident that the theory of rational-economic behavior is not fully applicable to individual decision-making, as no decision maker can know all alternatives or consequences, nor are preferences stable. Responding to this realisation, Simon (1955) introduced an “administrative” being, and the concepts of “bounded rationality” and “satisfice” (Simon 1957; 1991). The concepts of rational decision-making are challenged even more at the complex multi-actor level (March 1991; Kjørnøy and Thissen 2000). Multi-actor complexity exists both within a group of actors and within individual actors (i.e., intertwined with individual decision-making) and stems from the divergent interests among actors on the one hand and their divergent perceptions of reality on the other hand (Van de Riet 2003). Within complex multi-actor settings, such as environmental management, three cornerstones for realizing participatory, rational decision-making emerged. These comprise (i) *valid scientific knowledge* that is *relevant* to the policy or decision-making debate, (ii) *appropriate process management* in which actors agree to abide to a process so as to achieve the “most rational” decision-making outcomes, and (iv) *stable, participatory actor involvement*, which recognizes the different types of roles and contributions (Miser and Quade 1985; Van de Riet 2003; Kjørnøy and Thissen 2000; Agre and Leshner 2010).

Some of these characteristics may be shared by other paradigms in IEM and are not unique to the participatory, rational decision-making paradigm as will become apparent in Table 1 and in the discussion of the following sections.

Table 1
 Characteristics of the key paradigms underpinning Integrated Environmental Management (IEM)

Characteristic	Paradigm								
	Participatory, rational decision-making	Environmental monitoring	Environmental assessment	Objectives-based management	Results-based management	Ecosystem-based management	Adaptive management	Cumulative effects assessment and carrying capacity	Spatial planning
Participatory, actor involvement	●		●	●	●	●			●
Valid and relevant scientific knowledge	●		●						●
Proper process management	●		●	●					
Cooperative institutional structures across tiers of government and sectors with clearly defined roles and responsibilities	●					●			●
Established compliance and results-based objectives, indicators, and targets		●		●					
Monitoring and evaluation programs measuring against predetermined objectives, indicators, and targets		●			●		●		
Resource objectives set within the social-ecological system			●	●	●	●		●	
Geographical delineation of ecosystem management units and zoning of use areas						●		●	
Environmental management recognized as an iterative, adaptive process (learning-by-doing)							●		●

Acknowledgment of ecosystem limitation
to support ecological, social and
economic goods and services (e.g.,
carrying capacity and cumulative effects)
An enabling legal framework
The development of education and
awareness programs
The development of capacity building
programs
Sound funding structures (financial
support) for long-term sustainability

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Environmental Monitoring

The practice of monitoring dates back more than 5,000 years to the Egyptians who regularly monitored the grain and livestock production in their country (Kusek and Rist 2004). Closely associated with, yet distinct from, monitoring is evaluation, which comprises the systematic and objective assessment of a project, program, or policy (Görgens and Kusek 2009). Environmental monitoring and evaluation comprises the three generic functions of (i) *descriptive monitoring*, aimed at gaining improved scientific knowledge and understanding of environmental systems, (ii) *regulatory monitoring*, aimed at testing compliance against objectives as well as the effectiveness of policies and associated actions, and (iii) *results-based monitoring and evaluation*, aimed at evaluating the impact of projects, program, and policies against predetermined objectives (Harvey 1984; Kusek and Rist 2004).

Results-based monitoring and evaluation differs from traditional implementation-focused monitoring (i.e., descriptive and regulatory monitoring only) in that the former moves beyond an emphasis on inputs and outputs to an emphasis on outcomes and impacts (Linkov et al. 2006). The characteristics of the environmental monitoring paradigm, therefore, echo the importance of valid scientific knowledge already encountered in the participatory, rational decision-making paradigm, yet go further in specifying the type of knowledge considered relevant and valid in the environmental monitoring paradigm (Table 1).

Environmental Assessment

Although rooted in rational planning theory developed in the 1950s, specific requirements for environmental assessment (EA) were first formulated in terms of the National Environmental Policy Act in the United States in 1969 (Jay et al. 2007). Typically, EA is undertaken at two levels (Fisher 2002), namely the individual project level, referred to as Environmental Impact Assessment (EIA) and the plans, program or policy level referred to as Strategic Environmental Assessment (SEA). SEA is referred to as the “big brother” of EIA and has been applied in many countries worldwide (Fisher 2002). It does not constitute a substitute for traditional EIA project tools, but rather is complementary to these (OECD 2006).

In essence, EIA is a systematic process for considering potential impacts and the environmental consequences of a proposed project (or action) before the decision-making (Jay et al. 2007). The primary purpose of this *anticipatory, participatory environmental management* tool is to supply decision makers with an indication of the likely environmental consequences of their actions, with the idea that this will support environmentally sound development (Fisher 2002; Jay et al. 2007). SEA is defined as a range of analytical and participatory approaches that aim to *integrate environmental considerations* into policies, plans and programs and evaluate the inter-linkages *with economic and social considerations* (Partidário 1996). However, the theoretical foundations for SEA are still under development and there is no consensus yet (Herrera 2007; Bina 2007; Wallington, Bina, and Thissen 2007; Partidário 2008).

The environmental assessment paradigm views actor participation, appropriate process management (requirement for anticipatory management) and sound scientific knowledge as essential to environmental assessment. In this, the environmental assessment paradigm concurs with characteristics of the participatory, rational decision-making paradigm. Additionally, the environmental assessment paradigm explicitly addresses the strategic level (e.g., plans, policies, and programs) in addition to the local, project level (Table 1).

Objectives-Based Management

Objectives-based management or management by objectives (MBO) was first outlined in a monologue by Drucker (1954). The core concepts, according to Drucker, are to avoid the “activity trap” of getting so involved in day to day activities that their main purpose or objective is forgotten. Also, instead of just the top-managers, *all managers should participate* in the strategic planning process, in order to improve the implementability of a plan. The concept of MBO was introduced to environmental management with the aim of *integrating ecological concerns with national political structures and governance processes*. Politicians (or stakeholders) can determine *environmental objectives* to be implemented and assessed by civil servants in national, regional, and local contexts (Edvardsson 2004; Wibeck et al. 2006). Management strategies (or programs) are then developed in order to reach such objectives. For each of the above, outcome indicators (with associated target values) are required, providing *a quantitative measure to assess the degree to which objectives have been met* or will be met for a specific plan, program, or policy (Walmsley et al. 2007).

In objectives-based management the importance of participatory actor involvement comes to the fore, as in the participatory, rational decision-making and the environmental assessment paradigms discussed previously. The testing of compliance against indicators, or results-based monitoring, emerges as a characteristic that is shared with the environmental monitoring paradigm (Table 1). The objectives-based management paradigm, however, emphasizes the importance of setting objectives holistically for the environment (i.e., incorporating the biophysical environment, the social and the economic environment).

Results-Based Management

Results-based management (RBM) is a management approach introduced by development cooperation agencies in the 1990s (Binnendijk 2000), succeeding impact assessment approaches such as environmental impact assessment (EIA), social impact assessment and economic assessments. It was introduced to enable assessment of the environmental, social, and economic consequences of development projects before they commenced (Roche 1999). In essence RBM focuses on achieving results (Ortiz et al. 2004) and requires appropriate *process management*, specifically at the level for which quantitative data for evaluation are required. Embedded in the RBM approach is *results-based monitoring* (Kusek and Rist 2004). RBM approaches are essentially focused, inwardly orientated approaches best suited to evaluating lower-level projects where clear outputs can be achieved within a specific time span and where quantitative data for evaluation are more readily available (Crawford 2003; Bakewell and Garbutt 2005; Dearden and Kowalski 2003; Muspratt-Williams 2009). Appropriate *monitoring and evaluation* of progress toward the achievement of the *pre-determined objectives measured in terms of pre-selected indicators and targets* is central to the RBM approach (Binnendijk 2000). The approach is, however, less suited to tracking performance at higher levels, such as within programs and policies (Crawford 2003).

The results-based management paradigm combines characteristics from other paradigms to create a focused, outcomes-based approach for management at project and program levels. As do most of the preceding paradigms, this paradigm supports participatory actor involvement and appropriate process management (Table 1). Further, the paradigm reflects characteristics encountered in the objectives-based management paradigm (objective setting and results-based monitoring) and the environmental monitoring paradigm

(results-based monitoring). Indeed, Dearden and Kowalski (2003) and Bakewell and Garbutt (2005) view the results-based management paradigm as stemming from the objectives-based management paradigm.

Ecosystem-Based Management

Traditionally, management of natural resources and the environment is organized around specific uses or sectors such as fisheries, agriculture, water supply and demand, wastewater and housing development, each with their own governing structures (UNEP 2006). However, experience has shown that an exclusively sectoral approach not only results in conflict among different uses, but also in the ineffective and inappropriate use of valuable, and often limited, human and financial resources. This led ecosystem thinkers (e.g., Costanza 1998; Pretty and Ward 2001) to place the ecosystem centrally in management approaches and ultimately to the realisation that natural resources and the environment can be managed much more effectively if the *ecosystem becomes central and management occurs through cooperative governance between different sectors*—referred to as ecosystem-based management (UNEP 2006). Enhanced interaction between science and society is supported by moving from a centralized, top-down approach to governance to a decentralized regional and local approach to *resource management in which multiple stakeholder groups are involved*. In essence, ecosystem-based management recognizes that plants, animals, and human communities are interdependent and interact within a particular physical environment forming *distinct spatial units* referred to as ecosystems (UNEP 2006). This approach recognizes humans and development as an integral part of an ecosystem and requires development within the ecosystem to be sustainable (United Nations 1987; Balchand, Mooleparambil, and Reghunathan 2007). In order to be sustainable, human interaction (development) should be economically profitable, environmentally sound, and socially acceptable. These three considerations are presented as the vertexes of the “sustainability triangle” enclosing well-being (Moomaw 1996).

The ecosystem-based management paradigm supports participatory actor involvement. Similar to the participatory, rational decision-making paradigm it requires the establishment of multi-sector, cooperative governance systems (Table 1). While the characteristics of the environmental assessment paradigm and the objective-based management paradigm do alert to the importance of managing the environment in its entirety, namely the biophysical environment and the social and economic dimensions, this characteristic comes to the fore particularly in the ecosystem-based management paradigm. Further, in this paradigm the demarcation of the spatial boundaries of the environmental management units are regarded as important.

Adaptive Management

The concept of adaptive management dates from the early 1900s when ideas of scientific management were being pioneered (Haber 1964; Bornmann et al. 1999). In complex and dynamic environmental systems it is important to be realistic about the limitations of (predictive) environmental assessments, typically undertaken prior to action. Herein lies the value of adaptive management that “builds on learning—based on common sense, experience, experimenting, and monitoring—by adjusting practices based on what was learned” Bornmann et al. (1999, 506). Adaptive management focuses on accelerating learning and adapting by finding common ground where actors learn together to create and maintain sustainable ecosystems to support human needs indefinitely (Bornmann et al.

1999). Adaptive management adjusts for system changes, bifurcation, and the unexpected (Noble 2000). Central to the adaptive management paradigm are sound *monitoring and evaluation* programs to support learning and adaptation (Bornmann et al. 1999).

The adaptive management paradigm shares characteristics with the environmental monitoring paradigm (Table 1). However, the adaptive management paradigm goes further and introduces the use of iterative, adaptive approaches as a requirement in managing complex systems.

Cumulative Effects Assessment and Carrying Capacity

Cumulative effects assessment (CEA) is an “integral part of environmental assessment at both the project and the more strategic level” (Therivel and Ross 2007, 365). Important in the management of cumulative effects is the *selection of appropriate scales (e.g. spatial extent, temporal scale, and level of detail)*. If the scales selected for a CEA are inclusive, they enhance the ability to manage incremental (cumulative) effects of activities of which the effects may be insignificant at the individual scale (Therivel and Ross 2007).

Critical to understanding cumulative effects is the concept of carrying capacity. McLusky and Elliott (2004) and Elliott et al. (2007) underline the relevance of the concept in clarifying the capacity of the ecosystem to support both environmental and societal demands. “Carrying capacity” acknowledges the need to consider *cumulative effects* and use changes in ecosystem services (whether measured by function or value) in evaluating the consequences and tradeoffs, thereby acknowledging the *limitations* of the ecosystem to sustainably support different goods and services. Significant challenges remain in understanding the specifics of how different combinations of activities interact cumulatively and where nonlinearities in how activities affect ecosystems exist, but nevertheless these must be taken into account by management processes (Halpern et al. 2008). Ban, Alidina, and Ardron (2010) demonstrate that mapping techniques can be applied for a realistic consideration of cumulative impacts in the environment, effectively combining the paradigms of cumulative effects assessment and spatial planning.

Despite being viewed by some as integral to the environmental assessment paradigm, we view the cumulative effects assessment and carrying capacity paradigm as distinctive because it specifically addresses ecosystem limitations. Additionally, it emphasizes the importance of considering spatial scales, a characteristic shared by the ecosystem-based management approach (Table 1).

Spatial Planning

Spatial planning is one of the most common systems of use control in terrestrial environments (Courtney and Wigen 2003) and serves to link traditional land-use planning with economic, social, and environmental development policies, operating at all spatial scales, but focusing on informing development strategies at the regional level (Smith et al. 2011). Inherently spatial planning recognizes that *ecosystems have limits* to the goods and services they can provide (Ban, Alidina, and Ardron 2010). The development of spatial planning systems for the marine environment is in its infancy (Smith et al. 2011), but two emerging concepts, linked to spatial planning in the marine environment are evident, namely: ocean zoning and marine cadastre (Todd 2001; Widodo 2003; Agardy 2010). An ocean zoning plan has two components: (i) a *map* that depicts the zones and (ii) a *set of regulations or standards* applicable to each type of zone. There are a number of examples of marine types of zones, such as the demarcation of ship channels, disposal areas, military security zones,

concession zones for mineral extraction, aquaculture sites, and most recently marine protected areas (Courtney and Wiggen 2003; Douvère 2008). For some zones, the regulations might be very protective of marine resources or habitats only allowing few compatible uses, and excluding any use that would undermine the goal of resource protection. In other zones where resource protection is less of a priority, more intensive use might be allowed, presumably based on the suitability of the area for such uses (Courtney and Wiggen 2003; Agardy 2010). Ocean zoning is by nature also cross-sectoral because its purpose is to allow activities within a zone that are compatible, making good economic sense (Norse 2008). Furthermore, zoning makes economic sense by providing an explicit approach to resolving conflicts and determining tradeoffs (Halpern et al. 2008).

Spatial planning within the coastal marine environment is also echoed in marine cadastre-based planning (Rajabifard, Collier, and Williamson 2003; Ng'ang'a et al. 2003; Binns et al. 2004). In essence, the *marine cadastre provides a means for delineating, managing and administering legally definable boundaries* in the marine environment (Rajabifard, Collier, and Williamson 2003; Ng'ang'a et al. 2003; Binns et al. 2004).

Similarly to the cumulative effects assessment and carrying capacity paradigm, the spatial planning paradigm acknowledges the importance of spatial scales in ecosystem limitation. However, the spatial planning paradigm goes further in requiring the setting of specific objectives for the different spatial units, a characteristic that it shares with the objectives-based management paradigm (Table 1).

Cooperative Environmental Governance

Although environmental law arose from shifts in societal thinking in the 1960s (Plater 1994), it was the establishment of enabling environmental legal frameworks that created a consistent body of case law that recognized the broad legitimacy of environmental protection. In the 1990s, the emerging environmental agenda engendered a growing awareness of the need to create social institutions to facilitate sustainable human–environment interaction, through the concept of (cooperative) environmental governance (Young 1997). The key elements of environmental governance institutions are (i) the structural and sectoral tiers, (ii) the governance functions and their organization, and (iii) the formulation of key institutional rules according to which systems operate (Paavola 2006; Hague and Harrop 2007; Biermann and Pattberg 2008). First, the *hierarchical structure of governance* ranges from the international level to the local level and constitutes the structural tier in environmental governance institutions, whereas the *sectors or sector-specific actor groups* (e.g., fisheries, water, waste management, and mining) constitute the sectoral tier in environmental governance institutions (Hague and Harrop 2007; Biermann and Pattberg 2008). For example, an institution that operates across sectors, but at a single hierarchical level is termed a cross-sectoral institution. Alternatively, an institution that operates within a sector, but across several hierarchical levels is termed a multi-level institution. Second, in cooperative environmental governance, there are a number of generic functions. General environmental governance functions include the regulation of authorized resource users and the distribution of benefits, the exclusion of unauthorized users, provisions and the recovery of its costs, monitoring, enforcement, conflict resolution, and collective choice (Ostrom 1990; Agrawal 2002; Paavola 2006). The organization of governance functions occurs in three functional groups, which can both cut across or cohere with the existing structural and sectoral tiers. The three functional groups include (i) the operational level where individuals make decisions within the constraints of operational rules (e.g., constraints imposed by regulations), (ii) the collective choice level, where authorized actors make collective

choices (e.g., deciding on constraints to be included in regulations) based on institutional rules, and (iii) the constitutional level (e.g., decisions related to actors' authority and procedures) based on constitutional rules (Kiser and Ostrom 2000; Paavola 2006). Finally, key institutional rules associated with different functions need to be formulated, including exclusion rules (determining, for example, prohibited activities), entitlement rules (key factors in determining environmental outcomes and the distribution of resource use benefits), monitoring rules (determining what is to be monitored and by whom) and decision-making rules, determining whose interests are recognized, participants in environmental decisions, and the rules and procedures to be followed when making decisions.

A major challenge in cooperative environmental governance is the governing of common-pool resources (Ostrom et al. 1999), which are classically referred to as the commons (Hardin 1968). Coastal marine ecosystems are acknowledged as an example of a common-pool resource (Ostrom et al. 1999). The governance of common environmental resources is *increasingly based on simultaneous, multi-level solutions* (e.g., at the local, national and international levels) which call for *innovative ways to accommodate and deal with institutional diversity*, for example, dealing with traditional national policies based on the enforcement power of the state in conjunction with solutions based on voluntary cooperation (Ostrom 2005; Paavola 2006).

However, the importance of the *social dimension* of environmental governance is stressed by Folke et al. (2005). It often happens that natural scientists first do the science and governments first set their agendas, both parties underestimating the importance of complex social dynamics within social-ecological systems (SESs) such as building trust and managing power relations. The SES incorporates an *adaptive process*, with many long-lived SESs having adapted their institutions to the particular pattern of variability experienced over time as well as to the broader economic, political, and social system in which the systems are located (Janssen, Anderies, and Ostrom 2007). The social dimension of environmental governance comprises four prerequisites, as highlighted by Folke et al. (2005) in their review of this topic. The first prerequisite is that *all sources to build knowledge and understanding* of the resource and ecosystem dynamics are mobilized. Further, *ecological knowledge continuously feeds* into adaptive management practices. The system is characterized by *flexible institutions and multi-level governance* systems and is able to deal with external perturbation, uncertainty and surprise. This means that it is no longer sufficient to be in tune with the dynamics of the ecosystems under management, it is also necessary to develop capacity to deal with changes in climate, governmental policies and other externalities, combining the paradigms of cooperative environmental governance and adaptive management.

Another characteristic of the cooperative environmental governance paradigm is *continuous development of awareness and capacity*, through appropriate education and training programs, spanning local communities and extending to national-level politicians (Chua, Huming, and Chen 1997; Olsen and Christie 2000; Cicin-Sain et al. 2000; Smith 2002; Le Tissier et al. 2004; Barker 2005; Hills et al. 2006). Because training needs to be tailored to match the requirements of the target groups (Hills et al. 2006), capacity development initiatives exhibit extreme diversity as they attempt to address the diverse needs.

Cooperative environmental governance acknowledges the theory of pluralism, which in a general sense is the acknowledgment of diversity or difference (Paavola 2006). Indeed, the idiom of co-production of science and policy supports the notion that science and policy are two distinctly different activities following their own principles, but that they are interlinked and strongly influence one another (Jasanoff 2004; Knol 2010). In fact, there is increasing recognition that sustainable decision-making needs to be based on

sound scientific evidence, anchored in transdisciplinary research and knowledge exchange across the environmental, social and economic scientific disciplines (Von Bodungen and Turner 2001; Stojanovic et al. 2009; Knol 2010). Such scientific knowledge and evidence should, however, be “insulated from the appearance of politics in order to play an effective role in certifying that its findings conform to standards judged acceptable by the scientific community” (Jasanoff 1995, 279). The shift in environmental science toward joint problem-solving, manifested in the call for agreement on a shared vision (and associated objectives) among scientists and other stakeholders, strongly echoes characteristics of paradigms such as the participatory, rational decision-making paradigm and the management by objectives paradigm.

The cooperative environmental governance paradigm supports participatory actor involvement, specifically through the design of multi-level, cross-sectoral institutions (Table 1). Further the paradigm supports an adaptive approach to managing the environment, as does the adaptive management paradigm. The characteristic of valuing relevant scientific knowledge is shared with the participatory, rational decision-making paradigm and the environmental assessment paradigm. However, the cooperative governance paradigm goes further in specifying the requirement of an enabling legal framework and placing the focus on awareness and capacity building and sound funding structures.

Evolution of Integrated Coastal Management

Stojanovic, Ballinger, and Lalwani (2004) suggest that despite the highly contextual nature of ICM implementation there are uniformities that contribute to effective implementation worldwide. The literature on ICM is extensive and a selection of review articles, spanning the period from the early 1990s to the late 2000s form the secondary data considered appropriate to assess the evolution and learning from the ICM experience. We use the theoretical paradigms discussed earlier as the frames to label the uniformities encountered in ICM practice. In order to recognize the paradigms, we compare the findings of different ICM review articles with the listed characteristics distilled for each of the paradigms in the preceding section. Additionally, possible new uniformities are derived from the future challenges to ICM practice as articulated in complimentary secondary data. The analysis is presented chronologically to clarify the cumulative manifestation of the paradigms underpinning IEM implementation within ICM practice over time.

Learning from the ICM Experience

Sørensen (1993) provided an early review of the proliferation of ICM in which he described the achievements and lessons learned. Even at such an early stage of development, ICM clearly reflected characteristics of several key paradigms encountered in IEM. For instance, Sørensen (1993) characterized ICM practice as a dynamic process persisting over time, reflecting elements of the adaptive management paradigm. He identified aspects such as governance arrangements to establish multi-sectoral policies and make allocation decisions, and the use of one or more management strategies to rationalize allocation decisions, which are features of the cooperative environmental governance paradigm. By recognizing the inclusion of the relationships between coastal systems in management strategies as a characteristic achievement of ICM, he foreshadowed the explicit recognition of this aspect in the ecosystem-based management paradigm. Further, Sørensen (1993) implicitly acknowledged the importance of setting a geographic boundary for the coastal system with

seaward and inward limits, but did not deeply explore the implications of adopting the spatial planning paradigm in his review.

In 1998, Cicin-Sain and Knecht reviewed patterns in the ICM programs of twenty-two selected nations, including developed, middle-developing and developing countries. Although it was difficult to find a general model for successful ICM because of the absence of objective evaluative information on the different ICM programs, the authors identified a number of factors underlying the successful implementation of ICM. The emphasis placed on national-level coordination and intergovernmental coordination, knowing the value of the coastal marine environment, building a community-based ICM program and bringing ocean and coastal management together reflect elements of the cooperative environmental governance paradigm. The participatory, rational decision-making paradigm was reflected in the emphasis placed on incorporating traditional (indigenous) management practices and building public involvement in the ICM program. Additionally, the value of long-range planning—including marine spatial planning—in ICM implementation was highlighted. Clearly, public participation and consensus-building, within the institutional dimension, were viewed as critical from the early stages of the ICM process (Cicin-Sain and Knecht 1998).

The work by Olsen and his co-workers in the late 1990s (e.g., Olsen, Tobey, and Kerr 1997; Olsen 1998; Olsen, Lowry, and Tobey 1999; Lowry, Olsen, and Tobey 1999; Olsen and Christie 2000) provided insights into the implementation of ICM projects and programs in the United States (e.g., Rhode Island, as reported in Schwartz 2005) and in developing countries (e.g., Philippines and Sri Lanka; Olsen and Christie 2000). These projects were largely funded by international donors such as the United States Agency for International Development (USAID), the United Nations Development Programme (UNDP), the Global Environmental Facility (GEF), and the Swedish International Development Cooperation Agency (Sida). Drawing on their experience in the application of ICM, Olsen, Lowry, and Tobey (1999) identified key features in the ICM process that make implementation successful and applicable within the contexts of different countries and regions. First, they recognized that coastal management is primarily concerned with the processes of governance and that it is necessary to work at both the national and local levels, with strong linkages between levels. They advocated an open, participatory, and democratic process, with opportunities for all stakeholders to contribute to planning and implementation and the development of programs around issues that have been identified through an inclusive participatory process. Further, they recommended building constituencies that support effective coastal management by informing the public about the long-term implications of the issues being addressed and demonstrating the benefits of improved management. The use of the best available information for planning and decision-making is an essential element in their approach as is the commitment to building national capacity through short- and long-term training, learning-by-doing, and cultivating host country colleagues who can forge long-term partnerships based on shared values. Recognizing that programs undergo cycles of development, implementation and refinement, building on prior successes and adapting and expanding to address new or more complex issues, they advocate completing the loop between planning and implementation as quickly and frequently as possible, using small projects that demonstrate the effectiveness of innovative policies. Finally, they encourage setting specific targets and monitoring and assessing performance. Olsen and his co-workers specifically drew on and emphasized the participatory, rational decision-making paradigm, the adaptive management paradigm, the results-based management paradigm and the cooperative environmental governance paradigm in the ICM process. Additionally, Olsen and his co-workers introduced the assignment of intermediate outcomes of initiatives as a

sequence of achievements leading logically to the ultimate goal (or end outcome) of ICM to accommodate the fact that the time scales in which the ultimate goals are achieved lie beyond the duration of the first generation or first few generations of an ICM program, expanding on the objectives-based management paradigm and emphasized the important role of environmental monitoring as a means of assessing performance against specified outcomes (Olsen, Tobey, and Kerr 1997; Olsen 1998; Olsen 2003; Olsen, Page, and Ochoa 2009).

In their review of ICM early in the 2000s Tobey and Vlok (2002, 288) deemed the progress made in transitioning from the concept of ICM to an operational reality considerable, remarking that “In 1992, ICM was a fledgling discipline that was in an initial phase of discovery. Today, ICM is the accepted organising framework for advancing societies toward long-term goals of sustainable coastal development.” They identified five characteristics as central to effective ICM programs, which they viewed as increasingly well-defined practice. Tobey and Vlok (2002) characterized ICM first as strategic and adaptive, designing and effecting change to reflect the dynamism of the ICM process and its responses to different socioeconomic, political, and cultural conditions. Next ICM was characterized as participatory and deliberative in view of the decentralized governance and mechanisms to accommodate competing interests, multiple institutions, partners, and stakeholders. Further, ICM was characterized as integrative because its success depends on the coordination of efforts and on effective interorganizational linkages for multiple use management. One of the most fundamental tenets underlying the ICM concept is that decision-making is based on the use of the best information and science available, so that the application of science to management forms a further characteristic of ICM. Finally, by recognizing capacity limitations and needs as part of the strategic and adaptive process of ICM, the scope and complexity of planned activities is balanced by a realistic appraisal of capacity, allowing ICM to be characterized as developing capacity. While these characteristics align with the content of paradigms such as environmental assessment, adaptive management, ecosystem-based management, participatory, rational decision-making and cooperative environmental governance, the incorporation of paradigms such as results-based management (e.g., identification of specific issues and problems to focus management effort) and spatial planning (e.g., demarcation of management units) was not evident.

Although by the mid-2000s lessons learned through ICM experience had been documented well, Stojanovic, Ballinger, and Lalwani (2004) observed that theoretical realism (a forerunner of critical realism) was not commonly or rigorously applied in ICM research. Accounts of practice in ICM were often followed by conclusions about what is successful and the lesson learned with little explanation as to how the conclusions were reached or why this is so. Interestingly, the power of human intuition meant that such conclusions were usually quite valid, but Stojanovic and his co-workers insisted that more rigorous research methods could lead to greater confidence, clearer explanations, and prevent fallacious thinking. Drawing from other fields of environmental management, they were able to distill a number of important (common) explanatory factors for, or “uniformities” of, successful ICM. These factors are (i) participatory (i.e., process by which there are opportunities for common contribution and balanced sharing of activities), (ii) long-termist (i.e., recognizes that environmental management needs more than brief views of environmental circumstances to understand and manage links between the human and natural environment), (iii) focused (i.e., driving management toward clearly important or tractable issues so that solutions can be demonstrated), (iv) incremental (i.e., management is an iterative process that proceeds in a step-by-step manner), (v) adaptive (i.e., capacity for environmental management to adjust or alter to become suitable for new situations), (vi) comprehensive

(i.e., taking a sufficiently wide scope and full view of issues), (vii) precautionary (i.e., denoting an approach or activities undertaken in advance to protect against possible danger or failure), (viii) co-operative (i.e., process by which agencies operate together and are coordinated, to one end), and (ix) contingent (i.e., seeking to account for local variations in strategy, environment, or task). As anticipated, the nine factors exhibit many of the characteristics of the major paradigms discussed earlier, because the original theories within which they are rooted and the paradigms themselves were sourced from the same field, namely environmental management. However, these factors do not patently reflect features associated with the spatial planning (e.g., use of zoning as a tool) and ecosystem-based management (e.g., centralization of ecosystems) paradigms, indicating that these factors are still emerging uniformities in ICM. Additionally, in the view of Glavovic (2006), the evaluation of Stojanovic and his co-workers reflected a strong reconciliation of the ecological and economic imperatives in ICM, but is less adequate on social imperatives—the third pillar defining ecosystem-based management.

Toward the mid-2000s, with ICM well-established as an organizing framework for achieving the long-term goals of sustainable coastal development (Tobey and Vlok 2002), attention turned to factors that influence the sustainability of ICM. Christie and co-workers (e.g., Christie 2005; Christie et al. 2005, 469) noted that “A sustainable ICM process is one that supports sustainable coastal resource use beyond the termination of an ICM project. It is adaptive and multi-sectoral as appropriate and is supported by a stable source of financial and technical resources.” Sustainability was recognized as a multifaceted issue with no simple resolution. The establishment of an enabling legal framework delineating rights, responsibilities, and authorities among stakeholders and harmonizing laws from the international, national, to local levels in a complementary not contradictory fashion was recognized as a necessary factor for cooperative environmental governance by Christie et al. (2005). Stable institutions, committed and accountable, were identified as another necessary component of cooperative environmental governance. These included government ministries, nongovernmental organizations, and informal institutions. Although recognized as key to ICM sustainability, the community involvement and ICM project characteristics that foster long-term sustainable management were not well developed but were gaining attention reflecting a move toward more participatory, rational decision-making. Christie et al. (2005) emphasized that coastal ecosystems are often greatly undervalued owing to the perception that resources are inexhaustible. There was a need to understand the economic value of coastal ecosystems, ranging from direct benefits to services such as shoreline protection, and to appreciate that acceptable bio-physical conditions underpin the economic and other benefits deriving from coastal systems. In line with the ecosystem-based management paradigm, ICM was viewed as needing to balance economic growth with sustainable resource use.

Christie et al. (2005) called for properly designed programs, clarifying that the issue of how to sustain success through project design was not addressed well. Five factors were identified as important in the design of sustainable ICM programs. First, because it takes both community involvement and achievement of desired benefits to impact ICM sustainability, the effective management of ICM-derived outcomes must be accommodated in the design. Next, while community-based and local government-led management regimes are often not ideal from an ecological perspective, participatory management remains a critically important element in ICM from a socioeconomic perspective, particularly in developing countries where institutional structures to support large-scale interventions are often lacking. Further, ICM depends on integration within and between multiple governance levels, making integration in difficult contexts a third design element. Fourth, long-term

commitment is essential to the success and sustainability of ICM, not only requiring institutionalisation and financial commitments, but also long-term commitment of national and expatriate leaders. Often the successes of individual ICM efforts can be traced directly to relatively small groups of committed individuals who have dedicated their careers to the effort. Finally, continued evaluation and adaptation based on sound research is necessary. This includes monitoring of impacts, as well as mandate-independent research that challenges ICM orthodoxies through consideration of innovative science and management alternatives as well as the underlying goals and assumptions associated with ICM agendas. The work of Christie and co-workers reflects the importance of the participatory, rational decision-making paradigm, the ecosystem-based management paradigm, the adaptive management paradigm and the cooperative environmental governance paradigm and the environmental monitoring paradigm in the design of sustainable ICM programs. The concern of Christie et al. (2005) regarding participatory management particularly in developing countries is echoed by Glavovic (2006) in his call for the sustainability goals of ICM to be reframed or qualified by goals of social justice.

In a recent review of the ICM experience, Yao (2008) discussed the lessons learned in integrated ocean and coastal management applications in China and Canada (Chircop and Hildebrand 2006), nations that have recognized the importance of sustainable development of the coastal marine environment through integrated management approaches. Some of the outstanding lessons and commonalities include (i) using an ecosystem-based approach rather than an administratively focused or politically based framework, (ii) incorporating strategic environmental assessment (SEA) in the ICM process as a means of integrating environmental considerations into decision-making at a strategic level, and to assess the impacts of policies, programs, and plans on the management area and the stakeholders, (iii) establishing appropriate institutional structures with full jurisdiction to address potential internal conflict, provide for multi-user conflict resolution mechanisms, and that decentralize national government authority to allow greater local government and community involvement and decision-making to enact and implement legislation effectively, (iv) empowering the public in resource management through public education and awareness building, (v) ensuring participation by all interested and concerned stakeholders through meaningful participation frameworks, (vi) establishing an independent, multidisciplinary science expert group that can interact with management bodies, and (vii) implementing monitoring and evaluation as soon as possible as it provides essential information to assist decision makers and managers to link management efforts (input and output) and outcomes (environmental monitoring). Clearly, characteristics indicative of the participatory, rational decision-making, ecosystem-based management, environmental monitoring, environmental assessment, and cooperative environmental governance paradigms, are reflected in the lessons and commonalities gleaned from the Canadian and Chinese studies. However, the relevance of the results-based management paradigm (e.g., the importance of identifying specific issues/problems in order to focus management effort) and the spatial planning paradigm (e.g., demarcation of management units and zoning of uses) is less apparent in their learning experience.

Challenges to ICM Implementation

Looking forward to ICM-based management of coastal resources in the 21st century, Weinstein et al. (2007, 43) concluded that: "Conflict mitigation, consensus building, trade-offs, sacrifice, and compromise will become the norm for sustainable coastal management, because growing demands on coastal resources can no longer be met by access to

unexploited resources.” In their view the task of addressing such multidimensional conflicts, which involve normative frameworks, a vast base of empirical knowledge, yet an increasingly complex knowledge base “will not be easy, but progress is being made with current efforts at ecosystem-based management. . .” [own emphasis]. Crowder and Norse (2008, 772) reiterate the importance of ecosystem-based management in ICM stating that “The abrupt decline in the sea’s capacity to provide crucial ecosystem services requires a new ecosystem-based approach [own emphasis] for maintaining and recovering biodiversity and integrity.” Crowder and Norse (2008, 772) view ecosystems as places and urge that managers and spatial planners active in the marine environment come to an understanding of both the diversity of human uses and the mix of biological communities with their key components and the key processes that maintain them. They (Crowder and Norse 2008 772) view the maintenance of the resistance and resilience to stressors as critical and indicate that the very complexity of the behavior of marine populations and ecosystems means that “managers cannot safely assume they will recover when stressors are reduced, so prevention is a far more robust management strategy than seeking a cure for degraded systems.”

As explicated by Crowder and Norse (2008), the increasing need to incorporate *spatial planning* in environmental management is well motivated (Douvere 2008). Australia, Belgium, China, Germany, the Netherlands, the United Kingdom, and the United States have all begun to implement or experiment with marine spatial planning (e.g., Crowder et al. 2006; Chua, Bonga, and Bermas-Atrigenio 2006; Day et al. 2008; Dalton, Thompson, and Jin 2009). The development of marine cadastral systems to assist the sustainable management of marine resources is increasingly evident in the United States (e.g., Fowler and Treml 2001), Canada (e.g., Nichols, Monahan, and Sutherland 2000), Australia (e.g., Binns et al. 2004), New Zealand (e.g., Grant 1999), and the Netherlands (e.g., Barry, Elema, and Molen 2003), particularly at the national and regional scales (e.g., bioregional planning areas). However, the explicit incorporation of ocean zoning and the marine cadastre in ICM implementation models—beyond its traditional application within fisheries and conservation management areas—is still under exploration (Weinstein et al. 2007). For Weinstein et al. (2007, 46) spatial planning holds promise in overcoming some of the future challenges for ICM. They claim that “Ocean zoning [own emphasis]—the regulation (and allocation) of access to and use of specific marine geographic areas to help protect the environment, support economic development, and create equitable access to the ocean—is necessary for the successful management of coastal resources and watersheds.” This is echoed by Crowder et al. (2006, 617) who conclude that “Problems in ocean resource management derive from governance, not science. Ocean zoning would replace mismatched and fragmented approaches with integrated regulatory domains.” Since activities and their associated consequences are necessarily spatially explicit, managing the coastal marine environment spatially makes intuitive sense (Halpern et al. 2008). Norse (2008, 5) also posits ecosystem-based zoning as a workable approach for future consideration in ICM, noting that de facto, piecemeal zoning of their territorial waters is already happening in the United States and other countries with sectoral government agencies allocating rights to use particular sea areas for particular purposes such as drilling for oil. Norse (2008) considers that ignoring the interests of conservation and other competing sectors is neither fair nor wise as it aggravates disagreements and results in a sector-by-sector claiming of ocean areas (i.e., zoning that is not ecologically sound nor economically efficient). Norse (2008, 5) claims that “Comprehensive ecosystem-based zoning—a transparent, public participatory, adaptive process for establishing ecological and socioeconomic objectives throughout a government’s jurisdiction—is a far more workable way to govern what happens in the sea.” Foley et al. (2010) view the concept of ecosystem-based marine spatial planning as a means

to successfully support healthy coastal and ocean ecosystems and to sustain human uses of such systems. Because a key goal of ecosystem-based management is to maintain the delivery of ecosystem services to humans, they argue that marine spatial planning should be based on ecological principles that articulate the scientifically recognized attributes of healthy, functioning ecosystems. Such principles include maintaining or restoring native species diversity, habitat diversity and heterogeneity, key species, and connectivity. Marine spatial planning also needs to account for context and uncertainty.

Finally, a major challenge for future sustainability of ICM lies in cooperative environmental governance as Weinstein et al. (2007, 47) perceptively reflect that the performance and long-term capacity of a diversity of entities (including scientific and educational institutions) from global to local scales will determine the tempo and degree of transition to sustainability. Indeed they conclude that a successful transition to ecosystem-based management requires a broadly supported “complex infrastructure that translates science-based information into public policy.” This we interpret as incorporating appropriate environmental governance. Cicin-Sain and Knecht (1998) underscored the need for cooperative environmental governance. Noting that designing and implementing an effective ICM program is a complex task, they indicated that agencies need to overcome the tendency to compete and commit to coordinating and harmonizing policies and programs. They viewed the political will on the part of policy makers to put effective measures in place and provide the necessary resources as a vital ingredient, as are coastal stakeholders willing to invest their time and energy in the ICM effort. In essence, they believe that there is no other choice than to collaborate in ICM efforts stating “the gifts the world’s coasts and oceans provide can be ensured only in this way” (Cicin-Sain and Knecht 1998, 303).

In summary, while different models and review articles emphasize different combinations of uniformities, paradigms such as the participatory, rational decision-making, environmental monitoring, environmental assessment, objectives-based management, results-based management, adaptive management, and cooperative environmental governance are well-established as important uniformities in ICM implementation. Other paradigms, such as the ecosystem-based management paradigm, the cumulative effects assessment and carrying capacity paradigm, and the spatial planning paradigm, appear to be less established in ICM practice, posing the main challenges to sustainable ICM in future.

Developing Criteria for the Theoretical Validation of ICM Implementation Models

In the preceding sections, the theory underlying IEM implementation, the broader field within which the practice of ICM is nested, was explored in terms of ten paradigms. The characteristics that each paradigm contributes to the implementation of IEM are provided in Table 1. Several characteristics are not unique to a particular paradigm, but instead are shared among paradigms. For example, participatory actor involvement is a characteristic shared by the participatory, rational decision-making paradigm, the environmental assessment paradigm, the objectives-based management paradigm, the results-based management paradigm, the ecosystem-based management paradigm, and the cooperative environmental governance paradigm. The suites of characteristics recognizable in the review studies of ICM, were used to identify the degree to which the paradigms are manifested in ICM practice.

In Table 2, the manifestation of the key paradigms as uniformities within the ICM review literature is summarized. The analysis of the evolution of ICM practice over the past two decades has demonstrated that the uniformities that contribute to IEM implementation

Table 2
 Manifestation of the key paradigms as uniformities within the ICM review literature

ICM Review Study	Paradigm									
	Participatory, rational decision-making	Environmental monitoring	Environmental assessment	Objectives-based management	Results-based management	Ecosystem-based management	Adaptive management	Cumulative effect assessment and carrying capacity	Spatial planning	Cooperative environmental governance
Sørensen review (1993)						●	●		●	
Olsen and co-workers' reviews (1990s)	●	●		●	●		●			●
Cicin-Sain and Knecht review (1998)	●								●	
Tobey and Vlok review (2002)	●		●			●	●			●
Stojanovic and co-workers' review (2004)	●	●	●	●	●		●	●		●
Christie and co-workers' review (2005)	●	●	●			●	●			●
Yao review (2008)	●	●	●			●				●

● = incorporated; ● = incorporated to some extent.

Table 3

Translation of the characteristics to criteria for evaluating the design of ICM implementation models

No.	Criterion
1	Model acknowledges <i>participatory, actor involvement</i> .
2	Model acknowledges <i>valid and relevant scientific information and knowledge</i> (scientific support) as an integral element.
3	Model requires clear <i>process management</i> to be adhered to so as to achieve a desired outcome.
4	Model requires <i>cooperative institutional structures</i> —across tiers of government and sectors and with clearly defined roles and responsibilities, embedded in a sound legal framework.
5	Model requires the establishment of overarching (common) <i>objectives, and associated indicators and targets</i> related to the (central) coastal system against which to measure compliance (i.e., providing the environmental limits or thresholds of potential concern to be adhered to by activities potentially affecting the coastal system), as well as to assess results-based outcomes (i.e., extent to which ICM initiatives were able to achieve such overarching objectives for a coastal system).
6	Model requires <i>monitoring and evaluation</i> programs to be established.
7	Model considers the <i>coastal ecosystem in its entirety</i> (i.e., as a social–ecological system) with the <i>coastal system as the central focus</i> (rather than specific issues, problems or sectors) through which cooperative governance occurs between different sectors—the essence of the ecosystem-based approach.
8	Model requires the delineation of <i>coastal management units</i> and the geographical demarcation as well as geographical <i>zoning of different uses or use areas</i> within management units.
9	Model presents ICM as an <i>iterative, adaptive process</i> .
10	Model acknowledges the concept of <i>ecosystem limitation</i> .
11	Model requires an enabling <i>legal framework</i> .
12	Model acknowledges <i>continuous development of education and awareness</i> as an integral element.
13	Model acknowledges <i>continuous capacity-building</i> programs as an integral element.
14	Model acknowledges <i>sound funding structures</i> (financial support) as an integral element.

are also evident as uniformities in ICM implementation. While different review articles emphasize different combinations of uniformities, paradigms such as participatory, rational decision-making, environmental monitoring, environmental assessment, objectives-based management, results-based management, adaptive management, and cooperative environmental governance are well-established as important uniformities in ICM implementation. Other paradigms, such as the ecosystem-based management paradigm, the cumulative effects assessment and carrying capacity paradigm and the spatial planning paradigm, appear

to be less established in ICM practice, although their value comes to the fore in the review studies that did recognize them as uniformities. Indeed Cicin-Sain and Knecht (1998), Weinstein et al. (2007), Crowder and Norse (2008), and Norse (2008) argue that further exploration of paradigms such as the ecosystem-based management paradigm and the spatial planning paradigm is required to significantly improve the effectiveness and sustainability of ICM in the future. The exploration of innovative avenues to enhance cooperative environmental governance is also encouraged.

We consider the characteristics of the paradigms to constitute the building blocks of the uniformities in IEM and ICM implementation. Such building blocks form an appropriate set for constructing criteria against which the scientific credibility of contextual, country-specific ICM implementation models can be validated. Accordingly, the characteristics listed in Table 1 are translated into clear statements that constitute the criteria for evaluating the design of such ICM implementation models. In this process, the formulations of the criteria are adapted to clarify their practical meaning. For instance, the characteristic “The social–ecological system is considered and resource objectives are set within this broader context” is translated to the criterion “Model considers the coastal ecosystem in its entirety (i.e., as a social–ecological system) with the coastal system as the central focus (rather than specific issues, problems or sectors) through which cooperative governance occurs between different sectors.” This results in a full set of fourteen evaluation criteria as listed in Table 3. The extent to which an ICM implementation model meets these criteria reflects the degree to which scientific learning on the uniformities in ICM practice has been incorporated in its design.

Conclusion

In contrast to the lesson-learning orientation of the many reviews articles on ICM practice, we provide a theoretically founded set of building blocks for the design of ICM implementation models. We adopt a stance of critical realism in distilling uniformities from review articles, using the paradigms in IEM implementation, the broader domain within which ICM practice is nested, as a framing mechanism. A common set of easily recognizable building blocks is generated by characterising the key paradigms constituting the uniformities. This enables the translation of theory inaccessible to practitioners into readily accessible evaluation criteria. In essence, the evaluation criteria represent a theoretically founded, condensate of the accumulated scientific learning on ICM practice over the last two decades.

The theoretical foundation of the evaluation criteria means that the criteria can be used to scientifically assess and so refine the ICM implementation models designed for specific contexts purely on the basis of wise practice. However, testing the empirical utility of the evaluation criteria constitutes the next step in this research on ICM. Evaluation of ICM implementation within a pan-European context, for example, could provide a diversity of contextual settings within which such empirical testing could occur.

Further, techniques such as science mapping could be used to identify whether paradigms exist in fields other than environmental science and management that constitute uniformities in IEM and ICM, in addition to the ten key paradigms studied in this article. Fields such as economics, political science, education, and public administration can potentially contribute additional paradigms. Any new characteristics deriving from the analysis of additional paradigms can then be used to expand and revise the evaluation criteria for the assessment of the scientific credibility of ICM implementation models.

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