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Editorial

The growth of integrated coastal management and the role of indicators in integrated coastal management: introduction to the special issue

This special issue of the *Ocean & Coastal Management* journal includes ten papers that were prepared for the international workshop on *The Role of Indicators in Integrated Coastal Management*, held in Ottawa during April 29–May 2, 2002. The workshop was co-organized by the Department of Fisheries and Oceans, Canada, and the Intergovernmental Oceanographic Commission of UNESCO, with the co-sponsorship of the US National Oceanic and Atmospheric Administration (NOAA) and the International Geographical Union (IGU). The Center for the Study of Marine Policy (CSMP) of the University of Delaware acted as the workshop secretariat.

The aim of the workshop was to review the state of the art of the use of indicators to monitor the environmental state of the coastal zone, the socioeconomic conditions of coastal communities, and the effectiveness of integrated coastal management (ICM) programs. Based on this review, the workshop examined a selected number of national and local case studies in the application of coastal management indicators and discussed how to develop a common framework and template for the selection and application of coastal management indicators in different contexts.

This special issue of *Ocean & Coastal Management* journal is one of the outcomes of the workshop. It is accompanied by the workshop proceedings and an indicator compendium, which are being published by IOC in its Manuals and Guides Series, and will be followed by methodological guidelines on the use of indicators for ICM to be developed by an international group of experts. The guidelines will target coastal managers at the national and subnational level and will reflect ongoing activities in some of the most relevant issues for ICM as called for by the World Summit on Sustainable Development (WSSD, Johannesburg, August 26–September 4, 2002), such as the implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA), the management of marine protected areas, or initiatives for small-island states.

Coastal zones represent roughly 20% of land surface and yet over 50% of human population lives within 200 km of the coast. The average human population density in coastal areas is about 80 persons/km^2, twice the global average [1]. Seven out of the ten cities larger than 8 million people in the world are located in coastal areas [2].

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Out of 179 coastal sovereign or semi-sovereign states, 41 are small islands (22%). Coastal ecosystems are highly productive and diverse: they yield 90% of global fisheries and produce about 25% of global biological productivity. Out of 13,200 known species of marine fish, almost 80% are coastal. The estimated economic value of coastal biomes (estuaries, seagrass and algal beds, mangrove and tidal marsh, and coral reefs) represents about 98% of the total estimated value of marine biomes ($58,975 ha/yr) [3].

Following the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, ICM has known an impressive growth in both developed and developing countries. In 1993, 75 countries, semi-sovereign states, and international organizations were engaged in 217 ICM efforts at the national, subnational, and international levels [4,5], while in 2002 145 countries, semi-sovereign states, and international organizations had initiated 698 ICM initiatives at the same levels [5]. These efforts greatly differ in the type and scope, time span and financial resources committed, as well as in the actual level of implementation. Nevertheless, there is clear indication that nearly all coastal states and their respective subnational authorities, as well as international organizations, have undertaken ICM initiatives that include coastal management programs and projects, new legislation targeting coastal issues, and new institutions vested with authority over coastal zones [6].

Particularly since 1992, significant investments in coastal and marine related projects have been made by multilateral and bilateral donors, such as the World Bank, the Asian Development Bank (ADB), the Inter-American Development Bank (IADB), the Swedish International Development Agency (SIDA), the Canadian International Development Agency (CIDA), the Japan International Cooperation Agency (JICA), the Danish International Development Agency (DANIDA), the Norwegian Agency for Development Cooperation (NORAD), the US International Development Agency (USAID), and the European Union (EU), among many others. In Latin America, for example, the investments by international donors in coastal management between 1992 and 2000 totaled approximately $1.3 billion [7]. The World Bank strategy for coastal and marine areas has entailed investments of the order of $500 million in Africa [8] and of $175 million in lending operations in the Asia-Pacific region. The ADB has invested $1.2 billion for marine resources projects in the Asia-Pacific region [9]. The restructuring of international funding mechanisms led to the establishment of the Global Environment Facility (GEF) and related programs [10]:

- The International Waters initiative has funded 53 projects totaling $438 million between 1991 and 2000, operationalizing an integrated approach to river basin and coastal/marine management.
- The Biodiversity Initiative has funded 58 projects totaling $244 million through 2000 to protect coastal, marine, and freshwater ecosystems.
- The Climate Change initiative has funded many projects to assist small-island-developing nations in addressing impacts from climate change, totaling $60 million by 1999.

Over 30 years of practical experience in ICM and the formulation of a number of guidelines for ICM by international organizations [11–20] have allowed to elaborate a series of good practices of broad application for ICM and establish ICM as a model approach for the planning and management of coastal areas. Yet, in spite of these advancements, the conditions of coastal areas are deteriorating all over the world: pollution from land-based sources still represents 75–80% of total marine pollution, with 90% of urban wastes and 70% of industrial wastes discharged into the sea without treatment in developing countries; overexploitation of fishery resources in the coastal zone and on the continental shelf does not come to a halt, with three-quarters of fish stocks in need of urgent management measures; and proper land use in coastal areas and use of environmental impact assessments are not yet routinely implemented with consequent continuing loss of coastal habitats and biodiversity to human uses.

The apparent failure of ICM in many efforts worldwide in ensuring the environmental health of coastal ecosystems while obtaining benefits from coastal development makes the development and monitoring of appropriate indicators a necessity to track implementation of ICM both in terms of process and outcomes. The international guidelines for ICM and the scientific and technical literature recommend the use of indicators to appraise the effectiveness of the numerous and longstanding ICM efforts undertaken all over the world at all geographical scales. With almost 700 ICM initiatives recorded during the 1990s, it is imperative to develop and test measurements that can demonstrate "success" in the recovery and sustained health of coastal resources as well as in the improvement of socioeconomic conditions of coastal communities [21].

This is particularly important in the light of the priorities for action agreed upon at the WSSD, which placed great emphasis on protecting and managing the natural resource base of economic and social development. Among the commitments agreed at the WSSD, many are directly relevant to ICM and ocean management, as follows:

Integrated ocean and coastal management

- Encouraging the application of the ecosystem approach by 2010, particularly in the management of fisheries and the conservation of biodiversity.

Fisheries

- Implement the FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing by 2004.
- Implement the FAO International Plan of Action for the Management of Fishing Capacity by 2005.
- Maintain or restore depleted fish stocks to their maximum sustainable yield on an urgent basis and where possible no later than 2015.

Conservation of biodiversity

- Establishing representative networks of marine protected areas by 2012.

Protection from marine pollution

- Advancing implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities in the period 2002–2006 with a view to achieve substantial progress by 2006.

Science and observation

- Establishing a regular process under the United Nations for global reporting and assessment of the state of the marine environment, including socioeconomic aspects, by 2004.

Small-island-developing states

- Develop community-based initiatives on sustainable tourism in small-island-developing states by 2004.
- Reduce, prevent, and control waste and pollution and their health-related impacts in small-island-developing states by 2004 through the implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities.
- Strengthen efforts on energy supply and services in small-island-developing states by 2004.
- Undertake a comprehensive review of the implementation of the Barbados Programme of Action for the Sustainable Development of Small-Island-Developing States in 2004.

The achievement of such targets will require the development and use of indicators to monitor and demonstrate progress and results on a comparable way across countries, regions, and project portfolios. Environmental indicators applicable to the coastal zone have typically been developed within the pressure–state–response (PSR) or driving forces–pressure–state–impact–response (DPSIR) models originally developed by the Organization for Economic Development and Co-operation (OECD) [22]. The use of such indicators has been most diffused to monitor the reduction of point sources of pollution, the application of land-use planning techniques to coastal zones and protected areas, or the provision of public access to beaches. On the other hand, examples of indicators to describe socioeconomic costs and benefits in coastal zones are rare, particularly at the national level. While efforts have been made to monitor ICM progress at the global, regional, national, and program level [23–31], the use of governance performance indicators is still in its beginning. Difficulties are most apparent in tying ICM efforts to on-the-ground outcomes and the attribution of effects to ICM programs remains an open issue [32].

Therefore, there is a need for more systematic evaluations of ICM efforts, shifting from the use of sole environmental indicators to the use of the extended DPSIR model in the context of the ICM cycle. This is particularly needed to demonstrate the socioeconomic benefits of ICM [33]. Integrating environmental, socioeconomic, and

governance aspects and developing indicators capable of capturing all these processes remains one of the most difficult challenges for the ICM approach. This was one of the tasks of the Ottawa workshop and the organization of this special issue closely follows the articulation of the workshop presentations and discussions, reflecting the three main types of indicators useful for ICM. First, indicators to measure the environmental state of the coastal zones are presented; second, indicators to measure the anthropogenic pressures exerted over the coastal zones and the resulting socioeconomic conditions are discussed; and third, indicators to assess the effectiveness of coastal management efforts are reviewed. Finally, an overview of sustainable development measures is provided.

Indicators of ecosystem health (Rice) can play an important role in both communication for and support to decision making. The use of these indicators has become more relevant with the diffusion of the precautionary approach and the ecosystem approach. The operationalization of such indicators, however, is made difficult by the need to identify values of an ecosystem associated with serious or irreversible harm to the environment. This is complicated by the difficulty of combining indicators to provide a more holistic picture of the state of the ecosystem, often based on a priori criteria on which there is not yet scientific consensus.

Biological indicators to measure the health of ecosystems (Linton and Warner) can provide an early warning of pollution or degradation in an ecosystem and prompt policy responses. In the Caribbean, biological indicators are focused around particular ecosystems, such as coral reefs, seagrass beds and mangrove forests and include a range of biological parameters relating to particular species, groups of species and biological processes. The potential for the use of biological indicators in ICM depends on the determination of appropriate baselines to allow for comparison.

In the North Sea, an international agreement among the bordering countries in 1997 within the OSPAR Convention led to the identification of objectives of ecological quality for the North Sea ecosystem to implement the ecosystem approach (Kabuta and Laane). These objectives were operationalized by the Dutch Government into integrated policies for the management of the Netherlands sector of the North Sea and a series of ecological indicators were developed to evaluate long-term changes in the ecological performance of the ecosystem due to human effects.

Until recently, there has been relatively little attention to the measurement of the interactions between social systems and environmental variability (Bowen and Riley), with consequent limited understanding of the linkages between coastal systems dynamics and the social benefits associated with them. The past decade, however, has seen several and promising efforts at filling this gap. First, initiatives have been undertaken to improve the assessment of ICM programs; second, emerging models for indicator development have provided frameworks for such assessments to be articulated; and third, international monitoring and assessments protocols have provided opportunities for more systematic and integrated observations of coastal dynamics.

The measurement of global change phenomena (Christian) will require the integration of different types of global observing systems—the Global Climate Observing System (GCOS), the Global Oceanographic Observing System (GOOS), and the Global Terrestrial Observing System (GTOS). GTOS is currently developing a coastal observing system in collaboration with GOOS to integrate terrestrial, freshwater, and marine observations. Among the challenges of this undertaking are the evaluation of currently used variables and the identification of indicators of coastal conditions most appropriate at different scales.

Linking environmental conditions and human pressures, the Land Ocean Interactions in the Coastal Zone (LOICZ) Project of the International Geosphere–Biosphere Programme (IGBP) (Talaue McManus) focused on quantifying the role of the global coastal zone in the cycling of carbon and nutrients. From 1993 to date, it has developed protocols and tools that allow for site-specific and global assessments of coastal processes and their drivers. Indicators used in coastal assessments include the contribution of population and economic activities to waste load generation, and the resulting coastal system states relative to production and nitrogen cycling.

The potential contribution of indicators to assess the performance of the governance processes involved in ICM is then discussed (Ehler), focusing on the evaluation phase and the need to complement process-oriented indicators with outcome-oriented indicators to improve adaptive management and accountability. The example of integrated management of marine protected areas is used as a case study to propose a menu of indicators of global applicability.

The assessment of the achievement of the complex environmental and developmental goals pursued by ICM programs requires the development and testing of ad hoc evaluation frameworks (Olsen). To assess ICM progress over extended time periods, two elastic frameworks can be provided. A framework that encompasses four orders of outcomes grouping sequences of institutional, behavioral, and social/environmental changes can track the progress towards more sustainable forms of coastal development. A second framework monitors the steps involved in the ICM policy cycle. Together, these two frameworks can provide a useful tool to assess progress across portfolios of ICM initiatives.

Many governance contexts are characterized by limited integration between the land-use planning system administered by territorial authorities at different levels and sectoral laws that are usually reflected in sectoral administrations within the national government, like in France and other European countries (Henocque). The experience made by the French Coastal Environment Commission in 2001–2002 in assessing local experiences in ICM demonstrates the usefulness of combining process and outcome indicators in evaluation exercises and their contribution to improve communication and build capacity in ICM.

The sustainability of ocean and coastal development will have to be measured in the broader context of sustainable development (Hanson). While no widely accepted and tested set of sustainable development measures exists, there are different approaches that can be used to interpret sustainable development progress. These include the use of sustainability surveys, measuring the capital for sustainability,

developing national, as well as subnational and sectoral, sustainability indicators, aggregating indicators into a "dashboard of sustainability," and constructing scenarios.

When attempting to define an indicator framework capable of integrating the three main types of indicators and suitable to assess progress in ICM, some preliminary considerations have to be made. The PSR framework developed by OECD—the most diffused framework in the state of the environment report—appears to be of limited use to ICM given its focus on the environment. The revised DPSIR framework, adopted by the European Environment Agency (EEA) and other international organizations, provides a better context to integrate different types of indicators, allowing to take into account not only environmental impacts but also socioeconomic impacts resulting from changes in the state of coastal ecosystems. More focused on governance performance, the input–output–outcome–impact framework of the World Bank can provide a setting in which to track the progress in ICM through the use of two fundamental types of indicators: process indicators and outcome indicators. Finally, the frameworks developed by the Coastal Resources Center (CRC) and centered on different orders of subsequent outcomes over time can provide further insight into the sequence of results to be assessed in ICM. These include: (a) enabling conditions for ICM, (b) changes in behavior of coastal users, (c) short-term environmental and socioeconomic outcomes, and (d) long-term sustainable development outcomes.

The workshop discussed alternatives for the definition of a basic indicator template for ICM. Such a template could be based on the DPSIR model encompassing indicators to measure: (a) forcing variables, (b) pressures by human activities, (c) environmental conditions, (d) socioeconomic impacts on goods and services, and (e) governance responses. These would include processes, inputs, outputs, and primary and secondary outcomes (Fig. 1). Tentatively, a series of classes of indicators for different functions of ICM could be developed. While it is difficult or unnecessary to agree on a short list of indicators valid in every context, governance performance indicators should be able to measure milestones and thresholds of the ICM policy cycle and related sequence of outcomes. This would assist in developing an action-oriented approach to ICM evaluations, suggesting which action managers should take to advance programs and projects. The choice of indicators would ultimately depend on the environmental, socioeconomic, and governance context in which they are used, as well as on the specific goals and objectives of ICM programs and projects. It should be possible, however, to identify a "menu" of indicators from which managers could choose to self-assess their efforts.

Such key indicators to measure governance performance focusing on outcomes rather than on processes would help decision-makers better evaluate the effectiveness of ICM programs, but there is no broadly established methodology on which evaluation frameworks would best facilitate such measurement. The limitations and uncertainties in the causal linkages between specific ICM efforts and related outcomes suggests that further discussion is needed to identify the appropriate framework to measure the progress of ICM at different stages of development. In

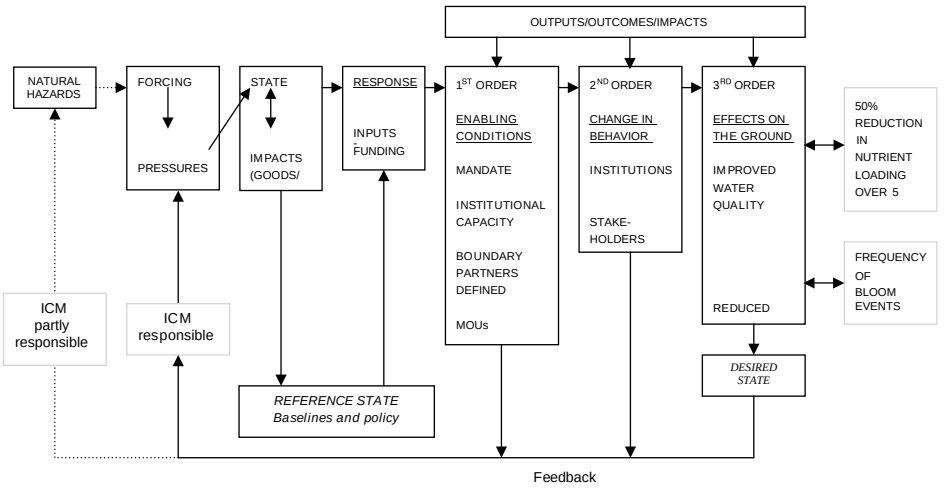

Fig. 1. General model for the use of indicators in integrated coastal management.

particular, the difficulty of ICM programs and projects in demonstrating their environmental and socioeconomic benefits compounds today with competing funding requests to international donors from traditional mainstream sectors. It is therefore important to link ICM efforts to the main issues on the world's agenda, such as poverty alleviation, curbing of pollution from land-based activities, reduction of overfishing in coastal areas, or management of marine protected areas.

Finally, based on the workshop discussions and the literature review that accompanied it, a series of recommendations can be formulated on the use of indicators for ICM:

- It is important for ICM programs to adopt objective-based, measurable outcome evaluations, defining environmental and socioeconomic goals and establishing baselines against which to measure the impact of ICM initiatives. An indicator system could be developed through a phased approach tied to the ICM cycle and, to this end, the causal relationships linking environmental, socioeconomic, and governance components should be clarified.
- Indicators developed for ICM should satisfy a series of basic characteristics: scientifically valid, linked to the outcomes being monitored, incorporated into a sound and practical management process, readily understandable and communicable, timely available for decision making, relevant to management actions to address important issues, and cost-efficient.
- Indicators should be user-led and coastal stakeholders should be involved in the process of selection and development of indicators since the beginning. In most cases, given the potential high cost associated with the development of complex indicators, it would be preferable to make the best use of existing information derived from different types of programs. On this basis, an enhanced report on the state of the environment and development of the coastal zone could provide an

occasion for collaboration between subnational and national levels for the achievement of shared objectives.

- The existing information could be enhanced by: (a) compiling baseline information on the condition of ecosystems; (b) standardizing, compiling and harmonizing existing data sets to develop global data sets; (c) identifying areas of high conservation priority, patterns of ecosystem interlinkage, and causal relationships in coastal systems; (d) utilizing multiple methods for monitoring and assessment; (e) improving integration and collaboration among coastal zone agencies and initiatives; and (f) developing techniques for governments and non-governmental organizations to engage policymakers and civil society for better evaluation of tradeoffs and improved decision making.
- Monitoring and evaluation mechanisms should be built in right from the beginning, and program monitoring linked to evaluation throughout project implementation. Indicators, therefore, should be set as an integral part of a program or project proposal, and revised accordingly as adjustments to project objectives, interventions, and implementation mechanisms are made.
- Headline indicators to measure key environmental and socioeconomic issues could be built based on combined indicators expressing more complex phenomena or effect-related equivalents. Headline indicators for ICM should be selected based on the following characteristics: policy relevance, predictability, interdependency, measurability, and performance.

References

[1] United Nations. UN Atlas of the Oceans. Internet: online, September 15, 2002, http://www.oceansatlas.org.
[2] IOC. IOC–SOA International Workshop on Coastal Megacities—Challenges of Growing Urbanisation of the World's Coastal Areas. IOC Workshop Report 166. Paris: IOC, 1999.
[3] Costanza R, et al. The value of the world's services and natural capital. Ecological Economics 1998;25(1):3–15.
[4] Sorensen JC. The international proliferation of ICM efforts. Ocean & Coastal Management 1993;21(3):3–41.
[5] Sorensen J. Baseline 2000 Background Report: The Status of Integrated Coastal Management as an International Practice—Second Iteration—26 August 2002. Internet: online, September 15, 2002, http://www.uhi.umb.edu/b2k/baseline2000.pdf, 2002.
[6] Cicin-Sain B, et al. Global and regional trends in efforts at integrated coastal management. Paper Presented at the Global Conference on Oceans and Coasts at Rio + 10, Paris. UNESCO, December 3–7, 2001.
[7] Rivera Arriaga E. International aid: assessment of coastal and marine management initiatives in the Latin America and Caribbean regions. Ph.D. dissertation. Newark, Delaware: University of Delaware, 2002.
[8] Hewawasam I. Managing the coastal and marine environment in Sub-Saharan Africa: strategic directions for sustainable development. Washington, DC: The World Bank, 2002.
[9] King P. Role of Asian development bank in promoting ocean and coastal development. Paper Presented at the Global Conference on Oceans and Coasts at Rio + 10, Paris. UNESCO, December 3–7, 2001.
[10] GEF. Internet: online, September 15, 2002, http://www.gefweb.org.
[11] OECD. Coastal zone management: integrated policies. Paris: OECD, 1993.

[12] IUCN. Cross-sectoral, integrated coastal area planning (CICAP): guidelines and principles for coastal area development. In: Pernetta JC, Elder DL, editors. Marine Conservation and Development Report. Gland: World Conservation Union, 1993.
[13] UNEP. Guidelines for integrated management of coastal and marine areas: with special reference to the Mediterranean Basin. Nairobi: UNEP, 1995.
[14] GESAMP. The contribution of science to integrated coastal management. GESAMP Reports and Studies 61. Rome: FAO, 1996.
[15] World Bank. Guidelines for integrated coastal zone management. In: Post JC, Lundin CG, editors. Environmentally sustainable development studies and monographs, Series 9. Washington, DC: World Bank, 1996.
[16] Barusseau P, et al. Guide métolodogique d'aide à la géstion integrée de la zone côtière, manuels et guides 36. Paris: Commission Océanographique Intergouvernamentale, 1997.
[17] FAO. Integrated coastal management and agriculture, forestry and fisheries. Rome: FAO, 1998.
[18] European Commission. Towards a European integrated coastal zone management (ICZM) strategy: general principles and policy options—a reflection paper, vol. 1999. Brussels: European Commission, 1999.
[19] Cocossis H, Burt T, Van der Weide J. Conceptual framework and planning guidelines for integrated coastal area and river basin management. Split: PAP/RAC, 1999.
[20] Henocque Y, Denis J, editors. A methodological guide: steps and tools toward integrated coastal area management. IOC Manuals and Guide 42. Paris: UNESCO, 2001.
[21] Matuszeski W. Coastal management: in search of success. InterCoast 2001;40(1–2):40.
[22] Vandermeulen H. The development of marine indicators for coastal zone management. Ocean & Coastal Management 1998;39:63–71.
[23] OECD. Integrated coastal zone management: review of progress in selected OECD countries. Paris: OECD, 1997.
[24] Trumbic I, et al. Assessment of integrated coastal area management initiatives in the Mediterranean: experiences from METAP and MAP (1988–1996). Athens: METAP/MAP/PAP, 1997.
[25] Government of Finland, UNEP, PAP/RAC. Assessment of integrated coastal management in Africa. Split: PAP/RAC, UNEP, 1998.
[26] Rodríguez JJ. Análisis regional de la situación de la zona marina costera centroamericana, ENV-121. Washington, DC: IADB, 1998.
[27] European Commission. Lessons from the European Commission's demonstration programme on integrated coastal zone management (ICZM). Brussels: European Commission, 1999.
[28] Hershman MJ, et al. The effectiveness of coastal zone management in the United States. Ocean & Coastal Management 1999;27:113–38.
[29] Lemay MH. Coastal and marine resources management in Latin America and the Caribbean, 12/98, ENV. Washington, DC: IADB, 1999.
[30] PAP/RAC. Legislation nationales relatives à l'aménagement et à la géstion des zones côtieres en Méditerranée et propositions de lignes directrices. Split: PAP/RAC, 2000.
[31] UNEP/MAP/PAP. Good practices guidelines for integrated coastal management in the Mediterranean. Split: Priority Actions Programme, 2001.
[32] Cordah Ltd. Indicators to monitor the progress of integrated coastal zone management: a review of worldwide practice. Edimburgh: Scottish Executive Central Research Unit, 2001.
[33] Firn Crichton Roberts Ltd., Graduate School of Environmental Studies—University of Strathclyde. An assessment of the socio-economic costs and benefits of integrated coastal zone management. Final Report to the European Commission. Fife and Glasgow: Firn Crichton Roberts Ltd. and University of Strathclyde, 2000.

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