15. Toward sustainability for coastal fisheries of Latin America and the Caribbean: effective governance and healthy ecosystems

Juan Carlos Seijo*, Anthony Charles, Ratana Chuenpagdee and Silvia Salas

Seijo, J.C., Charles, A., Chuenpagdee, R. and Salas, S. 2011. Toward sustainability for coastal fisheries of Latin America and the Caribbean: effective governance and healthy ecosystems. In S. Salas, R. Chuenpagdee, A. Charles and J.C. Seijo (eds). Coastal fisheries of Latin America and the Caribbean. *FAO Fisheries and Aquaculture Technical Paper.* No. 544. Rome, FAO. pp. 403-421.

1. Fishery governance and institutional design 404
   1.1 From open access to fishery use rights 405
   1.2 Overcoming exclusion costs and transactions costs 406
   1.3 Developing effective fishery institutions 408
2. Fishery assessment and the ecosystem approach 409
   2.1 Fishery assessment 410
   2.2 Ecosystem approach to coastal fisheries 412
3. Concluding remarks 416
References 417

Small-scale fisheries of Latin America and the Caribbean (LAC) have tended to suffer from the same overexploitation syndrome that characterizes many fisheries of the world today, one that has led to a global pattern of exploitation, in which there is little room for expansion of the world's fish catches and, indeed, many resources are overexploited or even exhausted (FAO, 2008). With the fish resources and fisheries of LAC so often in a poor state, what can be done about it? How can fishery sustainability be achieved in a coastal context – whereby the needs of the present local coastal populations of fishers can be met without

* *Contact information*: Universidad Marista de Mérida, Mérida, Yucatán, Mexico. E-mail: jseijo@marista.edu.mx.

compromising the ability of future generations to meet their needs – in the same location and other interdependent locations (Caddy and Seijo, 2005).

Chapter 14 drew on a synthesis of results from the country-specific chapters in this volume in order to review the overall state of fishery assessment and management along the coasts of the LAC region. This led to five specific directions proposed to improve the state of these fisheries, namely (i) comprehensive fisheries assessment; (ii) building capacity for fishery data collection, assessment and management; (iii) incorporating social, economic and livelihood considerations; (iv) adopting alternative management schemes; and (v) promoting equity, use rights and participation in fishery management. These themes all fit into the two major policy frameworks being advocated globally as essential to the future of fisheries – the development of new innovations in fishery governance and institutional design, and the adoption of an ecosystem approach to fisheries.

In this chapter, we examine in some depth the nature of these two major frameworks and explore how they can be effectively applied in the context of small-scale fisheries management, particularly in the LAC region. The chapter then closes with a synthesis of the key messages of this volume, highlighting in particular the directions forward in improving the state of coastal fisheries across Latin America and the Caribbean.

1. FISHERY GOVERNANCE AND INSTITUTIONAL DESIGN

A focus on 'governance' of fisheries implies a broad perspective that encompasses activities well beyond the day-to-day routines of management, and that also extends beyond the responsibility of governments alone. In other words, governance involves various social actors, including private enterprises, civic organizations, communities, political parties, universities, the media and the general public (Costanza *et al*., 1998; Chakalall *et al*., 2007). Governance is about the collective, aggregated and integrative process that these actors explore together in solving problems and creating opportunities for society (Kooiman *et al*., 2005).

These interactions can be fostered through communication, learning and negotiation. Such initiatives will help to rebuild catch levels and ensure sustainable livelihoods by providing the mechanisms for decision-making needed to initiate a control on fishing intensity. The resulting improvements will reduce the overall pressure on the resources and counteract the declines in catches and the consequent increases in travel and transaction costs that fishers incur when competing for the most valuable resources. Recognition of the dynamics of the fisheries calls for adaptive strategies. Institutional arrangements, bio-ecological processes, market conditions and environmental impacts must be reviewed and revised and then management strategies adapted accordingly.

Three major themes relating to these challenges of fisheries governance are explored in this section: (i) the need for, and the evolution toward, clear rights over access to and use of fishing grounds; (ii) approaches to reducing high exclusion and transactions costs in coastal fisheries; and (iii) the development of effective institutions for fishery governance.

1.1 From open access to fishery use rights

Open access fisheries – those in which there are no limits to access, so that anyone can go fishing – are still common in LAC countries. However, it has become accepted wisdom, based on experiences of fishery collapses worldwide, that open access is likely to result in overexploitation and overcapacity, thereby threatening the long-term sustainability of fisheries. The overall need for and desirability of restricting the access and use of fishery resources is now accepted as a basic premise in fishery management (Ostrom and Hess, 2007; FAO, 2006; OECD, 2006).

Such restrictions in fisheries are related to 'use rights' that define who can access a fishery and how much fishing each can undertake (Charles, 2001, 2002, 2004; Ostrom and Hess, 2007). As indicated in other chapters of this document, various forms of use rights are to be found in the small-scale fisheries of LAC (Salas *et al.*, 2007; Agüero and Claverí, 2007, and references therein; Sosa *et al*., 2008), fitting within an overall diversity of governance arrangements and institutional designs.

Use rights are key tools for the fishery manager not only in resolving open access problems, but also in helping to clarify who the stakeholders are in a certain fishery. They are essential as well to stakeholders – whether fishers, fishers' organizations, fishing companies or fishing communities – who are provided with some security regarding access to fishing areas, use of an allowable set of fishing inputs, or harvest of a certain quantity of fish. In addition, with secure and durable use rights, conservation measures to protect 'the future' become more compatible with the fishers' own long-term interests, which may encourage adoption of responsible fishing practices and greater compliance with regulations. Finally, use rights are seen as a mechanism to promote 'responsible fisheries' – indeed, as the FAO Code of Conduct for Responsible Fisheries notes, "The right to fish carries with it the obligation to do so in a responsible manner…" (FAO, 1995).

The key element of use rights in coastal fisheries is typically 'access rights', which deal with participation in the fishery, specifically relating to entry ('access') into the fishery or a specific fishing ground. A fishing licence would be an example of an access right as would the Customary Marine Tenure (CMT) and Territorial Use Rights in Fishing (TURFs), which determine the locations where community members can access fishery resources. Another form of use rights is an individually-set numerical right, whether to use a specific amount of fishing effort or to take a specific catch. There are some instances in Latin America of individually-based rights in small-scale fisheries, e.g. in some Chilean and Peruvian fisheries (CeDePesca, 2005; FAO, 2000; Castilla and Gelcich, 2008).

Just as use rights serve to specify and regulate who is to be involved in resource use, there is a parallel need to specify who is involved in fishery management – through 'management rights'. While the state has the general responsibility for management, it can delegate management functions. The question arises as to who else should be involved in fishery management, whether alongside government or delegated by government.

Both management rights and use rights reflect a trend toward rights-based management approaches, including systems of co-management as a key form of

management rights. Indeed, as reported by Sutinen (1999), countries that utilize use rights tend also to move towards co-management, since the latter tends to reduce administrative costs and improve compliance with management regulations. Many small-scale fisheries in LAC involve some form of community-based management or co-management rights (FAO, 2000; McConney and Baldeo, 2007; Salas *et al*., 2007; Sosa *et al*., 2008).

Much has been written about the need for rights in fisheries, but there is much less discussion of the process for assessing and (if necessary) implementing a rights system. There is a diversity of approaches to considering the role of use rights, and of steps in the process of assessing and developing a use rights system. For an examination of the sequence of events in such a process, see Charles (2002).

1.2 Overcoming exclusion costs and transactions costs

Small-scale fisheries in LAC share many of the same issues of all marine fisheries, notably high exclusion costs, high information costs and high enforcement costs. These key challenges and how they can be addressed are described here.

First, an inherent characteristic of a fishery with exploited fish stocks is the high cost of excluding unauthorized fishers from exploiting the resource and enforcing regulatory compliance on those authorized to fish. High *exclusion costs* (sensu Schmid, 1987, 2004) mean that the use of an existing fish stock is difficult to limit to only those who have the right to fish it. Just because fishers have the nominal right to exclude others from harvesting a resource (i.e. through use rights) does not mean that the exclusion can be done effectively. Furthermore, the mobility and migratory nature of most fish resources, combined with high uncertainty as to stock magnitude, means that an individual fisher is unlikely to benefit from postponing capture of a fish with the expectation of taking it at a larger and more valuable size later, since others are likely to have caught it in the meantime; that is, unless all or most fishers also agree to abstain. Consequently, each fisher tends to maintain a high rate of harvesting, and thus generates high exclusion costs to the other fishers who tend to behave likewise.

Options for avoiding the effects of high exclusion costs in small-scale fisheries involve institutional structures and rights systems (Berkes, 1989; Seijo, 1993; Castilla and Defeo, 2001) such as: (i) implementation of community-based and co-management systems where the right to harvest the commons during the fishing season is allocated by the community to small-scale fishers; (ii) pecification of individual rights through allocation within the fishing community; and (iii) community-allocated fishing grounds which can be transferred or leased among members of the voluntary collective organization of small-scale fishers (Seijo, 1993). All of these approaches involve varying degrees of transactions costs that are faced by small-scale fishers, costs which may or may not be shared with government.

Second, marine fisheries involve high *transaction costs*, which also diminish the efficiency of resource allocation over time. Transaction costs in most fisheries involve (i) costs of information; and (ii) enforcement or policing costs. First, efficient fisheries

management implies high information costs, to cope with the major uncertainties inherent in natural systems, as well as a range of other biological, social, political and economic factors requiring a precautionary approach to fisheries management (Hilborn and Peterman, 1996). Second, fisheries management involves high enforcement or policing costs if management schemes are implemented and/or fishery use rights allocated and policed. For many shelf fisheries, the areas to be policed are extensive and conventional patrol vessel operations are ineffective and costly. Under these circumstances, a non-enforceable right becomes an empty right.

The complexities of managing small-scale fisheries that are subject to high exclusion costs and high information and enforcement costs are further exacerbated by a naturally fluctuating environment, changing coastal ecosystem dynamics, and a lack of solid governance. A set of mitigating strategies is required to deal with these complexities and move towards fishery sustainability, as described above (Caddy and Seijo, 2005). To deal with these costs that prevent optimal harvesting of the resources, some strategies are presented in Table 1 for small-scale fisheries that target species with different degrees of stock mobility.

TABLE 1
Some strategies for mitigating the effects of high exclusion, information and enforcement costs in small-scale fisheries, targeting stocks with different degrees of mobility

Stock mobility	Exclusion costs	Information costs	Enforcement costs
Sedentary or low mobility Resources such as some invertebrates (bivalves, lobster)	Establish area-based use rights or leases among community members	Costs of stock assessment and bio-economic analysis are shared between those deriving resource rent and the government	Emphasis on self-policing Community-managed MCS[1] Co-management with government
Mobile (transboundary or shared stocks) Resources found in waters of multiple neighbour nations (e.g. Caribbean area). These include metapopulations	Limited entry agreed bilaterally or multilaterally with allocation of a shared total allowable catch	Bilateral/multilateral cooperation among parties, along with standardized data collection and stock assessment, and coordinated MCS, plus cost allocation proportional to use rights (e.g. quota)	Bilateral/multilateral cooperation in management and enforcement of common or harmonized regulations
Highly migratory Resources that pass nearby coastal areas targeted or incidentally harvested by small-scale fisheries	Harvest quotas are established by a commission Members of the commission set rules for entry to the fishery, and arrange allocation negotiations	Data collection and stock assessment are organized by the commission. Costs are shared proportionally to catch quotas	Commission members share enforcement costs proportional to annual harvest by individual countries

Adapted from Caddy and Seijo, 2005.
[1] MCS: monitoring, control and surveillance.

1.3 Developing effective fishery institutions

Latin American and the Caribbean fisheries are by no means alone in needing to improve their institutional arrangements in order to enhance the efficiency, equity and overall effectiveness of fishery management. Uncertainty as to future stock availability, particularly related to a common unsustainability of resources discussed earlier, has meant that attention tended to focus less on achieving long-run results and more on short-run benefits.

There are, however, positive measures that could improve governance. Some small-scale fisheries in the LAC region are very suitable for participatory institutional arrangements, such as the co-management and community-based management approaches noted above. Indeed, there are various such fisheries that already operate using traditional management systems and have established informal agreements within communities about access to fishing grounds. For such fisheries, three specific directions noted in Chapter 14 – incorporating social, economic and livelihood considerations; adopting alternative management schemes; and promoting equity, rights and self-regulation – are especially relevant.

Geographical remoteness of small-scale fishing communities, while often resulting in marginalization of this sector (especially in terms of the ability to influence management and decision-making) can, in some cases, be the incentive for self-help approaches to fishery sustainability. Whether small-scale fishing communities have the potential for community-based approaches to fisheries management, it is recognized that careful discussion is required for the design and arrangement of appropriate institutions. Discussion about the suitability of such a management scheme is also needed. As suggested by Chuenpagdee and Jentoft (2007), how the idea is conceived, communicated and discussed is as important to success in implementing co-management and community-based management systems as is the implementation itself.

The main principles for solid and lasting community management institutions in small-scale fisheries and the factors which contribute to successful implementation are well captured in Ostrom (1990). For example, clear boundaries and 'rules of the game' for the operation of the community managed fishery need to be identified. Fishers and other community members need to know who has the right to withdraw resources and from what areas. Appropriation rules and restrictions such as closed season and closed area need to correspond with the local environmental and social conditions, and fit within the capacity of the governing institutions to monitor and control. The complexity and the dynamics of the ecosystems and the human components within fishery systems require that these rules are amenable to being modified through a collective decision-making process.

In such institutional development, a key goal is to overcome individual incentives that operate counter to desired fishing behaviour. For example, in the absence of a consensus to respect rules such as catch limit, any single fisher's decision to increase their individual catch rate will benefit that individual while also increasing costs of other fishers. Using Shelling's (1978) terminology, this constitutes a social trap, because the micro-motives of an individual fisher in the short-run are not

consistent with the macro-results that this fisher, and others, desire in the long run. The short-run micro-motives consist of catching as many fish as possible in order to increase individual marginal benefits, while the long-run desired macro-results may involve achieving the maximum economic yield and/or sustaining the flow of protein-rich seafood. Another incentive to overcome is that of free rider behaviour, defined as participation in the harvest without participation in the costs and constraints imposed by management of the stock, which tends to be present in small-scale fisheries where the number of fishers is very large and fishing grounds extend widely in the coastal area, making self-policing unfeasible.

Allowing for temporal fluctuations in resource productivity and preferences of resource use, a sustainable yield from a fishery will tend to be attainable only when the number of fishers is limited, and they act together to implement a form of effort regulation. Co-management and community-based management schemes provide a platform for collective regulatory actions to take place. Furthermore, the participatory nature of co-management creates an expectation among fishers of a legitimate process, thus encouraging compliant behaviour (Chuenpagdee and Jentoft, 2007; Jentoft, 2007). A successful co-management plan requires that the design of institutions is decided through meaningful participation and representation of a broad range of stakeholders. For small-scale fishers, this implies that their rights to locally organize and to devise their own institutions are not challenged by the government authorities (Ostrom, 1990).

Other factors that may contribute to successful community management and co-management of small-scale fisheries are robust and transparent leadership, which also fosters cooperative behaviour, effective and timely conflict resolution mechanisms at the local level, and access to training and technical assistance to improve knowledge about ecosystems, use of habitat friendly and selective gears, and quality control during the harvesting and post-harvesting processes.

2. FISHERY ASSESSMENT AND THE ECOSYSTEM APPROACH

The Ecosystem Approach to Fisheries (EAF) is rapidly becoming one of the most prominent frameworks with which to assess and manage the world's fisheries. The EAF is a fundamentally 'integrated' approach that connects ecological, socio-economic and institutional considerations and which, in turn, requires an integrated approach to the assessment of fishery systems. The challenge then lies in simultaneously developing an ecosystem approach to fisheries management and an integrated approach to fisheries assessment.

These two approaches are described in this section, with a focus on coastal fisheries, particularly in LAC, where many coastal states are already exploring ecosystem approaches to improving fisheries management, and corresponding mechanisms for a comprehensive assessment of the fishery systems and the corresponding coastal ecosystems. Moves toward EAF draw strongly on the range of policy and management directions described in Chapter 14 – certainly the use of comprehensive fisheries assessment and the adoption of alternative management schemes, but also efforts to build capacity for fishery data collection, assessment

and management, and the incorporation of social, economic and livelihood aspects into management decision-making.

2.1 Fishery assessment

As noted in Chapter 14, effective management requires integrated approaches to the assessment of fisheries. However, meeting this need becomes especially challenging when considering the uncertain conditions faced by coastal small-scale fisheries (environmental variability, market demands, etc.) and the complexity involved (multigear, multispecies, resources and fleet interactions). In addition, application of integrated fisheries assessment and permanent programmes for the evaluation of stocks is greatly limited in many countries in the LAC region by lack of both financial support to conduct research and sufficient personnel with the skills required for that task in many countries in the LAC region.

Several key components of coastal fisheries assessment are important, among them: (i) assessment of the resource itself; (ii) assessment of habitat and stock distribution; and (iii) assessment of fishing effort, selectivity and impact of different fishing gears on resources.

Stock assessment in small-scale fisheries

Two fundamental approaches to evaluate the conditions of the fisheries and the stocks they depend on are: (i) using data from the fishery itself; or (ii) using fishery-independent data – and in a few LAC cases – both (Puerto Rico, Argentina, Mexico). Data collection methods in fisheries involve on-site as well as off-site methods. The former includes sampling of commercial fisheries and on-board observers on fishing vessels; the latter comprises reports of fishers about their landings. Biological sampling of size, age, sexual maturity, etc., of commercial fisheries is a task most countries in the LAC region report as part of their strategies to evaluate fisheries, generally because this is relatively cheaper than independent surveys and on-board observer programmes. The method involving on-board observers is less common in small-scale fisheries, but involvement of fisheries in research programmes is becoming more frequent in the LAC area.

Data reported by fishers could at times contain biased reports; however, it is becoming clearer that information derived from fishers' logdocuments, especially if those logdocuments are used for their internal accounting, could be very useful for fishery analysis, including that involving spatial stock distribution. In some cases fishers' logdocument data are recorded by species (Mexico, Salas *et al*., 2004) and gear (Costa Rica, Chacon *et al*., 2007). Other approaches that integrate catch records at a mostly global level are reported by Chuenpagdee *et al*. (2006).

As indicated in Chapter 14, the level of fisheries analysis in different countries varies from the simple catch and effort trend analysis and some aspects of population dynamics to more complex and sophisticated age structured analyses using numerical and acoustic methods. For instance, analytical methods, including acoustic studies combined with development of assessment models (Erhardt and Deleveaux, 2007), provide applications in the context of constrained data sources.

Complexity of some stocks like small pelagic fishes will necessarily demand reliable spatial data in order to incorporate the dynamic behaviour of fishes. A less complex analysis, including size data and reproduction indicators, has been applied to demersal or benthic species. For example, fisheries indicators proposed by Froese (2004) to evaluate overfishing conditions include: percentage of specimens with optimum length in catch, percentage of mature fish in catch, and percentage of mega-spawners in catch. The author argues that such simple indicators have the potential to involve more stakeholders in the evaluation and management of fishery resources and could easily be considered for small-scale fisheries. Assessment of time series data, including size distribution, have shown overfishing patterns where fishing intensity has increased over time (Bené and Tewfik, 2004).

Habitat assessment and spatial analysis

Habitats are particularly crucial to fishery sustainability, and spatial distribution of stocks can vary widely if changes occur in their habitat (Caddy, 2007). In this context, spatial analysis to evaluate the distribution or connectivity of stocks becomes relevant, especially in cases where meta-populations have been identified. Studies focused on stock distribution based on habitat characteristics through survey studies and fishery-dependent data have recently been reported for the region (Ríos *et al*, 2007; Jaureguizar *et al*., 2006). Other research has been designated to evaluate the effect of port location when spatially managing coastal fisheries (e.g. Seijo and Caddy, 2008).

It should be pointed out that spatial analysis and sophisticated laboratory techniques may be prohibitive for scientists in some countries in the LAC region. Modelling, however, could use simple spreadsheets through to more complex programming languages without necessarily requiring high technology. In both cases, improvement of skills for the personnel in charge of stock assessment may be required. Support from international agencies has been oriented in this direction (FAO, CIDA, IDRC, WWF, World Bank, UNDP); however, it is the commitment from the agencies in charge of management in the various countries that is essential in order to maintain the effort supporting detailed research once the agencies leave.

Fishing effort, methods and gear

In most cases, the need to properly assess and control the fishing effort of small-scale fleets has been recognized in the LAC region. Nevertheless, the wide distribution of fishers along coastal areas makes proper evaluation difficult. An important consideration when assessing fisheries is the dynamics of small-scale boats. The operators of these coastal boats make short-run decisions concerning *what* to fish for, *where* to allocate the corresponding fishing effort, matters of bycatch and discarding, and long-run entry and exit decisions, which may or may not include changes in fishing power. Studies concentrating on bycatch seem to be more common in industrial fisheries than in small-scale coastal fisheries.

The assessment of fishing effort allocations and investment was not common within the evaluations in this publication, nor among the participants at the CoastFish conference. However, some work in the LAC region has been reported (Bené and Tewfik, 2001; Cabrera and Defeo, 2001; Salas *et al*., 2004; Salas and Charles, 2008). On the other hand, evaluation of fishing power and gear selectivity appear to be the most common of the categories referred to above, and seem to be used especially in those cases where deterioration of fisheries resources has been acknowledged.

Given the high diversity of fishing methods and gear employed in coastal small-scale fisheries in LAC, assessment of these fishing gears is particularly relevant. In addition, the need to improve selectivity – something more than fishing efficiency – due to the level of deterioration of stocks in many parts of the region requires studies dealing with the effects of alternative fishing gear on species and size selectivity. These evaluations involve experiments to test different types of gears and methods, which can be demanding in terms of time and money. However, participatory research can be undertaken with small-scale fishers genuinely interested in sustaining the yield of their fishery (Chuenpagdee *et al*., 2003; Rueda, 2007).

To support management decision-making (in addition to supporting bio-ecological analysis and stock assessment), detailed information on the social and economic circumstances of the fishers and their communities, marketing patterns or conservation needs must be gathered in future research efforts in this field. It should be pointed out that a recent study by Garcia *et al*. (2008) indicates that conventional frameworks for fishery assessment do not provide an adequate basis for informed management decisions and development planning in small-scale fisheries.

2.2 Ecosystem approach to coastal fisheries

A particularly significant move globally, to build alternative management schemes in fisheries and to incorporate the other directions noted in Chapter 14, is that of the EAF. There is international pressure on all fishing nations to implement an ecosystem approach in their domestic fisheries and in any international fishery in which they participate. The importance of the EAF was recognized in 2001 by 47 countries participating in the Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem. The signing parties declared "that in an effort to reinforce responsible and sustainable fisheries in the marine ecosystem, we will individually and collectively work in incorporating ecosystem considerations into that management…" (FAO, 2001).

The vision of an ecosystem approach to fisheries management is summarized in Chapter 17 of Agenda 21: "The marine environment – including oceans and all seas and adjacent coastal areas – forms an integrated whole that is an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development. International law … sets forth rights and obligations of states and provides the international basis upon which to pursue

the protection and sustainable development of the marine and coastal environment and its resources". As pointed out by Cochrane *et al*. (2004) and Ward *et al.* (2002), a number of attempts have been made to translate this ideal into a practical and feasible approach, including those of the United States National Research Council (1999), the Convention of Biological Diversity and the World Wide Fund for Nature.

FAO (2003) developed an interpretation of these and other efforts in the form of a rationale and a definition. The rationale: "The purpose of an ecosystem approach to fisheries is to plan, develop and manage fisheries in a manner that addresses the multiplicity of societal needs and desires, without jeopardizing the options of future generations to benefit from the full range of goods and services provided by the marine ecosystem." And the definition: "An ecosystem approach to fisheries to balance diverse societal objectives by taking account of the knowledge and uncertainties about biotic, abiotic and human components and applying an integrated approach to fisheries within ecological meaningful boundaries". As recognized by Cochrane *et al*. (2004), the implementation of the EAF is likely to be slow, and many countries, agencies and individuals are still in the process of understanding and interpreting just what is intended by the term EAF. One agreement that is emerging from the discussion is the need to capture the human and ecological interdependencies relevant for wise management of coastal ecosystems (De Young *et al.,* 2008). This is particularly relevant in the context of small-scale fisheries.

Ecosystem considerations in assessment and management of coastal fisheries

Integrated management of marine ecosystems is an approach required to manage multiple and competing uses (including fish harvesting in this case) of certain designated marine areas, including managing multiple stakeholders. It also requires, like EAF, processes of participatory decision-making and conflict resolution. It requires estimation of externalities involved in using the ecosystem and valuation of the goods and services of the marine ecosystem. For the valuation of goods and services of coastal ecosystems, it is important to acknowledge that human welfare can be derived from them by direct use or by consumption of fish products, by recognition of the indirect value of a marine ecosystem ecological service to the production of other goods and services, by the use or consumption of goods and ecological services by future generations, and by the inherent existence of such goods and services (De Young *et al*., 2008).

Two aspects of ecosystems considerations that require attention are the time needed to learn and acquire knowledge on the ecosystem, including the knowledge from fishers, and the need to carefully assess the impacts EAF interventions may have over the distribution of benefits and costs. A recent expert consultation on the economic and social implications of EAF acknowledged that EAF objectives and principles needed to be revised and expanded to better reflect social, economic and institutional implications (De Young *et al.*, 2008). It has also been recognized that an understanding of EAF in the context of co-management and community-based management is a priority (Seijo, 2007).

Because of the greater uncertainties involved in considering ecosystem dimensions as opposed to the single species approach, application of decision theory to address situations of limited information seems to be the way to proceed while continuing to build appropriate ecosystem information systems. These require more extensive coverage of capacity building and also training mechanisms for applying EAF with appropriate parsimony.

Some of the main issues that will need to be dealt with in small-scale fisheries in the process of establishing ecosystem approaches for management are the following (Seijo, 2007):

- Changes in management measures to implement an EAF are likely to lead to potential conflicts with stakeholders; this reality needs to be considered and allowances made in the process of developing an EAF for specific fisheries.
- Data collection requirements are greater with the EAF than with single target species analysis of fisheries.
- In developing coastal states where it is already difficult to implement adequate data collection for single species, obtaining scientifically-valid data in support of fisheries management, following an ecosystem approach, could pose major problems.
- Costs of building and maintaining data collection and analysis systems for entire marine ecosystems and their users (i.e. artisanal and industrial fishers, eco-tourists and non-consumptive users) are likely to be substantial.
- Information costs may need to be paid for by the multiple users of the ecosystem in order to meet the basic requirements for implementing an operational EAF.
- Managing fisheries, while taking into account limited knowledge and uncertainties on biotic, abiotic and human components, will require the development of adequate monitoring approaches.
- The focus cannot be exclusively on biological monitoring but should also include the human dynamics involving institutional, economic and social dimensions.

Data and indicators for an ecosystem approach to fisheries

The complexities of managing fisheries within an ecosystem framework will require the best science available and sustained input of fishers who have valuable empirical knowledge of the marine ecosystem with which they interact. In the transition from single species management approaches to EAF, while there will remain an inevitable focus on collecting basic data for the economically most important species, fisheries assessments should also monitor: (i) changes in the abundance of their prey and predators through appropriate survey-based indicators; (ii) changes in those environmental factors of importance to their life histories; and (iii) social, economic and institutional considerations that bear on the goals of management, and affect its chances of success.

This broadening of management raises some practical research questions to be considered in managing small-scale fisheries with a scope that goes beyond

the stock assessment of target species. For example: What are the critical habitat requirements for targeted marine resources and at what life stage and to what areas of restricted habitat do they apply? What is the variable extent and status of such critical habitats and how are these impacted by multiple human activities? What are the use and non-use values of the ecosystem where species are harvested by small-scale boats? How should the costs of ecosystem monitoring and surveillance be distributed among users and coastal states? These and other related questions could be addressed in the future to enhance the importance of ecosystem considerations in the management of coastal small-scale fisheries.

A fundamental step in the process of extending beyond the single species approach to fisheries management is that of building an operational and useful system of indicators and corresponding reference points. In order for fishery indicators to become more meaningful, they should explicitly account for changes in the ecosystem in which they occur, which can arise from such causes as climate changes, overfishing, environmental degradation due to human activities, or the destruction of critical habitats. Pikitch *et al*. (2004) note in particular that "...we need to develop community and system level standards, reference points and control rules similar to single species decision criteria".

It should be pointed out, however, as indicated by Sainsbury and Sumaila (2003), that before specifying indicators and reference points, there are two basic questions to answer: (i) Is there a need for explicit reference points for the ecosystem, such as food web dynamics, ecological community structure and biodiversity, or are species-based reference points sufficient? (ii) If ecosystem reference points are needed, should they be based on properties of the undisturbed coastal ecosystem? There seems to be an additional question: How to proceed in the absence of baseline studies of early stages of coastal development? The latter is a common situation in many LAC countries.

Spatial dimensions in an ecosystem approach

In managing fisheries cost effectively and in a way that maintains the integrity of coastal ecosystems, countries in the LAC region may have to incorporate spatial structure and dynamic environmental processes to properly account for changes in habitat and ecosystem function in the context of dynamic change.

Small-scale fishers respond spatially to resource distribution when allocating their fishing activity over space and time. This should be accounted for when assessing how small-scale fisheries are targeting species where seasonality in the spatial distribution of the resource is relevant, and when targeting sedentary resources with heterogeneous spatial distributions. In this respect, fishery indicators should be disaggregated over space and time to provide meaningful information to decision-makers. To progressively move in the direction of spatial management of fisheries, issues like the setting of an MPA with respect to source and sink areas would need to be considered (Ríos *et al*., 2007; Seijo and Caddy, 2008).

3. CONCLUDING REMARKS

Coastal fisheries in Latin America and the Caribbean are remarkably *diverse*. As a result, there can be no "one size fits all" answer to the specifics of assessment or management. Instead, it is crucial to seek out broadly-applicable frameworks and approaches. Therein lies the importance of moving toward innovative governance systems, effective institutions, integrated assessment frameworks and broad-based ecosystem approaches, as described in this chapter.

Along with their diversity, coastal fisheries are also inherently *complex*. In developing frameworks and approaches for effective assessment and management of small-scale fisheries, we must acknowledge the human, ecological and technological interdependencies present in the multiple use of coastal ecosystems. This will often require expanding beyond single species thinking into multispecies and multifleet approaches (Van den Bergh *et al*., 2007). It is also important to take into account fisher decision-making in small-scale fisheries, the complexities of which include flexible switching of target species that may occur seasonally by artisanal fleets as a function of species availability (catch rates) and markets/demand. A third key source of complexity in coastal fisheries is spatial heterogeneity – this suggests the need to pay attention to spatially-explicit management, such as through seasonally-closed areas or permanently closed areas (marine protected areas) in areas of particular sensitivity, such as nursery grounds and critical habitats.

In seeking new directions to cope with the above-noted diversity and complexity in coastal fisheries, it was noted in Chapter 14, and emphasized throughout this chapter, that there is a need to broaden the perspective on management. This includes suitable governance frameworks (including development of alternative management schemes), more comprehensive fisheries assessments, as well as a framework for an Ecosystem Approach to Fisheries that is specifically relevant to small-scale fisheries management. These moves require incorporating social, economic and livelihood considerations and paying attention to capacity-building needs.

Suitable frameworks and approaches for assessment and management must focus on coping under conditions of uncertainty, through a systematic process over time. This could be envisioned as including several major steps, such as the following:

(i) Define fisheries management questions in the context of the multiple users of the marine ecosystem, and of relevant ecological and technological interdependencies among species, habitats and fisheries within the ecosystem.

(ii) Determine suitable performance variables (biological/ecological, economic, social, cultural and institutional) as well as corresponding performance indicators and their limit and target reference points.

(iii) Identify alternative management, co-management or community management strategies for the fishery within a coastal ecosystem context.

(iv) Design, adapt or select a suitable assessment framework within which to evaluate management alternatives; this may range from intuitive approaches through to dynamic models of ecologically and technologically interdependent fishery systems along with suitable collection of data to estimate model parameters.
(v) Identify the key sources of uncertainty and risk (including, where possible, states of nature in uncertain and sensitive parameters, and probabilities relating to these) and apply decision criteria that take uncertainties into account.

This process should be adapted and made as simple as possible to facilitate data collection systems and management frameworks that can progressively deal with the added complexities of decision-making implied by new governance systems and ecosystem approaches.

Attention to effective governance and healthy ecosystems, as highlighted in this chapter, is urgently needed in many coastal fisheries of the LAC region, facing a combination of difficult problems including depleted stocks, degraded coastal habitats, excessive catching capacity, a shortage of local livelihood alternatives, and a lack of empowerment among fishers and fishing communities to participate in management decision-making. As noted earlier, there is no magic answer to this set of challenges. However, as pointed out in a number of contributions in this document, there are some promising mitigating strategies to the overexploitation syndrome in coastal fisheries. Among those raised herein, related either to governance or to ecosystem well-being, are management measures such as: (i) community and co-management approaches; (ii) self-regulation and self-policing; (iii) increased use of habitat-friendly fishing methods and selective gear, to protect the ecosystem that sustains the fishery; and (iv) a systematic planning approach to capacity management, aiming to ensure a desirable 'mix' in the fishery. In combination, such measures have various implications; for example, capacity management in a multispecies fishery might favour maintaining small- to medium-sized multipurpose vessels, which would more easily allow for flexible switching among target species, reducing the incentive to fish depleted species and thus giving the stocks time to recover.

Whatever the particular management interventions – the choice of which will be context-specific – adoption of suitable policy frameworks and approaches, as outlined in this chapter, is crucial. These provide pathways that build on existing success stories, providing positive directions toward a future of sustainable and resilient coastal fisheries across LAC.

REFERENCES

Agüero M. & Claverí M. 2007. Capacidad de pesca y manejo pesquero en América Latina: una síntesis de estudios de caso. *In* Capacidad de pesca y manejo pesquero en América Latina y el Caribe. Edited by M. Agüero. FAO Documento Técnico de Pesca 461. pp. 61–72.

Bené Ch. & Tewfik A. 2001. Fishing effort allocation and fishermen's decision making process in a multispecies small-scale fishery: Analysis of the conch and lobster fishery in Turk and Caicos Island. *Hum. Eco*., 29(2): 157–186.

Berkes F. (ed). 1989. *Common property resources: ecology and community-based sustainable development*. Belhaven Press, London.

Cabrera J.L. & Defeo O. 2001. Daily bio-economic analysis in a multispecific artisanal fishery in Yucatán, Mexico. *Aquat. Liv. Res*., 14: 19–28.

Caddy J.F. 2007. *Marine habitat and cover: their importance for productive coastal fishery resources*. UNESCO, Paris.

Caddy J.F. & Seijo J.C. 2005. This is more difficult than we thought! The responsibility of scientists, managers and stakeholders to mitigate the unsustainability of marine fisheries. *Phil. Trans. R. Soc*., 360: 59–75.

Castilla J.C. & Defeo O. 2001. Latin American benthic shellfisheries: emphasis in co-management and experimental practices. *Rev. Fish. Biol. Fish*., 11: 1–30.

Castilla J.C. & Gelcich S. 2008. Management of the loco (*Concholepas concholepas*) as a driver for self-governance of small-scale benthic fisheries in Chile. *In* Case studies in fisheries self-governance. Edited by R. Townsend, R. Shotton and H. Uchida. FAO Fisheries Technical Paper. No. 504. pp. 441–451. Rome, FAO.

CeDePesca. 2005. The imperative of recognizing artisanal fishworkers' fishing access rights. www.cedepesca.org.ar/

Chacón A., Araya H., Váquez R., Brenes R.A., Marín B.E., Palacios J.A., Soto R., Mejía-Arana F., Shimazu Y. & Hiramatsu K. 2007. Estadísticas pesqueras del Golfo de Nicoya, Costa Rica, 1994-2005. INCOPESCA-UNA-JICA. Costa Rica.

Chakallal B., Mahon R., McConney P., Nurse L. & Oderson D. 2007. Governance of fisheries and other living marine resources in the Wider Caribbean. *Fish. Res*., 87: 92–99.

Charles A. 2001. *Sustainable fishery systems*. Blackwell Science. UK.

Charles A. 2002. Use rights and responsible fisheries: limiting access and harvesting through rights-based management. *In* A Fishery manager's guidebook. Management measures and their application. Edited by K. Cochrane. FAO Fisheries Technical Paper. No. 424. Rome, FAO.

Charles A. 2004. Rights-based fishery management: A focus on use rights. *In* Who gets the fish? Proceedings of the New England Workshop on Rights-Based Fisheries Management Approaches. Edited by M.E. Petruny-Parker, K.M. Castro, M.L. Schwartz, L.G. Skrobe and B. Somers. Rhode Island Sea Grant, Narragansett, Rhode Island, USA.

Chuenpagdee R. & Jentoft S. 2007. Step zero for fisheries co-management: What precedes implementation? *Mar. Pol*., 31(6): 657–668.

Chuenpagdee R., Morgan L., Maxwell S., Norse E. & Pauly D. 2003. Shifting gears: assessing collateral impacts of fishing methods in United States waters. *Front Ecol. Environ*., 1(10): 517–524.

Chuenpagdee R., Liguori L., Palomares M.L.D. & Pauly D. 2006. Bottom-up, global estimates of small-scale fisheries catches. *Fish. Cen. Res. Rep*., 14(8). (Available at www.fisheries.ubc.ca/publications/).

Cochrane K.L., Augustyn C.J., Cockcroft A.C., David J.H.M., Griffiths M.H., Groeneveld J.C., Lipinski M.R., Smales M.J., Smith C.D. & Tarr R.J.Q. 2004. An ecosystem approach to fisheries in the Southern Benguela context. *Afr. J. mar. Sci.*, 26: 9–35.

Costanza R., Andrade F., Antunes P., van den Belt M., Boersma D., Boesch D.F., Catarino F., Hanna S., Limburg K., Low B., Molitor M., Pereira J.G., Rayner S., Santos R., Wilson J. & Young M. 1998. Principles for sustainable governance of the oceans. *Science*, 281: 198–199.

De Young C., Charles A. & Hjort A. 2008. Human dimensions of the ecosystem approach to fisheries. FAO Fisheries Technical Paper. No. 489. Rome, FAO.

Ehrhardt N. & Deleveaux V. 2007. The Bahamas' Nassau grouper (*Epinephelus striatus*) fishery – two assessment methods applied to a data-deficient coastal population. *Fish. Res.*, 87(1): 17–27.

FAO. 1995. Code of Conduct for Responsible Fisheries. Rome, FAO.

FAO. 2000. Informe del taller sobre manejo y asignación de recursos pesqueros a pescadores artesanales en América Latina, Valparaíso, Chile, April 25–28, 2000. Rome.

FAO. 2001. Report of the Reykjavik conference on responsible fisheries in the marine ecosystem. *Fish. Rep.*, 658. Rome.

FAO. 2003. Fisheries Management 2. The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4. Rome.

FAO. 2006. *The state of world fisheries and aquaculture*. Rome.

FAO. 2008. *The state of world fisheries and aquaculture*. Rome. 176p.

Froese R. 2004. Keep it simple: three indicators to deal with overfishing. *Fish and Fisheries*, 5: 86–91.

García S.M., Allison E.H., Andrew N.J., Néné C., Bianchi G., de Graaf G.J., Kolikoski D., Mahon R. & Orensan J.M. 2008. Towards integrated assessment and advice in small-scale fisheries: principles and processes. FAO Fisheries and Aquatic Technical Paper. No. 515. Rome, FAO.

Hilborn R. & Peterman R.M. 1996. The development of scientific advice with incomplete information in the context of the precautionary approach. *In* The precautionary approach to fisheries. Part 2: scientific papers. FAO Fisheries Technical Paper. No. 350/2, pp. 77–101.

Jentoft S. 2007. Beyond fisheries management: The Phronetic dimension. *Mar. Pol.*, 30(6): 671–680.

Jaureguizar A., Menni R., Lasta C. & Guerrero R. 2006. Fish assemblages of the Northern Argentine Coastal System: spatial patterns and their temporal variations. *Fish. Oceanogr.*, 15(4): 326–344.

Kooiman J., Bavinck M., Jentoft S. & Pullin R. (eds). 2005. Fish for life. Interactive governance for fisheries. MARE Publ. Series No. 3. Amsterdam University Press. Amsterdam.

McConney P. & Baldeo R. 2007. Lessons in co-management from beach seine and lobster fisheries in Grenada. *Fish. Res.*, 87: 77–85.

National Research Council, Committee on Ecosystem Management for Sustainable Marine Fisheries. 1999. Sustaining Marine Fisheries. National Academy Press. Washington, DC.

OECD. 2006. Financial support to fisheries. Implications for sustainable development. Organization for Economic Co-operation and Development. Paris, France.

Pikitch E.K., Santora C., Babcock E.A., Bakun A., Bonfil R., Conover D.O., Dayton P., Doukakis P., Fluharty D., Heneman B., Houde E.D., Link J., Livingston P.A., Mangel M., McAllister M.K., Pope J. & Sainsbury K.J. 2004. Ecosystem-based fishery management. *Science*, 305: 346–347.

Ostrom E. 1990. *Governing the commons. The evolution of institutions for collective action*. Cambridge University Press, Cambridge, UK.

Ostrom E. & Hess C. 2007. Private and common property rights. Working paper Series SSRN-id1304699.pdf . Available at SSRN: http://ssrn.com/abstract=1304699

Ríos-Lara V., Salas S., Bello-Pineda J. & Peniche-Ayora I. 2007. Distribution patterns of spiny lobster (*Panulirus argus*). *Fish. Res.*, 87(1): 35–45.

Rueda M. 2007. Evaluating the selective performance of the encircling gillnet used in tropical estuarine fisheries from Colombia. *Fish. Res*., 87(1): 28–34.

Sainsbury K. & Sumaila U.R. 2003. Incorporating ecosystem objectives into management of sustainable marine fisheries, including 'best practice' reference points and use of marine protected areas. *In* Responsible Fisheries in the Marine Ecosystem. Edited by M. Sinclair and G. Valdimarsson. CABI Publishing, Rome. pp. 343–361.

Salas S. & Charles A. 2008. Are small-scale fishers profit maximizers?: Exploring fishing performance of small-scale fishers and factors determining catch rates. *Proc. Gulf Carib. Fish. Inst*., 60: 117–124.

Salas S., Sumaila R.U. & Pitcher T. 2004. Short-term decisions of small-scale fisheries selecting alternative target species: a choice model. *Can. J. Fish. Aquat. Sci*., 61(3): 374–383.

Salas S., Chuenpagdee R., Seijo J.C. & Charles, A. 2007. Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. *Fish. Res*., 87: 5–16.

Schmid A.A. 1987. *Property, power and public choice*. Praeger, New York.

Schmid A.A. 2004. *Conflict and cooperation: Institutional and behavioural economics*. Oxford: Blackwell.

Schelling T.C. 1978. *Micromotives and Macrobehaviour*. W.W. Norton and Company, New York.

Seijo J.C. 1993. Individual transferable grounds in a community managed artisanal fishery. *Mar. Res. Econ*., 8: 78–81.

Seijo J.C. 2007. Considerations for management of metapopulations in small-scale fisheries of the Mesoamerican barrier reef ecosystem. *Fish. Res*., 87: 86–91.

Seijo J.C. & Caddy J.F. 2008. Port location for inshore fleets affects the sustainability of coastal source-sink resources: implications for spatial management of metapopulations. *Fish. Res*., 91(2–3): 336–348.

Sosa-Cordero E., Liceaga-Correa M.A. & Seijo J.C. 2008. The Punta Allen lobster fishery current status and recent trends. *In* Case studies in fisheries self-governance. Edited by R. Townsend, R. Shotton and H. Uchida. FAO Fisheries Technical Paper No. 504. pp. 149–162.

Sutinen J. 1999. What works well and why: evidence from fishery management experience in OECD countries. *ICES J. Mar. Sci*., 56(6): 1051–1058.

Van den Bergh, J.C.J.M., Hoekstra J., Imeson R., Nunes P.A.L.D. & de Blaeij A.T. 2007. *Bio-economic modelling and valuation of exploited marine ecosystems*. Springer, the Netherlands.

Ward T., Tarte D., Hegerl E. & Short K. 2002. Policy proposals and operational guidance for ecosystem based management of marine capture fisheries. WWF Australia.

FAO
FISHERIES AND
AQUACULTURE
TECHNICAL
PAPER

ISSN 2070-7010

544

Coastal fisheries of Latin America and the Caribbean






incofish

FAO
FIAT PANIS

Cover photos and credits (from top left clockwise):
Fishing boat with bottom nets for hoki in Tierra del Fuego, Argentina (courtesy of Miguel S. Isla); landing products in Holbox, Quintana Roo, Mexico (courtesy of Mizue Oe); artisanal boat operating in Santa Marta, Colombia (courtesy of Mario Rueda); artisanal fisher fishing octopus in Yucatán, Mexico (courtesy of Manuel Solis); lobster boat with traps in Cuba (Centro de Investigaciones Pesqueras de Cuba); artisanal boat operating in Santa Marta, Colombia (courtesy of Mario Rueda).

Coastal fisheries of Latin America and the Caribbean

FAO
FISHERIES AND
AQUACULTURE
TECHNICAL
PAPER

544

Edited by

Silvia Salas
Centro de Investigación y de Estudios Avanzados Unidad Mérida
Mérida, Yucatán, Mexico

Ratana Chuenpagdee
Memorial University of Newfoundland
St. John's, Newfoundland, Canada

Anthony Charles
Saint Mary's University
Halifax, Nova Scotia, Canada

Juan Carlos Seijo
Universidad Marista de Mérida
Mérida, Yucatán, Mexico

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2011

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patterned, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The word "countries" appearing in the text refers to countries, territories and areas without distinction.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

ISBN 978-92-5-106722-2

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all other queries concerning rights and licences, should be addressed by e-mail to copyright@fao.org or to the Chief, Publishing Policy and Support Branch, Officer of Knowledge Exchange, Research and Extension, FAO, Viale Terme di Caracalla, 00153 Rome, Italy.

© FAO 2011

Abstract

The importance of fisheries for coastal communities and livelihoods in Latin America and the Caribbean (LAC) is well documented. This is particularly the case for 'coastal fisheries', including subsistence, traditional (artisanal) and advanced artisanal (or semi-industrial) varieties. There are, however, major gaps in knowledge about these fisheries, and major challenges in their assessment and management. Therein lies the key theme of this document, which seeks to contribute to a better understanding of coastal fisheries in the LAC region, as well as to generate discussion about ways to move towards sustainable fisheries. The document includes three main components. First, an introductory chapter provides an overview of general trends in the fisheries of the LAC countries, as well as some of the key challenges they are facing in terms of sustainability. Second, a set of twelve chapters each reporting on the coastal fisheries of one country in Latin America and the Caribbean, collectively covering fisheries of each main subregion: the Caribbean islands (Barbados, Cuba, Dominican Republic, Grenada, Puerto Rico, Trinidad and Tobago), North and Central America (Costa Rica, Mexico) and South America (Argentina, Brazil, Colombia, Uruguay). All these country-specific chapters follow an integrated approach, to the extent possible, covering aspects ranging from the biological to the socio-economic. Third, the final component of the document contains a synthesis of information from the countries examined, an analysis of the main issues and challenges faced by the various fisheries, an outline of policy directions to improve fisheries management systems in the LAC region, identification of routes toward more integrated approaches for coastal fisheries management, and recommendations for 'ways forward' in dealing with fishery assessment and governance issues in the region.

Salas, S.; Chuenpagdee, R.; Charles, A.; Seijo, J.C. (eds).
Coastal fisheries of Latin America and the Caribbean.
FAO Fisheries and Aquaculture Technical Paper. No. 544. Rome, FAO. 2011. 430p.

Contents

Dedication
Preparation of this document iii
Abstract iv
Acknowledgements vii
Preface viii

1. Coastal fisheries of Latin America and the Caribbean: issues and trends 1
Silvia Salas, Ratana Chuenpagdee, Anthony Charles and Juan Carlos Seijo

2. Coastal fisheries of Argentina 13
Inés Elías, Claudia Carozza, Edgardo E. Di Giácomo, Miguel S. Isla, J.M. (Lobo) Orensanz, Ana María Parma, Raúl C. Pereiro, M. Raquel Perier, ✞Ricardo G. Perrotta, María E. Ré and Claudio Ruarte

3. Coastal fisheries of Barbados 49
Patrick McConney

4. Coastal fisheries of Brazil 73
Marcelo Vasconcellos, Antonio Carlos Diegues and Daniela Coswig Kalikoski

5. Coastal fisheries of Colombia 117
Mario Rueda, Jacobo Blanco, Juan Carlos Narváez, Efraín Viloria and Claudia Stella Beltrán.

6. Coastal fisheries of Costa Rica 137
Ángel Herrera-Ulloa, Luis Villalobos-Chacón, José Palacios-Villegas, Rigoberto Viquez-Portuguéz and Guillermo Oro-Marcos

7. Coastal fisheries of Cuba 155
Servando V. Valle, Mireya Sosa, Rafael Puga, Luis Font and Regla Duthit

8. Coastal fisheries of the Dominican Republic 175
Alejandro Herrera, Liliana Betancourt, Miguel Silva, Patricia Lamelas and Alba Melo

9. Coastal fisheries of Grenada 219
Roland Baldeo

10. Coastal fisheries of Mexico 231
José Ignacio Fernández, Porfirio Álvarez-Torres, Francisco Arreguín-Sánchez, Luís G. López-Lemus, Germán Ponce, Antonio Díaz-de-León, Enrique Arcos-Huitrón and Pablo del Monte-Luna

11. Coastal fisheries of Puerto Rico 285
Mónica Valle-Esquivel, Manoj Shivlani, Daniel Matos-Caraballo and David J. Die

12. Coastal fisheries of Trinidad and Tobago 315
Elizabeth Mohammed, Lara Ferreira, Suzuette Soomai, Louanna Martin and Christine Chan A. Shing

13. Coastal fisheries of Uruguay 357
Omar Defeo, Pablo Puig, Sebastián Horta and Anita de Álava

14. Assessing and managing coastal fisheries of Latin America and the Caribbean: underlying patterns and trends 385
Ratana Chuenpagdee, Silvia Salas, Anthony Charles and Juan Carlos Seijo

15. Toward sustainability for coastal fisheries of Latin America and the Caribbean: effective governance and healthy ecosystems 403
Juan Carlos Seijo, Anthony Charles, Ratana Chuenpagdee and Silvia Salas

16. Concluding thoughts: coastal fisheries of Latin America and the Caribbean 423
Anthony Charles, Silvia Salas, Juan Carlos Seijo and Ratana Chuenpagdee

List of contributors 427

Editors' profile 429