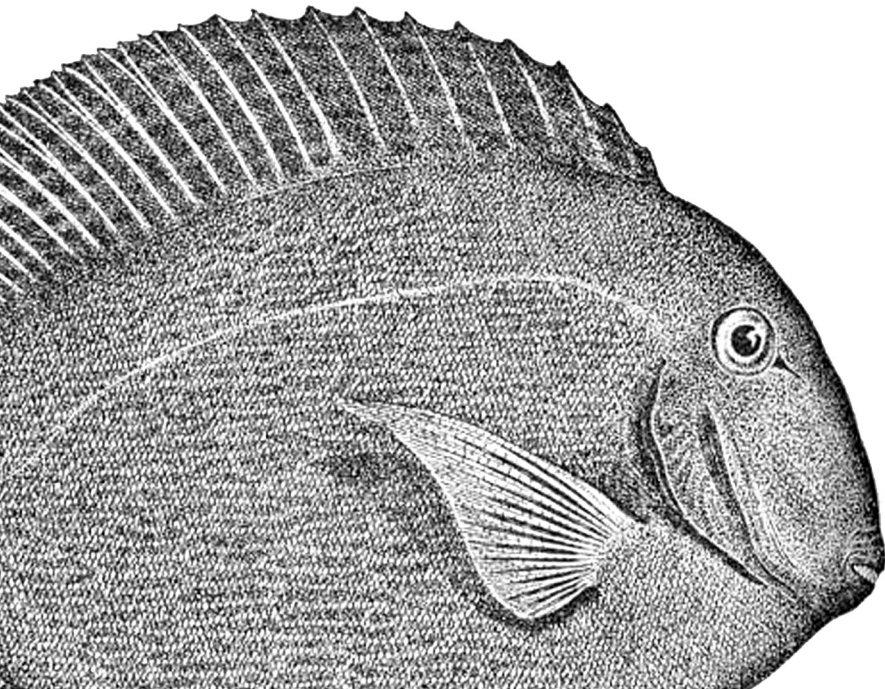


VOLUME

3

Territorial Use Rights for Fishing

Sarah E. Poon and Kate Bonzon



CATCH SHARE DESIGN MANUAL

VOLUME

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Introduction

Fishery stakeholders are increasingly interested in catch shares as an effective approach for managing fisheries. The **Catch Share Design Manual, Volume 1: A Guide for Fishermen and Managers**, first published in 2010, provides the first ever step-by-step planning guide of catch share design. Drawing on experience from around the world, it highlights the flexibility of catch shares and outlines how they can be specially designed to meet the specific characteristics and goals of different fisheries. The Design Manual is not prescriptive: It is a series of questions whose answers help guide and inform the catch share design process.

This volume of the **Catch Share Design Manual** builds on **Volume 1** and provides more detailed guidance on the design of area-based catch shares, commonly referred to as Territorial Use Rights for Fishing (TURFs)¹. These are a specific type of catch share in which secure, exclusive areas with appropriate controls on fishing mortality are allocated to groups of fishermen or in rare cases, to individuals. While less than 10% of catch shares are area-based, there is growing interest in the use and design of TURFs as an effective approach for ensuring sustainable fisheries.

¹ **Volume 1** generally refers to TURFs as area-based catch shares. In this volume, the term "TURF" is used because it is a familiar and accepted term in many fisheries. The guidance in **Volume 1** will help you determine whether a TURF is the most appropriate type of catch share for your fishery, including whether to allocate areas to groups ("Cooperatives") or individuals. Throughout these documents, "Cooperative" is capitalized when referring to a group that has been allocated and manages a secure, exclusive share of the catch or area of a fishery, as in a Cooperative catch share program. When not capitalized, "cooperative" refers to an organized group that has not been allocated secure fishing privileges, but may coordinate other activities, such as marketing.

This volume is intended to help you—whether you are a manager, a fisherman, a scientist or another interested party—design successful TURF programs. It should be used in conjunction with **Volume 1** of the **Catch Share Design Manual**, as well as additional research, analysis and consultation of experts in order to design the most appropriate catch share program for your fishery. It follows the same seven-step design approach, but expands upon the decisions that are unique to area-based catch shares. It also includes four in-depth **Catch Shares in Action** reports, starting on page 97, that highlight real-life examples of TURFs and design decisions in action:

- Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program
- Samoan Safata District Customary User Rights Program
- Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System
- Japanese Common Fishing Rights System

The reports provide a snapshot of the diversity of TURFs, including insight as to how TURFs are designed in different contexts and with varied levels of complexity.

Before you begin designing a TURF program, you should assess the existing state and context of the fishery. Most fisheries already have a management structure in place with established regulations, institutions, participants and stakeholders. Years or decades of fishing and management influence the current state of the fishery, and these traditions should be taken into account when considering, designing and implementing a catch share approach.

Assessing your fishery—from the ecological, economic and sociopolitical perspective—can help drive appropriate and effective design. It will help you identify current strengths to be leveraged, as well as challenges that can be addressed during the design process. See **Volume 1** for a more extensive discussion of actions to take before designing your catch share program.

WHAT IS A TURF?

A TURF is an area-based fishery management approach in which groups, or in rare cases individuals, are granted secure, exclusive privileges to fish in a specified area. Well-designed TURFs have appropriate controls on fishing mortality and hold fishermen accountable to comply with these controls.

TURFs have been used in a variety of contexts around the world, and there is increasing interest in using TURFs to manage fisheries. Most TURF systems do not grant ownership of fishing areas. Rather, they typically allocate exclusive harvesting privileges for one or more marine species in a specified area.² Most TURFs do not occur independently, but are instead part of a broader system of TURFs. In this volume, the term “TURF” is used in reference to the design features of a single TURF, and “TURF system” refers to the broader design features of a TURF management system, which may be comprised of one or multiple TURFs.

In addition to the strong record of biological, economic and social performance that has been shown for all types of catch shares (see **Volume 1** for a complete discussion), research and experience have shown that well-designed TURFs may have the following additional outcomes:

- Increased compatibility with multi-species fisheries management and ecosystem-based management (Wilén et al., 2012)
- Direct benefits from habitat conservation (Wilén et al., 2012)
- Management at a fine scale enabled by local science and decision making (Prince, 2003)
- Efficient spatial and temporal distribution of fishing activity (Pollnac, 1984; Cancino et al., 2007; Wilén et al., 2012)
- Compatibility with marine spatial planning, reducing direct competition for marine space with other industries (Sanchirico et al., 2010)

- Direct benefits to local communities from sustainable fisheries management (Ponce-Taylor et al., 2006; Pérez Ramírez et al., 2012)

TURFs are generally allocated to, and managed by, a group of fishermen. As a result, much of TURF design includes designing effective group-allocated catch shares (also called “Cooperative catch shares”). In this volume, the term “Cooperative” is used broadly to refer to any organized group of fishermen that has been allocated a secure area (such as a harvesting cooperative, association, fishermen organization, sector, producer organization, guild, union or community), whether or not the Cooperative has legal or formal recognition. Cooperatives are generally comprised of fishermen (often from the same community) who share commonalities, such as the same target species, fishing area or gear type. A key characteristic of successful Cooperatives is that members share common goals.

Hundreds of Cooperatives around the world participate in managing TURFs. The way Cooperatives are organized and the functions they perform vary depending on the social, economic and political contexts in which they operate, as well as their capacity and maturity as organizations. A well-functioning Cooperative aligns the incentives of its members with the long-term welfare of the group, thereby preventing overharvesting and a competitive race for fish. Cooperative members share a common goal of sustainable management and are collectively rewarded for stewardship. This volume describes the design considerations for establishing effective Cooperatives to manage TURFs in which the incentives of fishermen are aligned with the long-term health of the resource. **Catch Share Design Manual, Volume 2: Cooperative Catch Shares** provides design guidance for Cooperatives that are allocated quota-based privileges rather than TURFs,³ which are area-based.

The degree of organization among fishermen at the onset of designing a TURF will vary. In some places, fishermen may already be organized into a functioning group, whereas in

² Catch shares are designed to manage wild stocks. This volume is not intended to provide management guidance for aquaculture operations, even though they can involve area-based privileges. Some area-based catch shares do set up aquaculture operations in addition to wild capture, or enhance wild populations through seeding or other activities.

³ The design advice in Volume 2 is relevant to TURF design, and much of the content is duplicated in this volume to provide comprehensive advice on Cooperative co-management of TURFs.

others, organizing fishermen may be a necessary part of the design process. Whatever the starting point, fishermen and managers can work together to establish an appropriate program for the existing context and can evolve and adapt the program over time.

The guidance in this volume can also be used to design TURFs that are allocated to individuals. However, allocating TURFs to individuals is likely to be less complex, and not all of the guidance herein will apply.

The design steps in this manual will apply to decisions made at the single TURF level and the TURF system level. TURF design has generally been accomplished in two ways (Aburto et al., 2012):

1. Design of a TURF or TURF system is driven by local communities, and a national or regional government body provides a framework for TURFs

to be successful via legal, operational and financial support. For example, community-based territorial rights that have existed for centuries are now formally recognized by national law in Fiji, Vanuatu, Papua New Guinea, Samoa, the Solomon Islands and Palau (Aswani, 2005).

2. TURF or TURF system design is driven by the government, and fishing privileges and management responsibilities are allocated to users based on a national or regional framework.

Neither approach is inherently better than the other, but the one chosen may determine who is making the design decisions outlined in this volume. In either case, the roles of each managing body should be clearly defined. TURF design may be most successful when decisions are made jointly by local stakeholders and government fishery managers, combining both approaches.

HOW DO TURFS FIT INTO CO-MANAGEMENT?

A hallmark of TURFs is the ability to vest some management responsibilities to the TURF users in exchange for exclusive harvesting privileges. Many TURF systems around the world involve a co-management approach where managers and users share management responsibility and authority. Generally, managers maintain responsibility for identifying performance standards and ensuring effective compliance, while TURF users—usually organized as a Cooperative—are responsible for the day-to-day management responsibilities. A co-management approach

can allow for locally appropriate management and real-time decision making. Cooperatives typically do not need national level approval for basic management activities—such as implementation of catch limits, closed seasons, gear restrictions, size limits, no-take zones and locally appropriate means of monitoring and enforcement—as long as they are complying with performance standards set by the government, such as maintaining a sustainable stock. Much of the design advice in this volume is geared toward establishing Cooperatives that are effective and have a strong co-management relationship with the government.

CAN TURFS BE PAIRED WITH RESERVES?

There is growing experience with, and interest in, pairing TURFs with no-take reserves (areas where no fishing is allowed). Theory and practice show advantages to pairing TURFs with reserves, as fishermen directly benefit from reserves and have greater incentive to implement and enforce them. For example, fishermen will ultimately have

access to larger and/or more abundant fish that spill over from the no-take reserves and will therefore be incentivized to protect them. These benefits and design elements for pairing TURFs with no-take reserves are discussed in more detail in this volume.

UNDER WHAT CONDITIONS ARE TURFS IDEAL?

TURFs are widely used around the world and have existed in some regions for centuries. Appropriately designed TURFs allocate secure, exclusive privileges to a user or group of users and enable and encourage sustainable resource use. TURFs with scientifically based controls on fishing mortality are most appropriate for ensuring fishery sustainability.

Because TURFs allocate resources in a defined area, they are typically most feasible in fisheries where there is a clear spatial extent of fishing activity. A clear connection between fishermen and a defined fishing area facilitates boundary definition (Dahl, 1988). Additionally, natural boundaries such as enclosed bays can facilitate TURF boundary definition and enforcement.

TURFs are ideal for benthic and sedentary species, and are commonly used for shellfish fisheries (Defeo and Castilla, 2005). These species are most suitable for TURF management because there is little or no movement of adults beyond TURF boundaries; as a result, TURF users clearly see how their actions impact the resource and can directly benefit from their conservation behaviors. TURFs may also work well for mobile species that do not face significant fishing pressure outside of the TURF.

TURFs may be most effective when they are allocated to a defined, organized user group. Organized user groups with strong social capital and strong leadership are more likely to have the capacity to take part in managing their resources (Gutierrez et al., 2011). A group that relies on fisheries for its livelihood has a strong incentive to implement and enforce fishery regulations to protect the resource. Organizations of fishermen are a key component of TURF management, and the features of a successful co-managing group, or Cooperative, are discussed throughout this volume.

Even in the absence of the preferred conditions, TURFs are sometimes implemented because quota-based catch shares are not feasible or practical given the physical, social or economic characteristics of the region or fishery. For example, scientific data collection and analysis for setting catch limits may be prohibitively costly or otherwise infeasible to administer, whereas other fishing mortality controls that do not require as much data might be feasible. Fisheries involving many participants dispersed across broad areas may not be well suited for individual quota programs administered by a national government.

In Chile, for example, individual quotas for valuable invertebrate species were difficult to administer and enforce across the country's vast coastline. A national system of TURFs⁴ co-managed by community fishermen organizations was deemed more likely to meet management goals and was implemented as a feasible and effective alternative (see **Catch Shares in Action: Chilean National Benthic Territorial Use Rights for Fishing Program in Volume 1**). Similarly, customary marine tenure systems have emerged in many small island nations where fishing communities are widely dispersed and management by a centralized government authority is impractical.

TURF design and experience are rapidly advancing to ensure TURFs can be successful in a variety of contexts. For example, they can be implemented for more mobile species, with special design features to account for the movement of fish outside TURF borders. TURFs can also be designed to accommodate multiple user groups (see **Consider Which TURF Type is Best for Your Fishery**). Where fishermen are not well organized, managers may facilitate organization. Additionally, fishery managers retain the ultimate responsibility for ensuring sustainability and set performance standards for TURFs to ensure biological goals are met.

⁴ The system is formally named Management and Exploitation Areas of Benthic Resources, and referred to hereinafter as the Chilean TURF Program.

CATCH SHARE BASICS

WHAT IS A CATCH SHARE?

A catch share program allocates a secure area or privilege to harvest a share of a fishery's total catch to an individual or group. Programs establish appropriate controls on fishing mortality and hold participants accountable.

Catch shares can be either quota-based or area-based. Quota-based programs establish a fishery-wide catch limit, assign portions (or shares) of the catch to participants and hold participants directly accountable to stay within the catch limit. Area-based programs, or TURFs, allocate a secure, exclusive area to participants and include appropriate controls on fishing mortality that ensure long-term sustainability of the stock. Many catch share programs are transferable, meaning participants can buy, sell and/or lease shares. This market allows the fishery to internally adjust to changes in the catch limit and allows participants to enter and exit the fishery.

Catch shares are fundamentally different from other management approaches and are generally implemented after a variety of other approaches prove inadequate for meeting specific goals. Most commercial fisheries start as open access, where anyone who puts in the effort is allowed to catch fish. As competition increases, managers

often limit access by licensing participants. When licenses can no longer effectively control fishing effort and catches, managers implement more and more effort-based regulations to control catches. Examples of these regulations include limitations on the amount of catch allowed per trip, the size of vessel, fishing days and more. In many cases, these management efforts do not succeed in maintaining stable fish populations or in promoting profitable, safe fisheries.

By allocating participants a secure share of the catch or fishing area, catch share programs give participants a long-term stake in the fishery and tie their current behavior to future outcomes. This security provides a stewardship incentive for fishermen that was previously missing or too uncertain to influence their behavior toward long-term conservation. Catch share programs align the business interests of fishermen with the long-term sustainability of the stock, and provide more stability and predictability within a fishing year and over time. Furthermore, catch share fishermen are held accountable—they are required to stay within their allocated share of the overall catch, or to ensure harvesting activity in their allocated area complies with science-based controls on fishing mortality.

Icons Key | Icons used throughout the Design Manual to highlight key catch share design features



Single-species



Individually-allocated



Quota-based



Transferable



Multi-species



Group-allocated



Area-based

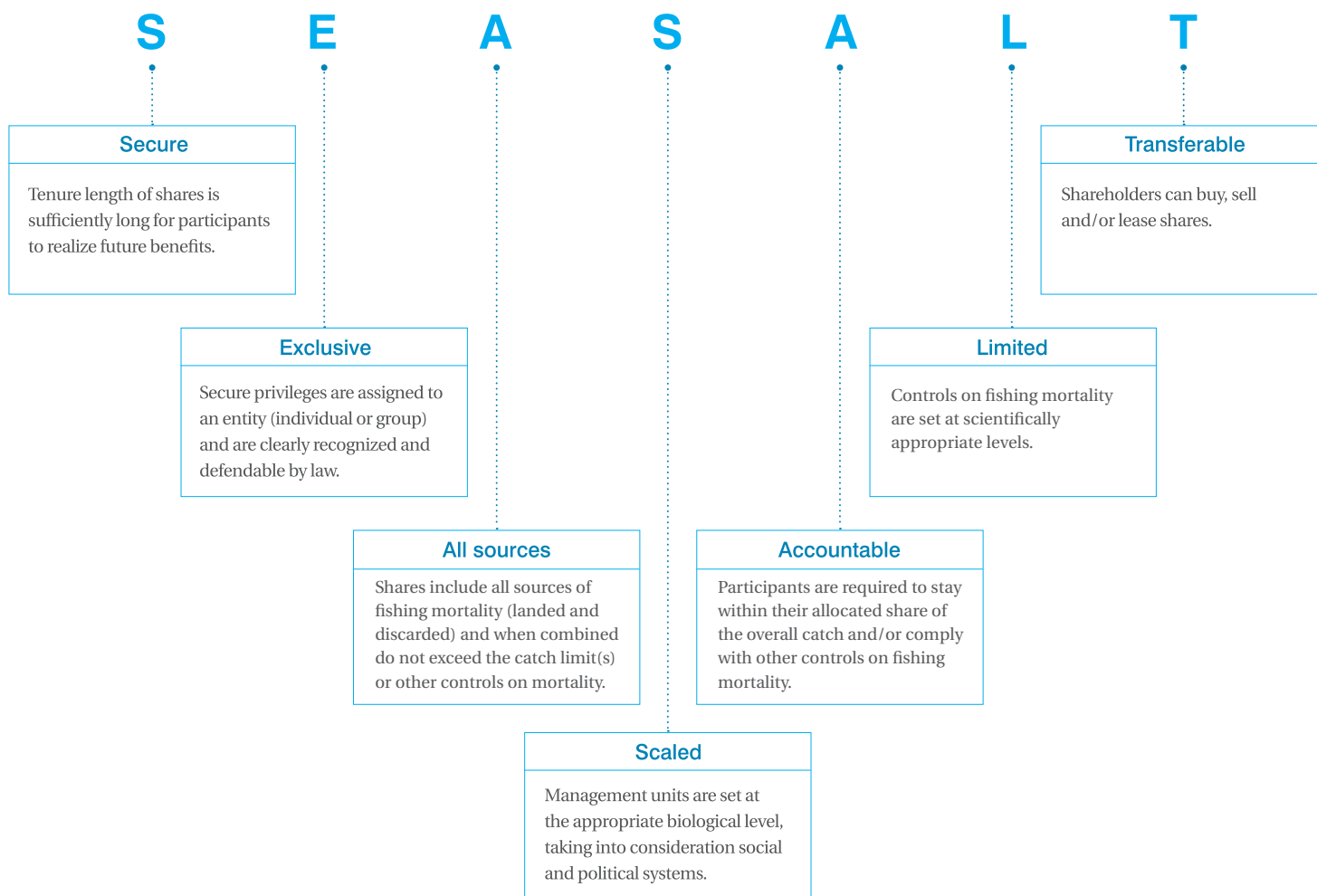


Non-transferable

WHAT ARE THE KEY ATTRIBUTES OF A CATCH SHARE?

In order to better understand catch share programs, it is useful to outline their key attributes. The SEASALT mnemonic, developed for the **Catch Share Design Manual**, describes commonly occurring attributes of catch share programs. It is based on a review of existing catch share programs and theoretical literature. Not all of these

components are required for a catch share to be successful. However, the more completely a program is designed to incorporate each of these attributes, the higher the likelihood of meeting the program's biological, economic and social goals.



Consider Which TURF Type is Best for Your Fishery

Before designing a TURF or TURF system, it is important to consider the context in which the TURF will occur and how the social and ecological characteristics of the fishery will affect the TURF design and outcomes. TURFs have been used in a variety of biological, geopolitical and socioeconomic contexts, from relatively simple to highly complex. Complexity in a fishery can be addressed by designing TURFs that are appropriately **Scaled**.

Fisheries vary in complexity in the characteristics of both the resource and its users, and key design features have enabled effective TURF management at all degrees of

complexity. Drawing from the experiences of fisheries around the world, this volume provides guidance for designing and implementing single TURFs at the local level and, when appropriate, forming a network of TURFs to account for resource and/or user complexity. *The key to effective TURF design is to break the fishery down into one or many single TURFs that match the biological and social characteristics of the fishery.* This concept serves as the basis for many of the design principles in this volume. Table A provides examples of factors that affect user complexity and resource complexity, and that inform the appropriate scale for TURF implementation.

TABLE A | EXAMPLES OF FACTORS AFFECTING COMPLEXITY IN A TURF SYSTEM

	LOW	HIGH
RESOURCE COMPLEXITY	<ul style="list-style-type: none"> Single or few species targeted Low to moderately mobile species with little ecological connection among fished areas Low degree of interaction with other species 	<ul style="list-style-type: none"> Multiple species targeted Highly mobile species that move among various fishing areas High degree of interaction with other species
USER COMPLEXITY	<ul style="list-style-type: none"> Fishing community is well-defined geographically Fishing community is geographically isolated Fishermen use low impact, selective gear; target specific species Fishermen are organized into clearly defined groups Few conflicts between users; low pressure from outside users 	<ul style="list-style-type: none"> Fishermen are highly dispersed Fishing occurs in densely populated areas Fishermen use high impact gears, multiple gear types; target multiple species Fishermen are heterogeneous, uncoordinated and many different types of users may access the same resource in the same area Conflicts between users are common; high pressure from outside users

Your TURF design process will likely be constrained by jurisdictional boundaries or other sociopolitical factors. Consequently, the way in which you think about fishery users and the resources they target may largely be determined by the management unit that you are responsible for or participate in, whether it is a local, regional or national fishing area. As you think about the complexity of your fishery, focus primarily on the biological and social elements within your management jurisdiction. Then, consider how your management unit is nested within the broader fishery management system and whether additional design features (e.g., cross-boundary coordination) will improve the likelihood of attaining your biological, economic and social goals.

Addressing complexity begins with understanding the biological characteristics of the fishery and the social characteristics of its users. In this volume, “functional units” are presented as a way to think about the dimensions of complexity in your fishery:

- *Biological functional unit* – The geographical range of a self-sustaining stock or sub-stock of fish (based on the movement of adult fish and the spatial scale of larval dispersal). The biological functional unit will reflect the most appropriate spatial scale for managing the fishery to ensure stock sustainability.
- *Social functional unit* – A group of people who have the capacity to organize and participate in managing

their fishery. A social functional unit will often be in the form of a Cooperative.

A fishery may have one or several spatially explicit functional units (biological or social), or it may have overlapping functional units representing different fished species or different user groups. In the simplest fisheries, the social functional unit and the biological functional unit will be congruent. In more complex fisheries, however, managers have the challenge of designing effective TURFs where the biological and social functional units are incongruent.

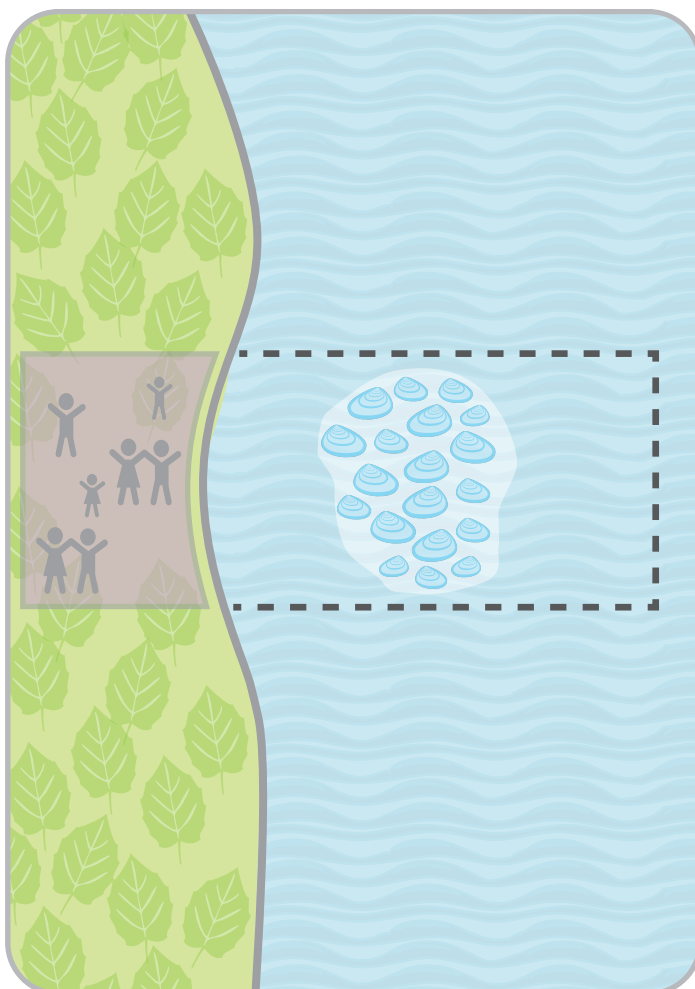
To help you understand how complexity in your fishery will affect TURF design, we present four TURF types that commonly occur. Most TURF systems fall into one of these four categories, and we will discuss TURF design elements throughout this volume as they pertain to each. Each TURF type is described below using a hypothetical fishery and a conceptual diagram of the relationship between the biological and social functional units. A summary showing all four TURF types is provided at the end of this section for easy reference. Additionally, the four fisheries presented in the **Catch Shares in Action** section reflect the full range of TURF types. Not all fisheries will clearly align with one of the types, but thinking about which type your fishery most closely resembles can help you identify necessary design features for managing the resource at the appropriate scale.

TURF TYPE 1

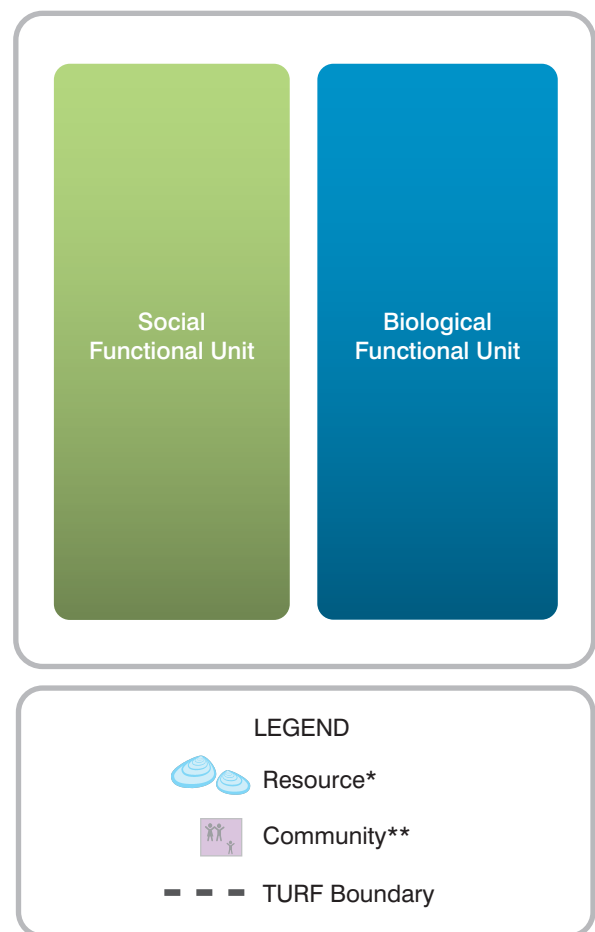
Consider the relative simplicity of scaling a TURF for hypothetical Fishery 1 in the figure below. In this fishery, one cohesive, organized community occupies the purple area and targets sedentary invertebrate species on the reef patch shown by the shaded area. The community is in an isolated area of the coastline. In this case, it is somewhat simple to design an appropriate TURF because the social functional unit and the biological functional unit are congruent (see, for example, the hypothetical TURF represented by the dashed line).

Fishery 1 is an example of what we have defined here as TURF Type 1. This TURF type commonly occurs for benthic species that have little movement across fished areas, and in areas where user groups are geographically defined and often isolated from one another. For example, the **Mexican Vigía Chico Spiny Lobster Cooperative** is a community-based Cooperative that has exclusive lobster harvesting privileges in an enclosed bay (see **Catch Shares in Action**).

Fishery 1



TURF Type 1



* Resource represents a biological functional unit.
** Community represents a social functional unit.

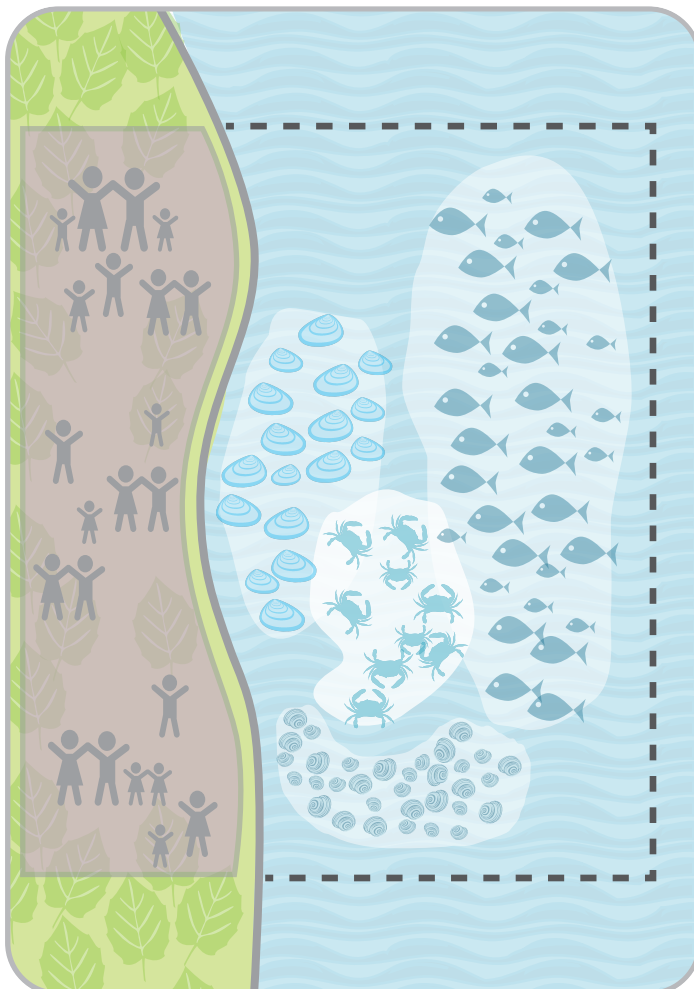
TURF TYPE 2

Hypothetical Fishery 2 spans a large section of a remote coastline and has multiple species—including some mobile species—with overlapping ranges. There is one community in the area, and it harvests all of these resources. All fishermen in the community are organized and comply with the fishing rules established by a respected community leader. In this fishery, there are various biological functional units representing the range of each species targeted. However, as there is only one social functional unit, a single TURF covers the range of all the resources harvested.

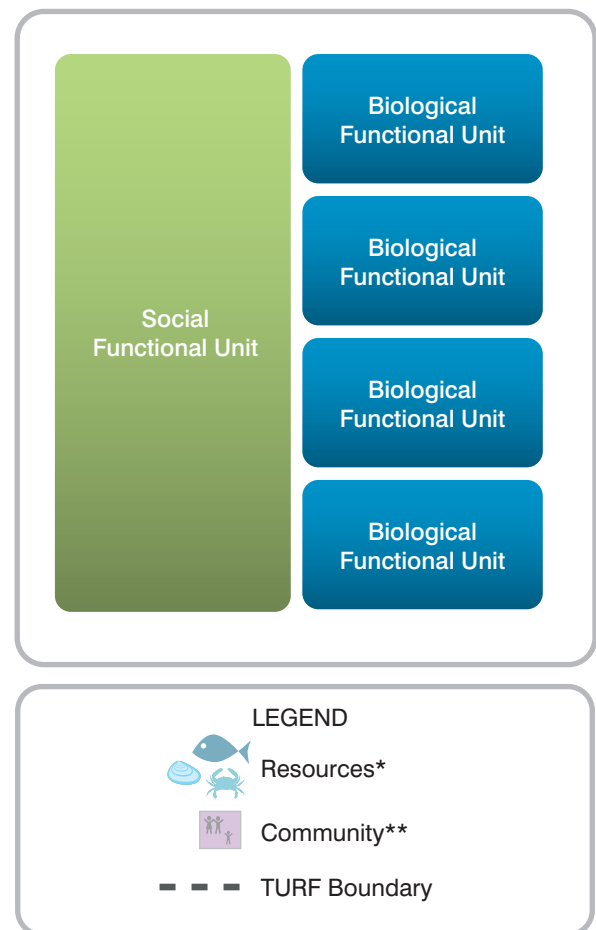
Type 2 fisheries are uncommon because mobile species often travel across large areas, and as a result, may

encounter multiple user groups. However, this type of fishery may occur where a single user group fishes a large and/or isolated area, or where species have somewhat localized population dynamics. The territorial customary rights exercised by the Safata District and similar coastal communities in Samoa may be characterized as Type 2 TURFs (see **Catch Shares in Action: Samoan Safata District Customary User Rights Program**). The resource users of Safata are represented by a District Committee that oversees TURF management. They target a variety of reef finfish and invertebrate species that have complex ecological interactions.

Fishery 2



TURF Type 2



* Resources represent biological functional units.

** Community represents a social functional unit.

TURF TYPE 3

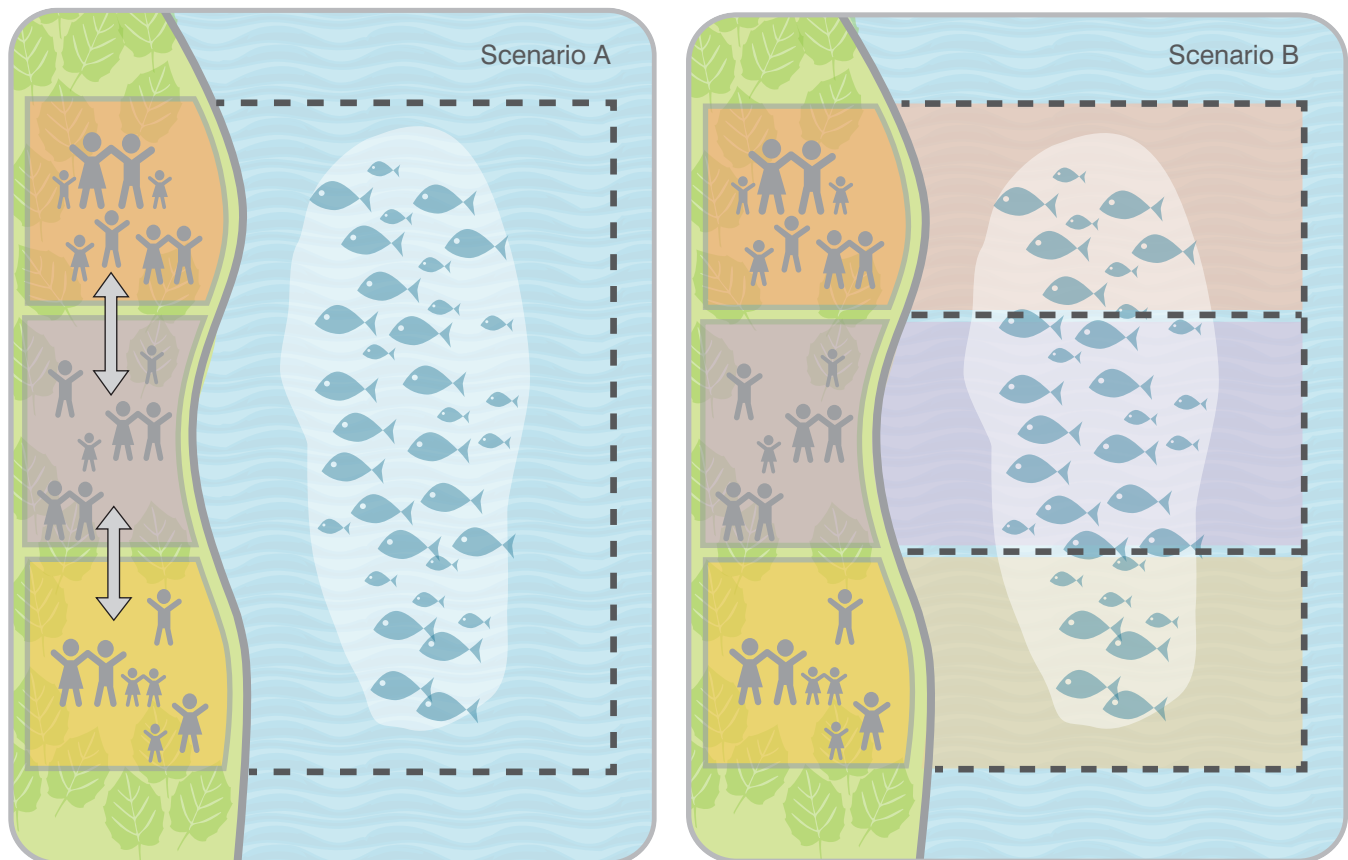
In hypothetical Fishery 3, there are three communities (orange, purple and yellow) that target one mobile reef fish species of a nearshore reef, represented by the shaded area. Fishermen from each community travel to various parts of the reef, depending upon where they expect to find the most fish. Within each community, there are strong family ties and social bonds. However, there are cultural differences between communities, and disputes between members of different communities are not uncommon. Three possible TURF design scenarios are shown below, with variations based upon how the social and biological functional units are integrated into the design.

In Scenario A, a single TURF that covers the entire fishing area is shared between the three communities. This TURF is scaled to reflect the stock (the biological functional unit) and the current fishing behavior, but it would require substantial coordination between the three dissimilar communities to manage the fishery. Rather than competing

with each other for a share of the catch, the communities work together to manage the fishery sustainably and to enforce TURF boundaries.

In Scenario B, the fishing area is divided among the communities into three individual TURFs. This scenario is scaled to the social functional unit. Each community is individually responsible for ensuring the sustainability of fishing within its assigned TURF. Unless there are access agreements between TURFs, this scenario constrains fishermen to fishing in their own TURF, rather than traveling the whole reef as they have done in the past. Heterogeneity in abundance of fished species along the length of the reef could lead to unequal allocation of resources and perceptions of unfairness. Because the three communities fish the same mobile stock, the fishing pressure from one community will affect the harvested resource of each other.

Fishery 3



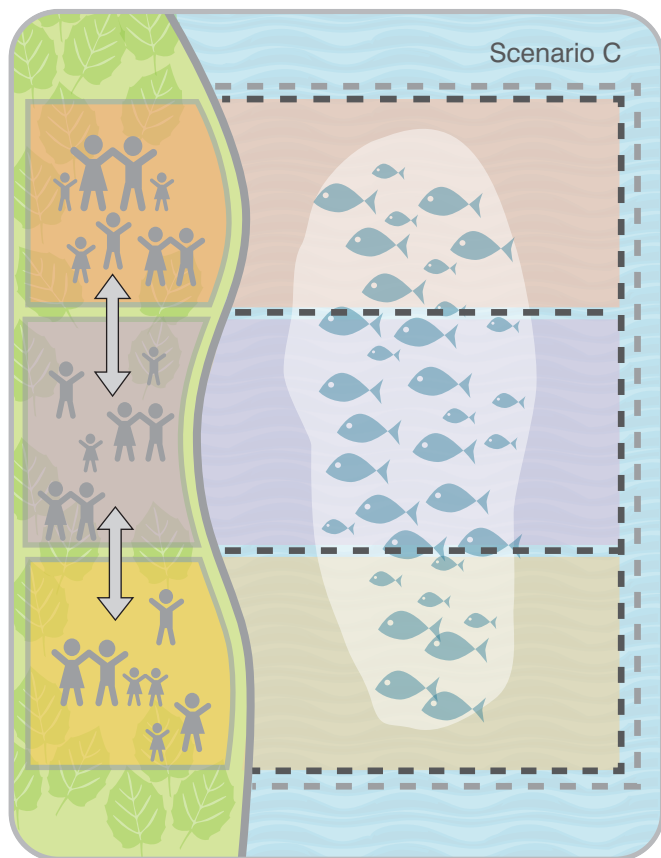
In Scenario C, the fishing area is divided in the same way as in Scenario B, but a regional management body (designated by the grey dashed line) oversees the sustainable management of the stock by setting biological targets and designating individual targets for each TURF. Each community is responsible for ensuring compliance within its own TURF. The management body can also facilitate coordination between the three TURFs, such as for data collection or by creating reciprocal access agreements between TURFs. The regional management body allows Scenario C to reflect both the social and biological functional units in Fishery 3.

The complexity of Fishery 3 demonstrates the challenge of choosing the appropriate scale for a Type 3 TURF system. Each scenario presents its own benefits and tradeoffs. Scenario C may be the most appropriate management option because it addresses the social and biological functional units, but Scenarios A or B may be most practical for some fisheries. Determining which design to use would require carefully considering the tradeoffs and

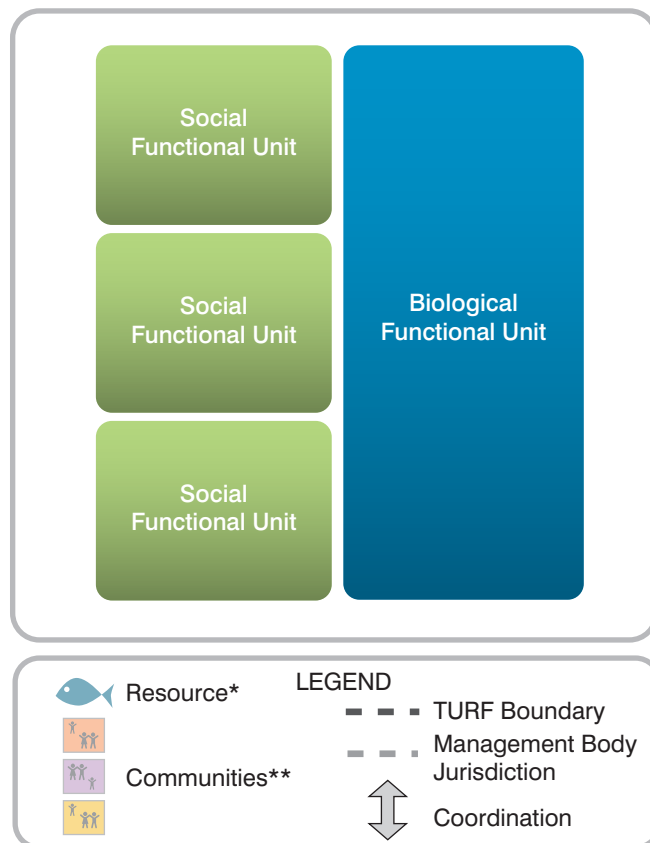
understanding which challenges might most practically be overcome. For example, setting and enforcing appropriate catch limits for each TURF in Scenario B can ensure harvest is sustainable and may be more practical than organizing fishermen in a biologically scaled TURF.

The scenarios developed for Fishery 3 are just a few of many design options, and the design should ultimately be determined by the goals of the TURF program, the biology of the resource and the characteristics of the fishermen.

The **Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System** exemplifies a Type 3 TURF, in which fishermen and fishery managers have designed a management system like Scenario C below (see **Catch Shares in Action**). The Cooperatives collectively cover an entire subpopulation of lobster, but the area is subdivided into concessions based on the location of each fishing community. FEDECOOP, the Regional Federation of Fishing Cooperative Societies, coordinates management across its 13 participating community-based Cooperatives.



TURF Type 3



* Resource represents a biological functional unit.

** Communities represent social functional units.

TURF TYPE 4

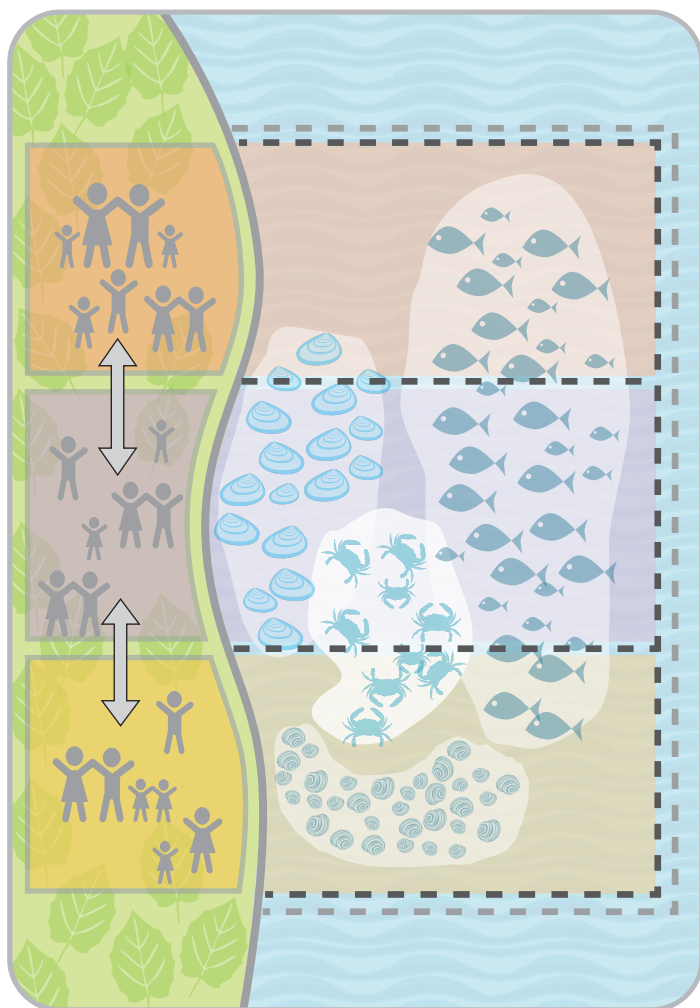
Finally, consider hypothetical Fishery 4, which has many different species with broad and overlapping ranges, and is targeted by several types of fishermen in multiple communities. This fishery has many biological and social functional units that are not congruent. Thus, TURF design is rather complex, and there are numerous design options.

One approach, as shown below, is to define TURFs based on social boundaries and to coordinate across TURFs as needed to address the biological scale of each targeted species. There may be overlapping social functional units since fishermen may identify with multiple different groups, such as fishermen using the same gear type who are from different communities, or fishermen in their own

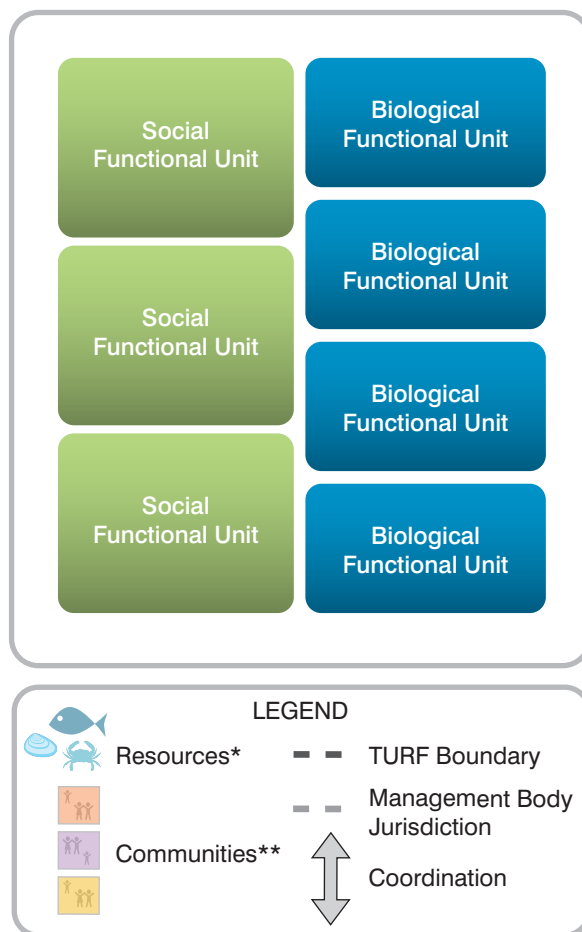
community. It may be best to allocate TURFs to the social functional unit that is best able to help manage the fishery with coordination across TURFs to meet the biological goals of the program.

The **Japanese Common Fishing Rights System** is a notable example of a Type 4 TURF system (see **Catch Shares in Action**). In this system, the government allocates all coastal fishery resources (both sedentary and mobile species) to Cooperatives defined by geopolitical boundaries. Fishery-specific organizations of fishermen fulfill additional management functions within and between TURFs, and additional coordinating committees manage migratory and wide-ranging species.

Fishery 4



TURF Type 4



* Resources represent biological functional units.

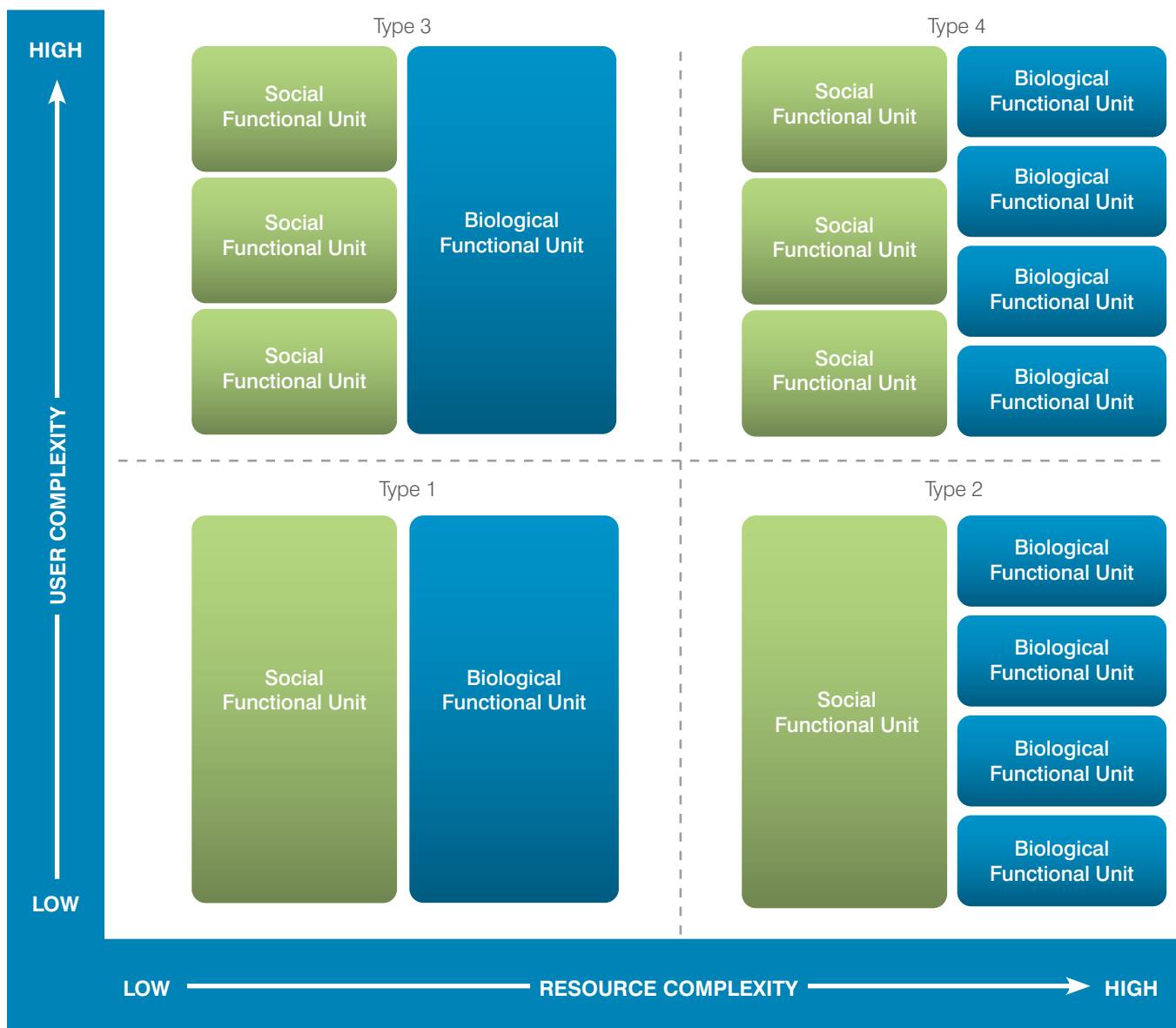
** Communities represent social functional units.

SUMMARY OF FOUR TURF TYPES

Fisheries vary in complexity in terms of the characteristics of both the resource and its users. The four TURF types presented in this section reflect varying levels of complexity, and are summarized accordingly in Figure A. The four TURF types were developed to help you understand your own fishery's complexity. We will discuss TURF design elements throughout this volume as they pertain to these types.

TURF design will be simpler for fisheries with lower complexity. For example, TURF Type 1 has the simplest design because it is the least complex, having just one biological functional unit and one social functional unit. TURF Types 2, 3 and 4 have multiple biological and/or social functional units, which may require additional design features to address their increased complexity. As you go through each of the design steps, keep these four TURF types in mind to help you determine the best design choices for your situation.

FIGURE A | *Four TURF Types According to Resource and User Complexity*





WHAT ARE THE KEY PRINCIPLES OF TURF DESIGN?

Volume 1 of the **Catch Share Design Manual** outlines 13 design principles that highlight clear lessons learned from around the world and basic rules of thumb for a successful catch share program. These design principles are summarized here for quick reference, along with seven additional design principles for TURFs. The principles are discussed in further detail in the design steps in this volume.

Basic Catch Share Design Principles

- 1 Design the catch share program based on clearly articulated goals with measures of success.
- 2 Consider including in the catch share program species that are commonly caught together.
- 3 Create separate catch limits and shares for each species, stock and zone in the catch share program. For area-based programs, other controls on fishing mortality may be appropriate. All controls should be science-based and account for all sources of fishing mortality, prevent overfishing and rebuild overfished stocks, if needed.
- 4 Develop mechanisms for accommodating new entrants during the design of the catch share program and prior to initial share allocation.
- 5 Allocate shares for sufficient length to encourage stewardship and appropriate investment by shareholders and associated industries. This can be achieved by allocating in perpetuity and/or for significant periods of time with a strong assumption of renewal, provided rules are adhered to.
- 6 Employ percentage shares, when possible, of the overall cap rather than absolute weight units for long-term shares.
- 7 To increase program flexibility, consider transferability of shares, permanent and/or temporary, which is generally a hallmark of catch share programs.
- 8 Develop a transparent, independent allocation process that is functionally separate from the rest of the design process. Allocations that retain the relative equity positions of stakeholders are the least contentious.
- 9 Employ an allocation appeals process that allows eligible participants to refute allocated amounts with verifiable data.
- 10 Encourage cost-effective, transparent trading that is easy for all participants.

- 11 Employ transparent catch accounting and complete regularly enough to ensure compliance with catch limits or other appropriate controls on fishing mortality.
- 12 Design and implement a fishery information system that keeps costs low and is effective for conducting catch accounting, collecting scientific data and enforcing the law.
- 13 Assess performance against goals and encourage innovation to improve the program over time.

TURF Design Principles

- 1 Define TURF boundaries to ensure the integrity of each biological functional unit for all managed species.
- 2 Define eligible participants based on a social functional unit that will have the best capacity to co-manage the resource to stay within biological limits.
- 3 When social or political factors call for TURFs that are small relative to the biological functional unit(s), develop coordinated TURF networks to achieve biologically appropriate management.
- 4 Clearly define and delineate TURF boundaries to aid enforcement. Consider the existing spatial distribution of fishermen and other users in defining TURF boundaries.
- 5 Develop mechanisms to ensure the Cooperative is accountable to its catch limit or other appropriate controls on fishing mortality and prevents a race for fish among members.
- 6 Clearly define the roles and responsibilities of fishery managers, Cooperatives and other entities to reflect program goals and the relative strengths and capabilities of each group.
- 7 Establish Cooperative administrative systems including a clear process for decision making and bylaws or contracts to formalize rules, roles and responsibilities.

STEP-BY-STEP DESIGN

Checklist

Step 1

Define Program Goals

- ☐ Identify the program's biological and ecological goals
- ☐ Identify the program's economic goals
- ☐ Identify the program's social goals
- ☐ Balance trade-offs

Step 2

Define and Quantify the Available Resource

- ☐ Determine which species will be included
- ☐ Determine which stocks will be included
- ☐ Determine the spatial range of the biological functional unit
- ☐ Determine the controls on fishing mortality for each species, stock and zone
- ☐ Determine if no-take reserves will be implemented

Step 3

Define Eligible Participants

- ☐ Decide if the privilege will be allocated to individuals or groups
- ☐ Determine which social functional units may receive privileges
- ☐ Define Cooperative membership
- ☐ Establish limits on concentration of area and/or quota
- ☐ Determine how new participants will enter the fishery

Step 4

Define the Privilege

- ☐ Decide what privileges are granted as part of the TURF
- ☐ Define and delineate TURF boundaries
- ☐ Determine how the Cooperative will be accountable to controls on fishing mortality

- ☐ Determine the tenure length of the privilege
- ☐ Define the long-term share
- ☐ Determine the annual allocation unit
- ☐ Decide if the catch share will be permanently and/or temporarily transferable
- ☐ Determine any restrictions on trading and use of shares

Step 5

Assign the Privilege

- ☐ Establish a decision-making body for initial allocation
- ☐ Determine when allocation will occur
- ☐ Establish an appeals process
- ☐ Determine who is eligible to receive shares
- ☐ Decide whether initial shares will be auctioned or granted
- ☐ Determine how areas will be allocated
- ☐ Identify and gather available data for allocation decisions

Step 6

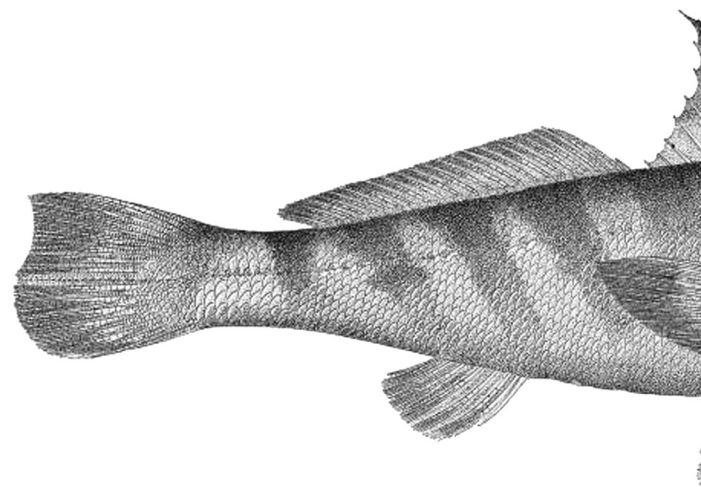
Develop Administrative Systems

- ☐ Determine the roles and responsibilities of the Cooperative
- ☐ Determine how the Cooperative will be governed
- ☐ Determine how coordination across TURFs will occur
- ☐ Determine how trading, catch accounting and information collection will occur
- ☐ Determine how the Cooperative will be administered and funded

Step 7

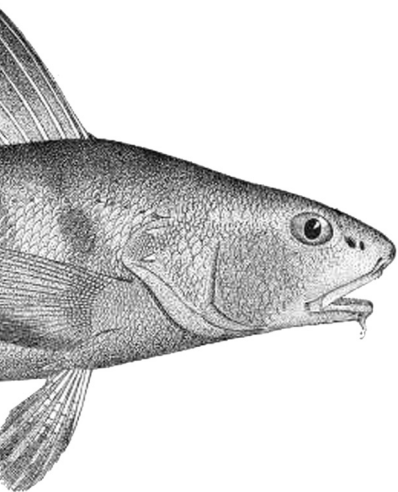
Assess Performance and Innovate

- ☐ Conduct regular program reviews
- ☐ Assess performance against goals
- ☐ Encourage innovation



Step
1

Define Program Goals





At a Glance

Defining goals is perhaps the most important step to ensure a well-designed catch share program. Goals should be clearly articulated prior to catch share design: They will drive design decisions and provide a basis for evaluating success.

KEY PRINCIPLES	Design the catch share program based on clearly articulated goals with measures of success. 22
SUB-STEPS	<div>1.1 What are the program's biological and ecological goals? 22</div> <div>1.2 What are the program's economic goals? 23</div> <div>1.3 What are the program's social goals? 24</div> <div>1.4 Balance trade-offs. 24</div>
SPECIAL FEATURES	Common Methods for Achieving Economic Goals through Cooperation 23

Define Program Goals

As in any catch share program, the first and most important step to designing a TURF is to clearly define program goals.

Step 1 of Volume 1 of the **Catch Share Design Manual** details common biological, economic and social goals of any catch share program, whether it is area-based or quota-based.

Fishery managers or fishermen may choose an area-based approach to optimize certain goals, and goals will inform how to design an effective TURF program. Because TURFs are often co-managed by fishermen organizations, hereinafter referred to as “Cooperatives,” the goals of TURFs also relate to the benefits that can be derived from Cooperative management.

In this section, common catch share goals are highlighted with an emphasis on goals that are often identified for TURFs, including those that are optimized by Cooperative co-management. Goals may be defined for both single TURFs and TURF systems. They may be defined by fishery managers, fishermen or both.

DESIGN PRINCIPLE

Design the catch share program based on clearly articulated goals with measures of success.



1.1 WHAT ARE THE PROGRAM'S BIOLOGICAL AND ECOLOGICAL GOALS?

Biological and ecological goals of catch shares include ending overfishing, rebuilding overfished stocks and reducing non-targeted catch. As with all well-designed catch shares, TURFs achieve these goals.

Fisheries implementing TURFs have often identified the goal of managing stocks at the localized level. Fish stocks made up of a number of smaller micro-stocks may be best managed under a TURF system because of their fine-scale nature (Prince, 2003). Additionally, local users may have the best knowledge and ability to formally assess and manage micro-stocks.

Another common goal of TURFs is to protect habitat, and the spatial nature of TURFs makes them particularly well suited to meet this goal (Wilén et al., 2012). Because TURF users benefit directly from healthy habitat within their exclusive fishing areas and are often excluded from moving their fishing activities to different areas, they have a clear incentive to implement habitat restoration activities, gear restrictions and other protections.

TURFs are typically allocated to Cooperatives, and well-designed, well-organized Cooperatives regularly achieve biological goals by collaborating and sharing information to stay within defined biological limits and contribute to fishery science.

1.2 WHAT ARE THE PROGRAM'S ECONOMIC GOALS?

Economic goals are commonly identified as critical to the design and performance of a catch share. TURFs often share the same economic goals as other catch shares, such as increasing revenue and profits, reducing overcapitalization and supporting jobs and fishery viability.

TURFs are usually allocated to Cooperatives that can meet economic goals through coordination. Cooperatives may be designed to provide economic stability for fishermen and can help participants achieve higher economic returns by increasing efficiency and improving marketing opportunities (See Table 1.1). For example, a cohesive Cooperative can coordinate the timing of landings to buffer against price fluctuations, or can redirect Cooperative funds to provide stability when revenue is low.

TURFs may also help optimize economic returns from a fishery by enabling fishermen to manage the ecosystem within their allocated area. TURF users sometimes take advantage of ecosystem processes and species interactions, including predator-prey relationships, to optimize the productivity of target stocks (Wilen et al., 2012).

An additional economic goal of TURFs can be to reduce the overall costs of management and administration for the government and industry. Appropriate administrative duties can be vested in Cooperatives, and by addressing some management needs at the local level, overall costs can often be reduced.

TABLE 1.1 | COMMON METHODS FOR ACHIEVING ECONOMIC GOALS THROUGH COOPERATION

INCREASE REVENUE BY	REDUCE COSTS BY
<ul style="list-style-type: none"> • Coordinating timing of product delivery in accordance with favorable market conditions • Coordinating harvest timing to catch fish at more valuable life stages • Slowing the race for fish to improve product quality via good handling of fish, improved training, new equipment, etc. • Creating economies of scale to increase market access and ability to better negotiate prices with buyers • Achieving higher market value through industry certifications 	<ul style="list-style-type: none"> • Coordinating harvest, reducing fishing capacity and distributing fishing effort efficiently (e.g. to avoid congestion and gear damage) • Sharing information to harvest efficiently, such as through reduced search time • Purchasing inputs (fuel, ice, bait, etc.) in bulk • Sharing equipment or infrastructure, such as boats, docks, transportation, processing facilities, etc.

1.3 WHAT ARE THE PROGRAM'S SOCIAL GOALS?

Social goals of catch shares are typically focused on ensuring access for specific sectors or communities, promoting fairness and equity and preserving the character and makeup of fishing fleets and communities.

A common social goal of TURFs is to ensure that the benefits of sustainable fisheries accrue to particular communities, usually those that have historically relied on the fishing grounds. By granting exclusive harvesting privileges, TURFs can retain employment opportunities for fishermen in designated communities, stabilize a community's income by keeping fishery revenue within the community and give the community more control over product marketing (Panayotou, 1984). By supporting local harvesting and processing, TURFs can also promote community food security. Design features can support these goals by ensuring the community maintains access to the allocated privileges and fishery revenues. These social goals are why TURFs are generally allocated to Cooperatives, and often to community-based Cooperatives.

A common TURF goal is to engage fishermen and fishing communities in resource management. Co-management

arrangements between fishery managers and TURF users can allow for cost-effective, locally appropriate management. A specific social goal of a formal TURF system may be to preserve existing management traditions, especially where customary marine tenure systems are present.

In addition to fishery-wide social goals, Cooperatives may establish their own social goals. These goals may relate to the function of the Cooperative, including developing greater capacity and maintaining fair and equitable decision-making processes. Cooperatives often seek to provide direct benefits to their members, both for the benefit of the group and to ensure members are incentivized to participate in the Cooperative. Sometimes these include non-fishery related benefits, such as improving social and/or political standing, funding education, providing health care or pensions and providing community infrastructure. These goals drive the design of internal Cooperative organization and governance structures.

1.4 BALANCE TRADE-OFFS

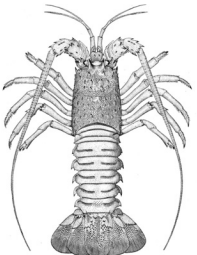

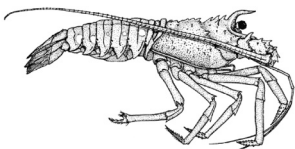
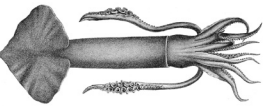
As in any fishery management approach, there are often trade-offs between the identified goals for Cooperative catch shares. Meeting biological goals should be paramount since managers are generally required by law to do so. Even if no legal mandate exists, keeping fish stocks productive is essential for meeting economic and social goals. Economic and social goals often present trade-offs. For example, maximizing economic efficiency may not always be compatible with maintaining the traditional structure of a fishery.

Local goals and system-wide goals may also differ. Fishery managers and stakeholders should weigh the trade-offs between goals to determine what the priorities are for the TURF or TURF system. To the extent practicable, the goals of a single TURF should be compatible with and support TURF system goals.

CATCH SHARES IN ACTION

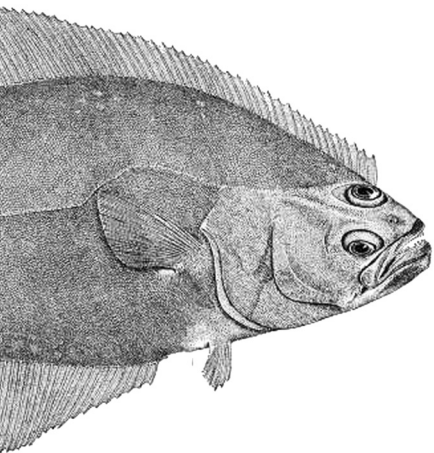
Step 1 – Define Program Goals

This chart provides a brief summary of the **Step 1** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

	1.1 BIOLOGICAL & ECOLOGICAL GOALS	1.2 ECONOMIC GOALS	1.3 SOCIAL GOALS
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	<p>Promote sustainable harvest through individual and collective responsibility for the resource</p> <p>Support ecosystem health through continued use of low-impact gears</p>	<p>Ensure long-term revenue to balance investment in costly fishing equipment</p>	<p>Co-management and self-governance</p> <p>Stability and self-sufficiency of the fishing community</p>
<p>Samoan Safata District Customary User Rights Program</p> 	<p>Sustainable use of coastal marine resources</p> <p>Protection of biodiversity and mangrove habitat</p>	<p>Sustain livelihoods into the long term</p> <p>Develop alternative income opportunities to diversify risk</p>	<p>Empowerment of local communities to manage resources</p> <p>Education efforts to increase compliance</p>
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	<p>Replenish and protect stocks</p>	<p>Increase productivity</p> <p>Increase market power and access new markets</p>	<p>Provide stability for fishermen</p> <p>Provide fishing community infrastructure and services</p>
<p>Japanese Common Fishing Rights System</p> 	<p>Conserve stocks</p> <p>Engage communities in management</p>	<p>Increase revenue</p> <p>Improve efficiency</p> <p>Stabilize fish prices</p>	<p>Protect small-scale coastal fishermen from outside fishing pressure</p>

Step
2

Define and Quantify the Available Resource





At a Glance

Defining and quantifying the available resource provides the biological basis for the catch share program. By carefully completing this step, you will ensure that you have included sources of significant mortality and established effective, science-based fishing mortality controls.

KEY PRINCIPLES	<p>Consider including in the catch share program species that are commonly caught together. 29</p> <p>Define TURF boundaries to ensure the integrity of each biological functional unit for all managed species. 30</p> <p>Create separate catch limits and shares for each species, stock and zone in the catch share program. For area-based programs, other controls on fishing mortality may be appropriate. All controls should be science-based and account for all sources of fishing mortality, prevent overfishing and rebuild overfished stocks, if needed. 33</p>
SUB-STEPS	<p>2.1 Which species will be included? 28</p> <p>2.2 Which stocks will be included? 29</p> <p>2.3 What is the spatial range of the biological functional unit? 30</p> <p>2.4 What controls on fishing mortality will apply to each species, stock and zone? 32</p> <p>2.5 Will no-take reserves be implemented? 34</p>
SPECIAL FEATURES	<p>Examples of Biological Functional Units 30</p> <p>Example of Three Overlapping Biological Functional Units 31</p> <p>Examples of Cooperative Participation in Fishery Science and Monitoring 32</p> <p>Including No-Take Reserves in TURF Design: The Lira Cooperative's Os Miñarzos TURF 35</p> <p>Hypothetical Reserve Placement in a TURF System 36</p>

Define and Quantify the Available Resource

Defining and quantifying the resource is important for determining how the catch share program will be designed to effectively limit fishing mortality. Completing this step will ensure you have sufficiently **Limited** the catch through appropriate controls on fishing mortality and have included **All sources** of fishing mortality.

This step discusses elements of TURF design that may be necessary to manage biological complexity. Determining which species will be managed and the spatial distribution of each managed species will help you identify the biological functional units within your fishery, as described in **Consider Which TURF Type is Best for Your Fishery**.

TURF boundaries are typically defined based on both the biological and social functional units in the fishery. Fisheries with high biological complexity (e.g., mobile species and multiple species) may require special design features to ensure the catch share is appropriately **Scaled** to the biology of the resource. Design may include networks of TURFs with coordination between them, or large TURFs.

TURFs can be implemented in fisheries with plentiful scientific data as well as in those with limited scientific data. When data are limited, defining and quantifying the resource may rely on data-limited methods for assessing stocks and setting controls on fishing mortality. See **Science-Based Management of Data-Limited Fisheries: A Supplement to the Catch Share Design Manual** for a framework and methods for assessing data-limited stocks.

Defining and quantifying the available resource may be the responsibility of fishery managers, Cooperatives or both, and the roles of each group should be clearly defined. Cooperatives may work with fishery managers to determine biologically appropriate controls on fishing mortality, or fishery managers may retain this responsibility. In any case, it is essential for fishing controls to be determined based on science and with the sustainability of fish stocks as the primary objective.

2.1

WHICH SPECIES WILL BE INCLUDED?



Key to defining the privilege is determining which species will be managed within a TURF or TURF system. Fishery managers will typically be responsible for determining which species to include. The TURF program may be single-species or multi-species, depending on program goals and characteristics of the resource. It is important to consider which species are caught in the fishery and how those species must be accounted for to meet management goals (see **Step 2.1 of Volume 1 of the Catch Share Design Manual**).

TURFs are ideal for benthic or sedentary species (especially those that have limited larval dispersal) because low emigration of fish from the TURF allows users to fully benefit from their conservation behaviors. However, mobile species and species with long-distance larval dispersal can also be managed using TURFs, especially by networks of TURFs that cover the species' full range. Designing TURFs for mobile species is practical, but requires more complex TURF design (see **Step 2.3**).

TURFs are often designed to optimize production of the most valuable species in a region. It is also common to start by managing one species and then include additional species as the program matures. Thus, initial TURF design may reflect the biology of the primary target species, with incorporation of additional species driving new design features over time. There are several potential benefits to giving users exclusive harvesting privileges to all of the resources—with the exception of endangered, threatened or otherwise protected species—in their designated area:

Enforcement feasibility

Some TURFs grant harvesting privileges only for select species and allow outsiders to harvest other species within the same zone. Enforcement in this case may be challenging because it is difficult to detect and prevent illegal fishing. Allocating TURFs for several species will allow one user group to oversee the stewardship of resources within the TURF and benefit from their management efforts.

Diversified fishing activity

Including multiple species in a TURF can have biological and economic benefits by allowing fishermen to diversify their fishing activity. Granting privileges for all species within a TURF can encourage more balanced exploitation of resources in an area. Instead of focusing all fishing pressure on a few species, communities can shift fishing pressure in accordance with stock productivity. This diversification of fishing pressure can support ecosystem function and stability of stocks (Zhou et al., 2010; Garcia et al., 2012). Additionally, when species abundance varies, the economic impact of fluctuations may be dampened by the ability to target other species within the TURF. When fishermen have access to multiple resources in their TURF, they have a greater incentive to engage in ecosystem conservation behaviors, such as creation of no-take reserves or habitat conservation.

DESIGN PRINCIPLE

Consider including in the catch share program species that are commonly caught together.



2.2

WHICH STOCKS WILL BE INCLUDED?

Most fisheries are made up of multiple, biologically distinct stocks. Because TURFs manage fisheries in a spatial manner, it is especially important to understand the spatial range (i.e., the movement patterns) of the stock managed. The range of stocks determines the biologically appropriate TURF boundaries and the scale at which controls on fishing mortality should be applied.

In fisheries with a diverse fleet structure, it may be necessary to divide stocks across multiple management

zones. Catch limits can be set with the health of the broader stock in mind to ensure collective harvest across all zones is appropriate. For example, nearshore sub-stocks may be managed separately from offshore sub-stocks, especially in cases where TURFs will only be implemented in coastal areas. Catch limits for Japanese fisheries are divided into limits for the offshore fleet and the nearshore, TURF-allocated fleet (Makino, 2011).

2.3

WHAT IS THE SPATIAL RANGE OF THE BIOLOGICAL FUNCTIONAL UNIT?

As described in **Consider Which TURF Type is Best for Your Fishery**, understanding the characteristics of the target species is important for determining the biologically appropriate scale for TURF management. Here we define a biological functional unit as the geographical range of a self-sustaining stock or sub-stock of fish. For species with localized population dynamics, a biological functional unit may cover a particular patch of habitat or a group

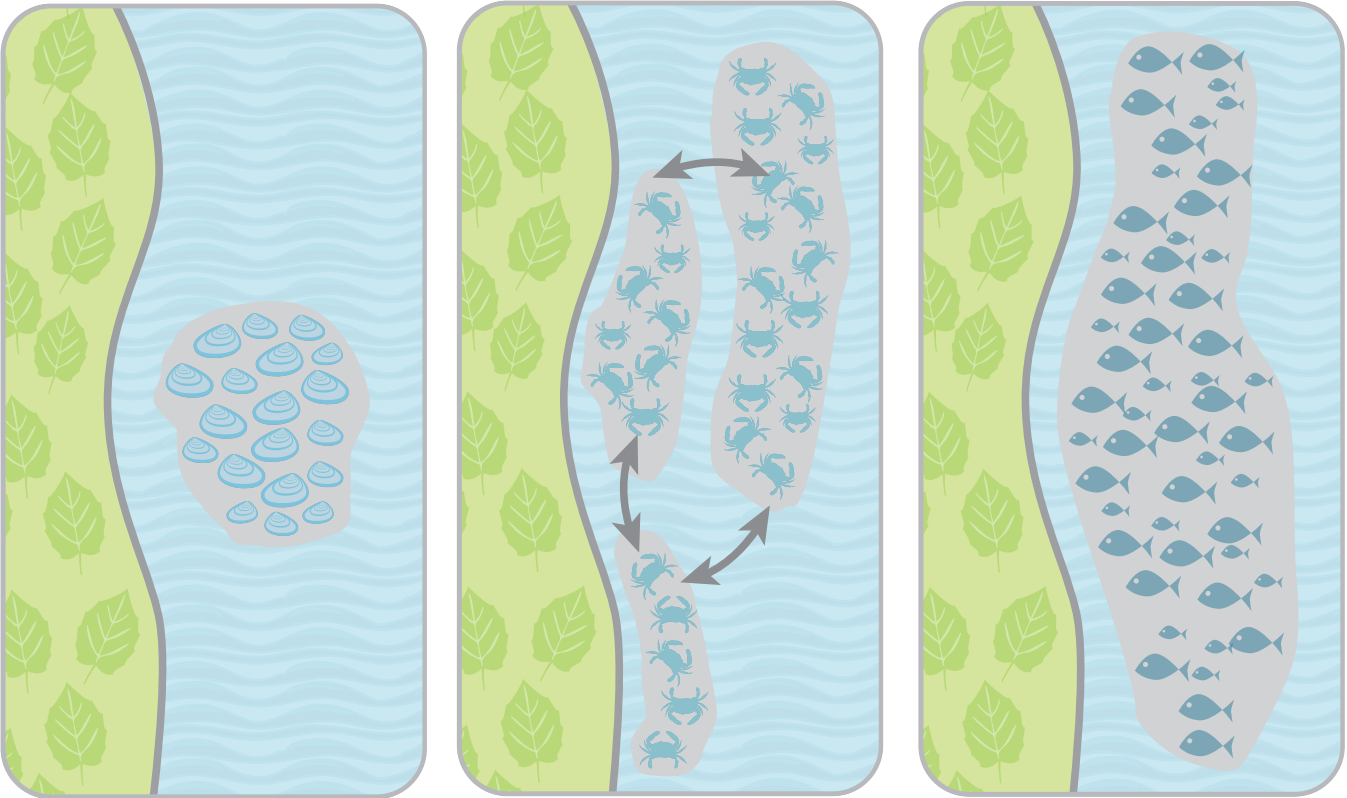
of neighboring patches (Figure 2.1). More mobile stocks will be more broadly distributed, and their population dynamics will occur on a larger scale. Each biological functional unit may also have a temporal component. Spawning grounds, nursery habitats, migratory routes and other seasonal elements may need to be considered in defining the biological functional unit.

DESIGN PRINCIPLE

Define TURF boundaries to ensure the integrity of each biological functional unit for all managed species.

FIGURE 2.1 | *Examples of Biological Functional Units*

Shaded areas represent the spatial distribution of one species, and arrows indicate movement of fish between various patches. The spatial range of the biological functional unit and the number of patches depend upon stock characteristics.

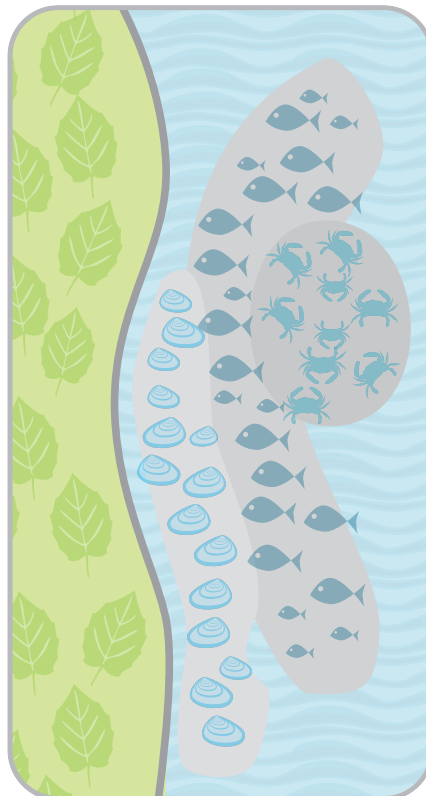


An ideal TURF would allocate the full biological functional unit to one responsible individual or group. A biological functional unit may be relatively small for a sessile species that has localized population dynamics, but would be quite large for a mobile, pelagic species. A multi-species fishery may have multiple overlapping biological functional units, representing the spatial distribution of each target species (Figure 2.2).

Designing a TURF to cover the full range of a target stock or sub-stock enables a single entity to manage the whole stock and allows TURF users to benefit fully from their conservation behaviors. However, there are often political, social and/or cultural factors that also drive TURF boundary delineation. In **Step 3.2**, you will define the social functional unit(s) in your fishery. These factors typically result in dividing the stock range into multiple TURFs based on various social functional units that cover different management zones. Defining TURF boundaries based on these considerations is discussed in **Step 4.2**.

FIGURE 2.2 | *Example of Three Overlapping Biological Functional Units*

Shaded areas represent the spatial distribution of three target stocks.



The most important function of a catch share, and usually one of the primary goals, is to ensure long-term sustainability of fishery resources. Having appropriate controls on fishing mortality is paramount. This is especially important in the face of coastal population growth, technological changes and a growing global market for seafood, all of which tend to increase fishing pressure (Pollnac, 1984). It is therefore important to set controls on fishing mortality based on scientific knowledge to ensure sustainable harvest.

The role of Cooperatives in setting fishery mortality controls varies and can include developing stock assessments, conducting biological surveys and monitoring catches. Data generated by fishermen can greatly improve the quality of information used to inform management decisions. Examples of Cooperative involvement in science and monitoring are highlighted in Table 2.1.

Implementing a TURF often coincides with efforts to create more formal controls on fishing mortality. In many fisheries, managers and fishermen interested in implementing a TURF may have relatively limited data on their fishery resources and historical fishing effort. Establishing appropriate controls on fishing mortality is vitally important, and there are methods for providing science-based guidance for management aimed at ensuring stock sustainability, even in the absence of large amounts of fishery data (see **Science-Based Management of Data-Limited Fisheries: A Supplement to the Catch Share Design Manual**). Some data-limited approaches result in a catch limit, whereas others result in guidance for limiting fishing mortality in different ways. The bottom line is that the status of fish stocks can be assessed even when very limited fisheries data are available. Science-based management measures aimed at maintaining fishing mortality at sustainable levels are possible and essential for both data-rich and data-limited fisheries.

TABLE 2.1 | EXAMPLES OF COOPERATIVE PARTICIPATION IN FISHERY SCIENCE AND MONITORING

PROGRAM	COOPERATIVE ROLES	DESCRIPTION OF INVOLVEMENT
Chilean National Benthic Territorial Use Rights for Fishing Program	Stock assessments Setting quota Monitoring	Each Cooperative is responsible for hiring an external consultant to develop a baseline biological study of the TURF area. The Cooperatives use this information to develop catch limits. Follow-up assessments are performed annually.
Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System	Stock assessments Monitoring	Each Cooperative is responsible for monitoring stocks and hiring a technical biologist to conduct a baseline study of the area for lobster and abalone. These data are used in conjunction with federal stock assessments to inform catch and effort limits.
Spanish Galicia Goose Barnacle Cofradía System	Data generation Setting quota Monitoring	Each cofradía hires an on-site fisheries ecologist to regularly monitor local goose barnacle populations and generate data for management decisions. Cofradías also have designated landing sites and markets where catch data are collected. Based on this information, cofradías develop annual management plans specifying daily catch limits, which can be adjusted during the season in response to new data.

DESIGN
PRINCIPLE

Create separate catch limits and shares for each species, stock and zone in the catch share program. For area-based programs, other controls on fishing mortality may be appropriate. All controls should be science-based and account for all sources of fishing mortality, prevent overfishing and rebuild overfished stocks, if needed.



Catch limits

Compliance with scientifically appropriate catch limits is a hallmark of effective fisheries management. Catch limits are a proven approach for preventing overfishing, rebuilding overfished stocks when necessary and buffering against changing conditions. Ideally, a TURF will have a scientifically determined catch limit for all species harvested, and fishermen within the TURF will be responsible for staying within that catch limit.

In many developed fisheries, setting catch limits has often relied on rich data sets and costly stock assessments. However, there are methods for establishing catch limits using basic fishery data that are commonly available or that can be collected at low cost. These data include species life history characteristics, catch records, length data and species density data. See **Science-Based Management of Data-Limited Fisheries**.

Catch limits may be set by Cooperatives within each TURF, by government fishery managers or by an independent party. For a catch limit to be biologically appropriate, it should be applied to the entire biological functional unit. Thus, when a network of TURFs (rather than a single TURF) covers the biological functional unit, coordination between TURFs or government oversight of catch limits may be necessary to ensure catch limits are appropriately scaled. If areas within the biological functional unit are not covered by TURFs and are managed in a different way, the harvest in these areas should be considered when setting the catch limit for the TURFs. If possible, creating a separate catch limit for these areas is recommended.

Other ways to control fishing mortality

Especially in fisheries with limited data, it may be prohibitively challenging to set or administer a catch limit. It is nevertheless important to place appropriate controls on fishing mortality that ensure sustainability of the stock by maintaining a healthy spawning biomass. These mortality controls should be based on the best available science and incorporate appropriate buffers for uncertainty. Other types of mortality controls that may be implemented as part of a TURF management system include:

- Individual effort allocations, which in some cases can be transferred between users to achieve economic efficiency (see **Transferable Effort Shares: A Supplement to the Catch Share Design Manual**).
- Spatial mortality controls that protect stocks during key life history stages. These may include permanent no-take or limited-use zones (discussed in more detail in **Step 2.5**), or they may be adaptive closures that are adjusted to attain specific biological targets.
- Input controls, such as limited licenses, size limits, trip or daily bag limits and gear restrictions.

These approaches all have their own data needs and limitations, but when combined with secure, exclusive area-based privileges may be effective for meeting fishery targets. In addition to regulations set by fishery managers, Cooperatives may implement their own regulations, including these approaches, to ensure they are fulfilling their responsibility to harvest sustainably within their TURF. **Step 4.3** provides more detail on how Cooperatives can administer these controls to uphold their management responsibilities, and it provides some discussion of the data needs and limitations of each.

Additional considerations

Selection of the appropriate method (or combination of methods) for controlling fishing mortality will depend upon the characteristics of the fishery and the resources available to fishery managers and TURF users. The biological and social complexity of the fishery may also

affect the complexity of implementation. Fishing mortality controls may be adapted over time as more data and resources become available. Though catch limits may not be an option at the time of TURF implementation, they may be administered later as fishery data, science and administrative capabilities improve.

2.5 WILL NO-TAKE RESERVES BE IMPLEMENTED?

A no-take reserve is a type of Marine Protected Area where all extractive activity is prohibited.⁴ If properly located and enforced, no-take reserves can help replenish fish stocks within their borders and in neighboring areas through a process known as spillover. TURFs can be paired with no-take reserves to allow the benefits of reserves to directly accrue to local TURF users. In exchange for these benefits, Cooperatives participate in administration and enforcement of reserves. Managers and Cooperatives may be interested in incorporating reserves into their TURF design to help meet biological and economic goals. The benefits of reserves are recognized by fishermen and fishery managers alike, and in practice, both entities have supported inclusion of reserves in TURF systems (see Snapshot 2.1).

No-take reserves can be established at any time—before, during or after the TURF design process. Sometimes preexisting reserves are incorporated into TURF design because fishermen are interested in directly benefiting from the closures by having exclusive access to the surrounding waters. Reserves can also be designed at the same time as TURFs as part of a holistic planning process. Alternatively, after fishermen have been allocated a TURF, they may choose to establish reserves to achieve fishery goals.

The following sections provide basic design guidance for establishing no-take reserves as they relate to TURF design. The importance of no-take reserves in global marine conservation is widely recognized, and a wealth of information exists on marine reserve network design that

should be used in conjunction with this manual to establish reserves (See **Appendix B**).

Reserve location

The location of reserves in relation to TURFs will affect the benefits to TURF users. Reserves may be located adjacent to TURFs, between TURFs, within a TURF, surrounding a TURF or simply nearby (Figure 2.3). Because the effects of adult fish spillover from reserves are local (Halpern et al., 2010), the proximity of a TURF to a reserve impacts the benefits to users. Fishermen commonly fish along the edge of reserve boundaries to benefit from spillover, and TURFs immediately adjacent to reserves will have exclusive access to these benefits. A reserve located between TURFs can act as a buffer to minimize the impact one TURF has on the other.

Choosing a site for a reserve depends upon fishery goals. Managers must weigh the tradeoffs between the benefits the reserve can provide for the fishery and the loss of fishing area (including the impact of redistributing fishing effort). The key to siting reserves is to select sites that will be a source of larvae and adult spillover. Reserve sites that have self-sustaining populations, are a net source (rather than a sink) for larvae, and have a high carrying capacity are ideal for both conservation and fishery objectives (Gaines et al., 2010). It may be especially beneficial to protect such productive areas if they have been historically overfished, because there will be conservation and economic gains from allowing the reserve population to recover, while

⁴ TURFs are sometimes implemented in designated Marine Protected Areas (MPAs) because MPAs that allow limited extractive use can provide a framework for TURF implementation. This section focuses specifically on no-take reserves, a special type of MPA that provides full protection for the resources within its boundaries.

SNAPSHOT 2.1 | Including No-Take Reserves in TURF Design**The Lira Cooperative's Os Miñarzos TURF**

The Os Miñarzos Marine Reserve of Fishing Interest is a TURF off the coast of Galicia in northwest Spain accessed exclusively by select fishermen from the Lira Cooperative and nearby communities. The TURF was designed by fishermen, government officials, scientists and non-governmental organizations to help recover fish stocks and protect biodiversity.

Within the TURF, two no-take reserves were sited in highly productive spawning and breeding grounds in order to promote larval and juvenile export to the surrounding TURF areas. The reserves cover 6.75% of the total Os Miñarzos area and are demarcated using topographical features and coordinates (Confraría de Pescadores Lira, 2012).

Fishermen have begun to realize the benefits of the TURF and no-take reserves since the implementation of the system five years ago. Fishermen report increased catch and larger fish (Perez de Oliveira, 2013). They are also enjoying more stable profits and can market their catch as a specialized sustainable product (Tindall, 2012). Recognizing the value of their effective TURF, community members have advocated for continued responsible management in the face of reduced government funding (Perez de Oliveira, 2013).

opportunity costs associated with the loss of fishing area may be low (Sanchirico and Wilen, 2001). The location of a reserve boundary can impact spillover into fishing areas. A boundary placed along a reef edge, for example, will minimize spillover of adults associated with the reef habitat, while a boundary that crosses a continuous patch of habitat will provide greater fishery benefits from spillover (Gaines et al., 2010).

Reserve networks

Reserves are most effective as a network in which larvae can disperse from one reserve to another. In a TURF system, reserves will ideally be scattered throughout the system, spaced appropriately to allow larval dispersal between reserves and also into fishing areas. Depending upon the stock, moderate spacing between reserves along a coastline, ranging from tens of kilometers to 100 kilometers, is ideal (Gaines et al., 2010).

Reserve size

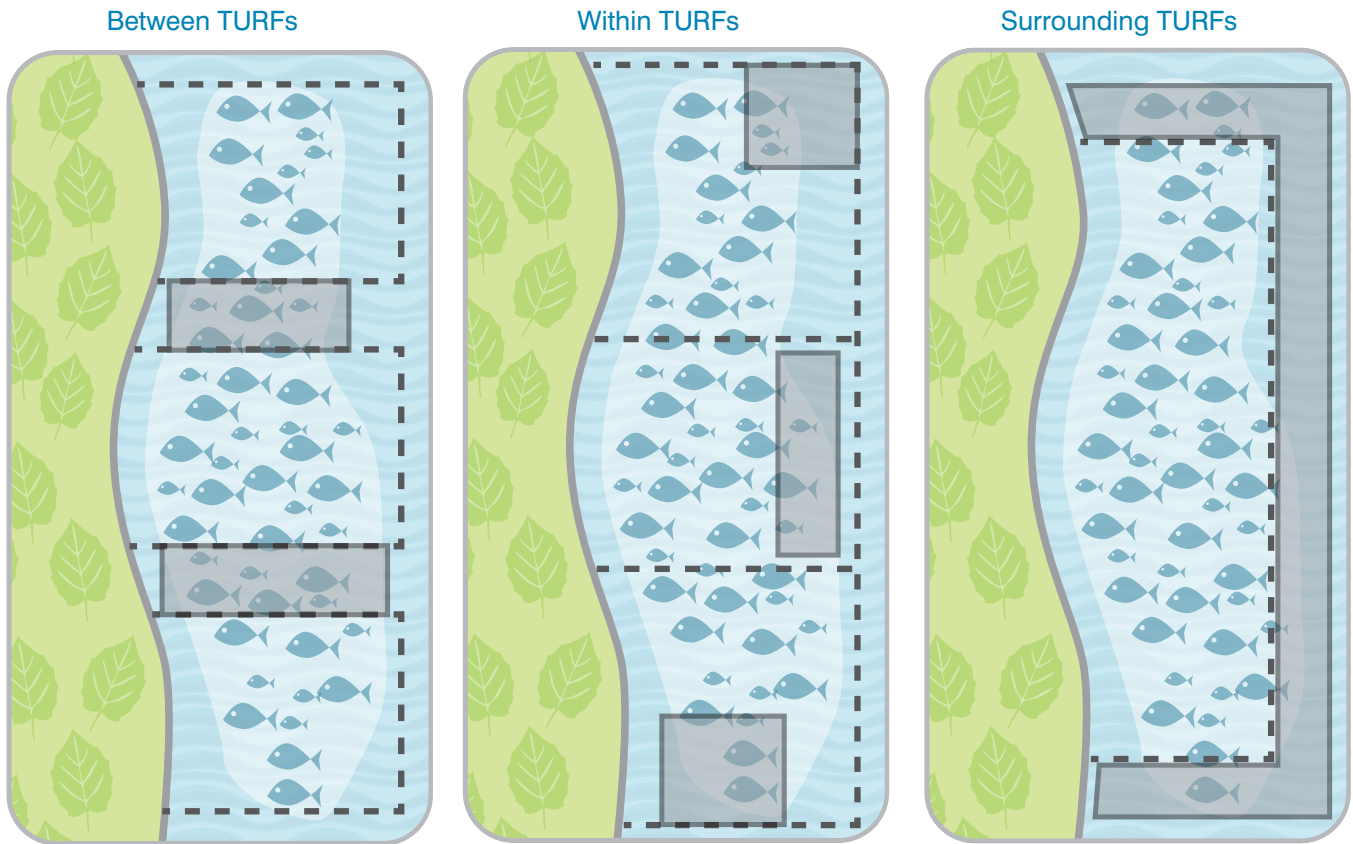
The ecological benefits of reserves increase as reserve size increases. However, it is important to recognize that for any given fishery there is an optimal reserve size that maximizes profits. Moderately sized reserves (i.e., several to tens of kilometers of the coastline and extending offshore) are ideal for balancing conservation objectives and fishery profits (Gaines et al., 2010). If there is coordination between TURFs fishing the same stock(s), reserves may be smaller than when there is no coordination (Costello and Kaffine, 2010).

Limiting fishing mortality with reserves

In locations where catch limit establishment is inhibited by data or budgetary constraints, reserves may serve as an alternative to formal catch limits. However, to be the sole control on fishing mortality, a reserve must be sufficiently large to replenish all of the fish that are harvested annually. Implementing no-take reserves of this size will likely be prohibitively challenging. Instead, smaller reserves may be

FIGURE 2.3 | *Hypothetical Reserve Placement in a TURF System*

Grey boxes show the placement of reserves. Diagrams are intended to demonstrate concepts of design; a comprehensive planning process should inform actual reserve design.



used along with a suite of other mortality controls to ensure fishery sustainability.

Scientists and fishery managers are developing innovative ways to use no-take reserves to set and meet fishery targets. For example, reserves can have flexible boundaries to rebuild stocks and control fishing mortality, and when appropriate, increase fishery yields. The reserve (or reserve network) can be designed to replenish fish caught within the TURF, and the size of the reserve may vary depending upon the need to rebuild the stock. If the goal for fishery managers is to rebuild the stock quickly, the reserve may be larger. For less depleted stocks or when slower rebuilding is

acceptable, the no-take zone can be smaller. As rebuilding occurs, reserves can be reduced to the minimum reserve size that achieves other fishery goals, such as maximizing yields or profits over time.

Limited-use areas

Some TURFs have implemented limited-use areas, in which only certain fishing activities are permitted. Limited-use areas are not as effective in meeting biological goals as no-take reserves (Lester and Halpern, 2008). However, there may be some cases where limited-use reserves are more feasible to accomplish biological and economic goals.

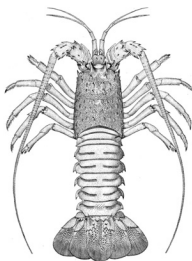

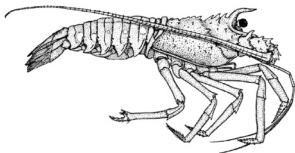
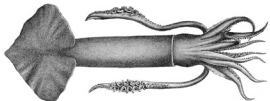
In the customary tenure system of Ahus Island, Papua New Guinea, for example, allowing one low-impact gear type to be used within areas that are otherwise closed makes the reserve more accepted by the fishing community. Even with limited fishing activity permitted within them, the reserves have greater biomass and larger fish than unrestricted areas (Cinner et al., 2005). Though limited-use areas can have fishery benefits, no-take reserves are recommended to provide the best biological and economic outcomes.

Additional considerations

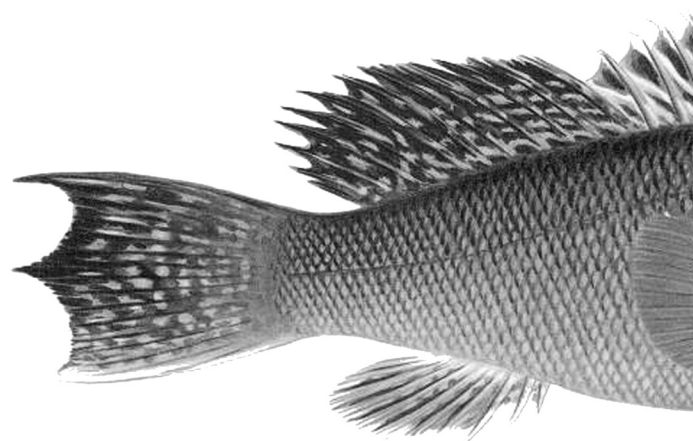
A well-designed reserve system (likely a network of moderately sized reserves) can help meet biological goals while supporting thriving fisheries in neighboring TURFs. As in any fishery, implementing no-take reserves in a TURF system requires closing off areas that would otherwise be open to fishing. A thoughtful design process guided by scientific and stakeholder input can help balance these goals. In some fisheries, it may be appropriate to undergo an adaptive, iterative approach to find an optimal design.

Step 2– Define and Quantify the Available Resource

This chart provides a brief summary of the **Step 2** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

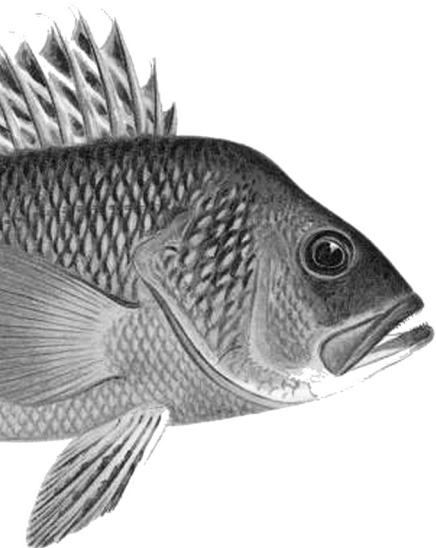
	2.1 SPECIES INCLUDED	2.2 STOCKS INCLUDED	2.3 BIOLOGICAL FUNCTIONAL UNIT
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	Spiny lobster	Ascension Bay spiny lobster stock	One single zone located in Ascension Bay
<p>Samoan Safata District Customary User Rights Program</p> 	Multiple reef fish and invertebrates	Local stocks of all species	One single zone covering the reef
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	Baja spiny lobster, abalone, sea cucumber, turban snail	Central Zone spiny lobster stock Local stocks of other benthic species	Ten zones based on lobster stock and Cooperative location
<p>Japanese Common Fishing Rights System</p> 	Multiple coastal species, including invertebrates, groundfish and migratory fish	All coastal stocks	All coastal waters Zones based on geopolitical boundaries

2.4 CONTROLS ON FISHING MORTALITY	2.5 NO-TAKE RESERVES
<p>Effort controls (seasons, gear restrictions)</p> <p>Protections for egg-bearing females and minimum size limits</p> <p>Internal Cooperative rules</p>	<p>Required 25-meter no-take zones between campos (individual plots)</p>
<p>Size limits, gear restrictions and bans on destructive fishing practices</p> <p>Spatial management approaches (permanent and periodic closures)</p>	<p>Network of 10 village-level no-take reserves</p>
<p>Effort limits (i.e., trap limits) for lobster; catch limits for other species</p> <p>Other effort controls</p> <p>Protections for egg-bearing females</p>	<p>Some no-take reserves voluntarily implemented to meet biological and economic goals</p>
<p>Catch limits for some species</p> <p>Additional effort controls as determined by each Cooperative</p>	<p>Some voluntary no-take reserves and limited-use areas</p>



Step
3

Define Eligible Participants





At a Glance

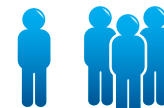
In completing this step, you will identify the parameters for participation in the catch share program. This will govern the ways in which current and future shareholders are permitted to operate within the program.

KEY PRINCIPLES	<p>Define eligible participants based on a social functional unit that will have the best capacity to co-manage the resource to stay within biological limits. 43</p> <p>Develop mechanisms for accommodating new entrants during the design of the catch share program and prior to initial share allocation. 47</p>
SUB-STEPS	<p>3.1 Will the privilege be allocated to individuals or groups? 42</p> <p>3.2 What social functional units are eligible to receive privileges? 42</p> <p>3.3 How will Cooperative membership be defined? 44</p> <p>3.4 Will there be limits on the concentration of allocated area and/or quota? 46</p> <p>3.5 How will new participants enter the fishery? 46</p>

Define Eligible Participants

Clearly defining eligible participants ensures that TURFs are **Exclusive** and that the program is **Scaled** to appropriate social units (i.e., those that have the ability to organize and co-manage the resource). Both managers and Cooperatives will help define eligible participants. Fishery managers generally determine what types of entities can receive area-based privileges. Cooperative membership requirements, whether determined by managers, the Cooperative or both, add an additional layer of exclusivity by defining who can fish in the TURF.

3.1 WILL THE PRIVILEGE BE ALLOCATED TO INDIVIDUALS OR GROUPS?



TURFs are usually allocated to groups but can be allocated to individuals. However, individually-allocated TURFs are uncommon because they are often not compatible with the social goals of TURFs. Fishery managers should consider these tradeoffs when determining whether to allocate TURFs to individuals or groups.

Group-allocated TURFs perform best when members act collectively (i.e., as a Cooperative). The Cooperative will be accountable for ensuring harvest within the TURF is sustainable by complying with catch limits or other controls on fishing mortality and enforcing boundaries. Furthermore, it is important for the group to manage its allocation to avoid or minimize a competitive race for fish among its members to help meet biological goals (such as reducing non-target catch and protecting habitats), as well as economic and social goals.

Cooperatives can be formed by allocating privileges directly to a pre-organized group—such as a fishermen's association, community or other organization—or by allowing, requiring or incentivizing fishermen to create groups. Groups of fishermen may be defined, for example, by where they live or fish, by the species they harvest, by their use of the harvest (e.g., subsistence, local consumption or export) or by the gear types they use.

Group organization strongly influences the outcome of a group-allocated catch share. It is important for a group to have leadership, clearly defined rules and clear responsibilities to ensure that the group is collectively accountable to meet the goals for the TURF, including biological targets (see **Step 6**).

3.2 WHAT SOCIAL FUNCTIONAL UNITS ARE ELIGIBLE TO RECEIVE PRIVILEGES?

As discussed in **Consider Which TURF Type is Best for Your Fishery**, the social functional units in your fishery are important for defining how fishery participants will be incorporated into the TURF program. Social functional units will likely form Cooperatives, which are organized groups of fishermen that can accept certain management responsibilities in exchange for secure, exclusive fishing privileges.

Defining social functional units

The characteristics of fishermen, primarily how they are organized and distributed geographically, will be the foundation for identifying the social functional units and defining Cooperatives within a fishery. In cases where fishermen are well organized, defining social functional units will be relatively simple—it may be an existing cooperative, fishermen's association, kinship unit or other

Define eligible participants based on a social functional unit that will have the best capacity to co-manage the resource to stay within biological limits.



organized group. When fishermen are not organized, it may be more challenging to identify groups that can work together to manage their fishery. These groups may be defined by fishery characteristics, such as the gear they use or the location they fish, or they may be defined based upon existing political or socio-cultural boundaries.

The most appropriate social functional unit for managing a TURF may vary from one fishery to another. Japanese coastal TURFs are delineated based upon existing geopolitical boundaries, specifically the boundaries of prefectures, which are similar to states (Uchida and Makino, 2008). Though a geographical area can often be comprised of diverse people (i.e., many overlapping social functional units), it may be simpler and more practical to allocate privileges based on fishermen's geographical distribution.

The size of a group affects its function, and thus defining a social functional unit may depend on fishery goals and the responsibilities the group will be expected to perform. A group that is too large may lack sufficient organization, whereas a particularly small group may not be able to achieve some of the benefits of cooperation. These tradeoffs may influence the appropriate scale for TURF implementation.

Defining eligibility to receive shares

It is important to clearly define who may be eligible to hold area-based privileges. Eligibility criteria for a TURF are typically determined at two stages. First, fishery managers will be responsible for determining which Cooperatives (or individuals) will be eligible to receive a TURF. Next, fishery managers and/or Cooperatives will determine Cooperative

membership requirements. Membership requirements are discussed in detail in **Step 3.3**.

Managers' criteria for allocating privileges to Cooperatives may be largely tied to Cooperatives' willingness and demonstrable ability to meet certain management goals. In particular, the Cooperative must be capable of ensuring its participants are accountable to the catch limit or other controls on fishing mortality. Fishery managers often create formal requirements for Cooperatives, which may include a combination of the following:

- Representing a certain group, such as a coastal community
- Having a clear connection to the allocated area (i.e., located adjacent to the fishing grounds)
- Establishment of a member agreement, contract, bylaws, etc.
- Having a minimum number of members
- Having a clearly defined organizational structure, decision-making process and representatives

In some contexts, these requirements are defined by law. Additionally, in accordance with the common social goals of Cooperative catch shares, eligibility to receive shares can be based upon the participant makeup of the Cooperative. For example, managers may require Cooperatives to represent the current composition of the fishery or to include both fishermen and processors.

Additional considerations

TURFs may be implemented in contexts where fishermen organizations are absent or insufficiently equipped for

effective co-management. By making TURF allocation contingent upon demonstrated ability to co-manage, fishermen may be incentivized to organize in ways that fulfill the responsibilities tied to their allocation. For example, in Chile, the government required fishermen to organize into Cooperatives in order to receive a TURF allocation. The government or other entities may provide resources for Cooperatives to form and/or build capacity, especially if the up-front investment will be balanced by the benefits of effective co-management. Organization and capacity building occur over long periods of time. Initial efforts may focus on the most basic needs for meeting biological targets, and long-term efforts can be geared toward additional goals.

It is common for fishermen to undertake migratory fishing patterns, traveling along the coastline to fish in multiple sites. Migratory fishermen may be incorporated into coastal TURFs along with non-migratory fishermen or they may

have their own designated fishing zones (TURFs or other zones). It is important to consider whether migratory fishermen who are granted TURF access will be able to participate in one or multiple TURFs. Moving across multiple TURFs can allow them to continue fishing in the way they are accustomed to, but they may not have as strong an incentive to steward a particular TURF if they can fish elsewhere.

Individuals may hold TURF allocations in trust for a group. This is common in customary marine tenure systems in which a chief is considered to be the privilege holder and decision maker, and access to the TURF by community members is by permission from the chief. This arrangement can have management benefits as long as the leaders' interests are aligned with the benefit of the group. However, there are numerous opportunities for corruption (Johannes, 2002), so granting privileges and responsibilities to the group is recommended.

3.3

HOW WILL COOPERATIVE MEMBERSHIP BE DEFINED?

Individuals typically gain access to TURFs through membership in a Cooperative. Cooperative membership criteria may be determined by fishery managers, Cooperative leaders or both. As with any catch share, eligibility requirements should reflect the goals of the program. Ideally, requirements will be determined jointly by Cooperative leaders and government fishery managers to promote equity, transparency and program support. Some of the basic criteria for Cooperative membership in TURF programs include:

- Citizenship
- Possession of a current license
- Historical and/or current participation in the fishery
- Membership in an existing organization of fishermen, community or family
- Connection to the resource and/or reside near the resource

- Maintenance of active participation
- Compliance with fishery regulations

Additionally, Cooperatives often require that members agree to comply with Cooperative rules. This is typically done by signing a member agreement, contract or bylaws. Cooperative rules are described in more detail in **Step 6.2**.

Cooperatives rely on a commitment from their members to meet their goals, and they may set requirements to ensure this commitment. Some Cooperatives limit membership by creating prerequisites, such as working as a crew member or an apprentice, to ensure participants have a vested interest in joining. Some Cooperatives have established minimum time requirements for membership, and a person may leave the Cooperative or join another Cooperative only after that time period has elapsed.

The role of fishery managers in setting membership criteria varies depending upon the goals of the program and the types of decisions fishery managers choose to vest in the Cooperatives. To promote social goals, managers sometimes require Cooperatives to accept all eligible license holders as members, thereby pre-determining Cooperative membership requirements. However, it may be important for Cooperatives to have a role in who may or may not join in order to meet their goals.

Managers should carefully consider membership criteria to ensure they are compatible with Cooperative success. It may be valuable to enable some flexibility to allow fishermen to form Cooperatives based on their interests and commonalities. Flexibility can also allow Cooperatives to determine how best to meet their goals. For example, some Cooperatives have non-fishing members who perform onshore duties or monitoring and enforcement roles, and it may be important to consider these types of Cooperative roles when defining membership criteria.

Additional considerations

Cooperative leaders and fishery managers should consider the appropriate size of the group based on the resource, including the size of the TURF, and weigh the benefits and consequences of membership restrictions. Creating appropriate limits on Cooperative membership affects exclusivity and therefore may affect participants' incentives and the program's performance. Cooperative catch shares will often be designed based on the organization of pre-existing groups, and the structure and goals of those groups may pre-determine membership requirements.

The number of members in a Cooperative can range from few to hundreds, and the characteristics of your Cooperative and/or fishery may partially define the appropriate number of members. Generally, large groups may need greater structure and leadership, whereas it may be easier for small groups to maintain a strong partnership between Cooperative members. Social cohesion may lead to greater success in meeting goals (Gutierrez et al., 2011), and homogeneous groups can maintain social cohesion at higher numbers than can heterogeneous groups. A larger group may better accommodate the ability for members to have specialized roles, including non-fishing roles. In Cooperatives where members conduct enforcement, groups must be large enough to monitor fishing activity and defend their resource (e.g., patrol their TURF). Fishery managers and groups of fishermen may find ways to scale group size to the characteristics of their fishery. For example, large groups may subdivide into smaller, more manageable groups, with a committee organizing across subgroups.

Limiting membership may not always be compatible with the social goals of the program. Shared decision making between Cooperatives and fishery managers can help ensure membership requirements are appropriate for meeting fishery-wide goals and Cooperative goals. It may be appropriate to adapt membership requirements over time and/or allow fishery participants to move between Cooperatives. Allowing groups to stratify based on interests, skills and needs can support greater social cohesion within each Cooperative.

3.4 WILL THERE BE LIMITS ON THE CONCENTRATION OF ALLOCATED AREA AND/OR QUOTA?

A common social goal for area-based catch shares is to support fishing communities by allowing fishery revenue from TURFs to accrue directly to the TURF participants and, more broadly, to other community members. To support thriving communities, you may limit the amount of allocated area or quota that can be held by each Cooperative and/or to individuals within each Cooperative.

It is uncommon for concentration limits to be needed for area-based privileges because privileges are often not transferable. However, if transfers of area-based privileges are permitted, it may be appropriate to have limits on the portion of the area a group or individual may hold

in order to meet social goals. A Cooperative that subdivides its TURF into individual harvesting plots may set concentration limits for its members. Managers may want to consider limits in the initial allocation process as well.

If there is a catch limit, it may be important to restrict the amount of the total catch that may be held by an individual or group. Managers may limit transfers of quota-based shares between TURFs to ensure fishing privileges do not become overly concentrated. Within a TURF, there may be limits on how much of the TURF's total catch limit may be held by an individual.

3.5 HOW WILL NEW PARTICIPANTS ENTER THE FISHERY?

It is important to consider during the design process how new fishery participants will be accommodated. Managers must consider whether new participants will be able to fish in existing TURFs, whether areas will be set aside for future allocation, or whether TURF boundaries may be modified in the future to accommodate new user groups.

Existing TURFs

In most cases, new entrants will be incorporated into existing TURFs by joining the Cooperative to which a TURF is allocated. Fishery managers may set requirements that determine how individuals may become eligible to enter a TURF-allocated group. Cooperatives may also set their own requirements. In some cases, fishery managers have required groups to accommodate new entrants who meet certain requirements. However, it may be important to allow Cooperatives some flexibility to limit new entrants to meet their goals.

Increasing Cooperative membership in a TURF can have a negative impact on existing members because the fixed

resource will then be shared across a larger group of fishermen. Replacing retiring members with new entrants is often easier to accept because it may have lower impact on the opportunities of current members.

Set-asides

If fishery managers anticipate future entrants, they may set aside a portion of the system-wide area for future TURF allocation. However, it may be difficult to predict whether the area set aside will be appropriate for future users, and it may be appropriate to combine set-asides with boundary modifications.

Boundary modifications

In some cases, it may be appropriate to modify TURF boundaries to accommodate new entrants. TURFs may be divided or shifted to create new TURFs. The security of allocated privileges should be a primary consideration for TURF boundary modification, as reduced security can interfere with the conservation incentive of current TURF

DESIGN
PRINCIPLE

Develop mechanisms for accommodating new entrants during the design of the catch share program and prior to initial share allocation.



users. The impacts of modifying TURF boundaries should be weighed against the benefits of accommodating new entrants. Boundary modification may be used to address other fishery changes as well (see **Step 7.3**).

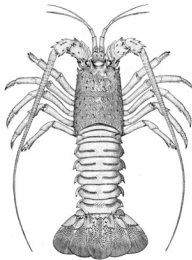
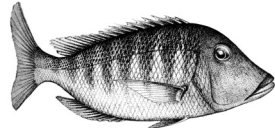
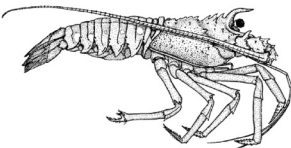
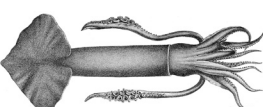
Additional considerations

It is important to consider how new entrants will receive fishing privileges without interrupting the security and exclusivity of the existing members' privileges. The decision to allow new entrants into a TURF or TURF system should depend on the goals of Cooperatives and fishery managers.

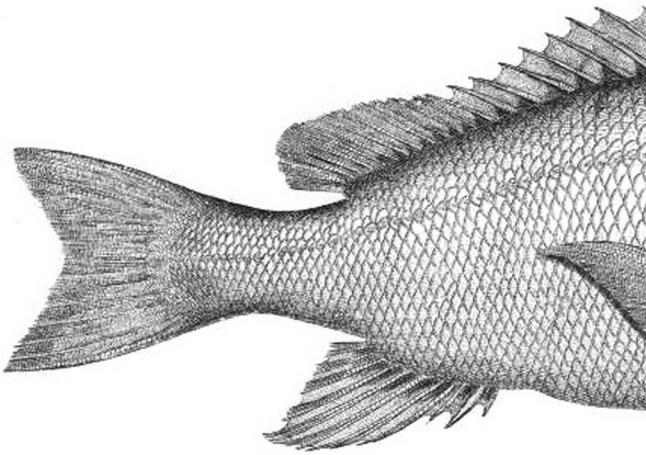
Social goals typically include supporting the livelihoods of fishing communities, which in many cases have increasing numbers of people engaged in fishing. However, without appropriate mechanisms in place, new entrants can impact Cooperative success by eroding a group's sense of exclusivity and weakening social cohesion. Thus the way new entrants will enter a fishery should be considered in program design and should involve both fishery managers and Cooperatives. The benefits of allowing new entrants should be balanced with the impacts on the functionality and effectiveness of the Cooperative.

Step 3– Define Eligible Participants

This chart provides a brief summary of the **Step 3** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

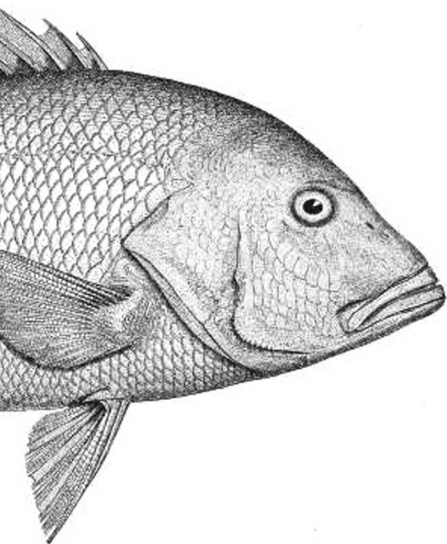
	3.1 ALLOCATED TO INDIVIDUALS OR GROUPS	3.2 SOCIAL FUNCTIONAL UNITS	3.3 COOPERATIVE MEMBERSHIP
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	Group	One community-based Cooperative comprised of local fishermen	Must have a license Historical participation in the fishery
<p>Samoa Safata District Customary User Rights Program</p> 	Group	Settlement of nine coastal villages managed under a representative District Committee	Must be a member of the community
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	Groups	Groups generally comprised of historical participants, organized into 13 Cooperatives	Each Cooperative responsible for making up its own participation rules regarding eligibility
<p>Japanese Common Fishing Rights System</p> 	Groups	Existing organizations formed into hundreds of Fishery Cooperative Associations	Must have a history in the fishery and compliance with regulations

3.4 CONCENTRATION LIMITS	3.5 NEW PARTICIPANTS
No official concentration limits	Only the children of current Cooperative members are allowed as new participants
None	Only community members
Cooperatives have access to a set amount of licenses, determined by fishery managers, and make distribution decisions among members	Cooperatives determine new entrants One Cooperative has an apprenticeship program among members
None	Determined by Cooperatives; usually undergo a trial period



Step
4

Define the Privilege





At a Glance

This step requires you to define the privilege and its main attributes. Many of these decisions will determine ongoing management of the program, as well as the stability and flexibility participants will have under the program.

KEY PRINCIPLES	<p>When social or political factors call for TURFs that are small relative to the biological functional unit(s), develop coordinated TURF networks to achieve biologically appropriate management. 54</p> <p>Clearly define and delineate TURF boundaries to aid enforcement. Consider the existing spatial distribution of fishermen and other users in defining TURF boundaries. 56</p> <p>Develop mechanisms to ensure the Cooperative is accountable to its catch limit or other appropriate controls on fishing mortality and prevents a race for fish among members. 57</p> <p>Allocate shares for sufficient length to encourage stewardship and appropriate investment by shareholders and associated industries. This can be achieved by allocating in perpetuity and/or for significant periods of time with a strong assumption of renewal, provided rules are adhered to. 60</p> <p>Employ percentage shares, when possible, of the overall cap rather than absolute weight units for long-term shares. 61</p> <p>To increase program flexibility, consider transferability of shares, permanent and/or temporary, which is generally a hallmark of catch share programs. 62</p>
SUB-STEPS	<p>4.1 What privileges are granted as part of the TURF? 52</p> <p>4.2 How will TURF boundaries be defined and delineated? 54</p> <p>4.3 How will the Cooperative be accountable to controls on fishing mortality? 57</p> <p>4.4 For how long will the privilege be allocated? 60</p> <p>4.5 How is the long-term share defined? 61</p> <p>4.6 What will the annual allocation unit be? 61</p> <p>4.7 Will the privilege be permanently and/or temporarily transferable? 61</p> <p>4.8 Will there be restrictions on trading and use of shares? 64</p>
SPECIAL FEATURES	<p>Examples of TURF Privileges and Management Responsibilities 53</p> <p>Scaling TURFs to Biological Functional Units 55</p> <p>Meeting Goals through Fishing Effort Coordination 59</p> <p>Basic Types of Transfers in a TURF or TURF System 63</p>

Define the Privilege

Defining the privilege is an important step because it allows managers and fishermen to clearly establish the attributes of the privilege being allocated. These decisions are outlined in **Step 4** of **Volume 1** of the **Catch Share Design Manual**, and expanded upon for area-based catch shares.

By effectively defining the privilege, you will ensure participants have **Secure** access to the fishery so they can effectively make long-term decisions. Part of this step is to determine how to effectively **Scale** the program to the biological, social and political systems. You may also design your TURF system to allow **Transferability** of quota or areas to support flexibility.

Cooperatives are often granted TURFs in exchange for accepting certain management responsibilities. The most important role of the Cooperative is to ensure its members are **Accountable** to the catch limit or other science-based controls on fishing mortality (**Step 4.3**). Other roles that the Cooperative may assume, such as monitoring, catch accounting and enforcement, are described in **Step 6 – Develop Administrative Systems**.

4.1

WHAT PRIVILEGES ARE GRANTED AS PART OF THE TURF?



TURFs are area-based catch shares, and most TURFs allocate exclusive harvesting privileges for one or more marine species (Table 4.1). Occasionally, TURFs grant outright ownership of fishing areas. The area-based allocation is paired with the privilege and responsibility to harvest within a scientifically determined catch limit, or other appropriate controls on fishing mortality. Some TURF users are formally allocated quota-based privileges to be harvested in their area (e.g., when portions of a fishery-wide catch limit are divided among Cooperatives).

As in any catch share, it is important that the privilege is defensible. A TURF that is formally recognized by law will have the stability provided by government enforcement and sanction (Pollnac, 1984). Not all TURFs will have this formal recognition, but they should at the very least be permitted so fishermen can exercise their privileges. In some cases, modifications to national law and/or regulations may be necessary, but you may be able to implement a TURF under the existing framework as long as TURFs are not expressly prohibited. In many countries, assigning exclusive harvesting privileges in a designated area may be more compatible with national law than assigning legal property rights over a marine space.

In addition to managing commercial fisheries, TURFs may permit and manage other activities. Most commonly, these include subsistence harvest and aquaculture within TURF boundaries.

Subsistence harvest

Many coastal communities may include subsistence fishermen who rely on the sea for their daily food intake, and this should be addressed in the fishery management design. Subsistence harvest may be included in a community's TURF, or separate areas may be designated. For example, the Seri community in Mexico's Gulf of California is comprised of both subsistence and commercial bivalve harvesters. Within the community's TURF, shallow sandbars that have traditionally been used for subsistence harvest are off limits to commercial fishermen (Basurto, 2005). In many customary marine tenure systems, all community residents can fish for subsistence purposes in their TURF (see **Catch Shares in Action: Samoan Safata District Customary User Rights Program**). By ensuring subsistence-harvesting opportunities are preserved for the long term, a TURF can support a community's food security, and the community can benefit from stewardship

TABLE 4.1 | EXAMPLES OF TURF PRIVILEGES AND MANAGEMENT RESPONSIBILITIES

TURF PROGRAM	NATURE OF ALLOCATED PRIVILEGES	MANAGEMENT RESPONSIBILITIES
Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program	Long-term marine concession for spiny lobster, divided into individual harvesting plots	Compliance with federal regulations and self-imposed internal rules to promote sustainability
Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System	Long-term marine concessions for benthic species	Manage group harvesting in compliance with annual catch and effort limits; implement additional measures to promote sustainability; contribute data to stock assessments
Chilean National Benthic Resources Territorial Use Rights for Fishing Program	Exclusive harvest privileges for select benthic species in coastal areas	Develop and administer management plan and annual catch limits for targeted species
Spanish Galicia Goose Barnacle Cofradía System	Exclusive harvest privileges for select intertidal species	Develop and administer management plan and limit fishing mortality through daily catch limits
Japanese Common Fishing Rights System	Exclusive harvest privileges for all species in designated coastal areas	Develop and administer rules for members, including gear restrictions and closures, to promote sustainable fishing
Samoan Safata District Customary User Rights Program	Exclusive harvesting privileges in customary fishing areas and the ability to manage community members and outsiders	Limit access and harvest based on customary rules; manage fishery through gear restrictions, closures, size limits, etc.
Mexican Pescadores de la Tribu Seri Cooperative Society (Seri Shellfish Cooperative)	Long-term marine concession for all commercial species in the area	Full management responsibility; prohibit fishing in productive areas; limit access by outsiders
Sri Lankan Negombo Estuary Stake-seine Fishery Cooperative	Limited rotational access to defined fishing sites	Manage fishery access and harvesting rules
Vietnamese Ben Tre Clam Cooperatives	Exclusive harvest privileges for a single clam species	Manage harvest and protect clam habitat; prevent illegal fishing; manage reseeding of harvesting areas

within the TURF. It is important for catch limits or other controls to account for **All sources** of fishing mortality in a fishery, including subsistence harvest.

Aquaculture

Aquaculture is commonly allowed within TURFs and may be compatible with TURF goals. Aquaculture may support social goals by providing alternative livelihoods in areas

where fishing opportunities are limited. When pursued responsibly, aquaculture can help meet the biological and economic goals of a TURF by boosting populations of harvested species or providing alternatives to wild capture. TURFs can provide the area-based privileges needed to culture target species—especially invertebrates—and thereby provide a sustainable alternative to overharvesting or destructive fishing practices that threaten many of the world's fisheries.

Some of the world's most advanced TURF systems include aquaculture. Small-scale aquaculture is permitted in Chilean TURFs, and some TURFs have supplemented their natural populations with cultured sea urchin, scallops and kelp. Chilean law originally permitted up to 20% of a TURF to be used for aquaculture, and the government recently expanded the allowed area to 40% based on the goal of increasing economic opportunities (Aburto et al., 2012; Ley General de Pesca y Acuicultura). Aquaculture activities are also undertaken by Fishery Management Organizations in Japan (Cancino et al., 2007).

Aquaculture within TURFs should be carefully regulated to ensure responsible practices. In Chilean TURFs, Cooperatives must comply with certain requirements to obtain approval from the government for aquaculture operations (Cancino et al., 2007). Because community fisheries may be affected by aquaculture activities in their TURF, communities will have an incentive to set up sustainable operations.

4.2 HOW WILL TURF BOUNDARIES BE DEFINED AND DELINEATED?

Defining TURF boundaries is often one of the most challenging steps of TURF design. This requires attention to both the biological characteristics of the fishery and the social characteristics of fishermen. Additionally, boundaries should be designed to be enforceable and compatible with the various uses of marine space.

Addressing scale

As indicated in **Consider Which TURF Type is Best for Your Fishery** and **Step 2.3**, an ideal TURF would allocate the full biological functional unit to one responsible individual or group. When a single defined social functional unit (as determined in **Step 3.2**) fishes within the biological functional unit, TURF design is relatively simple, as highlighted in a Type 1 TURF. However, the biological and social functional units in a fishery are not always congruent, and the design elements outlined below can ensure the TURF program is appropriate for the biology of the stock and the characteristics of fishermen.

When there is a discrepancy between biological and social functional units—as in TURF Types 3 and 4—a network of TURFs may be appropriate. Each TURF can be designed to be compatible with the social functional units in the fishery, and the TURF network can cover the biological functional unit. In these cases, coordination between TURFs is essential for implementing biologically appropriate controls on fishing mortality when a stock spans multiple TURFs. You can coordinate across multiple TURFs by creating joint management bodies, committees or other groups. The government can also play a role in overseeing and/or regulating the harvesting activity of multiple TURFs to support the biological functional unit. Coordinating bodies are discussed in more detail in **Step 6.3**.

The direct benefits fishermen receive from their conservation behavior are a key driver of success in TURF systems, and the size of a TURF relative to the biological functional unit plays an important role in rewarding fishermen for sustainable harvesting. If the TURF

DESIGN PRINCIPLE

When social or political factors call for TURFs that are small relative to the biological functional unit(s), develop coordinated TURF networks to achieve biologically appropriate management.



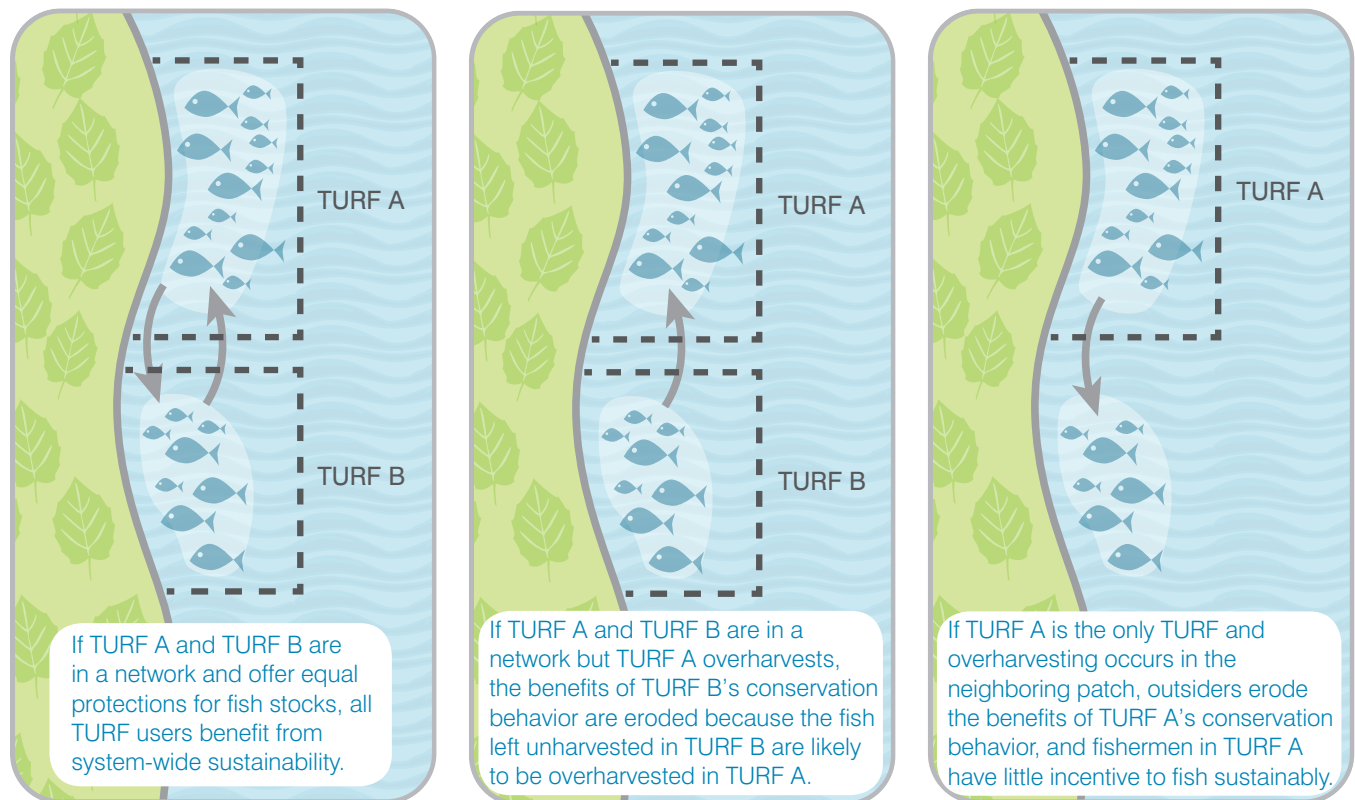
boundaries do not substantially capture the extent of adult movement and larval dispersal, some of the benefits of the stewardship by TURF users are dispersed to outsiders. The outcome is a reduction in exclusivity (Figure 4.1). Thus, the members of one TURF are affected by the fishing activity of outsiders, whether they are in a neighboring TURF or under different management. If the outsiders are not responsible and accountable for maintaining the stock's sustainability, then there may be an incentive for the fishermen in the TURF to overharvest (Holland, 2004; Janmaat, 2005; White and Costello, 2011). In a TURF network, harvest coordination between TURFs (via effort coordination

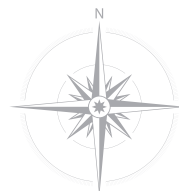
and profit sharing) can reduce the perverse incentives generated by species movement from one TURF to another, because users in all TURFs benefit equally from system-wide conservation behavior (White and Costello, 2011).

These design elements may not all be put in place at one time. You may start by implementing one TURF and over time, add new TURFs and coordination mechanisms. As the system develops and improves, catch limits or other appropriate controls on fishing mortality—within TURFs and outside TURFs—can be implemented and enforced to ensure overharvesting does not occur (**Step 2.4**).

FIGURE 4.1 | *Scaling TURFs to Biological Functional Units*

The shaded areas represent two patches of habitat with movement of the target species between patches (representing one biological functional unit). Three scenarios illustrate the importance of effective design.



DESIGN PRINCIPLE	Clearly define and delineate TURF boundaries to aid enforcement. Consider the existing spatial distribution of fishermen and other users in defining TURF boundaries.	
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Clear boundary definition and demarcation

It is essential for TURF borders to be clearly defined, and managers should consider the enforceability of boundaries during the design process. Boundaries should be defined in law or legal contracts to give TURF users the ability to defend their privilege. To support ease of enforcement, boundaries should be easily identifiable—for example, by using coordinates, taking advantage of landmarks or man-made markers, extending a certain distance from land, using straight lines, using depth contours or following a shelf or reef edge.

Understanding current fishing activity and existing boundaries

Because TURFs are designed to manage fishing activity spatially, it is important to consider the current and historical patterns of fishing activity when defining boundaries. TURF boundaries may be easiest to enforce if they reflect the current fishing locations of groups of fishermen. Fishing activity and fishermen organization is often complex, and TURF design may increase in complexity to accommodate various user groups. Fishing areas may depend upon the location of fishing communities, vessel types, gear types, the location of reefs and other factors. Boundary definition should take into account access points, landing sites, harbors and processing and distribution centers. If multiple user groups access these features, it may be appropriate to leave the waters surrounding them outside of designated TURFs (Yamamoto, 1983).

There may be existing customary boundaries that should be considered in the formal TURF boundary definition. Especially where customary tenure systems exist,

boundaries may be pre-determined by traditional rules. Translating those boundaries into formal, legal boundaries is discussed in more detail in **Appendix A**.

Considering enforcement feasibility

The feasibility of patrolling is an important consideration when determining TURF location and size. Many TURFs around the world are sited in enclosed areas, such as coves and bays, to take advantage of natural barriers. Reducing the overall length of the exposed boundary reduces opportunities for intrusion by outside vessels.

If TURF users are expected to enforce regulations within their TURF and keep outsiders from poaching, a large TURF may be burdensome. Designated patrollers may have difficulty accessing the whole TURF, especially if resources (e.g., funding for fuel) are limited. If TURFs are too large to be patrolled effectively, remote areas may become de facto open access areas.

Defining TURF boundaries based on the regular fishing grounds of TURF users may aid enforceability. In many cases, the fishermen themselves will be an important part of enforcement. The regular presence of TURF-associated fishermen in TURF areas will enable detection of illegal fishing activity.

Though large TURFs may be difficult to enforce, there are potential drawbacks from leaving marine space unallocated in favor of smaller TURFs. For example, fishing for *loco* is prohibited in non-TURF areas in Chile, but the difficulty of enforcing regulations along the country's vast coastline allows these areas to serve as de facto open access areas (Gallardo Fernández, 2008). In designing your TURF or TURF system, it is important to consider whether including

all fishing areas in TURFs or managing some using another method will be best for meeting fishery management goals based on the enforcement abilities of TURF users and the government.

Accounting for other marine uses

It is important to consider other uses of coastal waters—such as recreation, subsistence harvest, aquaculture, marine transport, and extraction of oil, gas or minerals—and determine whether these activities will be permitted within TURFs. It may also be beneficial to anticipate

future uses of marine areas, such as increased tourism, expanded aquaculture or ocean energy production. TURF boundaries, whether they include or exclude these other activities, should reflect the locations of the full spectrum of marine uses to avoid conflicts between users. In Taiwan, for example, conflicts arose in the 1990s when coastal development activities (i.e., power plants, jetties, etc.) overlapped with exclusive fishing areas allocated to fishermen's associations (Chen, 2012). The fishery rights system was revised in the early 2000s to better manage multiple marine uses by removing areas with existing public facilities from the system.

4.3 HOW WILL THE COOPERATIVE BE ACCOUNTABLE TO CONTROLS ON FISHING MORTALITY?

In a TURE, participants (usually Cooperatives) are allocated fishing privileges in exchange for ensuring the group's harvest complies with the catch limit or other science-based controls on fishing mortality (as determined in **Step 2.4**). Additionally, the Cooperative is responsible for promoting the biological, economic and social goals of the program by ensuring there is not a race for fish between members. There are many ways in which a Cooperative can manage its members' harvest, and the approach may depend upon which fishing mortality controls are employed.

Sub-allocating individual shares of the catch limit or the area is one way to prevent a race for fish between Cooperative members. This can help meet biological goals and promote efficiency in the fishery, especially when shares are transferable between members. If a social goal is to allow profits to accrue to the community rather than to individuals, you may prefer another method for managing the group's allocation.

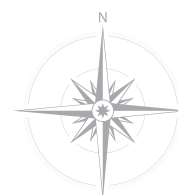
Sub-allocation of shares to members

If there is a catch limit for the TURE, the Cooperative may divide its total quota and assign individual shares to members. Cooperatives can allocate quota-based shares to individuals either formally or informally, and hold individuals accountable to their shares so that the Cooperative stays within its group allocation. For example, some Cooperatives in the Chilean National Benthic Resources TURF Program evenly allocate shares of the catch limit to fishing teams, which usually consist of a diver and two team members (Cancino et al., 2007). Sub-allocation prevents a race for fish between members because the distribution of the Cooperative's quota is clearly defined.

Cooperatives may also choose to divide their area-based allocation into individual harvesting plots, as the Mexican Pescadores de Vigía Chico Cooperative has done to manage the Punta Allen spiny lobster fishery in Mexico (see **Catch**

DESIGN PRINCIPLE

Develop mechanisms to ensure the Cooperative is accountable to its catch limit or other appropriate controls on fishing mortality and prevents a race for fish among members.



Shares in Action: Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program).

Individual members are allocated a *campo* in which they have exclusive privileges to set their harvesting gear. They are also responsible for compliance with harvesting rules in their campo.

The decision to sub-allocate shares will likely depend upon the Cooperative's ability to administer an individual quota program among its members. It may be especially advantageous in Cooperatives comprised of diverse members with limited social cohesion. For some Cooperatives, however, individual quotas may be challenging to administer and monitor. It is essential to pair individual quotas with an effective accounting system that holds each member accountable for his quota. If the Cooperative decides to allocate its quota or area to its members, it is advisable for the Cooperative to go through each step of **Volume 1** of the **Catch Share Design Manual** to design and administer an effective individual quota program among its members.

Harvesting effort coordination

Many Cooperatives employ fishing effort coordination mechanisms in which they dictate where, when, how and/or how much members can harvest. The Cooperative controls harvest by distributing fishing effort among members. Unlike conventional input restrictions, fishing effort coordination is often implemented to promote economic efficiency (see Snapshot 4.1) or to promote fairness among members. Achieving efficiency and promoting fairness may be at odds with each other under certain circumstances. Cooperatives should consider these tradeoffs when designing fishing effort coordination systems, and determine which outcome is more important in order to guide design.

Input restrictions

Conventional input restrictions include trip limits, size limits, seasons, gear restrictions and vessel size restrictions. These or other self-imposed restrictions can be used to limit harvest to ensure the Cooperative stays within its share. Cooperatives may implement conventional input

restrictions because they are familiar—for example, if the government has already implemented these types of restrictions—and may have lower administrative and monitoring requirements. Cooperatives can often implement input restrictions at a finer scale than government fishery managers, which may be more appropriate and effective for meeting fishery goals. When designed well, input restrictions may be effective at reducing fishing effort to achieve the desired harvest. However, input restrictions have a less direct connection to catch and are at risk of allowing overharvesting. Regular adjustments (usually, increasing restrictions) are often required to meet biological targets, but these restrictions may undermine economic goals. Input restrictions alone do not prevent a race for fish, and they often result in higher fishing costs, lower profits and reduced safety for fishermen. It is important to recognize the limitations of managing the Cooperative's share via input restrictions. If they are the most feasible option, input restrictions must be designed and enforced as effectively as possible to ensure the Cooperative stays within its share and prevents a race for fish.

Individual effort allocations

Cooperatives occasionally use individual effort quotas to control fishing mortality. Individual effort quotas are a special case of input restrictions, in which individuals are allocated an amount of effort they may apply to fishing. Effort units may include a number of traps that may be deployed, a number of days that may be fished, or other measurable units. Ideally, effort units are defined so that they have a clear, direct relationship to fishing mortality and cannot easily be substituted for through the use of other inputs. Allowing transferability of effort units between Cooperative members can improve efficiency. If the total amount of effort units allocated to Cooperative members is closely tied to the Cooperative's total quota allocation, individual effort quotas may be effective for managing the group's quota. A key challenge, however, is that as harvesting efficiency increases, a greater amount of fish can be harvested using the same allocated effort unit. Adjusting the effort allocation over time may be important for ensuring increases in harvesting efficiency do not

interfere with fishery sustainability. For more information on individual effort quotas, see **Transferable Effort Shares: A Supplement to the Catch Share Design Manual**.

Reserves

As discussed in **Step 2**, no-take reserves or limited-use areas can be used to meet biological targets within TURFs.

Pairing TURFs with no-take reserves allows the benefits of reserves to directly accrue to local TURF users.

In exchange for these benefits, Cooperatives typically participate in administration and enforcement of reserves. Cooperatives may play a role in defining the boundaries of reserves and the rules that apply to them. They will likely play a strong role in educating members about the

SNAPSHOT 4.1 | Meeting Goals through Fishing Effort Coordination

Most Cooperatives engage in some form of coordinated behavior, ranging from information sharing to coordinating harvesting regimes ("effort coordination"). Effort coordination can help eliminate the race for fish because all fishermen are working together to harvest within the group's allocation. Consequently, the biological impacts of the race for fish—including overharvesting of target or non-target species—are eliminated.

Economic efficiency is a common driver of effort coordination. For example, Cooperatives may require members to alternate fishing days, reducing effort to the optimal daily level. Cooperative members may rotate through fishing grounds or fish in designated places to reduce congestion in prime fishing grounds (Uchida and Watanobe, 2008). Cooperatives may choose to create specialized roles and assign only the best fishermen to fish in order to optimize efficiency.

The perception of fairness is often important for maintaining social cohesion and thus the effectiveness of the Cooperative. Rotational fishing can be used when species abundance varies spatially to allow all members equal access to the best fishing grounds. For example, the Hiyama Fishery Cooperative Association in Japan uses a highly organized rotational scheme to distribute fishing effort for walleye pollock in a way that is perceived as fair by its members (Uchida and Watanobe, 2008). Similarly, Cooperatives may engage in effort coordination to ensure members have a fair distribution of profits.

Effort coordination typically occurs within a Cooperative, but it is sometimes utilized by neighboring Cooperatives targeting the same resource. The Sakuraebi Harvesters Association, for example, was formed to coordinate effort between two Cooperatives in Japan that disputed over sakuraebi shrimp, which gain size as they move north between the Cooperatives. The association's committee, made up of vessel owners and skippers from each Cooperative, handles the many decisions that manage daily fishing activities. These include whether the fleet should fish that day, vessel departure time, vessel locations, which vessels will fish, target harvest amount and landing amounts in each port (Uchida, 2007).

purpose of the reserves, the location of reserve boundaries and the restrictions within reserves. Cooperatives are often responsible for actively patrolling reserves and issuing penalties to non-compliant fishermen. They may also be responsible for managing reserves adaptively to meet fishery management goals, such as by modifying reserve boundaries and harvest restrictions. This process may include conducting scientific assessments or working with the government or other entities to assess the health of fished stocks.

Additional considerations

Cooperatives may limit total harvest using whichever of the above methods is most compatible with the Cooperative's goals and management capacity. These methods may also be combined for a comprehensive approach to harvest management. Furthermore, the Cooperative may change its method(s) of harvest control over time to meet fishery management goals. Ultimately, the Cooperative is responsible for effectively limiting harvest within its allocated area, and the Cooperative should use whichever method is most effective within the local context.


4.4 FOR HOW LONG WILL THE PRIVILEGE BE ALLOCATED?

The tenure of shares affects the security of a catch share and the conservation incentive of fishermen. Area-based privileges should be allocated for a sufficient length of time for participants to realize future benefits. TURFs are commonly allocated for a period of 10 to 20 years, or in perpetuity.

Because TURFs are typically allocated to Cooperatives, it is especially important to consider the effect of the tenure of shares on Cooperative function. Developing and administering a Cooperative requires a commitment of time and resources. Participants will want to ensure that their efforts in organizing the Cooperative are sufficiently rewarded. Cooperatives often tend to improve their functioning over time, as participants' trust and social bonds are strengthened and as the group adapts to better meet its goals. A sufficient tenure length allows Cooperatives to strengthen and to innovate.

It is common for tenure to be contingent upon compliance with regulations set forth by fishery managers. Managers may implement an annual review and renewal process to ensure privilege holders are upholding their management responsibilities. In the Chilean National Benthic Resources TURF Program, for example, Cooperatives' area-based privileges are renewed every four years based on compliance with national laws specifying the permitted uses of TURFs.

There are tradeoffs between the length of tenure and the ability to accommodate new entrants in a TURF system. However, long-term tenure supports the common social goal of allowing fishery revenue to accrue to particular communities. The upfront costs of implementing a TURF and organizing fishermen to co-manage a TURF may be further reason to provide long-term tenure.

DESIGN PRINCIPLE	Allocate shares for sufficient length to encourage stewardship and appropriate investment by shareholders and associated industries. This can be achieved by allocating in perpetuity and/or for significant periods of time with a strong assumption of renewal, provided rules are adhered to.	
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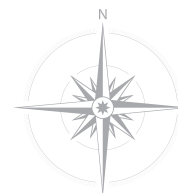
4.5 HOW IS THE LONG-TERM SHARE DEFINED?

Catch shares are commonly allocated for an extended period of time, so managers must determine the long-term share unit. In TURFs, the long-term share is defined as the privilege to harvest within the allocated area. This privilege will be paired with the responsibility to ensure the Cooperative's total harvest is appropriate for the long-term health of the stock.

If there is a fishery-wide catch limit, the long-term share may include a defined quota-based component—a specific amount of fish that the Cooperative is allowed to harvest each year. Especially in a Type 3 or Type 4 TURF, in which multiple social functional units are accessing the resource, each TURF may be allocated a percentage of the fishery-wide catch limit. Various ways to allocate long-term, quota-based shares are discussed in detail in **Step 4.3 of Volume 1** of the **Catch Share Design Manual**.

DESIGN PRINCIPLE

Employ percentage shares, when possible, of the overall cap rather than absolute weight units for long-term shares.



4.6 WHAT WILL THE ANNUAL ALLOCATION UNIT BE?

Most catch share programs differentiate between the long-term privilege and the annual catch allocation. The annual allocation is the measurement of the seasonal allocation that is issued to privilege holders and is computed based on

their long-term share. The allocation can be expressed in weights or numbers. These methods are discussed in detail in **Step 4.4 of Volume 1** of the **Catch Share Design Manual**.

4.7 WILL THE PRIVILEGE BE PERMANENTLY AND/OR TEMPORARILY TRANSFERABLE?

When privileges are transferable, participants are allowed to buy and sell shares, either permanently or temporarily, or both. Transferability increases flexibility in the program and can enhance performance in biological, economic and social goals. Transferability in a TURF system can enhance biological goals by ensuring the distribution of shares across TURFs is compatible with the spatial distribution of target species. Transferability can support economic goals by allowing members to improve efficiency. Social goals

can be supported by communities' ability to derive income through transfers.

There may be significant tradeoffs between the benefits of transferability and the impacts upon certain goals, such as the common social goals of allowing the fishery benefits to accrue to certain communities or preserving the historical fleet structure. Fishery managers and Cooperatives should consider these tradeoffs when determining whether to allow transfers.

In setting up a TURF system, fishery managers and Cooperatives must determine whether area-based and/or quota-based privileges may be transferred within a TURF (“intra-TURF”) or across TURFs (“inter-TURF”). Because Cooperatives typically determine who can access their TURF, privileges to access the area-based share may also be transferred between members of a community. Additionally, TURF users sometimes grant access to participants in neighboring TURFs or other fishery participants.

Intra-TURF transfers



In some TURFs, quota-based shares are sub-allocated to individuals within the Cooperative (**Step 4.3**), and some Cooperatives allow these shares to be transferred between members. Cooperatives often facilitate quota transfers between members to achieve efficiency gains and comply with catch limits.

If TURFs are subdivided into individual harvesting plots, plots may be transferred among Cooperative members. For example, the Pescadores de Vigía Chico Cooperative that targets spiny lobster in Punta Allen, Mexico, has divided its 324 km² TURF into more than 100 individual harvesting plots (Defeo and Castilla, 2005). Plots may be temporarily or permanently transferred between Cooperative members (see **Catch Shares in Action: Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program**).

In some community-allocated TURFs, fishermen within the community are given licenses conferring Cooperative membership and allowing them to fish in the TURF. Thus, while the TURF is allocated to the community, access to the

TURF is granted through the licensing system. Individuals within a community may be allowed to transfer licenses. Often fishermen are allowed to pass their fishing licenses down to their next of kin.

Transferring individual shares within a TURF provides flexibility that can help meet biological and economic goals. However, social goals are often very important in TURF systems, and transferability may not always be compatible with social goals. Fishery managers or Cooperatives may choose to limit intra-TURF transfers to support social goals (**Step 4.8**).

Inter-TURF transfers



Transfers of quota-based or area-based shares between TURFs are uncommon but can have benefits in some contexts if designed properly. For example, a TURF that is allocated quota-based shares may choose to sell its shares, permanently or temporarily, to a neighboring TURF if the species range changes (e.g., due to climate fluctuations). The transfer could have biological benefits because the shares would follow species abundance. It could also have economic benefits because harvest would be more efficient in the TURF with high abundance. A Cooperative could permanently or temporarily sell its area-based share if, for example, it began to rely less on fishing and more on other industries.

As an alternative to transferring its area-based share, a Cooperative may choose to grant TURF access to non-members. Within networks of TURFs, users may exchange reciprocal access between neighboring TURFs. Reciprocal access agreements can provide stability by allowing users more flexibility in their fishing location, and could

DESIGN PRINCIPLE	To increase program flexibility, consider transferability of shares, permanent and/or temporary, which is generally a hallmark of catch share programs.	
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TABLE 4.2 | BASIC TYPES OF TRANSFERS IN A TURF OR TURF SYSTEM

	INTRA-TURF TRANSFER	INTER-TURF TRANSFER
Quota-based share	An individual quota share is transferred from one member of a TURF to another member of the same TURF	Quota held by the members of one TURF is transferred to the members of another TURF
Area-based share	An individual plot formed from a subdivided TURF is transferred from one member of a TURF to another member of the same TURF	A TURF is transferred from one individual or group to another
Access to area-based share	A license and/or Cooperative membership is transferred between individuals of one community	Access to the TURF is granted to members of a neighboring TURF or to other fishermen

strengthen TURF enforcement if neighboring communities are engaged in enforcing each other's TURFs.

Cooperatives sometimes receive economic and social benefits from granting outsiders access to their allocated TURFs. The Seri community, which targets shellfish in a TURF in the Gulf of California in Mexico, allows access to outsiders through formal mechanisms authorized by the Seri government and through informal mechanisms facilitated by community members (Basurto, 2005). The benefits to the community—depending on the type of access agreement—include direct fees (per kilogram harvested), employment of Seri community members and sharing catch with Seri community members.

If outsiders are allowed to access TURF resources, the Cooperative has an obligation to track their harvest and ensure that aggregate harvest by all fishers in the TURF complies with the catch limit or other mortality controls.

Tradeoffs

Transfers of shares and access agreements can provide benefits to fisheries and fishing communities, but the benefits should be weighed carefully against the potential consequences.

Transferability in a TURF system can be at odds with biological goals if conservation incentives are dissipated. The value of TURF privileges is that long-term tenure of shares promotes sustainable fishing practices; additionally, long-term tenure incentivizes TURF users to enforce regulations within their TURF. However, non-members who are allowed to fish within a TURF may not have the same conservation incentives as TURF users and may be more likely to overharvest. TURF users can protect their interests by setting rules for outsiders and rescinding access when the rules are not followed. Access agreements and other transfers should be pursued with caution and the sustainability of fisheries in mind.

Transferring access outside the community may impact social goals by drawing benefits away from the community. Reciprocal access agreements between TURFs are not always balanced. In customary tenure systems of the Pacific Islands, for example, some communities have rights to fish in other communities' TURFs, but the reverse is not true (Aswani, 2005).

Furthermore, whenever the benefit of allowing access to outsiders accrues only to an individual or a small group, rather than to all TURF users, there is a risk of

overexploitation by outsiders driven by the self-interest of the individuals granting access. In the Seri community, for example, specific community members receive benefits from access agreements, and thus there are strong incentives to allow outsiders into the TURF. This creates a

potential for overharvesting. In this case, access rules that limit the location of harvest and the amount that outsiders may harvest have helped avoid overexploitation (Basurto, 2005).

4.8 WILL THERE BE RESTRICTIONS ON TRADING AND USE OF SHARES?

Numerous benefits may be derived from allowing transferability in TURF systems. However, transferability in TURF systems (especially inter-TURF transfers) is uncommon and is thus an area for further research. Fishery managers and Cooperatives should carefully consider the potential advantages and consequences of transfers, and should apply appropriate limits on transfers to ensure attainment of program goals. TURF users, who are incentivized to protect their allocated resources, can play a role in enforcing restrictions on transfers and monitoring the behavior of outsiders who are granted TURF access.

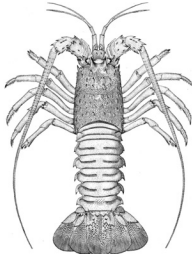

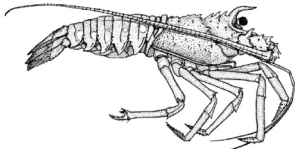
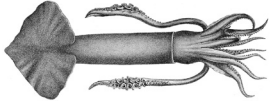
Fishery managers often prohibit temporary and permanent transfers of area-based shares, as well as access to TURFs by outsiders. In particular, restrictions on transfers of allocated areas support social goals by ensuring the resources are available to specific communities. Additionally, prohibiting transfers of allocated areas can help prevent outsiders from purchasing, leasing or accessing a TURF with the intent to overexploit the resources within it. Outside fishermen may have minimal conservation incentive because they are less reliant on local resources.

Fishery managers or Cooperatives may also set restrictions on intra-TURF transfers of sub-allocated shares (quota- or area-based) and access privileges. Unless intra-TURF transfers affect management goals, it may be most appropriate for fishery managers to allow Cooperatives to decide whether and how intra-TURF transfers will occur. Transfers of sub-allocated shares provide flexibility among participants to promote efficiency, but Cooperatives may choose to limit transfers if they want to maintain a certain distribution of shares among participants. Cooperatives may limit transfers of licenses to members of certain fishing groups or fishing families.

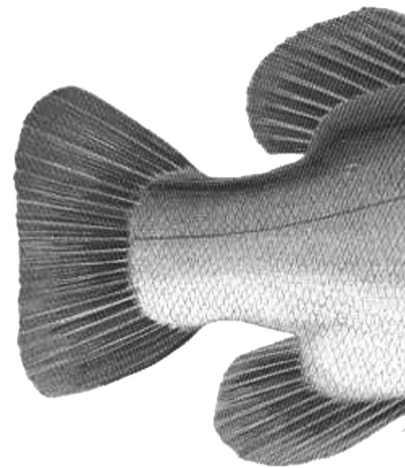
Transferability supports flexibility and fishery-wide profitability, but the common social goals of TURFs can be compromised unless careful attention is given to avoiding the potential drawbacks of transferability. Fishery managers and Cooperatives may implement restrictions on transfers as needed to support social goals.

Step 4 – Define the Privilege

This chart provides a brief summary of the **Step 4** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

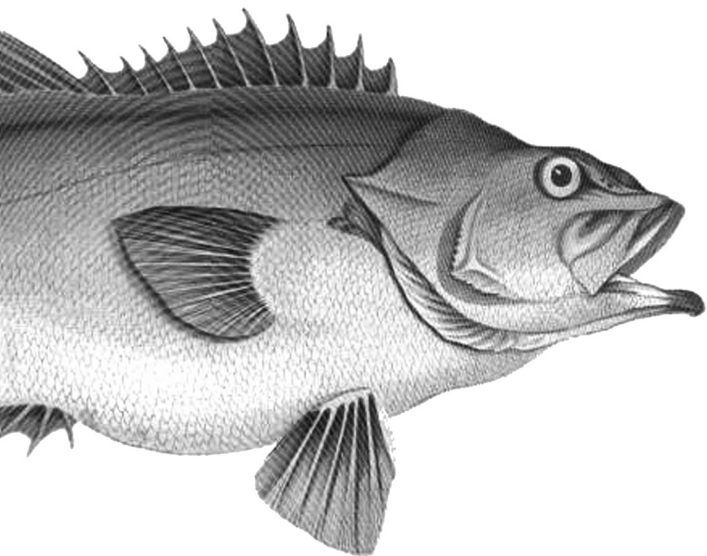
	4.1 PRIVILEGES ALLOCATED	4.2 BOUNDARY DEFINITION	4.3 COOPERATIVE ACCOUNTABILITY	4.4 TENURE LENGTH
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	Concession for commercial harvesting of spiny lobster	Based on geographical demarcations of Ascension Bay in Quintana Roo	<p>Compliance with government restrictions</p> <p>Individual members responsible for their individual plot, or campo</p> <p>Self-imposed rules, including no-take buffer around each campo</p>	<p>Concessions are granted for 20 years</p> <p>Renewable based on performance</p>
<p>Samoan Safata District Customary User Rights Program</p> 	Customary territorial user rights recognized by the government through bylaw process	<p>Based on traditional territorial boundaries</p> <p>Extend from shore to end of reef</p>	<p>Customary rules and no-take reserves</p> <p>Community members responsible for monitoring fishing activity</p>	Indefinitely
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	Concession for the commercial harvest of identified benthic species	Defined by the National Fisheries Institute based on biology and community locations	<p>Compliance with government regulations</p> <p>Self-imposed rules and some no-take zones</p>	<p>Concessions are granted for 20 years</p> <p>Renewable based on performance</p>
<p>Japanese Common Fishing Rights System</p> 	Privilege to harvest all species in defined area	Based on existing geopolitical boundaries of coastal communities and local Cooperatives	<p>Compliance with government regulations</p> <p>Cooperatives impose additional rules</p>	<p>Granted for 10 years</p> <p>Renewable based on performance</p>

4.5 LONG-TERM SHARE	4.6 ANNUAL ALLOCATION UNIT	4.7 PERMANENTLY AND/OR TEMPORARILY TRANSFERABLE	4.8 RESTRICTIONS ON TRADING AND USE OF SHARES
<p>Privilege to harvest lobster within the concession</p> <p>Management responsibility</p>	<p>Privilege to harvest within defined season</p>	<p>Concession cannot be transferred</p> <p>Intra-TURF transfers of individual campos</p>	<p>Concession cannot be transferred</p> <p>Individual campos can be transferred at the beginning of the year</p>
<p>Privilege to harvest all species within the TURF</p>	<p>Privilege to harvest within community-permitted areas according to defined rules</p>	<p>Shares not transferable, but outsiders may gain access with “monotaga” or longstanding contributions to the community</p>	<p>TURF cannot be transferred to another community</p>
<p>Privilege to harvest benthic species within concession</p> <p>Management responsibility</p>	<p>Annual harvest limit or number of traps for lobster</p>	<p>No temporary transferability of concessions; permanent transfers occur rarely</p>	<p>Transfers not common</p>
<p>Privilege to harvest all species</p> <p>Quota-based shares allocated for eight key species</p>	<p>Varies by species and Cooperative</p>	<p>No transferability of TURFs</p> <p>Intra-TURF transfers vary by Cooperative</p>	<p>Varies by Cooperative</p>



Step
5

Assign the Privilege





At a Glance

Assigning the privilege has often been the most difficult and controversial step of implementing a catch share program. Participants feel that much is at stake in the distribution of catch share privileges and initial allocation sets up the starting point for the program.

KEY PRINCIPLES	<p>Develop a transparent, independent allocation process that is functionally separate from the rest of the design process. Allocations that retain the relative equity positions of stakeholders are the least contentious. 70</p> <p>Employ an allocation appeals process that allows eligible participants to refute allocated amounts with verifiable data. 71</p>
SUB-STEPS	<p>5.1 What decision-making body will determine initial allocation? 70</p> <p>5.2 When will allocation occur? 70</p> <p>5.3 Will there be an appeals process? 71</p> <p>5.4 Who is eligible to receive shares? 71</p> <p>5.5 Will initial allocations be auctioned or granted? 72</p> <p>5.6 How will areas be allocated? 72</p> <p>5.7 What information is available for allocation decisions? 73</p>

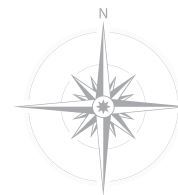
Assign the Privilege

Initial allocation is a key step in transitioning to a catch share program. Allocation decisions are outlined in detail in **Step 5** of **Volume 1** of the **Catch Share Design Manual** and summarized below with additional considerations for TURFs. Assigning the privilege can occur at two levels for TURFs. Fishery managers allocate privileges to individuals or Cooperatives, and sometimes Cooperatives sub-allocate shares to individuals. Furthermore, Cooperatives will often be responsible for determining which individuals will have the privilege to fish within their TURFs. Because initial allocation is often difficult and controversial, it is important for each allocation process to be transparent and to occur independently of the rest of the design process.

By successfully assigning the privilege you will ensure that shares have been **Exclusively** allocated to participants in order to end the race for fish. This step may also ensure that **All sources** of mortality are included as part of the catch share.

DESIGN PRINCIPLE

Develop a transparent, independent allocation process that is functionally separate from the rest of the design process. Allocations that retain the relative equity positions of stakeholders are the least contentious.



5.1 WHAT DECISION-MAKING BODY WILL DETERMINE INITIAL ALLOCATION?

An independent decision-making body should be responsible for making allocation decisions. The decision-making body may include national, regional and local government representatives; community members; fishery scientists; or ideally, a combination of these representatives. Many TURF systems also have advisory groups comprised of fishermen and other fishery participants, such as buyers

and processors. These groups can provide information to the decision-making body to help with allocation decisions.

A Cooperative interested in distributing shares to its members will likely need its own decision-making body for allocation. Cooperatives may seek input from fishery managers or from others outside the group to help facilitate a fair and transparent process.

5.2 WHEN WILL ALLOCATION OCCUR?

Initial allocation of shares can occur at any time during the design process. If Cooperatives sub-allocate shares or areas to individual members, allocation may occur in two stages—first to the group as a whole and then to individuals within the group.

Allocation of TURFs in a TURF system may occur all at once or on a rolling basis. Allocation may occur over a period of several years, especially when TURFs are designed

and implemented by communities rather than by the government. In the Chilean TURF Program, for example, allocation decisions have been made based on applications from organized groups of fishermen. Since 1991, hundreds of TURFs have gradually been granted there through the application process (Gallardo Fernández, 2008). In contrast, Cooperatives in Baja California were awarded nine concessions in a single year (1992) to harvest spiny lobster and other benthic species (Tindall, 2012).

5.3 WILL THERE BE AN APPEALS PROCESS?

As with any catch share, it is important to establish a formal appeals process as part of TURF allocation. Appeals processes are discussed in detail in **Step 5.3 of Volume 1 of the Catch Share Design Manual**.

In a TURF system, an appeals process ensures that user groups are protected from having their fishing areas allocated to other users. When a TURF is allocated to a community, the community may seek a larger fishing area, or neighboring communities may dispute the area allocated to them. All appeals should be backed with clear evidence supporting the claim that the allocation did not comply with the guidelines established for making allocation decisions. Appellants may seek to modify TURF boundaries, dispute the eligibility of the users granted privileges or

argue that other users should be allowed to fish in the allocated area.

Appeals may be especially important when TURFs are implemented on a rolling basis because stakeholders not currently engaged in seeking a TURF for their fishery may be unlikely to negotiate during allocation to a neighboring community. A thorough stakeholder process prior to allocation may reduce the likelihood of appeals being filed.

An appeals process is not a substitute for a fair and transparent allocation process. It should instead be used as a safeguard against inappropriate allocation decisions. Appeals rely on having clearly defined guidelines for how privileges are allocated, as described in **Step 5.6**.

DESIGN PRINCIPLE

Employ an allocation appeals process that allows eligible participants to refute allocated amounts with verifiable data.



5.4 WHO IS ELIGIBLE TO RECEIVE SHARES?

During the initial allocation process, it is essential to determine who will be eligible to receive area-based allocations. This decision will be based on fishery goals and the basic criteria set out in **Step 3 – Define Eligible Participants**. Managers will first determine generally which groups may be able to participate in TURF management, and will then decide which groups (or individuals) in particular will receive area-based allocations.

In most TURF programs, historical use is the primary determinant of eligibility. Fishery managers will often allocate areas to Cooperatives that represent groups of historical participants, whether they represent a particular community (or communities) or a group of fishermen that fishes in the same area.

Cooperatives that are allocated TURFs will typically be responsible for determining who may be a member of their group and which individuals are allowed to fish in the TURF. These decisions will be guided by the membership criteria defined in **Step 3.3**. Often the privilege to fish the Cooperative's allocation will be reserved for historical fishery participants or members of a community. Members are typically expected to agree to Cooperative rules or bylaws in order to fish the group's share. Members may be allocated an individual share, or may take part in the collective harvest of the group's share according to Cooperative rules.

5.5 WILL INITIAL ALLOCATIONS BE AUCTIONED OR GRANTED?

Area-based catch shares are typically granted to eligible participants, rather than auctioned. Granting privileges is more consistent with the common social goal of allowing fishery revenues to accrue to particular communities. Auctioning may be compatible with these goals as long as there are sufficient restrictions on who may receive TURF allocations. Especially in small-scale fisheries, however, fishermen may have limited resources to obtain privileges through auctions.

The Washington State wild geoduck fishery management program balances biological, economic and social goals by employing separate allocation processes for different user

groups. To meet social goals, half of the annual geoduck catch limit is reserved exclusively for 15 Tribal groups that fish in their traditional fishing grounds (Washington State Department of Natural Resources, 2001). The rest of the annual catch limit is harvested by private fishermen to whom the State auctions designated geoduck fishing areas four times per year. The revenues earned from auctions provide substantial funding for state programs—including coastal environmental management, and administration and enforcement of the geoduck fishery—while also providing revenue and jobs for fishermen, processors and distributors (Washington State Department of Natural Resources, 2001).

5.6 HOW WILL AREAS BE ALLOCATED?

Because most TURFs are granted rather than auctioned, a key step in assigning the privilege is determining which areas each Cooperative or individual will be allocated. Allocation decisions should be based on clear guidelines that outline the decision-making process for allocating a particular area to an eligible Cooperative or individual. The complexity of users affects the complexity of allocation.

A participatory process in which fishermen and other stakeholders work with managers to define TURF boundaries is recommended. Fishing behavior is often complex, and there may be spatial overlap of historical fishing areas by various user groups. A stakeholder process guided by mapping of fishing activity may be helpful for negotiating the placement of TURF boundaries relative to historical fishing.

Allocation decisions may be based on an application process, or TURFs may be delineated for an entire area based on the users that are present. In Chile, organized groups of fishermen can apply to receive a TURF allocation. Groups must submit a management and exploitation plan to government fishery management authorities for approval. Preference for management and exploitation

privileges is given based on proximity to the requested area, as well as on the size and age of the organization seeking the privileges (Gallardo Fernández, 2008).

It is typically ideal to allocate TURFs to local fishermen because the geographical proximity of users influences the effectiveness of TURF management (Aswani, 2005). However, historical users may not always be local, and failure to incorporate non-local users into the TURF system may result in conflict or illegal fishing. Appropriate ways to incorporate highly mobile small-scale fleets into a TURF system may be to assign TURF areas to mobile fishermen, or to keep non-TURF areas open for mobile fleets with appropriate limits on harvest. Allocation complexity also increases when multiple user groups have historically used the same area and/or accessed the same resource (such as in a Type 3 fishery). In this case, TURF areas may be shared among groups or divided into smaller areas.

Additional considerations

Each area-based allocation may be paired with a portion of the fishery-wide catch limit. The catch limit for each TURF may be determined based on the size of the TURF

relative to the entire fishing area, based on the number of fishermen in the TURF, or based on the abundance of fish within the TURF.

Especially for localized and moderately mobile stocks (e.g., for Type 1 TURFs), it may be most effective to determine the appropriate harvest amount for each TURF based on local conditions. This may involve setting a specific catch limit for each TURF or dividing a fishery-wide catch limit among TURFs based on the relative abundance of fish in each TURF (see **Science-Based Management of Data-Limited Fisheries: A Supplement to the Catch Share Design Manual** for guidance on assessing stocks). In the Chilean TURF Program, for example, each Cooperative is responsible for hiring an external consultant to conduct a baseline study of the area and establish the catch limit for target species. The Undersecretary of Fisheries confers final

approval of the TURF after the scientific recommendations are made (see **Catch Shares in Action: Chilean National Benthic Resources Territorial Use Rights for Fishing Program in Volume 1**).

For highly mobile stocks, other methods of allocation may be preferred. If the biological functional unit is large and covers multiple TURFs (as in a Type 3 and Type 4 TURFs), it may be best for an overarching management body to determine the appropriate fishery-wide catch limit and distribute it among TURFs based on whichever criteria are most appropriate for that fishery. If social goals are a priority, for example, you may distribute shares among TURFs based on the number of fishermen in each. However, it is important to consider potential threats of localized depletion, such as if fishermen are unevenly distributed across the various TURFs.

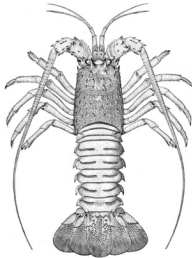
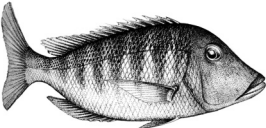
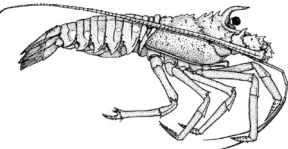
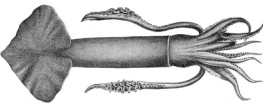
5.7 WHAT INFORMATION IS AVAILABLE FOR ALLOCATION DECISIONS?

Allocation decisions are typically based on historical use of the fishery. The data available for allocation decisions will vary from one fishery to another. When available, historical records of landings and fishing areas can be useful for confirming which fishermen have accessed a proposed TURF area. Where written records are unavailable, verbal accounts from fishermen may be confirmed by other fishermen, law enforcement personnel, local processors or

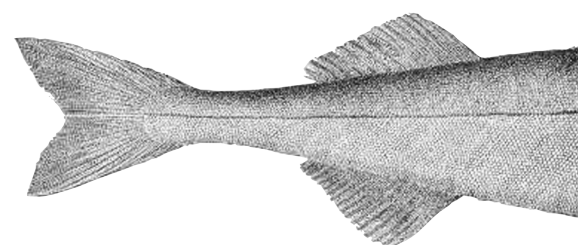
others with knowledge of local fishing activity. Alternatively, fishing activity may be monitored once a TURF is being considered for implementation. The drawback is that some fishermen may “cheat the system,” fishing in the proposed TURF area for the express purpose of gaining access to the TURF in the future. This can be mitigated by setting a “control date”—that is, a date beyond which fishing records will not count toward TURF eligibility.

Step 5 – Assign the Privilege

This chart provides a brief summary of the **Step 5** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

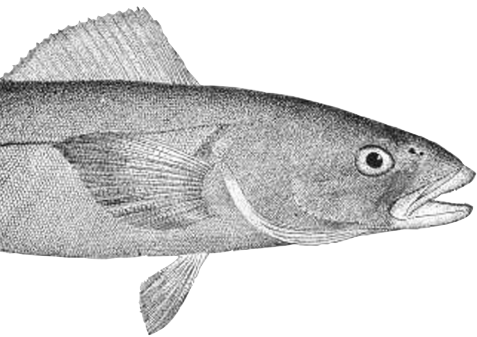
	5.1 DECISION-MAKING BODY	5.2 WHEN ALLOCATION OCCURRED	5.3 APPEALS PROCESS	5.4 ELIGIBILITY REQUIREMENTS
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	CONAPESCA	Concession allocated to the Cooperative upon organization in 1968; then individual campos allocated to members	None	<p>Based on historical use</p> <p>Allocated to organized Cooperatives</p>
<p>Samoa Safata District Customary User Rights Program</p> 	<p>Land and Titles Court works with chiefs to claim traditional grounds</p> <p>Samoa government approves bylaws establishing TURFs</p>	Village Fono Act of 1990 transferred management authority over traditional fishing areas back to native communities	Communities can formally dispute boundaries with the Land and Titles Court	<p>Community eligibility based on historical rights to land and sea and decision to implement bylaws</p> <p>Individuals eligible based on kinship</p>
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	CONAPESCA	Concessions first granted in 1992	None	<p>Members must have government-issued permit</p> <p>Cooperative determines individual eligibility</p>
<p>Japanese Common Fishing Rights System</p> 	Ministry of Agriculture, Forestry and Fisheries and prefectural governments	Formally allocated in 1949 with design features evolving over time	None	Allocated exclusively to Fishery Cooperative Associations

5.5 AUCTIONED OR GRANTED	5.6 AREAS ALLOCATED	5.7 AVAILABLE DATA
Granted	Historical fishing area within Ascension Bay	Historical knowledge
Granted	Customary fishing grounds registered through the Land and Titles Court TURF boundaries extend from shore to reef edge	Boundaries mapped through consultation process with customary users
Granted	Coastal areas adjacent to fishing communities	Historical knowledge
Granted	Coastal areas, defined by geopolitical boundaries	Historical landings



Step
6

Develop Administrative Systems





At a Glance

Administrative systems are an important component of a catch share program. By developing and implementing effective administrative systems, you will ensure that participants can successfully participate in the program and are held accountable for their privileges.

KEY PRINCIPLES	<p>Clearly define the roles and responsibilities of fishery managers, Cooperatives and other entities to reflect program goals and the relative strengths and capabilities of each group. 78</p> <p>Establish Cooperative administrative systems including a clear process for decision making and bylaws or contracts to formalize rules, roles and responsibilities. 80</p> <p>Encourage cost-effective, transparent trading that is easy for all participants. 83</p> <p>Employ transparent catch accounting and complete regularly enough to ensure compliance with catch limits or other appropriate controls on fishing mortality. 84</p> <p>Design and implement a fishery information system that keeps costs low and is effective for conducting catch accounting, collecting scientific data and enforcing the law. 84</p>
SUB-STEPS	<p>6.1 What are the roles and responsibilities of the Cooperative? 78</p> <p>6.2 How will the Cooperative be governed? 80</p> <p>6.3 How will coordination across TURFs occur? 82</p> <p>6.4 How will trading, catch accounting and information collection occur? 83</p> <p>6.5 How will the Cooperative be administered and funded? 86</p>
SPECIAL FEATURES	<p>Common Functions and Roles of Cooperative Members 79</p> <p>Enforcing TURF Boundaries and Fishery Regulations 85</p> <p>Distributing Member Payments in Cooperatives with Pooled Revenue 88</p> <p>Examples of Cooperative Pooling and Payment Arrangements 89</p>

Develop Administrative Systems

Developing any fishery management program requires consideration of how the program will be implemented and administered. Most TURFs are allocated to Cooperatives that will be responsible for many of the administrative systems. This step outlines administrative needs for a TURF program: to organize Cooperatives, track fishing participants, monitor and enforce fishing activity, conduct science and more. Many of these administrative features are outlined in detail in **Step 6** of **Volume 1** of the **Catch Share Design Manual** and summarized here with additional considerations for TURFs. By developing and implementing effective administrative systems, you will ensure that participants are **Accountable** to the program and their allocations.

An important design element is the co-management arrangement between fishery managers and Cooperatives, and sometimes other entities. The sub-steps in this section represent joint decisions. There may be trade-offs as to who fills which roles. Government fishery managers are often best suited to set and enforce performance standards, while Cooperatives are generally well suited to ensure compliance in a way that works best for their localized situation.

In addition to the overarching administrative systems of the TURF program, Cooperatives will need to develop their own internal administrative systems to meet their goals and fulfill their responsibilities. As such, this step includes design considerations that pertain specifically to how a Cooperative will be administered internally. These internal administrative decisions are often made by the Cooperatives themselves, but fishery managers may also have a role in determining how best to set up Cooperatives to meet program goals.

6.1 WHAT ARE THE ROLES AND RESPONSIBILITIES OF THE COOPERATIVE?

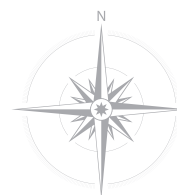
In exchange for secure, exclusive fishing privileges, Cooperatives often accept some management responsibilities. Some responsibilities will be required by the government, but Cooperatives often voluntarily implement management measures as well (Ovando et al., 2013). Therefore, administration of the Cooperative catch share program is often shared between Cooperatives, government institutions and sometimes other entities. In this co-management approach (sometimes referred to as community-based management), it is important to clearly define the roles and responsibilities of each group.

Cooperative responsibilities can vary, but often include:

- Ensuring compliance with catch limits or other controls on fishing mortality
- Monitoring catch (landings and discards) of members
- Tracking transfers of quota or area among members
- Contributing to fishery science and management by collecting data and providing local expertise
- Enforcing TURF boundaries and fishery regulations
- Creating and enforcing internal fishing rules and restrictions
- Reducing non-target catch and/or habitat impacts of fishing

DESIGN PRINCIPLE

Clearly define the roles and responsibilities of fishery managers, Cooperatives and other entities to reflect program goals and the relative strengths and capabilities of each group.



Determining Cooperative responsibilities will likely be a joint decision or negotiation between the government and the Cooperative, and it may evolve over time. Some of these roles, such as enforcement, may be pursued jointly by fishery managers and Cooperatives.

To fulfill its responsibilities, a Cooperative will designate roles to its members and/or hire third-party professionals. These roles may vary depending upon the number of members, complexity of operations, services provided and level of co-management. Examples of the roles individual Cooperative members or third parties perform are provided in Table 6.1. In addition to fulfilling Cooperative responsibilities, many of the roles members perform are

intended to support the economic and social goals of the Cooperative.

Cooperative members may have specialized roles or may rotate through different roles. In the Chilean TURF Program, for example, most Cooperatives have an infraction committee comprised of three or four seats that are filled by members on a rotating basis (Cancino et al., 2007). Other Cooperatives have designated individuals whose primary role is to manage the Cooperative to fulfill responsibilities and meet goals (see **Step 6.2**).

When determining responsibilities, it is important to evaluate whether the Cooperative has the capacity to

TABLE 6.1 | COMMON FUNCTIONS AND ROLES OF COOPERATIVE MEMBERS

FUNCTION	ROLES
Management	Cooperative managers or leaders Government or federation liaisons/representatives Management plan developers
Administration	Membership coordination Financial accounting Bylaw and contract development
Science	Stock assessment Surveying Quota setting
Fishery Monitoring	Catch accounting Quota management
Enforcement	Patrollers/officers Infraction committee members
Fishing	Fishermen and specialized fishermen Boat builders Mechanics Fishing gear manufacturers
Marketing	Marketplace administration Price negotiations Buyer relations
Processing	Plant operators Quality assurance specialists Drivers
Member Services	Community infrastructure Medical services

perform them. In instances where it makes sense for a Cooperative to take on certain responsibilities, but the Cooperative does not yet have the necessary skills or resources, capacity building or financial assistance may be helpful.

The roles of a Cooperative and its members may evolve over time. Especially as Cooperatives get stronger and more mature, they may be able to take on additional responsibilities and develop more specialized internal functions to meet their goals.

6.2

HOW WILL THE COOPERATIVE BE GOVERNED?

Effective governance is a vital component of Cooperatives, and a TURF is at risk of underperforming without well-established systems. Implementing good governance requires specialized skills and concerted effort. The importance of well-functioning governance structures cannot be underestimated, and both managers and fishermen will likely play a role in achieving good governance. Fishery managers often set certain standards for governance, such as establishing a legally recognized entity in order to receive an allocation of quota. Some countries have formal laws that mandate certain elements of Cooperative governance (e.g., specific leadership roles and decision-making processes). Cooperatives establish specific internal governance systems to carry out their management responsibilities and to coordinate with government fishery managers. The following considerations are important for internal Cooperative governance.

Bylaws and contracts

It is important to have a mechanism by which members formally acknowledge and agree to the Cooperative rules. To achieve this, most Cooperatives establish bylaws, rulebooks and/or contracts outlining the Cooperative's operations and rules. They commonly detail:

- Membership eligibility requirements
- Membership fees


- Members' roles and responsibilities
- Harvesting rules
- Governance, including election of leaders and representatives, voting methods, etc.
- Leaders' eligibility requirements and roles
- Penalties for non-compliance

In the Pescadores de Vigía Chico Cooperative in Mexico, for example, members agree to a set of written rules by signing the rulebook. Their formal acknowledgement ensures penalties can be issued for non-compliance, and the Cooperative rules have even been used to protect the Cooperative in legal disputes with ejected non-compliant members (Sosa-Cordero et al., 2008).

Some Cooperatives have rules designed to promote fairness (e.g., equal access to fishing areas, or an expectation for members to harvest a minimum amount). While the concept of fairness is important for building and maintaining social cohesion, promoting fairness can sometimes be at odds with economic goals, such as efficiency. Rules promoting fairness can also threaten biological goals if fishermen are encouraged to harvest rather than to keep fish in the water for the future. Cooperatives should carefully consider these trade-offs when setting expectations for members.

DESIGN PRINCIPLE

Establish Cooperative administrative systems including a clear process for decision making and bylaws or contracts to formalize rules, roles and responsibilities.



Ensuring compliance

A Cooperative's primary responsibility is to ensure members collectively stay within their allocated share of the catch limit or comply with other controls on fishing mortality. They may fulfill this responsibility independently, or alongside fishery managers. Under catch shares, fishermen have a strong incentive to ensure good compliance, but it is also important to develop and implement a deliberate system for compliance. Most Cooperatives use a combination of surveillance and penalties. Fishermen or third-party professionals may fill dedicated enforcement roles, and Cooperatives often rely on members to report non-compliant behavior to the government or other deputized enforcement officers (Snapshot 6.1).

It is important for Cooperatives to establish and enforce an internal penalty structure for non-compliance. Penalties are typically enacted when harvesting rules are violated, such as when fishermen land more than their quota or do not fulfill their responsibilities (e.g., reporting their catch, attending Cooperative meetings, etc.). Many Cooperatives establish a committee that is responsible for evaluating infractions and applying penalties. Clearly identifying penalties in the Cooperative's bylaws can ensure members are aware of the consequences of non-compliance and can add legitimacy to the enforcement process.

Graduated sanctions that escalate with the severity and quantity of infractions are recommended (Ostrom, 1990). Penalties usually fall into three categories: fines, loss of harvest and expulsion. Fines are the most common form of penalty, as the amounts can be adjusted to "fit the crime." Loss of harvest—typically in the form of reduced quota, less time on the water or confiscation of harvested fish—is most common when the infraction is committed while fishing. Expulsion from the Cooperative usually occurs for severe violations or after repeated offenses.

Decision making

It is important for Cooperatives to have a clearly defined process for decision making. There are three things to consider in regards to decision making: who votes, how

votes are weighted and what percentage of votes is required for a decision.

While some important decisions are made collectively by all Cooperative members (such as election of new leaders), Cooperatives typically deputize leaders or committees (e.g., a Board of Directors) to make the majority of decisions.

The Cooperative also needs to establish clear guidelines for the relative importance of each vote cast by a member or elected leader. The most common voting methods include:

- *Equal voting*
Commonly called "one member—one vote," this approach places equal value on each member's vote, and decisions are based on majority. It is the most common voting method used by Cooperatives, largely because it is often perceived as fair and equitable.
- *Proportional voting*
Under this approach, members are granted votes according to the number of shares they hold or control, with the majority of votes driving decisions. This creates a tiered governance structure based on the level of investment in the fishery. This method can seem most fair when some members disproportionately support the operation of the Cooperative, such as when the Cooperative is funded through a percentage fee on landings. However, when quota holdings are unequal, proportional voting can effectively shut out members who have fewer holdings from decision making (Yandle, 2003). Many Cooperatives balance voting power by placing a cap on the number of votes one member may have (Reynolds, 2000).

Finally, Cooperatives need to determine whether a decision needs to be agreed upon unanimously or by majority vote, and if the latter, what constitutes a majority. A Cooperative may have different requirements based on the importance of the issue at hand.

Cooperative federations will also determine which voting methods to employ. Federations are Cooperatives comprised of other Cooperatives, such as FEDECOOP in Mexico. If a federation chooses a proportional

voting method, the weighting can be based upon each Cooperative's aggregated landings, or based upon how many members each Cooperative has.

Leadership

Leadership is a critical aspect of Cooperative management, particularly in areas where formal governance structures are weak or non-existent. In many co-managed fisheries, strong leadership is the most important attribute contributing to successful management (Gutierrez

et al., 2011). Local leaders who identify with the needs and challenges of fishermen and work to address them may be most effective.

Leaders often emerge naturally and assume responsibilities. In the absence of a clear leader, fishery managers or other entities may need to help build leadership capacity. Different kinds of leaders may emerge, including those who have specific authority (such as elected officials or traditional authorities), or others whose personalities or relationships position them as de facto leaders.

6.3 HOW WILL COORDINATION ACROSS TURFS OCCUR?

As discussed in **Consider Which TURF Type is Best for Your Fishery** and throughout this volume, fishery management often occurs on a broader scale than a single TURF. Building opportunities for local, regional and sometimes national coordination into a TURF system enables proper scaling of management based on stock distribution and existing political jurisdictions. The need for inter-TURF management is heightened TURF Types 3 and 4, when biological functional units extend across multiple TURFs.

Coordination across TURFs can occur in a variety of ways. In many cases, the government will interface with all the TURF-allocated Cooperatives under its jurisdiction and implement regulations at the regional or national level. Additionally, Cooperatives often develop their own mechanisms to coordinate with neighboring Cooperatives to meet their goals and to facilitate communication with regional and national governments.

Local or regional coordinating committees can play an integral role in achieving biological, economic and social goals by managing shared stocks, marketing fishery products collectively and sharing innovations across TURFs. Committees may include Cooperative representatives, local government representatives, scientists and other stakeholders.

Cooperatives often facilitate coordination at the broader regional or national level by forming federations. A federation is a cooperative comprised of other Cooperatives (or in some cases, a mix of individuals and Cooperatives). The federation's role is to coordinate across Cooperatives and represent Cooperative members in regional or national decision-making processes. For example, the Mexican Baja FEDECOOP oversees marketing and the careful monitoring and enforcement of lobster harvest among its member Cooperatives (see **Catch Shares in Action: Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System**).

The Japanese Common Fishing Rights System is a prominent example of how effective institutions can support management across Cooperatives. In this tiered system, national and regional governments administer fishery regulations, and various cooperative organizations coordinate fishing activities at the local, regional and even national level (see **Catch Shares in Action: Japanese Common Fishing Rights System**).

6.4 HOW WILL TRADING, CATCH ACCOUNTING AND INFORMATION COLLECTION OCCUR?

Just like any fishery management program, performance of TURF programs will depend on good information, compliance and the ability for the program to be cost-effective. **Volume 1** of the **Catch Share Design Manual** provides a thorough discussion of how to set up a trading system (**Step 6.1**), track fishermen's catch against their share holdings ("catch accounting") (**Step 6.2**), and set up information systems to ensure the catch complies with catch limits or other science-based controls on fishing mortality (**Step 6.3**). Setting up these systems is an essential part of administering a TURF program. They are summarized here in brief with additional considerations for TURFs. Additionally, this sub-step focuses briefly on enforcement systems, and additional resources may be developed in the future to provide more detailed insights on enforcement in TURF systems, especially in resource-limited contexts.

Setting up trading, accounting and information systems will likely involve both fishery managers and Cooperatives. Because fishery managers are responsible for the sustainability of the resource, it is essential for them to ensure that monitoring and enforcement are effective. This may require that fishery managers maintain certain responsibilities or that appropriate checks are in place to ensure the Cooperative is fulfilling its responsibilities.

Where appropriate, it will be important to assess how existing systems can be leveraged and adapted into management to help minimize costs and simplify the process. In some communities with a history of community-based fisheries management, traditional


enforcement and monitoring systems may already be in place.

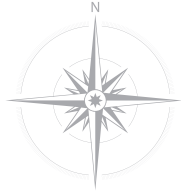
Trading

Temporary or permanent trading of quota- and/or area-based privileges may be permitted in TURFs to the extent that trading supports biological, economic and social goals. Where trading is allowed, a cost-effective, transparent trading system gives participants access to reliable information about availability and prices of shares and will allow shares to be freely traded (see **Step 6.2** of **Volume 1**).

Fishery managers or Cooperatives may develop and administer trading systems to facilitate and track transfers. However, in practice, many TURFs that do allow transfers do not require complex trading systems because fishermen make trades on a somewhat informal basis. For example, fishermen of the Pescadores de Vigía Chico Cooperative negotiate transfers of their individual *campos* at their Cooperative meetings (see **Catch Shares in Action: Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program**). Depending upon the capacity of the Cooperative, local laws and the social trade-offs, trading can be as simple as allowing fishermen to transfer access to an area or quota to a next of kin, or can be as advanced as a free-market trading system.

Trading systems may not always be administered by the government. Especially because most trades occur within a TURF rather than between TURFs, it may be most appropriate for Cooperatives to administer

DESIGN PRINCIPLE	Encourage cost-effective, transparent trading that is easy for all participants.	
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DESIGN PRINCIPLE	Employ transparent catch accounting and complete regularly enough to ensure compliance with catch limits or other appropriate controls on fishing mortality.	
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their own trading systems. Fishery managers may set minimum requirements for trading systems to ensure full accountability, and Cooperatives may be responsible for approving transfers between members.

Catch accounting

A catch accounting system tracks the Cooperative's catch relative to catch limits or other controls on fishing mortality, and in the case of a transferable system, tracks any increases or decreases in shares due to trades (see **Step 6.2 of Volume 1**). Cooperatives may be able to integrate into existing accounting systems, or accounting systems may need to be developed. Cooperatives may also work with third party service providers to facilitate catch accounting. Many Cooperatives track trades and catch within the TURF, while the government tracks inter-TURF trades and each group's total landings.

An important first step to setting up an accounting system is to ensure all fishermen are licensed. Licensing systems help verify fishermen's access privileges to a TURF and support tracking of landings. Many developing countries lack licensing systems, and may need to dedicate time and resources to organizing fishermen so that their landings can be tracked. More frequent catch accounting provides more opportunities for groups or fishery managers to make real-time management decisions.

Another key step is to define the role fishermen will play in reporting their catch. It is recommended that fishermen be


required to weigh and log their catch daily (ideally for all species, but most importantly, for the species prioritized for management). Upon landing, dealers may also weigh the catch and confirm accurate reporting. Accuracy may also be confirmed through onboard or dockside monitoring. If landings have traditionally occurred across many sites, it may be necessary to require landing at designated sites to ensure accurate catch accounting.

In the Pescadores de Vigía Chico Cooperative, for example, all catch must be solely processed through the Cooperative, making it easier to conduct dockside monitoring through logbooks and catch accounting at the processing plant (also owned by the Cooperative). Lobsters are weighed and the catch per member is recorded at the processing plant's storage facility.

In some contexts, fishermen may require training to learn how to log their catch. Catch accounting systems may also need to be adapted to accommodate fishermen with limited literacy.

Information systems

Information systems should be designed and used to conduct catch accounting, collect scientific data and enforce the TURF boundaries and regulations (see **Step 6.3 of Volume 1**). It is important for information systems to be cost-effective and transparent. An effective information system ensures Cooperatives and their members are accountable to government and Cooperative rules.

DESIGN PRINCIPLE	Design and implement a fishery information system that keeps costs low and is effective for conducting catch accounting, collecting scientific data and enforcing the law.	
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Fishery information systems include at-sea and dockside data collection to monitor compliance with catch limits and other controls on fishing mortality. Information may be self-reported or collected through an independent process. Additionally, many Cooperatives around the world

are responsible for enforcing fishery regulations to prevent poaching and other illegal behaviors by Cooperative members and other fishermen within their TURF (Snapshot 6.1).

SNAPSHOT 6.1 | Enforcing TURF Boundaries and Fishery Regulations

Enforcement is a critical component of TURF design, and enforcement mechanisms should be established at the onset of the TURF program. Setting up a good enforcement system is a challenge in resource-limited fisheries, but due to its critical nature, should nevertheless be established as effectively as possible. Additional enforcement elements can be added over time to strengthen the program as needed.

Because of the conservative fishing practices within them, TURFs often have more abundant fish stocks with larger, more valuable fish. This makes them appealing targets for illegal fishermen (Gallardo Fernández, 2008). Illegal fishing activity—by outsiders or by non-compliant TURF participants—has great potential to undermine the incentives of a TURF system. If illegal fishing is occurring, fishermen are unable to see the rewards of conservation behavior, and they are less likely to comply with the rules developed by the TURF. In some cases, they may be less likely to protect their TURF.

From the initial design stages, you should consider how to design a TURF system to minimize incentives for illegal fishing and optimize incentives for self-enforcement by TURF members. Sizing and locating TURFs appropriately and incorporating stakeholders in the design process may help avoid illegal fishing by creating TURFs that are enforceable by design. Additionally, a TURF that is scaled properly incentivizes fishermen to protect the resources within their TURF. Fishermen in TURFs often police their own fishing areas, which may range from reporting illegal activity to taking direct action to intercept and/or punish transgressions.

Patrolling, enforcement and sanctioning may be conducted by the government, Cooperatives or both. In any case, there must be an appropriate and effective authority to enforce TURF and reserve boundaries, catch limits and other fishery regulations. Patrols should be available for on-the-water enforcement, and appropriate penalties should be administered. To encourage compliance, legal resources should be in place to ensure that violators are prosecuted.

It is essential for enforcement and sanctioning to be conducted at the appropriate scale. In order to effectively deter illegal fishing, TURF users must be able to see a direct enforcement response when they report violations. For this to occur, local patrols must have the authority to intercept illegal fishing behavior by issuing warnings or citations, confiscating vessels, gear or fish, or through arrests. In the Chilean TURF Program, the local police force's lack of jurisdiction over marine waters has been a major barrier to reducing illegal *loco* fishing (Gallardo Fernández, 2008).

A potential benefit of Cooperative management is that a Cooperative can manage information that is specific to the portion of the fishery it represents. Cooperatives can account for catch by members within the TURF, track transfers if they occur and collect fishery information relevant to local management decisions. Cooperatives can share information with fishery managers in the form most appropriate for decision making at the regional or national level.

Identifying and meeting biological targets requires scientific data, and fishery managers should ensure appropriate data collection systems are in place to meet fishery goals. Data collection is often a challenge in small-scale fisheries and developing countries, where TURFs are often implemented. However, a growing number of fishery assessment methodologies rely on information that is easy to collect and can be used to set biological targets and

fishery mortality controls in data-limited fisheries (see **Science-Based Management of Data-Limited Fisheries: A Supplement to the Catch Share Design Manual**).

Fishery managers may rely on TURF users to collect data and contribute to biological assessment. This may be especially true for fisheries in remote areas or when harvest occurs at many different sites. Cooperatives may have the tools and capacity to develop their own data collection and assessment systems (Prince, 2003), or managers may guide them through the process. Third-party biologists may be also be hired to collect necessary data for management. In either case, fishery managers are responsible for ensuring biological goals are met through appropriate scientific assessment, and managers may require minimum data collection criteria be met for TURFs to be allocated, both initially and over time.

6.5 HOW WILL THE COOPERATIVE BE ADMINISTERED AND FUNDED?

As in any fishery management program, Cooperatives will have initial implementation costs and ongoing administration costs. Some of these costs may be paid for by the management authority while others will be the Cooperative's responsibility; this will largely be determined by the roles and responsibilities identified for each entity in **Step 6.1**.

A common goal of implementing Cooperatives is to maximize cost-effectiveness of management. The government can accomplish some roles more efficiently, while Cooperatives may best handle others. Cost-effectiveness should be considered when identifying roles and responsibilities. For a generalized discussion of financing the transition to catch shares and recovering management costs, see **Step 6.4 of Volume 1 of the Catch Share Design Manual**. This section will focus primarily on the costs typically incurred by Cooperatives and how the Cooperative will pay for program costs, including payments for members.

Administering a Cooperative requires effort, and Cooperatives will have startup costs and ongoing costs that largely reflect the goals and responsibilities outlined in this step. An established organization may have some systems already in place and may be leveraged to help reduce startup costs.

Cooperatives may pay their internal costs in full, or the government may provide financial assistance, especially during the transition. The government may consider a number of factors to determine how much of the costs it will cover, including how much benefit each entity will derive from the Cooperative management structure.

Cooperatives must obtain revenue to cover costs, which generally include governmental fees, the costs of resource management and the cost of Cooperative management. Cooperatives have typically funded these using one or several of the following methods:

- *Membership fees*

Cooperatives may collect entry fees or yearly dues. The fee can be equal for every participant or proportional to each participant's quota holdings. These fees are often easiest to administer and provide upfront, predictable funds. The amount collected should account for the social and economic goals of the Cooperative; the impact of fees on participation in the Cooperative should be balanced with the administrative costs.

- *Harvest fees*

Some Cooperatives collect fees based on the amount harvested by each member. Harvest fees may be particularly appropriate if shares are allocated to individuals, either directly or sub-allocated from the Cooperative. Harvest fees may be unpredictable and may be insufficient in years of low harvest. It may be advantageous for the Cooperative to hold a reserve to ensure it can consistently cover costs.

- *Pooled revenue deduction*

Some Cooperatives pool revenue and cover costs before distributing profits to members (see Snapshot 6.2). As long as the fishery is productive, an annual deduction ensures the Cooperative can cover all costs for each year. A reserve can help cover costs in years of low productivity. Members may find pooled revenue deduction to be less burdensome than paying direct membership or harvest fees from their perceived income.

Cooperatives sometimes employ other ways of financing their operations. For example, revenue can also be generated through the enforcement of penalties.

It may be necessary to allow the fee structure to evolve over time to meet the needs of Cooperatives. In response to challenges with fees paid by Cooperatives in the Chilean TURF Program, for example, the government revised its Fisheries and Aquaculture Law in 2013 to exempt certain

communities from required fees. Communities will not pay fees: in their first two years of TURF implementation; following a year of no extraction from the TURF; and, in the event of a natural disaster (Ley General de Pesca y Acuicultura). Once participants begin to benefit from TURF implementation, they will have a greater ability to share management costs.

Member compensation

Cooperatives compensate fishermen and non-fishing members in a variety of ways. Member payment structures include:

- *Wages and salaries*

Cooperatives may pay wages or salaries to fishermen and/or non-fishing members. Wages and salaries are especially common for non-fishing members who perform Cooperative duties.

- *Payments per harvested amount*

Many Cooperatives pay fishermen individually, based upon the amount of fish they land. This payment system rewards fishermen for the resources they dedicate to fishing. It is important to consider that fishermen paid solely based upon the amount landed are incentivized to compete with one another. Cooperatives using this payment system should ensure that appropriate mechanisms are in place to prevent a race for fish among members.

- *Pooled profit distribution*

Many Cooperatives that fish their shares collectively pool their revenue and distribute profits to members. Payments may be uniformly distributed or may be weighted, usually based on the costs incurred by each member. The way payments are distributed is particularly important for Cooperatives in which fairness and social cohesion support coordinated harvesting. These factors are discussed in more detail in Snapshot 6.2.

SNAPSHOT 6.2 | Distributing Member Payments in Cooperatives with Pooled Revenue

Cooperatives that harvest their allocated share collectively often achieve efficiency by pooling their harvest and revenue (Uchida, 2007). When Cooperatives pool revenue, they will need to establish an appropriate system for paying their members. The way payments are distributed affects the incentives of members to harvest sustainably and efficiently. Payments may be weighted based upon the contribution of each member, or they may be uniform across members (Uchida, 2007). See Table 6.2 for examples.

Weighted payment systems pay members based on differences in fishing effort, costs and/or landings. Essentially, members who contribute more in the chosen category will receive a higher payment. A weighted distribution system can serve the Cooperative's economic and social interests by rewarding fishermen for productivity. They can also promote fairness by ensuring that those with the highest skills and investments in the fishery are rewarded. However, weighted distribution can also promote competition between fishermen and lead to a race for fish and its negative biological outcomes. Thus if weighted systems are used, the Cooperative will need to ensure other mechanisms are in place to prevent racing.

In uniform payment systems, all members are paid equally. Cooperatives using uniform distribution tend to have fairly homogenous levels of input, either naturally or as a result of Cooperative actions such as effort coordination or cost sharing. Cooperatives may choose a uniform payment system to foster social cohesion among members, or simply because uniform payments are easier to administer than weighted payments (especially when catch and/or revenue are pooled). When effort is highly coordinated and evenly distributed, members will likely perceive uniform payments as fair. Because uniform systems pay all members equally, Cooperative rules may need to outline expectations for how, and how much, members will contribute to the group.

Cooperatives may combine weighted and uniform payment systems to balance the benefits of each; this is typically accomplished by having two payments. By ensuring Cooperative members are rewarded for their work while minimizing competition among members, a well-designed payment system can help achieve the biological, economic and social goals of the program.

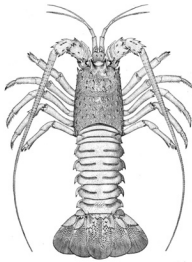
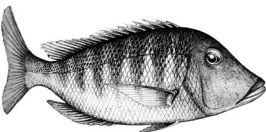
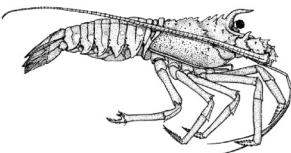
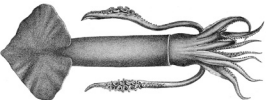
TABLE 6.2 | EXAMPLES OF COOPERATIVE POOLING AND PAYMENT ARRANGEMENTS

COOPERATIVE	DISTRIBUTION TYPE	POOLING AND PAYMENT DISTRIBUTION DESCRIPTION	RATIONALE
Japanese <i>Sakuraebi</i> Harvesters Association	Uniform	Revenue is pooled and a portion covers Cooperative costs. The remaining profits are distributed evenly among groups of fishermen.	Equal distribution perceived as fair, especially because fishing effort is highly coordinated and shared among participants.
Buzos y Pescadores de Isla Natividad, FEDECOOP	Weighted (with some uniform payments)	Fishing members paid based on landings. Non-fishing members paid wages. 70% of remaining revenue is used to fund Cooperative activities, and the rest is evenly distributed to all members.	Costs are shared by the Cooperative to balance profits among members. Uniform distribution of profits rewards all members for Cooperative performance.

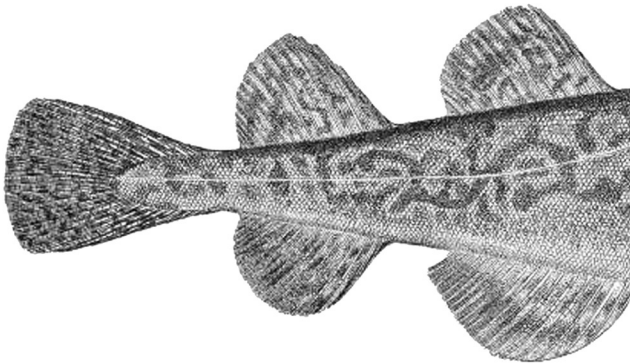
Sources: Uchida, 2004; C. Calderon, personal communication, 2012.

Step 6 – Define Eligible Participants

This chart provides a brief summary of the **Step 6** design decisions for the four programs featured in this TURF volume. For an in-depth discussion of each fishery, please see the full reports in the **Catch Shares in Action** section starting on page 97.

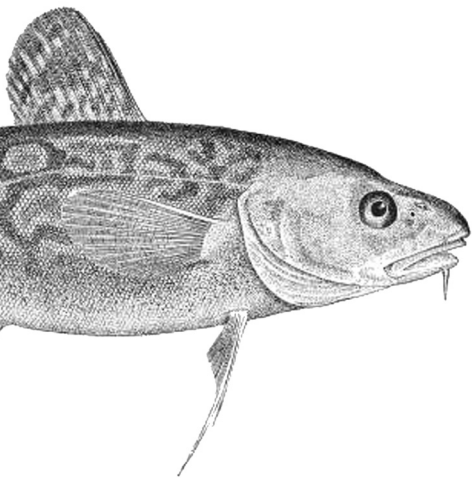
	6.1 COOPERATIVE ROLES AND RESPONSIBILITIES	6.2 COOPERATIVE GOVERNANCE	6.3 COORDINATION MECHANISM
<p>Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program</p> 	<p>Ensure compliance with fishery regulations</p> <p>Contribute to monitoring</p>	<p>Formal rulebook</p> <p>Member assembly meetings</p>	<p>Operates independently</p>
<p>Samoan Safata District Customary User Rights Program</p> 	<p>Develop integrated ecosystem management plans</p> <p>Set harvest restrictions for responsible management</p> <p>Contribute to fishery science and monitoring</p>	<p>Authority vested in District Committee comprised of high chiefs and representatives from each village</p>	<p>Operates independently</p>
<p>Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System</p> 	<p>Ensure sustainable harvest within TURFs and fair allocation of individual trap limits</p> <p>Contribute to fishery science</p>	<p>Bylaws</p> <p>Formal leadership and administrative roles</p> <p>Member assemblies to make decisions</p>	<p>Federation coordinates across multiple TURFs</p>
<p>Japanese Common Fishing Rights System</p> 	<p>Ensure compliance with national and prefectural regulations</p> <p>Regulate and coordinate harvest of members</p>	<p>Internal rules agreed upon and approved by government</p>	<p>National and prefectural government oversight</p> <p>Fishery Management Organizations</p> <p>Committees for highly mobile species</p> <p>Federations</p>

6.4 TRADING, ACCOUNTING AND INFORMATION	6.5 ADMINISTRATION AND FUNDING
Dockside monitoring through fishermen logbooks and processing plant activity logs Cooperatives have an internal vigilance committee that handles enforcement Trading conducted at meetings	The Cooperative pays for all monitoring costs
Community members responsible for enforcing no-take reserves and other fishing restrictions Villages typically responsible for monitoring adjacent no-take reserve Annual community-run biological surveys	Establishment of trust fund to support management Funds generated through collection of fees from fines and tourism revenue
Fishermen required to land at shore-side processors who take daily records Fishermen keep logbooks Cooperatives responsible for surveillance and enforcement	Each Cooperative funds its own monitoring, enforcement and data collection
Cooperatives responsible for catch accounting Accounting by Cooperative staff at markets	Each Cooperative determines how to manage costs and member payments

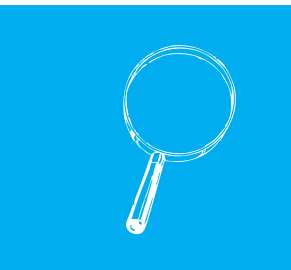


Step
7

Assess Performance and Innovate



SEASALT



At a Glance

The final step of catch share design is to ensure the program is functioning well and achieving the identified program goals. You should conduct regular assessments and modify the program as necessary to meet existing and new goals. In addition to formal program changes, participants should also be encouraged to innovate in order to improve the program.

KEY PRINCIPLES	Assess performance against goals and encourage innovation to improve the program over time. 94
SUB-STEPS	<p>7.1 Conduct regular program reviews. 94</p> <p>7.2 Assess performance against goals. 94</p> <p>7.3 Encourage innovation. 95</p>

Assess Performance and Innovate

The final step of TURF design and implementation is to assess program performance and innovate to address emerging opportunities and challenges. A well-designed TURF system will have institutional support for adaptive management. It will also have a process, co-managed by government and the Cooperative, to regularly assess program performance and make adjustments to laws, policies and regulations as needed to meet system goals. Flexibility is a key aspect of catch shares and programs must be dynamic in order to meet the changing needs and conditions of the fishery. Completing this step is a key part of ensuring all key attributes of the catch share program are being met.

7.1 CONDUCT REGULAR PROGRAM REVIEWS

As with any fishery management program, it is important to regularly review a TURF program, both at the single TURF level and system wide, to ensure goals are being met. Building regular program reviews and opportunities for modification into your TURF program is recommended. In their absence, making adjustments may be a lengthy process (Gelcich et al., 2010).

TURFs occur in dynamic systems, and their performance may be influenced by changing conditions, especially

because they are area-based. Coastal communities in many parts of the world are changing rapidly, presenting new challenges for fishery management. Stocks may shift in response to warming and acidification of global oceans, and TURF systems must be able to adapt to meet the needs of coastal fishing communities and to protect vulnerable stocks. As coastal communities grow and marine resources are affected by global disturbances, it is important to build flexibility into TURF systems (Aburto et al., 2012).

7.2 ASSESS PERFORMANCE AGAINST GOALS

It is important to regularly assess program performance against the goals defined in **Step 1**. Assessing performance of a TURF system will require system-wide and individual TURF assessment. Because TURFs are often implemented across diverse communities, there may be variability in performance from one TURF to another. This is the case

in Chile, where the TURF program has proven highly effective for some TURFs, but others have not fully met biological, economic and/or social goals. Updates to the Chilean Fisheries and Aquaculture Law were implemented in 2013 to improve the TURF system. The updates include greater penalties for illegal fishermen, exclusion of non-

DESIGN PRINCIPLE

Assess performance against goals and encourage innovation to improve the program over time.



artisanal vessels from the coastal zone and a more relaxed fee structure for communities (Ley General de Pesca y Acuicultura).

Modifying TURF boundaries

As fisheries and coastal populations change, it may be necessary to modify TURF boundaries accordingly. Population growth, advances in technology and changes in commercial markets impact the spatial distribution of fishing activity and the intensity of fishing pressure within TURFs (Pollnac, 1984). In response to these changes, fishermen and managers may agree that TURF boundary modifications are appropriate for meeting management goals. Modification options include increasing the size of the TURF, consolidating multiple TURFs or dividing

TURFs to reflect changes in functional units. In addition, or alternatively, managers and fishermen may modify the species that TURF users are permitted to fish within their boundaries. For example, if fish stocks move based on changing environmental factors, TURF users may be able to take advantage of new species entering their TURF.

Any modifications to TURF or reserve boundaries should be implemented through a stakeholder process with the long-term security of privilege-holders in mind. Regular and drastic changes to TURF boundaries undermine the security of the catch share, and fishermen anticipating significant boundary modifications may have a reduced incentive to conserve the resource. If boundary modifications occur, it is most appropriate to make changes when a tenure period expires.

7.3

ENCOURAGE INNOVATION

A TURF may be especially well suited to support innovations when management decisions and responsibilities are devolved to TURF users. Because some of the decision-making power is in the hands of users, TURF operations may be easily adapted to meet fishermen's needs and goals. As a result, fishermen can implement innovative strategies that directly benefit their fishery.

TURF users often innovate to meet biological and economic goals by finding ways to increase the biomass of target species. Fishermen in TURFs enhance habitat, boost populations of target species' prey and directly supplement wild populations with cultured specimens or through seeding. These actions help them to meet economic goals (with potential tradeoffs for meeting ecological goals). Fishermen in TURFs implement their own harvest rules and sometimes refrain from harvesting to boost future harvest opportunities. They create no-take zones to protect important life stages and replenish fished populations.

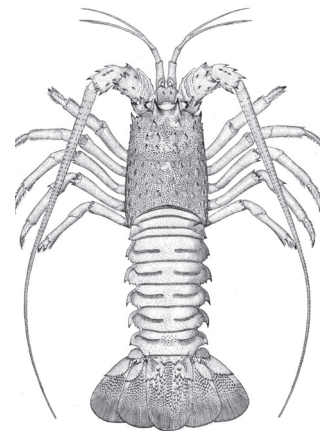
TURF users also find innovative ways to maximize economic gains. They often self-organize to coordinate harvest. TURF users form organizations to improve market opportunities through economies of scale. Some have added value to the fishery by improving processing and marketing.

TURF systems should be designed to evolve over time, with continued interaction between TURF users and government to allow innovation at the system-wide level (Gelcich et al., 2010). As your experience with a TURF system develops, you may find ways to better meet fishery goals. Encouraging innovation allows a TURF system to meet the changing demands of a fishery to continue to provide better outcomes for fishermen.



CATCH SHARES IN ACTION

Mexican Vigía Chico Cooperative Spiny Lobster Territorial Use Rights for Fishing Program



SPECIAL DESIGN FEATURES



SINGLE-SPECIES, GROUP-ALLOCATED,
AREA-BASED, NON-TRANSFERABLE

The Mexican Pescadores de Vigía Chico Cooperative is a group-allocated, area-based catch share that manages the Punta Allen spiny lobster fishery. The catch share, or Territorial Use Rights for Fishing (TURF) program, includes a number of special design features to achieve goals set by the Mexican government and the Cooperative, including sustainable harvests and Cooperative self-sufficiency and self-governance. Important design features include a secure tenure length of 20 years with a strong assumption of renewal, clearly defined co-management responsibilities between the federal government and the Cooperative and the use of individual fishing zones developed by the Cooperative to maintain member accountability (Solares-Leal and Alvarez-Gil, 2003).

The Punta Allen fishery is located in the Sian Ka'an Biosphere Reserve in the state of Quintana Roo in southeast Mexico. In 1968, the Mexican National Commission on Aquaculture and Fisheries (CONAPESCA) awarded the Pescadores de Vigía Chico Cooperative a 20-year lobster concession, or TURF. As a result of achieving performance standards set by the Mexican government, the concession has since been renewed twice (Nuñez, n.d.).

Punta Allen is a fishing village of about 500 people. Approximately 80 fishermen using 55 small fishing skiffs, called *pangas*, comprise the Vigía Chico Cooperative. Fishermen harvest lobster (*Panulirus argus*) using *casitas*, underwater concrete structures that aggregate lobster by mimicking their natural reef habitat. Using snorkel gear, fishermen hand-retrieve lobster with nets known as *jamos*. The Vigía Chico Cooperative has established individual fishing zones, or *campos*, with 25-meter, no-take buffer areas between each. Fishermen are sub-allocated campos and coordinate effort to ensure sustainable harvest. Fishermen from the Cooperative land over 100 tons of whole, live lobster annually (Ortiz Moreno, personal communication, 2013).

SYNOPSIS

Road to a Catch Share

For more than 60 years, fishermen from Punta Allen have been harvesting spiny lobster in traditional fishing areas inside two large bays, Ascension Bay and Espiritu Santo Bay, on the remote Caribbean coast of Quintana Roo, located on the Yucatán Peninsula in Mexico.

In 1968, local fishermen formed the Vigía Chico Cooperative in order to fish spiny lobster and gain exclusive access inside Ascension Bay through a government-granted concession, or TURF (Nuñez, n.d.). The Vigía Chico Cooperative and TURF were established to achieve a number of goals, including promoting a high degree of self-sufficiency and maintaining a healthy spiny lobster population, which provides the basis for the local economy. Given its isolated location, it was also important for the community to achieve a high degree of self-governance.

The government supplied financing to help the Cooperative in its early years, issuing loans for capital equipment such as a truck and an icing container, and in-kind donations of panga boats, motors and equipment. The government also provided the community with basic infrastructure such as roads, a power plant, a potable water system and a small fish processing plant, as well as technical assistance and training programs. Coupled with strong and adaptable self-governance, the TURF has helped the Punta Allen fishing village maintain its historical livelihood and a strong economy from 1968 to today.

Performance

The Vigía Chico Cooperative is a model for sustainable management. The Cooperative continually meets its biological and economic goals, including maintaining a stable stock, sustainable landings and high catch-per-unit-effort. In addition, the Cooperative structure and TURF system have improved access to financial resources, boosting the economic prosperity of the local community.

Since the 1980s, the Cooperative has seen higher landings by weight than any other lobster cooperative in the Yucatán (Ojeda, 2005) and has sustainably increased spiny lobster landings since 2000. Most other areas of the Caribbean have seen declines. In recognition of its successful and sustainable fishery management, the fishery recently received Marine Stewardship Council (MSC) certification.

The program has fostered economic and social prosperity as well. Many members of the community are involved in the fishery, and a variety of jobs have been created for both men and women. Although fishing remains a traditionally male activity, women assist by building casitas and acting as representatives for marketing and management. Women also assist in the processing phase, handling the cleaning and packaging of lobster, while men do most of the receiving and freezing (Solares-Leal and Alvarez-Gil, 2003). According to national poverty statistics from Mexican census data, the community of Punta Allen fares better economically than other fishing communities, and current wages place residents well above the poverty line (Ortiz Moreno, personal communication, 2013).

STEP 1 IN ACTION

Define Program Goals

The Vigía Chico Cooperative was formed to meet a number of biological, social and economic goals. Goals for the fishery were developed by the Mexican government and the Vigía Chico Cooperative. Because the Punta Allen village and TURF are within the boundaries of the Sian Ka'an Biosphere Reserve, reserve goals established by the Mexican government apply to the activities of the Cooperative members. These include ensuring low ecosystem impacts from harvesting within the reserve.

The Vigía Chico Cooperative also specified a number of additional goals. Echoing the goals of the Mexican government, the primary biological goal established by the Cooperative is to manage resources sustainably. Economic and social goals of self-sufficiency and self-governance were also extremely important in the development of the Cooperative and TURF given the remote location of Punta Allen. To help meet these goals, federal agencies such as CONAPESCA established complimentary public policies that make co-management feasible (Ojeda, 2005; Sosa-Cordero et al., 2008).

STEP 2 IN ACTION

Define and Quantify the Available Resource

The catch share is a single-species program managing all harvests of the Punta Allen spiny lobster (*Panulirus argus*). The stock is an independent population, confined to the geographical limits of Ascension Bay and separate from spiny lobster stocks in other locations in the Caribbean (Ojeda, 2005). The TURF covers the entire range of the Punta Allen spiny lobster stock.

Fishing mortality is controlled through federal regulations and Cooperative rules designed to ensure sustainable harvests. Federal regulations include an annual four-month closed season, restrictions on the type of fishing gear, a minimum size limit and zero retention of female lobsters carrying eggs.

Internally, the Cooperative controls fishing mortality through the use of no-take zones and selective gear placement. Campos, or individual fishing areas, must be at least 25-meters apart, creating no-take buffer zones between fishing areas that help control fishing mortality and minimize conflicts between fishermen. Additionally, casitas, concrete aggregating structures, may not be placed in areas known for high productivity and/or in sensitive reef locations (Sosa-Cordero et al., 2008). Undersized lobsters and egg-bearing female lobsters must be discarded, and both the fishing methods and gentle handling practices ensure a low discard mortality rate.

STEP 3 IN ACTION

Define Eligible Participants

The Mexican government allocates the TURF, in the form of a concession, to a group, the Vigía Chico Cooperative, which is then responsible for ensuring sustainability of the resource. Under Mexican Fisheries Law, only fishing cooperatives are eligible to receive area-based concessions for select marine species. The Vigía Chico Cooperative was allocated the TURF based on existing fishing grounds of fishermen in Ascension Bay.

The Vigía Chico Cooperative includes general members and fishing members. Any member who wishes to participate in fishing activities is required to have a fishing license provided by the government. In addition, the Cooperative has identified its own eligibility requirements for membership and fishery access in order to ensure sustainable management of the fishery. Only Cooperative members are permitted to harvest spiny lobster in the TURF. Any member of the Cooperative is eligible to own or access a casita and/or a campo.

The Cooperative defines its fishing members as either a *dueño* (owner) or a *chalan* (assistant). Dueños are men and women who manage campos, invest in casitas and have their own boats. Chalanes do not manage campos or own casitas or boats, but often do own fishing and snorkel gear. Typically, dueños are senior fishermen, and several hold key positions in the Cooperative's administrative structure. Chalanes tend to be younger and less wealthy, but can also hold official positions in the Cooperative (Solares-Leal and Alvarez-Gil, 2003). New entrants are allowed, but must be children of current fishermen within the community.

Fishermen must be Cooperative members to either own a casita or have access to one. If a fisherman is unable to own a casita due to the cost, they can gain access to one by negotiating with an owner and giving him a percentage of the catch revenue. There are no limits on the number of casitas that can be used, but Cooperative members are obligated to abide by management rules and scientific biological studies to ensure sustainability (Ortiz Moreno, personal communication, 2013).

STEP 4 IN ACTION

Define the Privilege

The Vigía Chico Cooperative is an area-based catch share, or TURF. The long-term share—the concession permitting harvest of spiny lobster—is granted for 20 years by CONAPESCA to the Vigía Chico Cooperative, and there is a strong assumption of renewal if the program meets its stated goals. As of 2013, the concession has been renewed twice, in 1988 and again in 2008.

The Cooperative is responsible for ensuring sustainable harvest within the concession. To accomplish this, the Cooperative ensures compliance with federal fishing regulations and imposes internal harvesting rules. The Cooperative also voluntarily subdivides its concession into individual fishing zones, called campos, and allocates them to Cooperative members (Figure 1).

FIGURE 1 | *Individual fishing zones of the Vigía Chico Cooperative*



Campos within the Cooperative's concession are identified through geospatial planning and based on population dynamics of lobster and topographical information of the seafloor. In 2001, researchers supported by the United Nations Development Program helped Punta Allen fishermen use global positioning systems (GPS) satellites to mark the borders of their campos. These boundaries are used to collect data on catch and movement of lobster during the season (Ojeda, 2005). The size of each campo also minimizes competition for additional zones, and the strategic placement of the campos makes it easy to detect any attempt to move lobsters from one area to another (Ojeda, 2005).

Campos are granted to Cooperative members in perpetuity, but the zones are transferable among Cooperative members on both a temporary and permanent basis. Cooperative members can freely trade campo access and ownership through a bargaining process at the beginning of each season during Cooperative assembly meetings (Cochran, 1998). Members must be rule-abiding (of both internal Cooperative regulations and federal laws) in order to access or trade campos (Ortiz Moreno, personal communication, 2013).

There are 128 delineated campos in Ascension Bay (Ortiz Moreno, personal communication, 2013). The Cooperative harvests lobster in teams of two to four fishermen per panga. There are currently 29 teams. The number of casitas in each campo varies depending on the location of the campo, composition of the seafloor and surrounding habitat (Ortiz Moreno, personal communication, 2013).

STEP 5 IN ACTION

Assign the Privilege

CONAPESCA awarded the lobster concession in Ascension Bay to the Vigía Chico Cooperative in 1968. The concession was granted for 20 years and has since been renewed twice (Nuñez, n.d.). Ascension Bay and the village of Punta Allen are located in remote areas of Mexico, and historical fishing activity was mainly conducted by Vigía Chico Cooperative members, resulting in few conflicting claims to the area. As such, allocation did not require an extensive data collection or appeals process.

The Cooperative manages the concession by creating and allocating campos to members. Allocation decisions are based on consensus of Cooperative members (Sosa-Cordero et al., 2008). These decisions are generally related to an individual's seniority in the fishery, his trustworthiness and reputation and the degree of member support for his allocation. Not all members own a campo, but all members' opinions are taken into consideration when fishing teams are formed (Defeo and Castilla, 2005).

STEP 6 IN ACTION

Develop Administrative Systems

Developing administration systems for the TURF program was important in meeting program goals, including co-management and effective self-governance. Currently, the Vigía Chico Cooperative works with multiple government agencies including CONAPESCA and the Mexican National Commission for Natural Protected Areas, academic institutions, such as the Colegio de Frontera Sur and the Universidad de Quintana Roo, and local non-governmental organizations, such as Razonatura, to manage and administer the Punta Allen spiny lobster fishery. Important administrative activities include Cooperative governance, monitoring, catch accounting, marketing and collection of biological information.

The Cooperative is governed by a member assembly that establishes rules in an organized and democratic process. Federal government authorities recognize the right of the Cooperative to develop and apply its own policies and regulations as part of the co-management agreement (Sosa-Cordero et al., 2008). Rules cover everything from member responsibilities, to basis for fines, to expulsion from the Cooperative. Cooperative

members have both the right and obligation to participate in meetings and incur fines for not attending. Vigía Chico has its own “vigilance committee” that enforces Cooperative regulations; violators face financial sanctions or possible expulsion (Cochran, 1998), and internal rules have been used as evidence in court cases as part of the formal justice system.

Dockside monitoring and catch accounting are performed by the Cooperative at the Cooperative-owned processing facility. All catch from Cooperative members must be processed through this facility, reducing the complexity of monitoring and catch accounting. Upon landing at the processing plant’s storage facility, lobsters are weighed and catch per member is recorded. A refrigerated truck delivers the catch to marketing sites, where it is sold live to buyers and restaurant owners (Calderón, 2011). The Vigía Chico Cooperative covers all monitoring costs dealing with monitoring and catch accounting.

An important feature of the Cooperative is joint marketing and sales of Cooperative members’ catch. While fishermen harvest their catch individually, the Cooperative has hired managers that specialize in marketing to increase the effectiveness and price received. This marketing approach has also helped eliminate competition between members to increase landings or race to market, both of which have led to overexploitation in other cooperatives in Mexico (Ojeda, 2005). The cost of marketing is covered by a regional marketing association, Chakay, which is comprised of six cooperatives, including Vigía Chico.

The Cooperative works with a number of partner organizations to collect information on the Punta Allen spiny lobster fishery. Scientific data is collected by academic centers such as Instituto del Mar of UNAM (Ocean Institute from National Autonomous University of Mexico), CINESTAV (The Center for Research and Advanced Studies of the National Polytechnic Institute) and Colegio de Frontera Sur. These organizations assist in conducting annual stock assessments and larval recruitment surveys to determine the biological status of the spiny lobster population.

STEP 7 IN ACTION

Assess Performance and Innovate

The Vigía Chico Cooperative has achieved a high level of success in meeting goals established by the Mexican government and the Cooperative itself. The program has contributed to a highly productive and sustainable lobster fishery for the village of Punta Allen through self-governance and co-management. While many areas of the Caribbean have seen a decline in lobster catch, Vigía Chico has been the most productive fishing cooperative in the Mexican Caribbean since 1982, and lobster landings in Punta Allen have been increasing since 2000 (Sosa-Cordero et al., 2008). Due to this success, the Mexican government has renewed the concession twice, first in 1988 and again in 2008.

In addition, the Cooperative’s high level of organization and governance structure allows it to effectively adapt to changing conditions and innovate on the design of the program. Through partnerships with scientific organizations, the Cooperative and Mexican government have improved the understanding of the Punta Allen spiny lobster resource, which has led to better controls on fishing mortality. More recently, Cooperative members have worked with researchers and academics to conduct studies on critical spiny lobster habitat in order to minimize damage when placing casitas. The results combine biological data with local fishermen

knowledge to indicate optimal casita locations: namely, areas of solid bottom seafloor containing vegetation (such as sea grass), low sedimentation and gentle currents (Zapata-Araujo et al., 2008). These improvements in understanding the resource, coupled with an adaptive governance structure, allow the program to continually evolve to meet program goals.

Over the years, the Vigía Chico Cooperative has also adapted well to outside events, such as hurricanes, that often strongly affect the local lobster population. In 1988, Hurricane Gilbert caused the catch to decline by roughly 80%. During the 1990s, the Cooperative slowly and carefully brought the stock back to high abundance levels. In doing so, the Vigía Chico Cooperative fine-tuned its management efforts and is now seen as one of the most organized cooperatives in Mexico (Cantor Barreiro and Dominguez, 2006). Stocks continued to increase until Hurricane Wilma hit during the 2005-2006 season (Sosa-Cordero et al., 2008).

Despite the strong co-management arrangement, rules and sanctions continue to evolve to address developing challenges. Recent data show around 12% of Vigía Chico's landed lobster are below the minimum legal size (Sosa-Cordero et al., 2008). As a result, Vigía Chico is working with authorities to implement more stringent fishing laws to protect juvenile lobster (Ortiz Moreno, personal communication, 2013). Overall, the Vigía Chico Cooperative is considered exemplary in the region, and serves as a model for co-management and TURF systems (Ortiz Moreno, personal communication, 2013).

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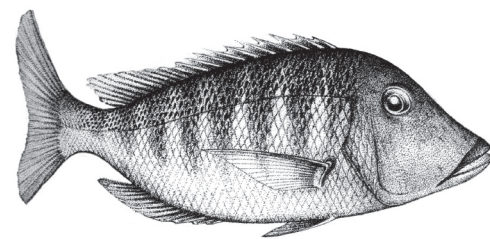
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CATCH SHARES IN ACTION

Samoan Safata District Customary User Rights Program



SPECIAL DESIGN FEATURES



MULTI-SPECIES, GROUP-ALLOCATED,
AREA-BASED, NON-TRANSFERABLE

The Samoan Customary User Rights System is an area-based catch share program that formalizes the customary fishing rights of native communities. Authorized by legislative reforms, fishing communities voluntarily establish and manage Territorial Use Rights for Fishing (TURFs) in traditional fishing areas. The program has been designed to meet the goals of sustainable resource use and empowering villages in fishery management. Key design features include the active participation of the Samoan government in guiding the creation and management of TURFs and the integration of traditional management practices to achieve sustainability. In Safata District, community members have established a district-wide TURF with a network of no-take reserves to increase biological performance and sustain local livelihoods into the future.

In the late 1980s and early 1990s, the Samoan government embarked on major efforts to formalize and support customary fishing rights. Through legislative reforms, groups of fishermen organized by villages are able to hold management authority over traditional fishing grounds, and establish laws regulating the harvests of community members and outsiders fishing in their waters. Through the bylaw formation process, many communities have established effective TURFs in which they manage their fishing grounds, including regulating access by community members and outsiders to ensure fishery sustainability.

Safata District is a settlement of nine villages located along the remote southern coast of Upolu, the second largest island in Samoa. Safata has formalized customary fishing rights and has established a district-wide TURF extending over traditional fishing grounds. With the assistance of the Samoan government, Safata has developed comprehensive management plans and has established 10 village-level, no-take reserves within its TURF area. The Safata District Committee, comprised of leaders from each of the nine villages, oversees marine resource management within the TURF (CRISP, 2008). Safata's population of 5,100 residents (Samoa Bureau of Statistics, 2012) is highly dependent on fisheries as a source of food and income. Approximately 88% of households engage in fishing activities and the community derives about 77% of its entire food source from adjacent lagoons and reefs (Zann, 1991). Residents target a variety of finfish and invertebrate species using methods including spear fishing, hook and line, netting and gleaning (Zann, 1991).

SYNOPSIS

Road to a Catch Share

For centuries, resource use in the coastal lagoons and reefs of Samoa was governed by customary management. The ability for village chiefs to hold secure and exclusive tenure (known as “matai” in Samoa) over a defined fishing area contributed to sustainable management of traditional fishing grounds. As in many Pacific Island nations, a period of colonization in Samoa beginning in the 1800s transferred ownership of the sea away from village chiefs and to the public domain (Techera, 2009). The adoption of Western legal systems constrained the ability for native communities to exercise their forms of customary management (Johannes, 2002; Techera, 2006; Govan et al., 2009).

In the mid-1980s, Samoa’s inshore fisheries were threatened by overexploitation, destructive fishing practices and environmental disturbance from land development (Fa’asili and Kelekolio, 1999; Techera, 2006). The degradation of important habitats, especially mangrove areas and beaches mined for sand, posed a threat to ecosystem health (King et al., 2001; Techera, 2006). National fishing regulations, which focused mainly on banning destructive fishing practices, were unsuccessful in addressing management challenges (Mackay, 2001). Although many communities attempted to manage their local resources using customary approaches, efforts were often subverted by the activities of outsiders who were not subject to community-based regulations (Techera, 2009).

In the late 1980s, the Samoan government recognized that villages were well positioned to manage inshore resources and embarked on a major effort to strengthen community-based management (Govan, 2011). The process began with a series of legislative reforms to enable community-based management under the modern legal framework. The Fisheries Act of 1988 created the opportunity for village leaders to work with the Samoan Fisheries Division to formalize local laws through a bylaw process (Johannes, 2002). The Village Fono Act of 1990 transferred management authority over traditional fishing areas back to the fono, or local council of chiefs (Fa’asili and Kelokolo, 1999). However, their jurisdiction was limited to internal community members (Troniak, 2008). An amendment to the Fisheries Act of 1988 allowed the fono to apply village bylaws to all persons, expanding legal jurisdiction to cover outsiders fishing in community-managed waters (Troniak, 2008).

To complement these legal changes, the Fisheries Division established a Fisheries Extension Program in 1995, which provides guidance and technical support to individual villages developing village-based management plans (Mackay, 2001; Tauaefa, 2007). By 1999, 62 villages had developed fisheries management plans, and 57 had implemented small no-take reserves within their fishing grounds (Kallie et al., 1999). Building off the successful extension program, in 2000 the Samoan government worked with international non-governmental organizations to develop integrated fishery management areas, synergizing efforts between individual villages at the district level. To ensure a sustainable fishery, leaders of Safata District implemented an effective TURF by creating bylaws managing the fishing access of community members and outsiders. Within its TURF boundaries, Safata’s leaders have established a network of no-take reserves to improve biological performance. The community-managed TURF of Safata is known locally as the Safata Marine Protected Area (MPA).

Performance

Where implemented, Samoan TURF programs have improved local management of marine resources and had positive impacts on both communities and the environment. The Safata District TURF serves as one example and is one of the largest and most successful in Samoa. After development and implementation of the district-wide TURF in 2000, food fish and other species increased in abundance (J. Ward, personal communication, 2013). There has been very strong community support and buy-in (Ministry of Natural Resources and the Environment, 2005) and high compliance with local regulations (J. Ward, personal communication, 2013). Community members report that their catches are increasing and they are spending less time fishing (Govan et al., 2009). Meanwhile, additional income from tourists visiting the TURF site has benefitted community members (Govan et al., 2009).

The current legal framework and government support provide an opportunity for any community to improve management, including the implementation of catch shares (i.e., TURFs) to strengthen local management in support of sustainability. By 2007, more than 80 villages had prepared management plans through the Fisheries Extension Program, 62 of which have developed no-take reserves within community managed areas (Govan, 2011). Many of these communities have elected to create bylaws that manage access and include the key attributes of a catch share program. By promoting community responsibility for the health of marine resources, the Fisheries Extension Program has gained international recognition (Tauaefa, 2007). It serves as model for the Pacific Islands region and has been adapted and implemented in neighboring American Samoa (MacKay, 2001; Sauaefa-Ainu'u, 2002).

STEP 1 IN ACTION

Define Program Goals

The overarching goals of the Fisheries Act and Village Fono Act, respectively, were to:

- Specify the “conservation, management and development of Samoan fisheries”
- “Validate and empower the exercise of power and authority by Village Fono in accordance with custom and usage of their villages”

Through an extensive consultation process, the Samoan government worked with the community of Safata to define social, economic and biological goals, including:

- Protection and sustainable use of threatened coastal marine biodiversity
- Empowerment of local communities to protect and manage coastal marine biological diversity effectively and to help them achieve sustainable use of marine resources

Additional goals outlined within Safata's fishery management plan include:

- Improvement of monitoring and enforcement of local regulations
- Education efforts to increase compliance and create a culture of conservation
- Protection of mangroves to maintain ecological health and increase tourism value

Food security was another big issue identified by Safata's leaders. To diversify long-term risk and ease short-term pressure, leaders identified the development of aquaculture and tourism activities as additional management goals (CRISP, 2008).

STEP 2 IN ACTION

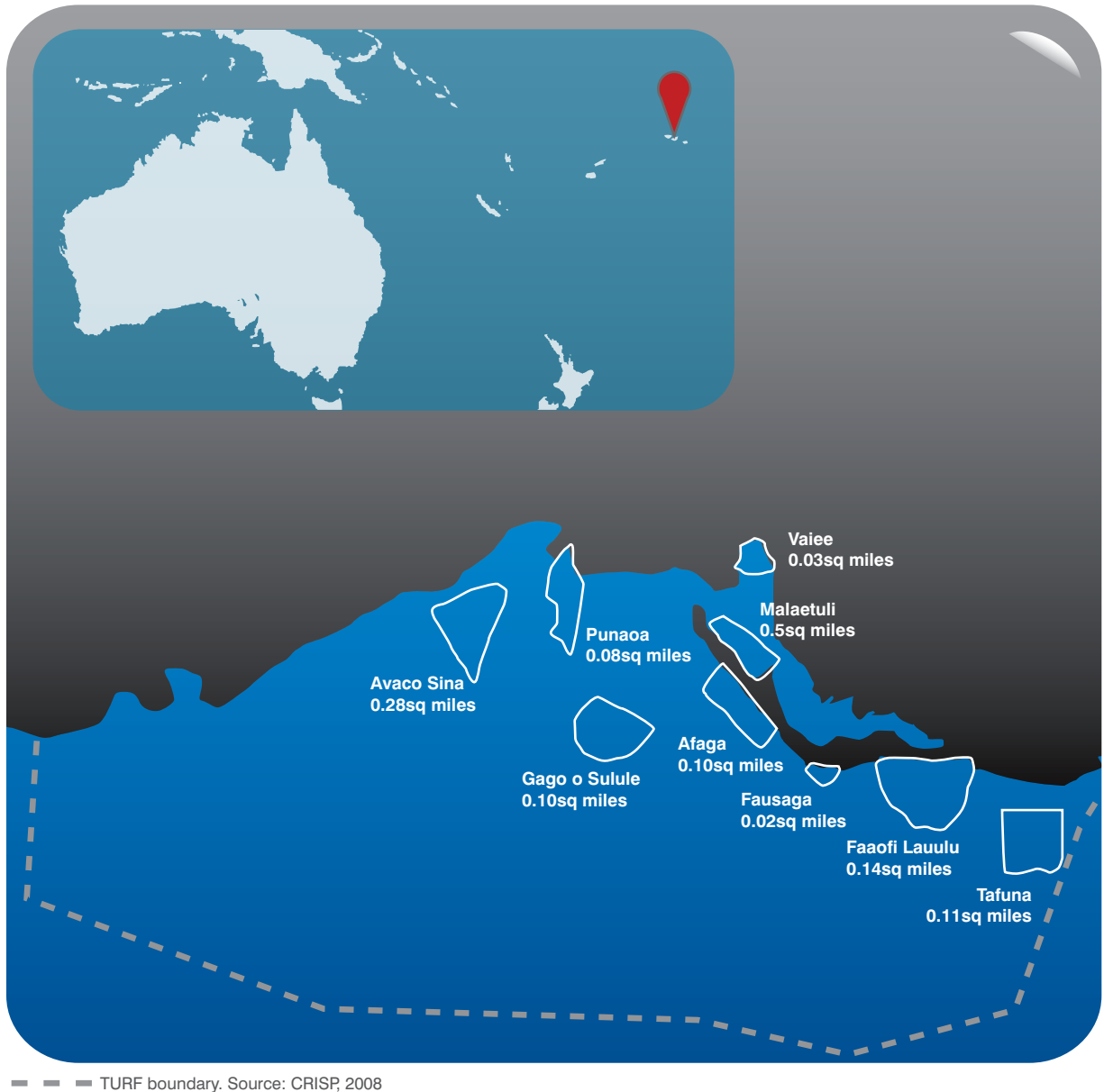
Define and Quantify the Available Resource

The Safata TURF spans 24.6 square miles from Ava o le Fu'a to Le nui, covering all mangrove and reef areas as well as offshore areas within one nautical mile from the reef edge (see Figure 1) (CRISP, 2008). Safata is one of the last remaining mangrove areas in the country and therefore has been a key site in which to develop comprehensive catch share management to protect this habitat. The community manages all species (more than 100) found within TURF boundaries. The most commonly harvested finfish include surgeonfish (Acanthuridae), groupers (Serranidae), mullets (Mugilidae), carangids (Carangidae), rabbitfish (Siganidae) and parrotfish (Scaridae) (Zann, 1991; FAO, 2009). Commonly harvested invertebrates include octopus, giant clams, sea cucumbers and crabs (FAO, 2009).

Catches in Safata are often shared between community members and primarily used for subsistence. There are no catch limits in Safata, but fishing mortality is controlled with a network of no-take reserves in addition to series of input-based restrictions. Safata has instituted a total of 10 village-level no-take reserves within the TURF based on traditional closures known as "sa." Scientific surveys and local knowledge informed placement of the no-take reserves (Ministry of Natural Resources and the Environment, 2005), which generally cover inshore reefs and lagoons where fishing pressure has been highest (Figure 1). The community has placed reserves close to shore to improve visibility and has demarcated boundaries with buoys. Together, the no-take reserves cover 4% of total TURF area (CRISP, 2008). Although this area is small relative to the entire TURF, the coverage of no-take reserves relative to the amount of inshore reefs and lagoon habitat (where fishing pressure is highest) is estimated to be 20%. Removal of any living material in these no-take reserves is banned, other than for approved research purposes (CRISP, 2008).

As outlined in its management plan, the community prohibits the use of destructive fishing gear, dynamite, toxic chemicals, poisonous compounds, coral pounding, fish traps and fish nets with a mesh size smaller than 2.5 inches (CRISP, 2008).

FIGURE 1 | *Safata TURF boundary and no-take reserves*



STEP 3 IN ACTION

Define Eligible Participants

All villages with chiefs holding customary tenure, or matai, over inshore lagoons and reefs are eligible to exercise their customary rights. Through the bylaw process, the Samoan government grants legally enforceable, secure and exclusive privileges to communities.

Members of Samoan villages are closely tied by kinship, and village chiefs typically manage fishing activities in the community (Mollica, 1999). Through the bylaw process, each community can specify who will be eligible

to fish within their community-managed area. In Safata, the combined fishing grounds of the nine individual villages within the district are shared by all of the villages. The District Committee, comprised of village chiefs and leaders, has determined that all residents and individuals living outside of Safata with “monotaga” are eligible to fish within the TURF (CRISP, 2008). Monotaga refers to outsiders who participate in community meetings and contribute either money or food to the community (So’o, 2002).

Given that the program has been based on historical use and traditional heritage, there is no apparent provision for becoming a new participant in the TURF other than being born or married into the Safata community, or cultivating monotaga. To limit entry, outsiders are completely excluded from fishing within the TURF for both subsistence and commercial purposes.

STEP 4 IN ACTION

Define the Privilege

The Fisheries Act of 1988 and Village Fono Act of 1990 provide the opportunity for communities to establish area-based privileges based on their traditional fishing grounds. Certain communities have elected to design and implement programs that include the key attributes of catch share programs. Once established through the bylaw process, the tenure length of the privilege is indefinite, providing long-term, secure access. Fishing grounds typically extend from the shore to the reef edge and are defined by historic territorial boundaries.

Generally, communities have worked closely with the Fisheries Division to develop bylaws and management plans to ensure controls on fishing mortality. Management plans clarify local regulations and outline tasks and responsibilities. Communities are responsible for administering management plans and for monitoring and enforcing local fishing rules.

Since 2000, Safata has developed several management plans for its TURF area, specifying community goals, local fishing regulations, location of no-take reserves, specific bans, monitoring and enforcement strategies and penalty structures. The privilege to harvest within Safata is non-transferable to outside communities, as rights have been determined by customary and historical tenure. However, in Safata, the District Committee has granted access to individuals from the outside possessing monotaga.

STEP 5 IN ACTION

Assign the Privilege

Allocation of the area-based catch share involves registering traditional fishing grounds, and developing bylaws to formalize management authority over fishing grounds. The Land and Titles Court of Samoa determines allocation, as communities with matai are eligible to claim traditional fishing grounds with the court. Allocation is an ongoing process based on when communities choose to establish their claims. Disputes over fishing grounds and boundaries can be resolved through the Land and Titles Court (Techera, 2009).

To obtain full management authority over fishing areas, communities must develop bylaws that regulate the fishing activities of community members and outsiders. Communities can work with the Fisheries Division to determine whether proposed bylaws are in conflict with existing national laws. Once the Samoan government approves the bylaws, communities are able to manage all fishing activity within their traditional fishing grounds.

STEP 6 IN ACTION

Develop Administrative Systems

The movement to revitalize customary management in Samoa is based on a system of co-management between the government and participating communities. The government has provided a supporting role in enabling community-based management efforts, while individual villages have held responsibility for executing management duties on the ground.

The nine villages in Safata are equal partners in managing the TURF. The District Committee is the representative body that oversees TURF administration and management. The District Committee is comprised of high chiefs and members of working committees, which include women, from each village. Church leaders are also integrated into the management process to help with education and promotion of conservation goals. Some functions are handled at the village level, while others are handled at the District level.

All Safata villagers are responsible for surveillance and monitoring of the TURF area to ensure that fishing regulations are followed. A District Officer serves as a liaison between the community and the Samoan Division of Environment and Conservation. Each village is typically responsible for monitoring adjacent no-take reserves, which tend to be sited with sufficient visibility from the shore. If an infraction occurs and the offender is from the same village as the observer, then the observer is to report to the village council. If the offender is from another village, then the observer will report to the District Committee. Penalties for community members include monetary fines, provision of pigs or canned fish, or community service (Tauaefa, 2007). Offenders from outside of Safata must be reported to the District Officer, who handles the infraction in accordance with national law.

The Division of Environment and Conservation conducts annual biological surveys that typically enlist the participation of community members. The primary outcome of the surveys is an assessment of biodiversity and species abundance within the Safata TURF (Ministry of Natural Resources and the Environment, 2005). The surveys are used to inform the development of future management plans.

Initial funding for Safata's TURF was provided by the Samoan government and international aid agencies. However, since 2003, the community has established a trust fund to work towards sustainable financing of community management. The trust fund manages income from fines and tourism activities to support future management efforts (Govan et al., 2009).

STEP 7 IN ACTION

Assess Performance and Innovate

The experiences of Samoa and Safata demonstrate how government can work with communities to revitalize customary forms of management. Villages across Samoa established bylaws and developed management plans to strengthen local management of marine resources. Where communities have established TURFs, the right incentives are in place for sustainable management at the local level.

The catch share program in Safata has met its goals of protecting ecosystem health and strengthening management at the local level. Biological surveys have indicated that the abundance of food fish and other species have increased, while poaching and illegal fishing have been diminished due to improved community monitoring within the TURF (J. Ward, personal communication, 2013). There has been very strong buy-in from the community (Ministry of Natural Resources and the Environment, 2005) and high compliance with regulations.

The catch share program has also provided flexibility to achieve simultaneous goals of increased biological performance and improved livelihood for community members. To provide additional opportunities and diversify risk, leaders adopted the alternative income and food strategy promoted by the Samoan government. The community of Safata incorporated a trochus reseeding strategy into its 2008-2010 management plan, and the government of Samoa helped institute a bivalve restocking program that has greatly improved the abundance of trochus and other clams (Ministry of Agriculture and Fisheries, 2008; J. Ward, personal communication, 2013). Meanwhile the Samoan government has provided low-cost boats to enable community members to access fish for food within the outer reef of the TURF area (Ministry of Agriculture and Fisheries, 2008).

To create a lasting culture of sustainable management, Safata embarked on extensive education efforts to heighten awareness among its community members of fishing rules and the value of conservation. Such education efforts have been integral to increasing buy-in and creating a culture of sustainable resource use into the future.

As a small island nation in the South Pacific, Samoa is highly susceptible to natural disasters. A devastating tsunami struck Samoa in 2009, followed by Cyclone Evan in late 2012. Both natural disasters heavily impacted Safata, and communities there and across Samoa have been focusing their time and resources on recovery efforts. Strong and dedicated leadership within these communities will be integral to continuing sustainable resource management.

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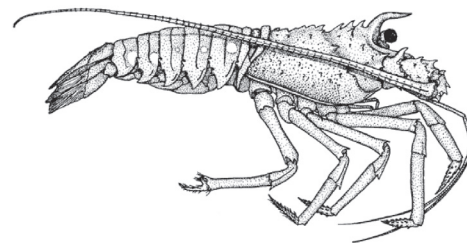
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PHOTO: KRISTIAN BEADLE

CATCH SHARES IN ACTION

Mexican Baja California FEDECOOP Benthic Species Territorial Use Rights for Fishing System



SPECIAL DESIGN FEATURES



MULTI-SPECIES, GROUP-ALLOCATED,
AREA-BASED, NON-TRANSFERABLE

The Baja California Regional Federation of Fishing Cooperative Societies (FEDECOOP) is a group-allocated, area-based catch share, or Territorial Use Rights for Fishing (TURF), program. FEDECOOP consists of 13 fishing Cooperatives that collectively manage 10 TURFs to promote sustainable harvests, increase market access and power and provide stability to fishermen and fishing communities. The catch share program is a model for coordination across multiple Cooperatives and TURFs to achieve fishery goals. Key design features include voluntary no-take reserves to increase productivity and protect vulnerable fish species and the evolution of FEDECOOP to coordinate activities and provide services to multiple Cooperatives and TURFs.

In 1992, the Mexican government granted nine area-based concessions, or TURFs, along the remote west coast of Baja California, and granted a tenth further south in 2000. A total of 13 Cooperatives from 10 associated villages currently manage these areas. These villages are highly dependent on their fishery resources and actively co-manage the TURFs with the government. To ensure coordination, they have formed an overarching federation, FEDECOOP, and are an example for sustainable management. The TURFs were initially established for Baja spiny lobster (*Panulirus interruptus*). Over the years, additional species have been added, including abalone (*Haliotis fulgens* and *H. corrugata*), sea cucumber (*Stichopus parvimensis*) and turban snail (*Astrea undosa*).

The fishery is a model for appropriately scaling management to meet biological and social goals. Government agencies and the regional Cooperatives under FEDECOOP work together to establish catch limits and manage harvests across the entire fishery (Vega-Velazquez, 2008). FEDECOOP Cooperatives have continually complied with catch limits for all four main target species. Total FEDECOOP spiny lobster landings in 2011 were 1,898 metric tons (Scientific Certification Systems, 2011), and the annual value is approximately U.S. \$24 million (Vega Velazquez et al., 2008). As of 2004, the program included 1,300 active fishermen who use 230 skiffs to deploy more than 13,000 lobster traps each season from September to February. An estimated 30,000 people benefit directly from FEDECOOP's lobster fishery operations (INAPESCA, 2004).

SYNOPSIS

Road to a Catch Share

The Pacific coast of Baja California is a remote and isolated area, characterized by poor infrastructure and scarce water resources. Foreign enterprises largely dominated fishing along the coast in the early 20th century, targeting benthic species such as lobster and abalone. In the mid-1930s, the Mexican government began a national program for the formation of cooperatives in agriculture and fishing. The informal fishing camp communities along the Pacific coast of Baja were thus converted into the first fishing cooperatives in the area (Ponce Diaz et al., 1998). In 1948, under the General Fisheries Law, the cooperatives were granted fishing permits for lobster and abalone, although poaching by unlicensed fishermen continued to be a problem despite the legislation (Espinoza-Tenorio, 2010).

In the early 1990s, the cooperatives appealed to the government for secure, exclusive access to their fishing resources in exchange for meeting clear performance goals. This was especially important to these communities because they were highly dependent on their fishing grounds. In 1992, the Mexican government awarded nine geographically defined management areas, or TURFs, to the 13 Cooperatives of FEDECOOP, an existing federation of fishing camps in the region. A tenth TURF was granted in 2000. Each management area was a 20-year “species concession”, or “concesión pesquera”, for Baja spiny lobster and other benthic species (Tindall, 2012). FEDECOOP actively co-manages the TURF system with the National Commission on Aquaculture and Fisheries (CONAPESCA) and the National Fisheries Science Institute (INAPESCA).

Performance

The FEDECOOP TURF program is a model of sustainable, small-scale fisheries management, and is meeting biological, economic and social goals. In recognition of this success, the government renewed FEDECOOP's concessions in 2012 for an additional 20 years. The catch share program has largely been seen as having instilled a greater sense of stewardship among fishermen, improving economic well-being and increasing social cohesion.

Biological goals have also largely been met as the Cooperatives have stayed within catch and effort limits for all high-value species in their TURF system and increased coordination on important stocks that exist across all TURF areas. As a result, FEDECOOP has seen sustainable increases in catch and fishing effort. Additionally, the catch share program has been certified sustainable by the Marine Stewardship Council.

Many Cooperatives have also implemented voluntary no-take zones, which show increased larval production, larger lobsters and higher stock density than fished populations outside the reserve boundaries (Micheli et al., 2012). Additionally, the no-take zone system has helped the abalone stock recover, improved juvenile recruitment and increased resiliency to changes in the environment (Micheli et al., 2012). Other cooperatives in the Baja Peninsula region now look to FEDECOOP as an example of successful TURF management.

STEP 1 IN ACTION

Define Program Goals

FEDECOOP established a series of fishery management goals for the catch share program including biological, economic and social objectives. These goals have evolved along with the catch share and presently include:

- Replenishing and protecting stocks within their TURF boundaries
- Increasing productivity, market power and access to new markets
- Providing stability for fishermen, and infrastructure and services for the fishing community

STEP 2 IN ACTION

Define and Quantify the Available Resources

FEDECOOP is a multi-species catch share program that covers harvests of all benthic species within each Cooperative's TURF. Cooperatives primarily target Baja spiny lobster, also called red rock lobster (*Panulirus interruptus*), pink (yellow) abalone (*Haliotis corrugata*), green (blue) abalone (*H. fulgens*), sea cucumber (*Stichopus parvimensis*) and turban snail (*Astrea undosa*). The program also manages other species such as sea urchins (*Strongylocentrus franciscanus* and *S. purpuratus*) and kelp (*Macrocystis pyrifera* and *M. undosa*). Finfish, including halibut, are caught within the TURFs but are not formally part of the catch share program and are regulated separately.

TURF borders were determined by biological and social factors. Important factors included biological assessments of species' biomass, habitat, reproduction and recruitment, as well as the Cooperative's proximity on land. All FEDECOOP TURFs are located within the Vizcaino Biosphere Reserve, and are subject to legislation administered by the Mexican National Commission for Protected Areas (CONANP).

Cooperatives are responsible for controlling fishing mortality within their TURFs. The primary controls on fishing mortality include catch limits and effort caps, depending on the species. Sustainable limits are set based on assessments conducted by INAPESCA and biological monitoring conducted by the Cooperatives. Effort caps limit the number of traps that can be used and are set annually for the spiny lobster stock (Vega Velazquez et al., 2008). Catch limits are set for other high-value benthic species within each Cooperative's management area (see Figure 1). Additional regulatory measures include minimum size limits, area and temporal closures, protection for females carrying eggs and escape windows in traps to protect reproduction and recruitment.

Voluntary no-take zones have also been implemented as a result of collaboration between FEDECOOP, academic institutions and non-profit organizations. For example, the Cooperative of Buzos y Pescadores on the island Isla Natividad established two no-take zones to replenish and protect target stocks, especially abalone, which had been in decline since the 1960s (F. Micheli, personal communication, 2012).

FIGURE 1 | *Map of FEDECOOP Concessions and Certified Cooperatives*

(1) La Purisima, (2) Pescadores Nacionales del Abulon, (3) Buzos y Pescadores, (4) Bajía Tortugas, (5) Emancipación, (6) California de San Ignacio, (7) Leyes de Reforma, (8) Progreso, (9) Punta Abreojos (Perez-Ramirez, 2012)

Note, this map does not show the concession of Puerto Chale, which is located farther south.

STEP 3 IN ACTION

Define Eligible Participants

FEDECOOP is a Cooperative catch share program under which privileges are granted by the Mexican government to groups generally consisting of local community members. Cooperatives maintain eligibility by renewing membership in FEDECOOP and paying a fee each year (M. Ramade, personal communication, 2012).

Cooperative membership is determined by individual Cooperatives within FEDECOOP. Each Cooperative determines who may fish and on which fishing team or skiff. To be eligible to participate in a Cooperative, fishermen must hold a valid fishing permit issued by CONAPESCA and have complied with all fisheries laws. Cooperatives have access to a set amount of licenses and distribute them among members. Cooperatives are also responsible for creating their own participation rules regarding new entrants and eligibility. For example, new entrants are allowed in Buzos y Pescadores Cooperative through an apprenticeship process in which prospective members must work as an “extra” for 10 years before becoming a full voting member. An apprentice’s work initially includes driving product to market, building lobster traps and working in the processing plant. Extras may eventually be allowed to fish (C. Calderon, personal communication, 2012).

Groups of fishermen may also enter the fishery by creating a new Cooperative and joining FEDECOOP. To be eligible, a group of fishermen may form a fishing cooperative under Mexican law and invite the FEDECOOP assembly to attend one of their cooperative meetings. If the FEDECOOP assembly agrees the new cooperative is a good fit, their representatives are invited to attend a FEDECOOP annual meeting where a majority vote is taken to determine admission of the new group.

STEP 4 IN ACTION

Define the Privilege

The FEDECOOP Cooperatives receive area-based privileges that confer secure and exclusive access to harvest benthic species within each concession’s defined territory. Privileges are granted for 20 years with a strong assumption of renewal.

Each year, CONAPESCA determines catch or effort allocations to each Cooperative for all four high-value species. Through assembly mechanisms, each Cooperative then determines which fishermen are eligible to receive an individual allocation. For example, INAPESCA recommends to CONAPESCA a limit on the number of traps permitted to target spiny lobster for the entire Baja California region. A proportion of the total number of traps permitted is then allocated to FEDECOOP Cooperatives based on the sub-stock fished in their region. This allocation is further divided and assigned to the Cooperative(s) that manages each of the concessions (INAPESCA, 2012).

Each Cooperative typically manages its own allocation to maintain accountability. For example, effort allocation for lobster normally consists of a set number of traps per boat. The Cooperatives grant trap limits to each skiff, and the associated fishing team is responsible for reporting its catch (F. Micheli, personal communication, 2012). The annual allocation unit for sea cucumber, turban snail and abalone is by weight (metric kilograms or tons). Mexican law does not allow temporary transfer of concessions, but the title of the concession can be passed down to another name in certain rare cases (Diario Oficial de Mexico, 2012).

STEP 5 IN ACTION

Assign the Privilege

In the early 1990s, local fishing cooperatives appealed to the government for secure, exclusive access to the marine resources adjacent to their communities. Based on their historical use of the areas, the Mexican government granted nine area-based concessions to 13 Cooperatives in 1992. Each area is a 20-year “species concession”, or “concesión pesquera”, for Baja spiny lobster and other benthic species (Tindall, 2012). A tenth TURF was granted in 2000. The Cooperatives receive the long-term concessions and collectively manage the system through FEDECOOP.

Annual allocations of effort and catch limits are determined through negotiations between FEDECOOP and INAPESCA. Before the fishing season begins in March, INAPESCA announces quota and effort limits for the year (F. Micheli, personal communication, 2012). FEDECOOP plays a role in ensuring fair allocation of fishing rights by holding bi-annual meetings in which Cooperative leaders discuss the catch and trap limits, stock assessments and compliance.

STEP 6 IN ACTION

Develop Administrative Systems

Administrative systems for the catch share program are established and conducted by the Mexican government, FEDECOOP and the individual Cooperatives that hold TURF concessions. Close collaboration occurs to promote co-management and ensure effective administration of the program.

Cooperatives are governed individually and through the umbrella organization of FEDECOOP. Each Cooperative has its own organizational structure consisting of bylaws, formal leadership and administrative roles. Cooperatives are in charge of organizing their own members and holding assemblies to set goals and uphold or modify bylaws. FEDECOOP functions as an umbrella organization to ensure best practices in administration across TURFs and to coordinate market initiatives, such as Marine Stewardship Council certification.

Coordination across Cooperatives and TURFs is primarily conducted through FEDECOOP. FEDECOOP was initially established to represent fishing Cooperatives to the government, but has evolved over time. Today, it also provides increased cohesion, coordination, leadership and administration of the Cooperatives' commercial products. FEDECOOP helps maintain the catch share by coordinating management of the TURF system with government authorities and representing the Cooperatives' interests in government committee and consultation meetings.

Each Cooperative manages its day-to-day fishing activities and is responsible for ensuring compliance with catch and effort limits, enforcement and catch accounting, and for helping with stock assessments (F. Micheli, personal communication, 2012). Cooperatives carefully monitor landings and fishing activity of members. Fishermen from each Cooperative land their products at designated shore-side processing plants. Each

fisherman offloads lobster into holding pens or directly to a Cooperative-owned plant that serves one to three Cooperatives. Pay is distributed to the fishermen at that time. To deliver to a plant, fishermen must have good standing in their Cooperative. Because Cooperatives must report to multiple agencies, careful records are kept of daily activity. Fishermen keep logbooks of fishing effort, trap depth, the number of traps used and number of legal and undersized lobsters caught (Leal et al., 2008).

Cooperatives also handle enforcement. They invest an estimated U.S. \$1 million collectively each year in equipment such as radar, radio systems, boats, night vision goggles, road surveillance and checkpoints to monitor the TURF areas. The Cooperative also conducts 24-hour surveillance of the no-take zones to protect against poaching or illegal activity (Dawson, n.d.). All enforcement activities are conducted in close collaboration and partnership with authorities from CONAPESCA and the Federal Attorney for Environmental Protection (PROFEPA), who prosecutes and penalizes offenders. In order to deter illegal fishing, FEDECOOP successfully lobbied for stricter penalties in the Federal Penal Code. Based on this code, fishermen charged with illegally fishing abalone or lobster cannot be released on bail and must face criminal charges (Marine Stewardship Council, 2010).

FEDECOOP and Cooperatives also partner to perform annual biological assessments of the TURFs and no-take zones. FEDECOOP employs a head biologist, and each Cooperative employs a technician biologist to assist with data collection and provide advice. For example, divers from the Cooperative Buzos y Pescadores on Isla Natividad survey inside and outside the no-take zones and collect data. This enables them to assess the reserve's effect on critical habitat and larval recruitment and whether their no-take zones are helping increase productivity in surrounding fishing areas. These annual assessments help FEDECOOP retain Marine Stewardship Council certification for the spiny lobster fishery.

Costs accrued by each Cooperative include concession fees, a small payment for each registered skiff and FEDECOOP membership fees. Additionally, each Cooperative funds its own monitoring, as well as data collection for stock assessments (Leal et al., 2008). The Mexican government supports the yearly assessment of target stocks by assigning an INAPESCA scientist, while the Cooperatives provide any additional needed manpower.

STEP 7 IN ACTION

Assess Performance and Innovate

Over the 20-year history of the program, FEDECOOP has largely met biological, economic and social goals. Due to this success, as demonstrated through yearly stock assessments, the 20-year concessions were renewed in 2012 (Diario Oficial de Mexico, 2012). Additionally, the catch share program has helped FEDECOOP be the first small-scale fishery awarded Marine Stewardship Council certification.

The adaptive co-management arrangement has allowed FEDECOOP Cooperatives to innovate and improve program performance over time. Since initially forming and receiving TURFs, FEDECOOP has taken a number of steps to improve the design of the catch share. The Cooperatives have voluntarily implemented no-take zones to

increase productivity of target stocks and protect vulnerable species, such as abalone. Additionally, FEDECOOP has coordinated management across Cooperatives, which is especially important for lobster as the stock inhabits all 10 TURFs (McCay et al., in press).

Individual Cooperatives have also innovated to improve the economic performance of the system. The Cooperative Pescadores Nacionales de Abulón, located on the island Isla Cedros has its own state-of-the-art plant on the island that processes fresh abalone in a variety of methods (whole, cut, marinated, ground, etc.) (Cooperativa Pescadores Nacionales de Abulón, 2012). The commercial success of the Cooperative has greatly aided the island community and brought economic prosperity to local fishermen.

Despite high levels of prosperity and resource health, some challenges persist. Illegal fishing by outsiders still occurs, especially in the lobster and abalone fisheries. In 2005, illegal catch of abalone totaled approximately 27% of the official catch, worth about U.S. \$5 million (Castillo, 2012). Continued innovations and investment in enforcement are needed to address this challenge. Overall, FEDECOOP provides a model for small-scale fisheries management through TURFs, and maintains an adaptable co-management arrangement used to address current and future challenges.

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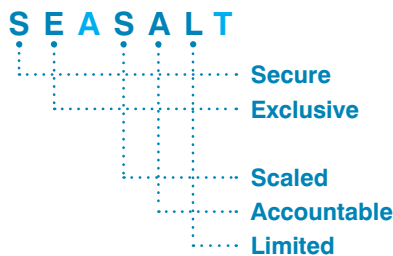
Ashley Apel, Karly McIlwain and Tonya Van Leuvan

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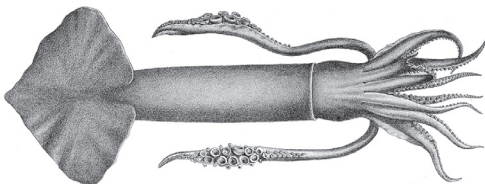
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CATCH SHARES IN ACTION

Japanese Common Fishing Rights System



SPECIAL DESIGN FEATURES



MULTI-SPECIES, GROUP-ALLOCATED,
AREA-BASED, NON-TRANSFERABLE

The Japanese Common Fishing Rights System is a comprehensive catch share program that manages the nearshore fisheries along Japan's vast coastline by allocating secure areas, or Territorial Use Rights for Fishing (TURFs), to harvesting Cooperatives. The system has evolved over time and is a model for managing mobile nearshore species through a network of scaled Cooperatives. The program depends upon a coordinated system of co-management, including nested layers of governance from the federal level down to the regional level. The program design has promoted innovative approaches—especially by fishermen—including coordination within and across TURFs (and Cooperatives), and pooling of harvesting arrangements to improve economic efficiency and resource sustainability.

SYNOPSIS

Dating back to the 1700s, Japanese coastal fisheries have been managed by organizations of local fishers, now called Fishery Cooperative Associations (FCAs). The current system was officially recognized in 1949 when FCAs were granted exclusive access to coastal TURFs. FCAs co-manage coastal fisheries along with the Ministry of Agriculture, Forestry and Fisheries (MAFF), prefectural governments, and specialized fishermen-led associations called Fishery Management Organizations (FMOs). Japan's TURF program encompasses most of the nation's coastline and includes 1,057 FCAs (JF Zengyoren, n.d.) and 1,738 FMOs (Makino, 2011).

The federal government establishes seven annual catch limits to manage eight species within the program: Japanese sardine (*Sardinops melanostictus*), jack mackerel (*Trachurus japonicus*), Pacific saury (*Cololabis saira*), walleye pollock (*Theragra chalcogrammus*), Japanese common squid (*Todarodes pacificus*), snow crab (*Chionoecetes opilio*), chub mackerel (*Scomber japonicus*) and spotted mackerel (*Scomber australasicus*). The latter two species are managed together under a single catch limit. All catch limits are divided and allocated to specific FCAs. Individual FCAs and FMOs can implement self-imposed catch limits for additional species as well as stricter catch limits for federally managed stocks. These coastal fisheries landed approximately 1.3 million metric tons in 2009, and coastal fishery value has been estimated at U.S. \$4.3 billion (Japan Statistical Bureau, 2013).

Road to a Catch Share

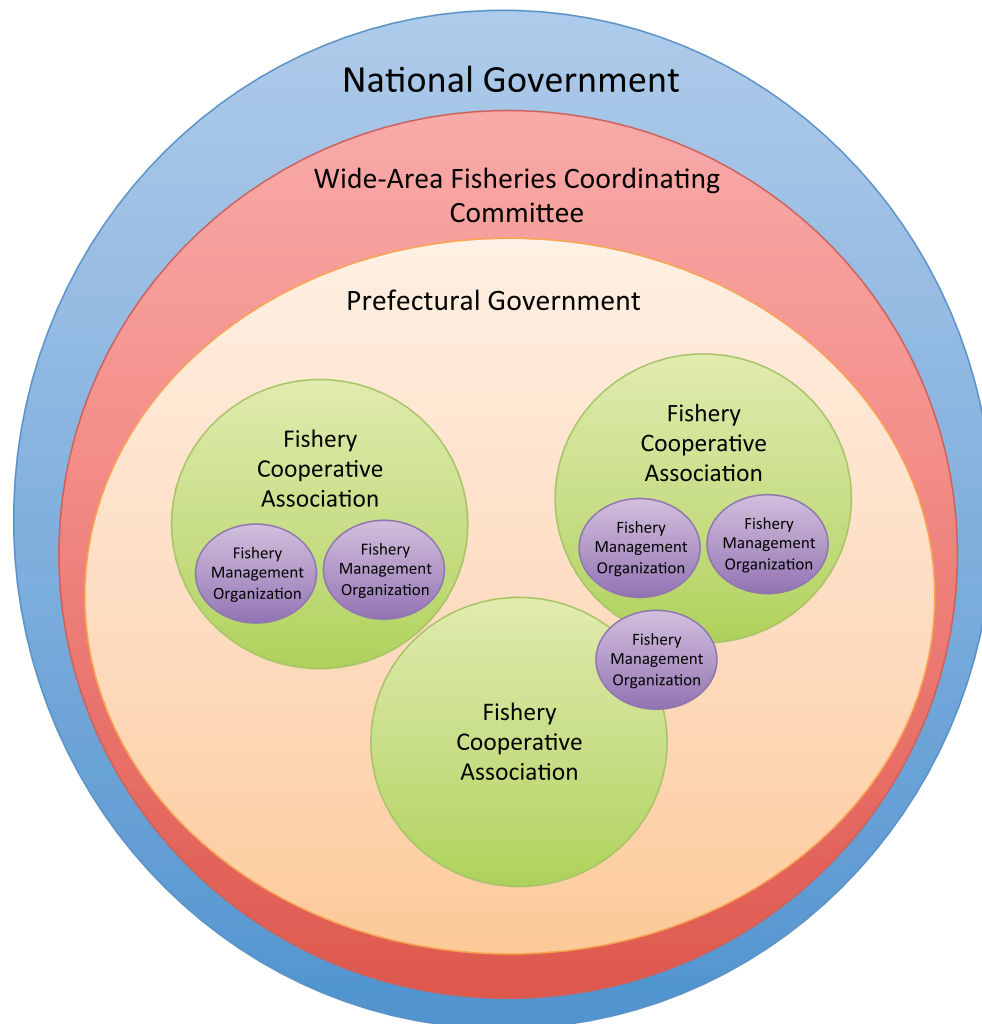
Japan's long history of locally managing small-scale, coastal fisheries provided the foundation for the current catch share program. Starting in the early 1700s, local fishermen were given exclusive use of marine resources (Yamamoto, 1985). Fishing societies formed to protect coastal areas from outsiders; these organized groups were a precursor to FCAs. In 1901, the Meiji Fisheries Law provided the first form of exclusive rights in coastal fisheries to these fishery societies. During the 1930s, as most coastal fishing boats became motorized, fishing pressure increased on coastal fish stocks. Overfishing and conflicts among fishermen, particularly between coastal fishermen and industrial trawlers, began to occur.

To address these issues, the Japanese government formalized the current rights and co-management responsibilities to FCAs as part of the Fishery Law of 1949. The Fishery Law established nested layers of governance to co-manage coastal resources (Figure 1). At the national level, the MAFF was authorized to administer the fishing rights and licensing systems to control fishing pressure (Makino, 2011). Fishery regulations, including prohibitions of species, size limitations, area closures, season closures and limitations on fishing gear were delegated to the governments of 39 coastal prefectures, which are akin to states. Prefecture governments became responsible for issuing fishing licenses and exclusive common fishing rights (TURFs) to FCAs, which in turn are subject to regulations set by the national and prefectural government agencies. Wide-area fishery coordination committees, consisting of prefectural representatives, were formed to work together for the management of highly migratory species. In the early 1980s, FMOs started to form to improve the co-management system and support innovation among FCAs (Uchida and Makino, 2008).

Performance

Almost 65 years after implementation, the program has clearly enhanced coastal fishery management by establishing a nested governance program that improves the sustainability of fish populations and strengthens fishermen's role in the management process. The system has also enabled innovation by fishermen by giving FCAs the authority to adapt and implement additional regulations tailored to local, day-to-day operations within their TURFs (Ruddle, 1987). However, the biological, economic and social outcomes vary by TURE, with some performing better than others.

FIGURE 1 | Japanese Fisheries Co-management System



1. National Government

Ministry of Agriculture, Forestry and Fisheries

Administers the fishing rights and licensing systems. Sets catch limits based on advice from the Fisheries Agency and Fisheries Research Agency.

2. Wide-Area Fisheries Coordinating Committee

Manage and coordinate highly migratory species.

3. Prefectural Governments

Manage coastal fisheries and implement regional fishing regulations. Allocate common fishing rights to FCAs.

4. Fishery Cooperative Associations

Manage common fishing rights (TURFs). Establish formal fishing rules for members. Coordinate with national and prefectural governments.

5. Fishery Management Organizations

Coordinate fisheries, fishing grounds, and/or gear types within or across FCAs. Establish additional fishing rules.

STEP 1 IN ACTION

Define Program Goals

The National Fishery Law of 1949 established the current key program goals for coastal fisheries, specifically (Miki and Soejima, n.d):

- Protect small-scale coastal fishermen from outside fishing pressure
- Promote strong involvement of fishermen in management processes
- Incorporate community knowledge in management decisions

In support of these goals, the National Fishery Law of 1949 formalized the management of coastal natural resources by allocating secure exclusive access to existing FCAs, and formalizing the operation of these Cooperatives.

The Law Regarding the Preservation and Management of Living Marine Resources of 1996 identified additional goals. In particular, it called for national productivity, conservation and management goals within Japan's exclusive economic zone, including the introduction of a total allowable catch (TAC) system for eight species (Makino, 2011).

Complementing the national goals, each FCA and FMO also has identified goals. These goals vary depending on ecology, resource availability and other local conditions. Consequently, an FCA prioritizes management goals in accordance with the most pressing issues occurring within its TURF and among its members. Goals among FCAs commonly include the effective use of fishing grounds, recovery of resources, increased revenue, sustainable businesses and maintaining stable fish prices (Yadava et al., 2009). FMOs can further develop and refine goals to be more specific based on the species, area or gear type. For example, the Council for Promoting Sea Cucumber Resource Utilization in Mutsu Bay, an FMO, aims to sustainably manage the sea cucumber stocks and to conduct processing and marketing activities on behalf of the fishermen (Matsuo, n.d.).

STEP 2 IN ACTION

Define and Quantify the Available Resource

The catch share program is a multi-species program with responsibility for managing eight commercially important species. In 1997, the federal government introduced a national catch limit system and a total allowable effort (TAE) system. The government set seven catch limits for 19 stocks of the eight species that were in need of conservation or targeted by foreign fleets. Stock assessments and allowable biological catch calculations are performed annually by prefectural research stations and the Fishery Research Agency, which recommends the nationally set catch limits (Nishida, 2005). The nationally set catch limits are then divided up and allocated to fishing sectors, including FCAs. These catch limits can be adjusted due to socioeconomic conditions, a practice that has drawn criticism from the scientific community (Nishida, 2005; Takagi and Kurokura, 2007; Sustainable Fisheries Partnership, 2013).

Many TURFs manage a variety of additional species, including seaweed, sedentary shellfish (clams, mussels, sea urchins, abalone and shrimp), moderately mobile groundfish (flatfish and rockfish) and migratory fish (mackerel, pollock and herring). Coastal fishermen employ various types of gear (Uchida, 2007). As only eight species are managed under government-defined catch limits, FCAs are responsible for creating management measures for any additional species within TURF boundaries. FCAs and FMOs have the authority to self-impose catch limits for managed species, and some choose to do so. Prefectural research stations may assist FCAs with conducting stock assessments and determining a scientifically-based catch limit. In 2003, 30% of FMOs adopted catch limits for some of their species, and more than 15% of FMOs had stock assessments and catch limit measures (Uchida and Makino, 2008). FCAs with limited capacity and access to scientific data may impose daily or seasonal limits to manage mortality. These management measures are approved upon submission to the Sea Area Fisheries Coordinating Committees, advisory bodies consisting of fishermen representatives, academics and public interest representatives (Makino, 2011).

Cooperatives have voluntarily established more than 1,000 marine protected areas along the coast (Yagi et al., 2010). Many are designated as no-take reserves to support stocks in their TURFs. For example, the Kyoto Danish Seine Fishery Federation (KDSFF), which is certified by the Marine Stewardship Council as a sustainable and well-managed fishery, designated permanent no-take zones for areas of critical snow crab habitat and seasonal spawning reserves. Combined, these no-take zones cover approximately 19% of KDSFF fishing grounds (Makino, 2008). Similarly, the Sakuraebi Harvesters' Association, targeting sakuraebi shrimp (*Sergia lucen*), implemented a self-imposed closure during spawning season for its target stocks (Uchida, 2007).

STEP 3 IN ACTION

Define Eligible Participants

The catch share program was designed to ensure local communities and fishermen have continued access to fishery resources while promoting their involvement in management. To meet these goals, common fishing rights are allocated only to existing local FCAs and not to individual FCA members (Uchida and Makino, 2008). To be eligible for allocation, FCAs must have a minimum of 20 members and must include the majority of the fishermen within the FCA's geographic area.

The national government also established minimal requirements for fishermen to become members in a local FCA. FCA members must have prior fishing experience, cannot have any fishery violations and cannot possess other fishing rights (Hirasawa, 1980). Members must also be residents of the community and participate in commercial fisheries a certain number of days per year (minimum number of days ranges from 90 to 120 depending on individual FCA bylaws) (Makino, 2011). These requirements were established to prevent the consolidation of rights to individuals from outside the community and non-active fishermen (Ruddle, 1987).

FCAs have the authority to modify the terms of eligibility for new entrants. The most common way FCAs allow fishermen to enter the fishery is through a trial period as a crewmember on an FCA vessel (Uchida, 2007).

FCAs are legally recognized entities that are allocated common fishing rights granted by the government and are authorized to manage coastal fisheries. In comparison, FMOs are often created by groups of fishermen utilizing

the same fishery or fishing grounds and can be considered an eligible group to fish within an FCA's TURF. FMOs are voluntary, autonomous groups of fishermen that have evolved to coordinate and scale management to the appropriate social and biological characteristics of the fishery. The federal government does not make provisions or rules regarding the operation of FMOs. FMOs often adopt stricter management measures than those in place by the FCA, including rules for catch limits, fishing effort controls, harvest coordination, monitoring and stocking (Uchida and Makino, 2008). These regulations are typically developed in coordination with, and cannot contradict, members' FCA regulations. FCAs are not required to have an FMO, although many are associated with FMOs.

STEP 4 IN ACTION

Define the Privilege

The Fisheries Law of 1949 formalized the unofficial TURF boundaries that dated back to the 1700s (Yamamoto, 1985). The size of each TURF was based upon existing geo-political boundaries of the local communities, and encompassed the fisheries within each area. Cooperatives were granted the right to co-manage and exclusively operate in the assigned area for a period of 10 years. An FCA must then apply to the Sea Area Fisheries Coordinating Committee for renewal of the fishing right. Renewal is dependent upon whether the FCA is managing the TURF resources effectively and complying with fishery regulations.

Each FCA determines how to distribute its allocated fishing rights among its members. Not all fishermen may access the entire TURF area; some areas within the TURF may be reserved for the exclusive use of individuals and/or groups. For example, in the Yaeyama FCA, fishermen are organized into groups based on fishery type and residency location. A seasonal lottery is used to allocate fishing spots among the groups (Ruddle, 1987). Alternatively, Mutsu Bay's Council for Promoting Sea Cucumber Resource Utilization equally allocates the catch limit among eligible vessels. Each vessel is assigned to one of four harvesting groups, which determines the days they are allowed to harvest sea cucumbers. Vessels are provided a daily catch limit (Makino, 2011).

To adhere to the social goals of the program, the Fishery Law prohibits transfers, leases, loans and mortgages of TURFs. Individual FCAs, and some FMOs, have the authority and responsibility to determine regulations regarding the allocation and transferability of harvesting privileges among their respective members. As transferability rules are determined by individual FCAs and FMOs, restrictions on trading and use of shares vary across the coast. Many FCAs allow harvesting privileges to be inherited by a relative or successor who belongs to the same FCA (Ruddle, 1987). FCAs typically do not allow members to transfer their fishing rights from one FCA to another. A fishermen moving to another FCA will be required to meet the basic eligibility requirements to harvest in the new area (H. Uchida, personal communication, 2012).

STEP 5 IN ACTION

Assign the Privilege

As directed by the Fishery Law of 1949, eligible nearshore Cooperatives were allocated quota and area-based privileges called common fishing rights (also referred to as TURF rights). Common fishing rights are granted

exclusively to FCAs. A fisherman must be an FCA member to be an eligible participant. Once an FCA receives approval and the prefectural government officially issues the TURF, each FCA is allocated a percentage of the annual catch limit for the eight species managed under the national quota. While this percentage is based upon the FCA membership's catch history, the government neither assigns nor accounts for catch limits at the individual fishermen level. Rather, catch limits are managed at the Cooperative level and the FCA is responsible for ensuring its members comply (H. Uchida, personal communication, 2012).

STEP 6 IN ACTION

Develop Administrative Systems

The catch share program relies on coordinated co-management between national, regional and local organizations. The national government is responsible for setting catch limits for key species and ensuring system-wide compliance. Prefectural governments allocate rights and also ensure some coordination on a regional level. FCAs have the responsibility to ensure compliance with their allocated catch limits and have the authority to adapt and implement additional regulations tailored to local, day-to-day operations within their TURF to compliment federal fishery management (Ruddle, 1987).

FMOs emerged in the early 1980s as national policy promoted and fostered their development to improve the co-management system and support innovation among FCAs (Uchida and Makino, 2008). FMOs formed from groups of FCA fishermen with the objective of developing mutually agreed upon fishery management strategies for specific fisheries, grounds and/or gear types. FMOs have been formed by a single FCA, a subgroup of FCA members (such as trawl fishermen) or multiple FCAs (encompassing larger areas to better manage migratory stocks) (Uchida, 2007). Most commonly, FMOs are housed within the infrastructure of FCAs.

Administrative systems for the TURF program are largely decentralized and conducted by the FCAs and FMOs. Members agree upon Cooperative bylaws that define FCA rules and responsibilities, including internal governance and administrative systems. They submit the bylaws to the prefecture for approval and formalization. The self-imposed rules developed by each FCA encourage compliance from members (Yadava et al., 2009). Additional functions of the FCA include the operation of wholesale markets, collective purchasing and providing financial services (loans and crediting).

Fishermen largely land and sell their catch at the local wholesale market, where FCA staff conduct catch accounting and create reports for prefectural government agencies (Makino, 2011; H. Uchida, personal communication, 2012). Should fishermen sell catch directly to retailers or restaurants, they are required to report their catch record to FCA staff (M. Makino, personal communication, 2013).

The local FCA or FMO handles enforcement on a day-to-day basis, including fishery regulations and TURF boundaries. Violations are typically handled internally within the FCA or FMO without the involvement of third parties or government authorities. Penalties vary in severity among the Cooperatives. Government authorities largely address issues of noncompliance during the TURF renewal process when management practices are assessed for proficiency.

Operational costs of each FCA are covered through a fee system in which 3-5% of total sales from the wholesale market are collected. Administrative costs may be supplemented from direct sales of seafood as well. In such

instances, the FCA will buy seafood from its wholesale market and resell to local consumers (H. Uchida, personal communication, 2012).

FMOs typically operate within the infrastructure of an FCA and therefore have low startup costs (H. Uchida, personal communication, 2012). Additional collections for operation and administrative costs are determined on an individual FMO basis. For example, the Sakuraebi Harvester's Association pools and distributes revenues to members according to a set formula. This formula deducts costs for ice and storage, a 3% commission fee and a 1% port fee from the total revenue (Uchida, 2007). The remaining amount is divided equally among all association members.

STEP 7 IN ACTION

Assess Performance and Innovate

The Common Fishing Rights System was implemented with goals to involve fishermen in the management process and protect them from outside fishing pressure. Almost 65 years later the program has met and exceeded these goals. It has created a co-management system that allows management to operate on the appropriate scale and promotes local fishermen innovation, improving coastal fisheries for fishermen and their communities.

One of the hallmarks of this program is effective co-management through nested government entities, which has achieved an appropriate scale for proficient fishery management and enabled fishermen to incorporate local fishery knowledge and expertise into the management process. This is highlighted by the development of FMOs—entities that were not initially formed through legislation but rather evolved over time to coordinate management of fish stocks at the proper biological scale. FMOs have reduced conflict and promoted coordination between Cooperative members (Yadava et al., 2009). FMOs also allow fishermen to manage straddling stocks between FCA territories, a feature that has evolved from fishermen's ability to incorporate community knowledge into management decisions.

FCAs rarely exceed their catch limits and the catch share system has been integral in ensuring landings have not exceeded federally set catch limits. Despite good compliance in the TURF system, the current status of the eight species managed with a catch limit is mixed.¹ This may be due to catch limit overages in the offshore fleet or political pressure to raise catch limits for socioeconomic reasons (Makino, 2011; Sustainable Fisheries Partnership, 2013). In order to address this, it will be important to ensure appropriately set catch limits and good compliance from all sectors.

Every 10 years, the Sea Area Fisheries Coordinating Committees assess the operation and management practices of FCAs for effectiveness in the management of their TURFs. The Committee may revoke allocated common fishing rights if FCAs are not serving as stewards of their coastal fisheries. Individual FCAs have also chosen to conduct their own annual assessments for both biological and social impacts. For example, the Kaiwuchi-machi FCA, in partnership with a local community, conducts annual stock assessments and social assessments. Social assessments determine the impacts of the sea cucumber fishery and branding on the local economy, including jobs and tourism opportunities (Makino, 2011).

¹ The Japanese government has determined that chub mackerel, sardine and walleye pollock have low stock levels; jack mackerel and snow crab have medium stock levels; and Pacific saury, spotted mackerel and Japanese common squid have high population levels (Makino, 2011)

Fishermen and Cooperatives have also adopted innovative management approaches within the program. This is evidenced by the growing prevalence of pooling arrangements within and between Cooperatives, in which fishing effort, costs and/or revenues are pooled. Such management measures may be developed and modified to promote better coordination among members and neighboring Cooperatives, to increase profits and to improve stock conditions, among other things. The more successful TURFs in Japan often have high levels of cooperative behaviors (i.e., pooling arrangements, coordination, etc.) incorporated into their management processes to achieve biological, social and economic goals (Makino and Sakamoto, 2001; TQCS International Pty Ltd, 2008; Makino, 2011). For example, the success of the KDSFF has been empirically linked to the voluntary reduction in eligible days for harvesting snow crabs and the permanent no-take zones the FMO established that increased catch-per-unit-effort and landing values (Makino and Sakamoto, 2001; TQCS International Pty Ltd, 2008). Pooling arrangements have social, financial and managerial advantages, and continue to grow in use. All of these innovations have been made possible because of privileges provided to fishermen through the establishment of the Common Fishing Rights System.

Although economic goals were not an identified priority in the development of the Common Fishing Rights System, there is growing evidence that co-management allows FCAs and FMOs to improve profitability within coastal fisheries. For example, the KDSFF has shown that landing values and revenue per unit of effort have increased. Additionally, the unit price of sea cucumbers, managed by the FMO Council for Promoting Sea Cucumber Resource Utilization, has steadily increased since 2003 (Makino, 2011).

While some TURFs may perform better than others, the TURF and co-management system in Japanese coastal fisheries is a platform for localized solutions. The successes of the Japanese system are spreading globally and gaining the attention of those who are looking for more effective ways to manage small-scale fisheries. Through supporting best practices and sharing lessons learned, the Cooperatives stand to benefit from their collective experiences.

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Incorporating Customary Marine Tenure Systems into Formal TURF Systems

Especially in island nations of the Pacific, communities have historically managed their coastal resources through customary marine tenure systems in which they exercise exclusive rights over their traditional fishing grounds. In many cases, however, changing social, economic and governance situations have weakened these systems, or in some cases have made them obsolete. To the extent that customary tenure systems persist today, there may be value in incorporating them into formal TURF systems.

Customary tenure systems provide a framework for fisheries management practices that are centered on a community's social and cultural customs. Community leaders typically implement and enforce permanent and temporary spatial closures, gear restrictions, species-specific rules, protection of spawning aggregations and other controls on harvest. The effectiveness of these rules is not well understood and varies from one community to another. In many cases, however, the efficacy of these community-based management measures is evidenced by the persistence of stocks over the course of decades, by local evidence that traditional management practices protect fish stocks (Cinner et al., 2005), and by communities' perceptions that management is successful (Johannes, 2002).

Changing governance and socioeconomic conditions have generally weakened customary tenure systems (Aswani, 2005). Customary tenure systems emerged under local economies, in which fish were harvested for personal consumption or were traded locally. As economies have changed dramatically in these areas, customary users have had access to currency and new markets. This shift enabled a dramatic change in the incentives of users—they could

derive benefit from harvesting more than what could be immediately consumed locally (Dahl, 1988). Under these conditions, there is a greater likelihood for illegal fishing activity and overharvesting. Furthermore, technological improvements to fishing gear and vessels make it more challenging for communities to defend their territory against outsiders (Dahl, 1988). Urbanization, population growth and other competing marine uses have also interfered with customary tenure systems (Bryant-Tokalau, 2010).

It may be easiest to implement formal TURFs where customary tenure exists, and to the extent possible, customary tenure should be incorporated into formal TURF systems (Aswani, 2005). Integrating existing customary rules into formal TURFs may require fewer resources than starting from scratch, and will reduce the likelihood of conflicts between customs and formal rules.

Successfully incorporating customary tenure systems into formal TURF systems relies on preserving the elements of the tenure systems that make them successful, while introducing additional institutions that strengthen customary management (Dahl, 1988). Formal TURFs may be most successful by preserving the existing connection between a defined social group and territory to which it identifies (Dahl, 1988). This may include protecting or strengthening community organization and formally recognizing the authority of community leaders. Formal TURFs should clearly define boundaries based on users' knowledge and perceptions of traditional boundaries (Dahl, 1988). TURFs should also strengthen the community's ability to manage its resources and defend its territory in the face of improved fishing technology and socioeconomic

changes (Dahl, 1988). To continue participating in resource management, users must perceive a benefit from protecting their resources. The benefits of management may be communicated through community education and may also be increased by finding ways to add value to fishery products.

A key element of maintaining and strengthening customary management practices is to ensure that customary marine tenure is formally recognized by law. Legal recognition of customary marine tenure enables communities to

exclude outsiders from their fishing areas. Formal laws can strengthen customary tenure by recognizing village regulations as legal bylaws and restoring the ability of village leaders to exercise their customary authority (Johannes, 2002). It is challenging to translate traditional rules into formal law. Managers may spend a considerable amount of time mapping traditional boundaries and guiding villages through formalizing their regulations into bylaws (Johannes, 2002). As a result, however, the legal TURF system will accord with and strengthen customary management practices.

APPENDIX B

Suggested Marine Reserve Design Resources

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Glossary

Accountable – In reference to the attributes of a catch share program, participants are required to stay within their allocated share of the overall catch and/or comply with other controls on fishing mortality. See SEASALT.

All sources – In reference to the attributes of a catch share program, shares include all sources of fishing mortality (landed and discarded) and when combined do not exceed the catch limit(s) or other controls on fishing mortality. See SEASALT.

Allocation – Distribution of a secure share of the catch to individuals or groups.

Annual allocation unit (*syn.*: Quota pounds) – The measure used to determine the annual amount of fish each participant is allowed to catch, usually defined as total weight. It is often calculated as a percentage of the catch limit based on a participant's holdings. In the case of area-based programs, the unit is a specified area.

Area-based catch share – See Territorial Use Rights for Fishing.

Biological functional unit – In reference to designing Territorial Use Rights for Fishing, the geographical range of a self-sustaining stock or sub-stock of fish.

Bycatch (*syns.*: Incidental catch, Non-target catch/species) – Fish other than the primary target species that are caught incidental to the harvest of those species. Bycatch may be retained or discarded. Discards may occur for regulatory or economic reasons (NRC, 1999).

Catch (*syn.*: Harvest) – The total number (or weight) of fish caught by fishing operations. Catch includes all fish killed by the act of fishing, not just those landed (FAO, n.d.).

Catch accounting – The tracking of fishermen's catch, including landings and discards, against their share holdings.

Catch limit (*syn.*: Total allowable catch) – The scientifically determined, acceptable level of fishing mortality.

Catch share (*syn.*: Catch share program) – A fishery management system that allocates a secure area or privilege to harvest a share of a fishery's total catch to an individual or group. Programs establish appropriate controls on fishing mortality and hold participants accountable.

Co-management – A process of management in which government shares power with resource users, with each given specific rights and responsibilities relating to information and decision making (FAO, n.d.).

Community – The populations that live and interact physically and temporally in the same area (Blackhart et al., 2006).

Concentration – A measurement of the percent of privileges held by one entity.

Concentration cap (*syn.*: Accumulation limit) – The limit on the percentage of shares that any one participant or entity can hold and/or fish.

Controls on fishing mortality – Management measures such as catch limits, gear restrictions and seasonal and spatial closures that limit the total amount harvested each year. When set at appropriate levels, they ensure long-term sustainability of stocks.

Cooperative – 1. A group of fishery participants that is allocated a secure share of the catch limit or a secure area, and collectively manages its allocation. 2. A group of people who come together to coordinate activities in some way.

Cooperative catch share – A type of catch share in which one or more groups of fishery participants are allocated a secure share of the catch limit or a secure area, and accept certain fishery management responsibilities, including ensuring compliance with controls on fishing mortality.

Customary marine tenure (*syns.*: Traditional marine tenure, Customary sea tenure) – A traditional fisheries management approach in which access to a marine territory is limited to a defined local group. Traditional authorities and local community members are responsible for decision making, monitoring, enforcement and other management roles (Ruddle, 1996).

Discard (*syns.*: Regulatory discard, Economic discard) – To release or return a portion of the catch, dead or alive, before offloading, often due to regulatory constraints or a lack of economic value (FAO, n.d.).

Dockside monitoring – The monitoring of activities taking place upon a vessel's landing, including weighing or counting offloaded catch, biological sampling and identifying species composition.

Ecosystem-based management – An approach that takes major ecosystem components and services—both structural and functional—into account in managing fisheries. Goals include rebuilding and sustaining populations, species, biological communities and marine ecosystems at high levels of productivity and biological diversity (FAO, n.d.).

Effort (*syn.*: Fishing effort) – The amount of time and fishing power used to harvest fish; effort units include gear size, boat size and horsepower (Blackhart et al., 2006).

Effort-based – Fishing privileges based on a percentage or absolute number of the total effort units available, often allocated as days, pots or trawl tows. Effort-based programs do not qualify as a catch share.

Effort unit – A unit of fishing effort. In reference to designing transferable effort share programs, a unit defined by a fishing input or set of inputs and the frequency or duration of their use; for example, the use of a trap for a season, the length of a trawl tow or the use of a vessel for a fishing day.

Eligibility – Standards or guidelines that qualify individuals or entities for allocation of catch shares.

Enforcement – Measures to ensure compliance with fishery regulations, including catch limits, gear use and fishing behavior.

Exclusive – 1. In reference to the attributes of a catch share program, secure privileges are assigned to an entity (individual or group) and are clearly recognized and defensible by law. See SEASALT. 2. A program or privilege that permits only assigned users to participate, thereby ensuring that benefits and costs of the privilege will accrue to the holder.

Fish – Used as a collective term that includes finfish, molluscs, crustaceans and any aquatic plant or animal that is harvested.

Fish stock – The living resources in the community or population from which catches are taken in a fishery. Use of the term fish stock usually implies that the particular population is more or less isolated from other stocks of the same species and hence self-sustaining. In a particular fishery, the fish stock may be one or several species of fish but here is also intended to include commercial invertebrates and plants (FAO, n.d.).

Fishery – The combination of fish and fishermen in a region, the latter fishing for similar or the same species with similar or the same gear types (Blackhart et al., 2006).

Fishery information – The information needed in a fishery for science and compliance, which can be collected through various forms of monitoring and self-reporting.

Fishing community – A community that is substantially dependent on or engaged in the harvest or processing of fishery resources to meet social and economic needs. Includes fishing vessel owners, operators, crew and processors that are based in such a community (16 U.S.C. 1802).

Fishing effort (*syn.*: Effort) – The amount of fishing gear of a specific type used on the fishing grounds over a given unit

of time (e.g., hours trawled per day, number of hooks set per day or number of hauls of a beach seine per day) (FAO, n.d.).

Fishing mortality (*syn.*: Mortality) – A measurement of the rate of fish removal from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous mortality is the percentage of fish dying at any given point in time (Blackhart et al., 2006).

Group-allocated – A catch share program in which privileges are allocated to a clearly defined group of people, often a community or fishing association.

Harvest – The total number or poundage of fish caught and kept from an area over a period of time (Blackhart et al., 2006).

Individual Fishing Quota (IFQ) – A type of catch share program in which shares are allocated to individuals or individual entities. Recipients are generally fishermen and shares may or may not be transferable.

Individual Quota (IQ) – A type of catch share program in which shares are allocated to individuals or individual entities. Recipients are generally fishermen and shares are not transferable.

Individual Transferable Quota (ITQ) – A type of catch share program in which shares are allocated to individuals or individual entities. Recipients are generally fishermen and shares are transferable.

Individually-allocated – A catch share in which privileges are allocated to individuals or individual entities.

Input controls (*syns.*: Input regulations, Input-based regulations, Input-based controls, Input measures) – Management instruments used to control the time and place, as well as type and/or amount, of fishing in order to limit yields and fishing mortality; for example, restrictions on type and quantity of gear, effort and capacity and closed seasons (FAO, n.d.).

Landings – The number or weight of fish offloaded at a dock by fishermen. Landings are reported at the locations where fish are brought to shore (Blackhart et al., 2006).

Limited – In reference to the attributes of a catch share program, controls on fishing mortality are set at scientifically appropriate levels. See SEASALT.

Logbook (*syn.*: Logsheet) – A detailed, usually official, record of a vessel's fishing activity registered systematically onboard the fishing vessel. It usually includes information on catch and species composition, the corresponding fishing effort and location (FAO, n.d.).

Marine reserve (*syn.*: Marine protected area) – A geographically defined space in the marine environment where special restrictions are applied to protect some aspect of the marine ecosystem including plants, animals and natural habitats (Blackhart et al., 2006). No-take reserves are a type of marine reserve.

Maximum Sustainable Yield (MSY) – The largest average catch that can be taken continuously (sustained) from a stock under average environmental conditions. This is often used as a management goal (Blackhart et al., 2006).

Monitoring (*syn.*: Catch control) – The collection of fishery information for the purposes of science, including setting catch limits and assessing stocks, and ensuring accountability, including catch accounting and enforcing fishery regulations.

Mortality – A measurement of the rate of death of fish, resulting from several factors but mainly predation and fishing.

Multi-species fishery – A fishery in which more than one species is caught at the same time. Because of the imperfect selectivity of most fishing gear, most fisheries are “multi-species.” The term is often used to refer to fisheries where more than one species is intentionally sought and retained (NRC, 1999).

No-take reserve (*syn.*: No-take zone) – A defined marine area in which fishing and other extractive activities are prohibited.

Non-target species (*syns.*: Bycatch, Incidental catch) – Species not specifically targeted as a component of the catch but which may be incidentally captured (Blackhart et al., 2006).

Open access – Condition in which access to a fishery is not restricted (i.e., no license limitation, quotas or other measures that would limit the amount of fish that an individual fisherman can harvest) (NRC, 1999).

Overcapitalization (*syn.*: Excess capacity) – In the short term, fishing capacity that exceeds the level required to capture and handle the allowable catch. In the long term, fishing capacity that exceeds the level required to ensure the sustainability of the stock and the fishery at the desired level (FAO, n.d.).

Overfished – A state in which a fish stock is below a scientifically determined target biomass (e.g., one half of the biomass that produces Maximum Sustainable Yield).

Overfishing – A rate of fishing mortality that, unchanged, will result in an overfished state.

Quota – The maximum number of fish that can be legally landed in a time period. Quota can apply to the total fishery

or an individual fisherman's share under a catch share program (Blackhart et al., 2006).

Quota-based catch share – A catch share program in which secure shares of the catch limit are allocated to individuals or groups and participants are held accountable to their share. Shares are based on the number or weight of fish.

Quota shares (QS) – The percentage of the annual catch limit to which a catch share privilege holder has access to harvest.

Race for fish (*syns.*: Derby-style fishing, Olympic fishing) – A pattern of fishing characterized by an increasing number of highly efficient vessels fishing at an increasing pace, with season length becoming shorter and shorter (FAO, n.d.).

Scaled – In reference to the attributes of a catch share program, management units are set at the appropriate biological level, taking into consideration social and political systems. See SEASALT.

SEASALT – A mnemonic that describes commonly occurring attributes of catch shares (Secure, Exclusive, All sources, Scaled, Accountable, Limited, Transferable).

Sector – 1. A specific division of a fishery with unique characteristics including management regulations, gear types, fishing locations, purpose of activity or vessel size.
2. A type of group-allocated catch share program, most commonly used in New England.

Secure – In reference to the attributes of a catch share program, the tenure length of shares is sufficiently long for participants to realize future benefits. See SEASALT.

Shareholder (*syn.*: Privilege holder) – An individual or entity holding a secure share in a catch share fishery.

Single-species fishery – A type of fishery in which fishermen target only one species of fish, although it is usually impossible not to catch others incidentally (Blackhart et al., 2006).

Social cohesion (*syn.*: Social capital) – The social resources (networks, memberships of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods (FAO, n.d.).

Social functional unit – In reference to designing Territorial Use Rights for Fishing, a group of people with the capacity to organize and participate in managing their fishery.

Stewardship – Responsible management of resources for future generations, such as maintaining populations of target and non-target species, protecting wildlife, conserving key habitats and strengthening ecosystem resilience.

Stock – A part of a fish population usually with a particular migration pattern, specific spawning grounds and subject to a distinct fishery. A fish stock may be treated as a total or a spawning stock. Total stock refers to both juveniles and adults, either in numbers or by weight, while spawning stock refers to the numbers or weight of individuals that are old enough to reproduce (Blackhart et al., 2006).

Sustainable fishing – Fishing activities that do not cause or lead to undesirable changes in the biological and economic productivity, biological diversity, or ecosystem structure and functioning from one human generation to the next (FAO, n.d.).

Sustainable harvest (*syns.*: Sustainable catch, Sustainable yield) – The biomass or number of fish that can be harvested without reducing the stock biomass from year to year, assuming that environmental conditions remain the same (Blackhart et al., 2006).

Target species (*syn.*: Directed fishery) – Those species primarily sought by fishermen in a particular fishery. There may be primary as well as secondary target species (FAO, n.d.).

Tenure length of shares – The duration for which an individual's or group's share is allocated.

Territorial Use Rights for Fishing (TURF) (*syn.*: Area-based catch share) – An area-based management program that assigns a specific area to an individual, group or community. To meet the definition laid out in the Design Manual, one or more species in the area must have a scientifically based catch limit or other appropriate controls on fishing mortality.

Total allowable catch (TAC) (*syn.*: Catch limit) – The annual recommended or specified regulated catch for a species or species group (Blackhart et al., 2006).

Total catch – The landed catch plus discard mortality (Blackhart et al., 2006).

Transferable (*syns.*: Transferability, Tradable) – In reference to the attributes of a catch share program, shareholders can buy, sell and/or lease shares. See SEASALT.

Transferable effort share (*syn.*: Transferable effort share program) – A fishery management system that sets an effort cap based on fishery inputs and their use, allocates shares to individuals and allows trading..



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