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THE RUDIMENTS OF A REVISED THEORY OF
THE ORIGINS, SURVIVAL, AND PERFORMANCE OF INSTITUTIONS
FOR COLLECTIVE ACTION

by

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THE RUDIMENTS OF A REVISED THEORY OF THE
ORIGINS, SURVIVAL, AND PERFORMANCE OF INSTITUTIONS
FOR COLLECTIVE ACTION¹

Considerable attention has been paid by the authors of the case studies presented in Part 2 of this volume to the theory of collective action. Accepted theories of collective action appear to conclude that individuals using a common-pool resource are locked into a struggle leading to the destruction of the very resource on which their livelihood depends (G. Hardin, 1968; Olson, 1965). Several cases, however, have described situations where individuals using a common-pool resource have devised their own customs or rules to limit individual actions in ways that avoid the tragedy of the commons. Other cases illustrate outcomes predicted by the accepted theories, that is, resource systems that are over-used and whose capability to sustain a productive flow of resource units into the future is seriously endangered.²

The apparent contradiction between some of our cases and the current interpretation given to major theories of collective action led me to re-examine the theories of Garrett Hardin and Mancur Olson to ascertain if these theories had been adequately understood. Given space constraints, I can only summarize my conclusions here (see E. Ostrom, 1985b). Garrett Hardin's theory is generally well-understood and the empirical evidence presented in some of the case studies represents a challenge to his theory. On the other hand, Mancur Olson's theory is not well-understood due in part to a lack of

consistency and clarity in his original presentation. Most of the successful cases discussed above would be classified in Olson's scheme as "intermediate groups." Olson does not make a determinate prediction for whether intermediate groups would or would not organize themselves for collective action. He argues that some will and some will not organize. Thus, the evidence presented above cannot be used to refute his theory.

Olson's theory is not, however, particularly useful in helping to explain which intermediate groups will organize and which ones will not. Several important conceptual building-blocks are developed by Olson that can be further refined. His stress on the importance of the characteristics of goods as they affect individual and group behavior is important. He makes an effective case that the nature of a good itself, as well as the size and form of organization adopted by a group, contribute to the strategic opportunities available to individuals. His concept of "noticeability," which is related to the degree of knowledge that individuals have about the actions of each and all individuals, is also an important building-block for future work.

The Need for Clarification of Key Conceptual Terms

To move beyond the work of Garrett Hardin and Mancur Olson, considerable effort is needed to clarify key conceptual terms. The framing paper by Ronald Oakerson (Chapter 2 above) was a major step in this direction. Members of the panel and participants at the Annapolis meeting have all been attempting to clarify basic conceptual terms of relevance to the study of common-pool resources.

Common-Pool Resources (CPRs)

One of our major efforts has been to work on a definition of common-pool resources. The definition we developed at the Annapolis conference was:

Common-pool resources (CPRs): Natural or man-made resources which produce flows of separable use-units per unit of time (or, several flows of different types of use units) where physical exclusion from the resource system is costly to achieve and the resource system can potentially be utilized by more than one person or production unit simultaneously and/or sequentially.

This is still a working definition, but it seems to capture the key attributes of the phenomena of interest to this group.

Instead of using only one defining criterion for common-pool resources, we posited two criteria: (1) the cost of achieving physical exclusion from the resource system and (2) the presence of separable (rather than joint) use-units. Both exclusion and jointness are viewed as variables which are characteristic of all goods:

Exclusion: The costs or technical problems associated with excluding potential users or beneficiaries from the good or resource.

For relatively small resource systems, a single family or small production unit may be technically able to enclose the entire resource system and exclude others at a low cost. For very large and amorphous resource systems, such as ocean fisheries or the radio spectrum, it is extremely difficult, both technically and economically, to exclude potential users from obtaining benefits from the resource. The cost of exclusion is affected by the size and type of the resource system's natural boundaries and the technology available to enclose them (fences, markers, electronic passwords, decoders, etc.) Entry and exit rules also affect the operational patterns of exclusion, but they

must be tailored to the particular attributes of specific types of resources within a cultural and historical setting.

Jointness: The number of individuals who can simultaneously or serially use a good or resource without substantially affecting one another or the flow of future use-units.

Goods such as apples and cups of coffee are separable goods and are not usually subject to joint use. The heating plant in a house is jointly used by a relatively small group. A bridge is jointly used by an even larger group. An ocean fishery may be jointly used by a very large group.

The definition of a Common-Pool Resource (CPR) distinguishes between the flow of use-units and the resource system producing the flow. Use-units are what individuals produce and/or use from a resource system. Examples of use-units include: fish harvested from a fishery, the animals fed on a grazing plot, wood and/or other usable plants harvested from a forest. Separateness of use is a characteristic of the use-unit derived from a common-pool resource. The fish harvested by one boat are not there for someone else. Jointness of use is, however, a characteristic of the resource system. More than a single boat can harvest fish simultaneously from the same fishery. More than one family production unit can graze animals on a commons, or harvest a variety of forest products from a forest.

Failure to make this distinction between the subtractability of the use-units and the jointness of the resource system has contributed to past confusion about the attributes of common-pool resources. Common-pool resources and collective goods share one major attribute and differ in regard to a second. The relatively high cost of achieving physical exclusion is an attribute of both collective goods

and CPRs. The theoretical literature focusing specifically on the problem of free-riders is relevant to the analysis of both collective goods and CPRs because the problem of free-riding stems entirely from the difficulties of excluding beneficiaries from resources.

Collective goods and CPRs differ, however, in regard to jointness of consumption. Consumption units of collective goods are jointly consumed while consumption units of CPRs are separately consumed. The "crowding effect" or "over-use" problem of CPRs does not occur in regard to the use of such collective goods as a weather forecast or national defense.

The subtractability of the use-unit leads to the possibility of approaching the limit of the number of use-units produced by a CPR. When the CPR is a man-made structure, such as a bridge, approaching the limit of crossing units leads to congestion and a general slowing or even stopping of traffic. When the CPR is a biological resource, such as a fishery or a forest area, approaching the limit of use units may not only produce short-run crowding effects but may destroy the capability of the resource to reproduce itself and to continue to generate use-units in the future. Thus, the concept of a maximum sustainable yield is important in the analysis of CPRs.

Maximum sustainable yield: The maximum number of use-units that can be obtained from year to year while still maintaining the resource system's capability to continue to yield these use-units.³

If the human demands made on a CPR are considerably lower than the maximum sustainable yield, many individuals can simultaneously use the CPR without adversely affecting each other or the total long-run yield. As demands increase, the degree of interdependence among users

increases. If demands continue to rise and users act independently, users find themselves in the Commons Dilemma.⁴ If each user does not continue his or her own level of use of the resource, the use-units he or she would have obtained will simply go to others. This is the structure of the situation analyzed by Garrett Hardin (1968). This is also the structure of the situation which Mancur Olson (1965) referred to as an "exclusive good," although he did not use resource problems to illustrate the attributes (difficulties of exclusion and separability of consumption) used to define exclusive goods.

How is the Tragedy Avoided?

If a relatively large number of individuals make high demands on a single CPR, do not communicate with one another, and act independently taking only their own expected return into account, the overuse of the commons will continue and/or escalate. Many of our cases, however, illustrate situations in which individuals using a CPR do talk with one another about the long-run condition of their shared resource and take account of one another's use of the resource. If we are to move beyond the work of Hardin and Olson, we need to begin to specify the conditions that are conducive to the emergence of coordinated, rather than independent, actions by the individual users of a CPR.

To do this we need to define some additional terms. First, we need to define the various groups of individuals who: (1) may actually use a CPR, (2) may have claims to use that CPR, and (3) may have the authority to exclude others. We will call these groups: Users, Claimants, and Proprietors.⁵

Users (N_u): A set of individuals who have access to a CPR and withdraw use-units from it.

Claimants (N_c): A set of individuals who may make sustainable claims (i.e., they have rights) to access to a CPR and the withdrawal of use-units from a CPR.

Proprietors (N_p): A set of individuals who have rights of access to a CPR and can also make sustainable claims that no one, who is not a proprietor, can have legal access to the same CPR and withdraw use-units from it. Proprietors can claim right of access to a CPR and exclude nonproprietors from a CPR.

The users of a CPR are not necessarily either claimants or proprietors. Let us define Squatters:

Squatters (N_s): A set of users of a CPR who cannot make sustainable claims either to access or to the exclusion of other Users.

As defined, the set of users includes those who at any particular time enter a CPR and withdraw use-units from it whether or not they are claimants, proprietors, or squatters.

Claimants are the set of individuals who can effectively demand access to a CPR to withdraw use-units from it. In other words, persons with effective legal claims to access and use of a CPR could demand that a fence or other exclusion mechanisms that kept them out of the CPR be taken down. Citizens of most nations, for example, have the status of claimants in regard to many public facilities. As claimants, they may not be excluded.

Proprietors, like claimants, have the rights of access to a CPR. In addition, proprietors have the right to exclude anyone else who is not a co-proprietor from access. In other words, proprietors can erect a fence or other means of exclusion that can be used to exclude all others except co-proprietors. If proprietorship is established, the legal status of claimant is eliminated.

Users, who are neither claimants nor proprietors, would be legally considered as squatters. In the history of resource development, many CPRs were originally developed by squatters. Further, when squatters have been ignored for some time, they have sometimes been able to sustain claims to rights as claimants and eventually as full proprietors through appeal to a common-law tradition or by gaining legislative recognition. A squatter or claimant community, which established and enforced its own rules of access and use, would be able to control a CPR unless others with more sustainable claims tried to disrupt these use patterns. Some of the most perplexing cases in the developing countries concern users who had developed full proprietorship rights in traditional legal institutions and had them stripped away by colonial and other "modern" legal arenas to that of claimant or, even worse, to that of squatter (see Hamilton, 1982).

In the following discussion, the set of individuals we have defined as "Users" is the base group for analysis. Users may live in or nearby a CPR or they may live far away and travel to the resource (which itself may shift locations) to harvest use-units. The group of individuals who are using a CPR may remain completely latent in that they do not organize themselves in any way. Or, the users of a CPR may begin to discuss their problems with one another, recognize some commonly accepted rules for who has access to the CPR under what conditions, and develop some mechanisms for conflict resolution about the CPR. The forum for discussion and decision may be a local gathering place, a village council, or any other place where the users of the same CPR congregate from time to time to discuss their common problems.

Because organizational arrangements frequently emerge from the patterns of behavior which are informally agreed upon over long periods of time, it is difficult to determine when user groups are latent and when they are organized. Demarcation criteria are provided in the following definition:

User Group Organization (UGO): A user group is considered to be a UGO whenever a user group shares common understandings about:

- (1) who is and is not a member of their group,
- (2) the type of access to a CPR conveyed by membership or other grounds for such rights (e.g., the rights, duties, liberties, and exposures of different individuals),
- (3) how decisions will be made that affect the development of coordinated strategies for using the CPR, and
- (4) how conflicts over these use patterns will be resolved.

User Group Organizations, so defined, can vary from relatively informal organizations meeting occasionally where users discuss how their individual strategies affect one another to formal organizations with written rules clearly specifying mutual rights and duties and procedures for making binding decisions on all members. A UGO could be a village governed by local oligarchs or by open democratic processes. A UGO may be a unit of local government where members of the local community select their own representatives and can pass discretionary legislation about the use of the CPR and other matters.⁶ A unit of local government that is primarily an administrative district of a central government is not included within the meaning of the term "UGO."

The members of a UGO may be squatters, claimants, or proprietors. When a UGO is created by a set of proprietors, who are consequently able to make their claims to the exclusive use of their resource stand in external courts and administrative bodies, the UGO is obviously a more stable enterprise. However, examples of UGOs organized by users with less than full proprietorship rights are illustrated in the cases presented above. Many of these "squatter" or "claimant" UGOs have been rather ingenious in their efforts to control the CPRs on which their livelihood depends. Given the external legal orders in which they find themselves, they are exposed to greater uncertainty than if they could gain proprietorship rights in those external fora. The size of a UGO is not necessarily the same as N_u , N_c , N_p , or N_s , and thus needs to be kept as a separate variable. Let us use N_m for the number of individuals who are members of a UGO.

All of the cases describing long-run success in managing CPRs subject to high levels of use also include reference to some type of UGO that meets the criteria stated above. This leads me to argue that the development of a UGO is a necessary, but not sufficient, condition for avoiding the tragedy of the commons through the actions of local users themselves. Stating this proposition as a necessary condition for managing CPRs where potential use exceeds maximum sustainable yield makes it possible to challenge the proposition empirically. Finding a single case where local users, whose demands for the use-units from a CPR are high relative to supply, and who have avoided the tragedy of the commons through their independent actions without a UGO, is an effective challenge to this proposition. Given that the proposition is stated as a necessary but not sufficient condition,

cases should be found where UGOs exist, but where users have not succeeded in regulating the use of their CPR in an effective manner.

The Emergence of User Group Organizations

Given the importance that UGOs appear to have in providing User Groups with the potential to cope with the problems of managing their CPRs, we must examine the factors that may be associated with the emergence of some form of User Group Organization. It is also obvious from the cases that UGOs do not emerge whenever they are needed. Consequently, we need to examine the conditions that appear to be conducive for the emergence of UGOs. We discussed this extensively at the Annapolis conference and identified a series of variables that appeared to be important for their positive or negative effect on the origin of one or more UGOs related to a common-pool resource.⁷ Some of these variables related to attributes of the CPR, some to the relationships between use and supply, and some to attributes of the User Group. The variables discussed at the Annapolis conference are reproduced in Table 1.

Towards the Rudiments of a Theory of the Origins of UGOs

This is a long list of variables. Too long! There is no question that many of these variables play an important role in specific cases, but such a list of specific variables is too unwieldy to allow for further theory development and testing. To develop a theory of the emergence of some form of user organization, we need to develop a smaller set of key variables that can form the basis of a theory of origin.

TABLE 1 Variables Mentioned by Case Authors as Being Associated with the Emergence of User Group Organizations

A. Variables related to the CPR:

1. **Size of the CPR:** The boundaries of the CPR are sufficiently small, given the transportation and communication technology available, that users can develop accurate knowledge of external boundaries and internal microenvironments.
2. **Clear-cut boundaries:** The boundaries of the CPR are sufficiently distinct that users can develop accurate knowledge of the external boundaries.
3. **Indicators of CPR conditions:** Reliable indicators of the condition of the CPR can be obtained as a result of regular use.

B. Variables related to the relationship between use and supply:

1. **Scarcity:** The amount of resources extracted from the CPR are sufficiently high that users are aware that their use-patterns are interdependent.
2. **Asset structure:** The claims that some members of the User Group can make are sufficiently large that they are motivated to pay a major share of the initial organizational costs of creating or restructuring a UGO.

C. Variables related to the User Group:

1. **Size of the User Group (N_u):** The User Group is sufficiently small that the costs of communication and decision making are relatively low.
2. **Residence:** The User Group permanently resides near or "in" the CPR.
3. **Degree of homogeneity:** The User Group is not strongly divided by:
 - a. Natural boundaries;
 - b. Different, conflictual use patterns;
 - c. Different perceptions of the risks of long-term extraction from the CPR;
 - d. Cultural antagonisms; and/or
 - e. Substantially different exposures to risk (e.g., up-stream versus down-stream users).

4. Existing organization: The user group has some prior experience with at least minimal levels of organization due to:
 - a. The presence of a general purpose organizational structure, such as a village council or a cooperative organization.
 - b. The presence of a specialized organizational structure related to this resource without prior management responsibilities, such as a boating club.
 - c. The presence of nearby UGOs which have helped others to solve similar CPR management problems.
5. Ownership status: The rights that users have to access, use, and, potentially, to the exclusion of others, are sustainable and certain.
6. Degree of centralization: The user group is not prevented from exercising local initiative by a centralized government.

One strategy is to ask if any of these variables appear to be more important than any of the others. In other words, let us ask whether it is possible to assert that:

- (1) one or more of these variables must have values between either a lower or upper bound (or, both) for a UGO to emerge (a necessary condition); or
- (2) anytime the value of a particular variable is within bounds, a UGO will emerge (a sufficient condition).

From a careful reading of the cases, neither assertion appears warrantable.⁸ Some participants at Annapolis argued that the size of the User Group (N_u) was such a key variable. This is because the costs of organization rise as the number in the latent group grows. No particular size range, however, appears to be necessary or sufficient for the emergence of a UGO. Examples exist of fairly large members of users creating very effective UGOs and managing complex

CPRs over long periods of time. (See Blomquist and E. Ostrom, 1986, for a description of the emergence of a successful UGO involving over 500 pumpers from a ground water basin.) The real problem for groups of any size to solve is how to develop low cost methods of communication and monitoring.

A second strategy in an effort to develop a theory of the origin of UGOs is to move from the level of specificity exhibited in the list of variables shown in Table 1 to variables that are more general in nature. In this effort, we can also draw on previous theoretical work related to the theory of constitutional choice.⁹ A UGO can be conceptualized as a small polity constituted by users for the purpose of gaining a joint benefit (the regulation of the CPR). A central assumption of the theory of constitutional choice is that the costs of decision making involved in arriving at a set of coordinated strategies for the members of a collectivity are greater than the costs of decision making involved when each and every person is free to adopt his or her own independent strategies. In deciding whether or not to create a new polity -- in our case a new UGO -- it is presumed necessary for individuals to examine not only the expected benefits to be derived from the coordinated strategies of the collectivity but also the expected costs in time and resources devoted to decision making and the expected, potential deprivations imposed on individuals by the polity itself.

A general proposition of the theory of constitutional choice is that a group of individuals will constitute a new polity whenever the perceived benefits to be gained from the enterprise are greater than the total estimated decision-making costs of the enterprise using a

particular set of rules (Buchanan and Tullock, 1962). By thinking in a more general fashion about the list of variables shown in Table 1, it is consistent with our inductive findings to make the same general proposition regarding the emergence of a UGO. UGOs do not emerge unless perceived benefits of organization exceed the perceived cost of organization. To make this proposition, it is necessary to assume that many of the variables listed in Table 1 affect the perceptions that users have of the benefits and costs to be derived from changing from independent strategies to coordinated strategies.

If a CPR is a valuable resource worth the costs of managing it, the perception that benefits exceed costs is more likely when members of a User Group have relatively full and accurate information about: (1) the physical structure of a CPR, (2) the past actions of other users, (3) the relationship of demand to yield, (4) the benefits and costs of various actions and outcomes impinging on different users, and (5) the likelihood that members of the User Group will keep promises. Thus, the specific variables in Table 1 can be viewed as the type of variables that enhance the information that individuals possess about both the benefit and the cost side of constituting a new organization. With this view of why these variables are important to the emergence of UGOs, we can now make the following more general propositions:

Individuals will tend to switch from independent strategies for exploiting a CPR to more costly, coordinated strategies when they share a common understanding that:

- (O-P₁) Continuance of their independent strategies will seriously harm an important resource for their survival,
- (O-P₂) Coordinated strategies exist that effectively reduce the risk of serious harm to the CPR,

- (O-P₃) Most of the other users of the CPR can be counted to change strategies if they promise to do so, and
- (O-P₄) The cost of decision making about future coordinated strategies is less than the benefits to be derived from the adoption of coordinated strategies.

Let us now discuss how these general propositions are related to the specific variables in Table 1.

Common Understanding of the Problem

Whether users share a common understanding that the continuance of their independent strategies will seriously harm an important resource for their survival (O-P₁) depends on the size and performance of the CPR itself and on the actions of users. If the CPR is relatively small (A1), the boundaries are easy to determine (A2), and reliable indicators of the conditions of the CPR are present (A3), users can begin to develop a consistent understanding of the amount and value of the maximum sustainable yield of the CPR. Users either need relatively good information about the amount of the yield or reliable and sensitive indicators of the condition of the CPR to begin to assess whether their own actions are cumulatively leading to a deterioration of the commons. How fast this type of information is obtained and synthesized depends heavily on the type of CPR involved and the level of scientific knowledge used. Gilles and Jamtgaard (1981) have described a wide variety of grazing commons where information about the conditions of the commons is rapidly conveyed to users through the quality of milk or wool produced by the animals grazing on the commons. Similar rapid and accurate feedback about the condition of the commons is more difficult to obtain from daily use in regard to a groundwater basin.

If users live in a small community (C1) near to the CPR (C2), they would have a relatively accurate picture of the use patterns of each other. Further, open communication about the problems they face, as well as potential solutions, is enhanced when users live in a small community near to the CPR. This is consistent with a major finding from the research of scholars who have constructed commons situations in laboratory experiments. When communication is unconstrained in such laboratory settings, participants more frequently choose to cooperate with one another (see Wilson, 1985).

As users come to recognize through communication that demands are close to or are exceeding the sustainable yield (B1), then one can expect that users will share an understanding that the continuance of their independent strategies will seriously harm the CPR. This recognition is not sufficient for a change from individual to coordinated strategies. The users must also place a high value on the CPR itself in terms of their own economic and social survival, and the other three propositions stated above must be met.

Common Understanding of Alternatives for Coordination

Users must also be able to conceptualize the possibility of alternative strategies that might avoid this harm (O-P₂). The capacity to think about alternative coordinated strategies is affected by the prior experience that users have had with other forms of local organization (4a and 4b), knowledge about the experiences of other groups trying to solve similar problems (4c), the certainty of their own status as owners (5), and a capacity to take local initiative (6). One would expect users with little or no common experience with or

knowledge of successful efforts to achieve coordinated strategies to have greater difficulties in developing strategies to manage a CPR.

Common Perception of Mutual Trust and Reciprocity

Further, users need assurance that if they change to more costly, coordinated strategies, others will do likewise (O-P3). This is the central argument in the work of Runge (1981; 1984), who stresses the importance of assurance of mutual promise-keeping in solving CPR problems. Given the structure of the commons dilemma as it is frequently modeled, this is the problem that each individual must be assured that he or she will not be the "sucker" who adopts the most costly coordinated strategies (cooperates) while others yield to their "temptation" not to cooperate and continue their own practices. In formal models, the problem of gaining assurance is sometimes solved by assuming that all individuals will adopt a trigger strategy to not cooperate forever (or for a very long time) if the group benefit from cooperating falls below some given level (see Lewis and Cowens, 1983; Bender and Mookerjee, 1985). Assurance may also be obtained through reliance on formal police, formal surveillance and investigations, and formal courts. Use of formal legal methods to gain assurance is costly, however, and users of a CPR can reduce the costs of assurance dramatically if they are willing to develop relationships of trust and reciprocity among themselves (Oakerson, 1985a; R. McKean, 1975).

Mutual trust has been conceptualized as an asset that individuals build over time by engaging in mutually beneficial transactions that cannot be consummated in an immediate quid pro quo exchange in which they have kept their respective promises and obligations (see

Breton and Wintrobe, 1982; see also Posner, 1980). Perceptions concerning the likelihood that other users will follow an agreed upon coordinated strategy are affected by all of the factors related to the User Group (C1, C2, C3a, C3b, C3c, C3d) and prior experience with local organization (4a and 4b).

**Common Perceptions that Decision-Making Costs
Do Not Exceed Benefits**

Users would also need to share an expectation that future decision-making costs about coordinated strategies will not exceed the benefits to be derived from the use of coordinated strategies ($O-P_4$). Expectations about decision-making costs are affected by all of the characteristics of a User Group (C1, C2, C3a, C3b, C3c, C3d) and prior experience and knowledge about organization arrangements (4a, 4b, and 4c). Almost all theories of organization posit that decision-making costs rise with the size of the group making decisions (C1). One would expect that the greater the homogeneity of the user group as identified in (C3), the lower the costs of arriving at decisions. Decision-making costs are also lowered if some individuals are willing and able to make considerable entrepreneurial efforts to get a UGO organized or to persuade an existing organization to include the CPR within its frame of interest.

Consequently, some inequality in asset structure (B2) may enhance the probabilities of local entrepreneurship. Those with more at stake can afford to spend longer hours and resources trying to arrive at new organizational forms and arrangements. Olson (1965) discussed the problem he called the "small exploiting the large." He meant that

those with small assets relative to the problem at hand are not willing to spend large amounts of other resources to solve what for them may be a problem of little consequence due to their low stakes. If entrepreneurs willing to take on a considerable proportion of the decision-making costs do not emerge, users will share a perception that decision-making costs will be very high.

When the Tragedy is Not Avoided

By focusing on the conditions necessary for the emergence of coordinated strategies to use a CPR, the four propositions developed above also help to explain why so many CPRs have been destroyed or are suffering severe problems of degradation. One can reverse the direction of the propositions in the following shortened version:

Users will continue independent strategies for exploiting a CPR unless they share a common understanding and perception of: (1) the nature of the problem, (2) the alternatives for coordination available to them, (3) the likelihood of mutual trust and reciprocity, and (4) expected decision-making costs less than the benefits to be derived.

Given this statement of the problem, one can understand why, for a very large class of CPRs, users continue their independent strategies for exploiting CPRs. Unless creative efforts are expended to create large-scale user group organizations, such as "international special regimes," independent, exploitative strategies are a dominant strategy for all participants. Problems such as the control of ocean fisheries, migratory wildlife, and international air pollution are an order of difficulty greater than localized common-pool problems such as grazing lands, irrigation projects, inshore fisheries, etc. It is

more difficult to gain common understanding of the nature of a problem such as acid rain than of a grazing area.

The general principles involved in solving large-scale CPR problems are similar to those involved in dealing with smaller resource systems. The processes of gaining a common understanding and devising workable coordinated strategies are, however, far more difficult and costly for large-scale common-pool problems. Institutional designs relying on nested structures of small organizations within larger organizations, or federal structures, are most likely needed (see Bender and Mookerjee, 1985). The development of such structures, when the resource crosses jurisdictional boundaries (or, even worse, exists outside all jurisdictional boundaries), is itself a costly and difficult process.

On the Survival of UGOs

The creation of a User Group Organization and the development of coordinated strategies for using a common-pool resource are no guarantee that the UGO can survive over time. Many stories are told of efforts to achieve coordinated strategies that looked hopeful but collapsed after a few years. The initial perceptions of the nature of the problem, the alternatives for coordination, the likelihood of mutual trust, and the costs of decision making may be altered by experience. Is it possible to posit the variables that may be conducive to the survival of a UGO, once it has emerged through the slow accretion of common understandings or has been consciously designed by users trying to solve a specific problem? Yes, I think we can.

Instead of generating a list of specific variables as I did above, I will present the general propositions derived from the discussion at Annapolis of more specific variables.

A User Group Organization will be more likely to survive if:

- (S-P1) The UGO devises a small set of simple rules related to access and use patterns agreed to by users.
- (S-P2) The enforcement of these rules is shared by all users supplemented by some "official" observers and enforcers.
- (S-P3) The UGO is constituted with internally adaptive mechanisms.
- (S-P4) The users of the CPR are able to sustain claims as proprietors of the CPR ($N_u = N_p$).
- (S-P5) The UGO is nested in a set of larger organizations and authorities in which it is perceived as legitimate.
- (S-P6) The UGO is not shocked by several very large changes or many small changes in exogenous variables during a short period of time.

I shall discuss each of these propositions in turn.

A Small Set of Simple Rules

The development of a small set of simple rules agreed to by users has many survival advantages. The key advantage is that users can remember the rules and transmit them to new users over time. The constraints that social systems use to structure behavior -- rules -- are constraints only to the extent that humans can understand what is and is not allowed and can transmit this information to new participants (see V. Ostrom, 1980; 1985; and E. Ostrom, 1985a). To the extent that rules can be backed up by physical constraints (e.g., fences or governors on motors), it is both easier for individuals to

follow a rule without actually knowing the rule and to be sure that behavior is in conformance with rules. Most rules, however, are constraints only in so far as humans learn them, follow them almost automatically, tell others about them, and know when others are or are not following them.

The fewer rules used to organize activities (relative to the complexity of the activities), the more likely that individuals can understand, remember, and follow them. Further, the fewer and less ambiguous rules are, the higher will be the agreement among all participants about what is and what is not an infraction. At the Annapolis conference we discussed the multiple functions of the simple rule: "You must live locally to use this system." This simple rule has the following results:

- (1) It is extremely easy to learn, remember, and transmit.
- (2) Following this rule enhances the local knowledge that users have about the CPR.
- (3) Following this rule enhances the possibility for reciprocity and trust among users because they have a higher probability of knowing one another and engaging in other transactions.
- (4) Following this rule reduces decision-making costs about who can or cannot use the system.
- (5) Using this rule keeps enforcement costs relatively low since a stranger will be obvious to most participants.

We identified several other types of simple rules used by UGOs that had survived long periods of time. Frequently, these had to do with access to the CPR. An unchanging rule that a grazing commons will be open for use between the same dates every year (and closed otherwise) is a low cost rule for coordinating behavior of large numbers of users who may live miles apart during much of a year. Assigning a single

individual in a residential community the responsibility for announcing the dates for opening and closing of a commons is a more flexible and equally clear rule of access, but may be difficult to use when users live far apart without modern modes of communication.

Dual Enforcement

That the rules of a UGO are enforced by the users themselves backed up by some "official" enforcers also appears to be an important condition for survival. If the rules are not enforced at all, their constraint breaks down rapidly. No one even has to try to cheat. One or two users simply forgetting to follow the rule without anyone (users or official enforcers) saying anything can be the beginning of the end. Once some users unconsciously (or consciously) forget to follow the rules, and no one says or does anything to them, others observe this lack of sanctions and are less inclined to follow the rules themselves.

Dual enforcement is a mutually re-enforcing process. No UGO can hire enough guards to see all the boundaries of a CPR and all of the activities of users. Users are the effective "public eyes" (Jacobs, 1961) that cover much more of the territory than official guards could ever see. If users know, understand, and have agreed to a simple set of rules (SP-1), and if they use social sanctions against one another for rule infractions of various kinds (SP-2), there is a higher probability that a rule infraction will not go unnoticed and unsanctioned. Further, if social sanctions are backed up by official guards, this both helps everyone remember the rules and gives the social sanctions more weight.

Internally Adaptive Mechanisms

Two aspects of adaptability were discussed at Annapolis. The first had to do with the capacity of a UGO to use multiple decision rules and to relate these to different types of problems. We saw a need for at least three types of authority rules that would:

- (1) Create a position for a single individual who is authorized to make decisions for the UGO related to important and rapidly changing conditions.
- (2) Create a council (either representative or a full assembly) where major problems can be discussed, general rules formulated (particularly those related to distribution and problems of equity), and penalties assessed.
- (3) Rely on broad consensus and/or formal rules requiring extra-ordinary majorities for deciding on actions that may involve considerable sacrifice or penalties.

This implies that even though the rules that a UGO uses should be as simple and as few as possible, the governance structure of a UGO should be relatively complex if it is to survive over a long time period. It is the complexity of having at least three different decision rules used in different contexts that enables a UGO to take rapid actions in relationship to exogenous conditions that may change rapidly while protecting the interests of most participants from deprivations imposed endogenously.

The second aspect of adaptability has to do with the capacity of the UGO to change its own structure over time. A UGO that can change its own rules regarding membership, access to and use of the CPR, collection of information, the incentives and sanctions to be used, was thought to have a higher probability of being able to survive in a changing environment than one that must continue to use the same rules for internal organization over time. This aspect of adaptability is

closely related to what W. Ross Ashby referred to as ultra-stability (Ashby, 1956).

Users are Proprietors

For survival, participants at the Annapolis conference argued that those who are the users of a CPR should also be the proprietors of the CPR ($N_u = N_p$). While our cases illustrate instances where users, who are merely claimants, have developed rather ingenious methods for allocating the use of a CPR, the cases also illustrate the marginal character of these UGOs. One of the more poignant illustrations of the tenuous situation of users who are not able to gain proprietor status in a larger legal system is the case of the swamp fishermen of Bahia (Cordell, 1985). While the participants view each other as "co-owners" of the resource, outsiders also perceive themselves as having legal claims to the resource. Conflicts among residential users can be worked out within their own legal framework. Conflicts between residential users and "outsiders" cannot be worked out within the local legal system and must be settled within the national court system. Such conflicts will escalate as the coastal fishery becomes more valuable. As this happens, the local users are exposed to greater and greater uncertainty about their own claims. If the swamp fishermen are not able to exclude the mechanized trawlers from entering their waters, a system of res communis negotiated among the users themselves will become a system of res nullius. As Bromley has pointed out, "open access is nobody's property" (Bromley, 1984).

Nesting of a UGO in a Larger System

The fifth proposition has to do with the nesting of a UGO within a set of larger organizations and authorities for dealing with problems beyond the boundaries of the UGO. This is particularly critical when the CPR itself is very large and UGOs are organized around its subparts. (If those on a tertiary channel of a large irrigation system organize a UGO to keep their channels clear and to regulate the opening of valves, they also need to be able to communicate effectively with the operators of the headwaters from time to time (see Uphoff, 1984).)

Nesting of organizational arrangements in federated structures of various kinds may also enable users to cope with hold-out problems more effectively in large groups. Once a UGO has become quite large, informal sanctioning among members becomes more difficult. But building up a larger UGO from smaller units enables users to continue to monitor each other and impose informal sanctions within the small UGO, yet also to be complemented by the actions of the larger unit against a smaller unit is lagging behind (see Bender and Mookherjee, 1985, for a formal analysis of several types of federated structures).

Even when a particular UGO is effectively organized to deal with the internal problems of a CPR, many events from outside the system can affect the operation of the CPR, and local users need mechanisms for effective communication with larger organizations to cope with these problems. External organizations or authorities can provide essential inputs to the decision making undertaken at the UGO level. Examples include scientific information, capital fund raising, modern technological training (where this is really needed), and supplemental

conflict resolution mechanisms (available when the UGO cannot resolve its own conflicts successfully). Survival over time is also enhanced when external authorities perceive a UGO as a legitimate form of organization rather than as a competitor for power.

Lack of Simultaneous Exogenous Changes

A UGO is more likely to survive over time if it is fortunate enough not to have to cope with many, simultaneous changes in key exogenous variables such as population, technology, number of users, external demands, relationship to central authorities, etc. All large changes in exogenous variables threaten the capacity of a UGO to learn fast enough about the change to make adaptive responses. The faster the change and the larger the amount of the change, the higher the probability that the UGO cannot respond rapidly enough.

Is Survival Sufficient?

A key proposition in the theory being developed in this paper is that some form of organization including the participation of users of a CPR is a necessary, but not sufficient, condition for solving the tragedy of the commons. We have identified a series of variables that are conducive to the emergence of such an organization. Further, we have identified a series of variables that are conducive to the survival of such an organization. It is tempting to stop here. But simple survival of a UGO is not a sufficient condition for effective performance of a UGO.

The survival of a UGO over a long time leads one to presume that the UGO is doing something well. However, the key question is "what" is it doing well? For some UGOs, the answer may be that the only thing they are doing well is surviving. Unless UGOs are in highly competitive environments sustaining selection pressures that tend to eliminate inefficient and inequitable UGOs, we cannot presume that those that survive are performing well. If UGOs were firms in a highly competitive market, the theory of market processes would enable us to infer that survivors use efficient, long-term strategies (even though the survivors may not have consciously selected these strategies through a full analysis) (Alchian, 1950).

We do not yet have a theory of UGO-system processes which enables us to make similar predictions about UGO survivors. Further, we know that some UGOs have extraordinary powers not available to private firms in a competitive market. These powers enable such UGOs to survive even though performing poorly. UGOs which can enforce membership and contributions to collective actions (e.g., have public powers to coerce and sanction) can survive even when most of their members do not evaluate them as performing efficiently or equitably. It is even possible for a UGO that has survived for a long time to generate more costs than benefits. The latter can occur when membership is coerced and the costs of exit are high. Many UGOs organized in the public sector can coerce membership, and exit may involve extraordinarily high costs. Consequently, it is especially important not to presume that surviving UGOs, which have full governmental powers, automatically perform well.

UGOs operating over a long time period without full governmental powers -- established and maintained primarily through voluntary agreement -- are most likely to generate more benefits than they impose costs. Other than a situation in which the users have a gross misperception of the level of benefits and costs, it is hard to imagine how strictly voluntary UGOs could survive unless net benefits are positive. In a strictly voluntary association, members can leave the UGO at any point they perceive costs of participation to exceed benefits. Yet a positive benefit/cost ratio is not equivalent to high performance.

What is Good Performance for a UGO?

In Oakerson's framework paper, he defined two criteria that could be used to evaluate the outcomes of user interactions related to the CPR: efficiency and equity. The first aspect of efficiency mentioned by Oakerson is whether users have achieved an optimal rate of use. A less rigorous efficiency criterion is that users are not exceeding the maximum sustainable yield. A second aspect of efficiency has to do with the difference between the benefits resulting from the operation of a UGO and the decision making and potential deprivation costs of the UGO. A minimal efficiency criterion is that this difference is positive. A comparative efficiency criterion can be used to explore whether the difference between the benefits and costs of one UGO in one setting is as large or larger than that of another UGO in a similar setting. When one uses the criterion of equity one asks two questions: First, is the distribution of the costs of regulation

roughly similar to the distribution of benefits? Second, are there patterns of redistribution which a User Group wishes to achieve at this level of organization?

It is easier to state the evaluative criteria than to measure them in natural settings. Evidence that the conditions of a CPR have not deteriorated over time is consistent with an inference that total use is within the maximum sustainable yield. Data about the comparative costs of obtaining use units also helps in making inferences about the relationship of total withdrawals to maximum sustainable yield. Data about users' perceptions of efficiency and equity can be used as a first approximation of these two criteria. Still further data about the flow and distribution of benefits and of costs is needed to make firmer evaluations using efficiency and equity as criteria.

On the Performance of UGOs

At the Annapolis meetings we discussed several factors -- in addition to those identified as conducive to emergence and to survival -- that we thought should enhance the performance of UGOs in maintaining withdrawal of use-units below maximum sustainable yield in an efficient and equitable manner. One broad set of conditions is concerned with the "match" of the membership of the UGO and that of the User Group. A second consideration involves the relationship between the incidence of benefits and the incidence of costs derived from the operation of the UGO. A third factor is the knowledge generated by users about the CPR and about user preferences, benefits,

and costs. While these might possibly be stated in propositional form, our understanding of what is involved is not yet sufficient to do so. Rather than give a false precision to this discussion, I will simply discuss each of these conditions in turn.

The Match of Membership of the UGO and the User Group ($N_m = N_u$)

A key factor that affects the long-run performance of organizational arrangements is whether organizations can be established and maintained whose boundaries are roughly coterminous with those of the CPR and its users. This is NOT easy to accomplish in natural settings.¹⁰ Most communities are simultaneously concerned with many types of problems. The boundaries most relevant for managing a particular CPR may not be the same as those most relevant for managing another CPR or some types of pure collective goods. Even assuming a considerable amount of user discretion in establishing UGOs, it is unlikely that the boundaries of any private or public UGO created will exactly match those of a particular resource system. In governmental systems, where jurisdictional boundaries are firmly established from the center and citizens are discouraged from establishing local organizations with quasi-public powers, the likelihood of even a rough match between the most relevant organizational arrangement and the User Group is low.

Type One Mismatch: $N_m > N_u$

Mismatches can take two forms. The first form involves the case where a UGO is considerably larger than the User Group ($N_m > N_u$). A possible outcome of this mismatch is total indifference by the larger

unit to the problems of regulating the CPR. Even assuming that users were effectively represented in a democratic process in the larger unit, poor performance can be predicted. Individuals living outside the boundaries of the CPR would have little or no information about what was happening in the CPR and would certainly not want to support policies that might require them to pay taxes to support regulatory activities within the CPR.

If the users of the CPR were not in a majority of the larger unit, they would need to use log-rolling techniques to convince others to "go along" with their needed projects. The users of the CPR would have to promise support for similar projects in all other regions of the larger organization. Such log-rolling efforts are very likely to lead to an "over-investment" in local public facilities.¹¹ The over-investment is the result of the motivations facing each sub-group. Each of the sub-groups within the larger unit will receive the full benefits from each project they propose without having to pay the full costs of the project. Each sub-group will be motivated to propose projects where the perceived marginal benefit exceeds its own perceived marginal cost. Given log-rolling over time, one could expect that a total set of projects will have been approved whose marginal benefits are less than their marginal costs. Thus, we would not expect efficient outcomes if the only relevant organizational arrangement related to a CPR is a much larger organization, whether a government organized by the center, a self-organized local government, or a private organization.

Type Two Mismatch: $N_m < N_u$

A second type of mismatch would occur if the organization attempting to regulate the CPR is substantially smaller than the CPR in territory or number of users. We could express this condition as $N_m < N_u$. If a UGO could gain the cooperation of only a small sub-set of those actually using a CPR, this small sub-set would be the only one contributing to the regulatory program. Those who were not cooperating with the UGO (either by changing their own use patterns or through the payment of a tax to support investment in the UGO) would obtain substantial gains without contributing their fair share. If the number of noncooperators was very large, those who initially might be willing to cooperate would not be willing to cooperate over the long-run. While a mismatch of the first type is likely to result in an over-investment in collective activities and projects, a mismatch of the second type is likely to result in an under-investment in collective activities and projects.

We must be careful, however, to examine operational patterns of relationships before presuming a lack of match between the boundaries of the User Group and a UGO. While no single, formal organizational unit may exist with roughly similar boundaries, informal arrangements among organizations can enable users to develop effective, informal organizational arrangements that roughly match the boundaries of the CPR. This is frequently done in western settings where the ability to contract between and among private and public enterprises is well-established. It is far more difficult to accomplish in most Third World countries where jurisdictional boundaries are more rigid and fewer contractual arrangements are authorized to public and private units operating at sub-national levels.

The Relationship Between the Incidence of Benefits and Costs

A second consideration is the relation of the rules used for the distribution of costs and of benefits. Many simple rules (needed for survival) are not the optimal rules that enable a UGO to become as efficient as possible. As Roumasset (1985) points out, the simple rule used for allocation of water from irrigation works is equal quantities of water per unit of irrigated land. If the irrigation system is very large, such an allocation rule is NOT the most efficient rule to use since it costs far more to get water to the tertiary canals than it does to the main canals. The equal distribution rule may, however, be preferred by some analysts to other rules as a method to enhance equitable distributions (see Bromley, et al., 1980).

Another simple rule that can be used is to allocate according to the number of shares purchased by the water users (see Roumasset, 1985). This rule is more likely to yield an efficient investment and use pattern than the equal allocation rule. Many simple allocation rules lead individuals to take into account both their own and social costs of their actions when making choices about use patterns. When rules operate so as to enhance the match between personal and social distribution of costs and benefits, efficient and equitable performance can be enhanced.

The Type of Knowledge Generated

It is conceivable that individuals will organize a UGO that survives for some time without detailed information about the characteristics of the CPR and use patterns. It is inconceivable,

however, that such a UGO can perform efficiently or equitably without obtaining detailed and accurate information. Without detailed knowledge about the yield patterns of the CPR, rules that reduce the quantity of use-units that participants are allowed to withdraw may be more or less stringent than needed to manage the CPR efficiently. Even when users are able to obtain relatively reliable information about the characteristics of their CPR, they may not obtain valid information about the actual use patterns of various users over time. Users are not motivated to reveal the full extent of their use since such information may lead others to try to limit their activities. Unless the CPR is very small and easy to understand and each user can easily monitor the use patterns of others, obtaining accurate information is not a trivial problem.

Some of the technical knowledge needed about the physical operation of the CPR may be provided by larger public or private agencies who provide experts to map the CPR and describe its yield patterns. A key question, however, is whether this information is made available to the users themselves or only to central agencies who are not involved in the day-to-day operation of the CPR system. It is a common practice of donor agencies to make technical reports to the bureaus of central governments and not to the users themselves. Institutional arrangements used in developed countries, such as those of a Watermaster associated with equity courts, provide technical information about the CPR and about use patterns to all participants (see Blomquist and E. Ostrom, 1986), but such arrangements are used infrequently in the developing world.

Conflict can be an important feedback mechanism for the participants in a UGO about how past efforts (or projected future efforts) affect the interests and behaviors of different participants. UGOs vary to the extent to which they use conflict creatively to gain information about problems perceived by different participants. If conflict is suppressed, key information about the effects of past actions is lost. If conflict is encouraged, valuable resources are spent in potentially harmful disputes. The development of effective conflict resolution mechanisms within a UGO is also an important aspect of its capacity to achieve efficient and equitable performance.

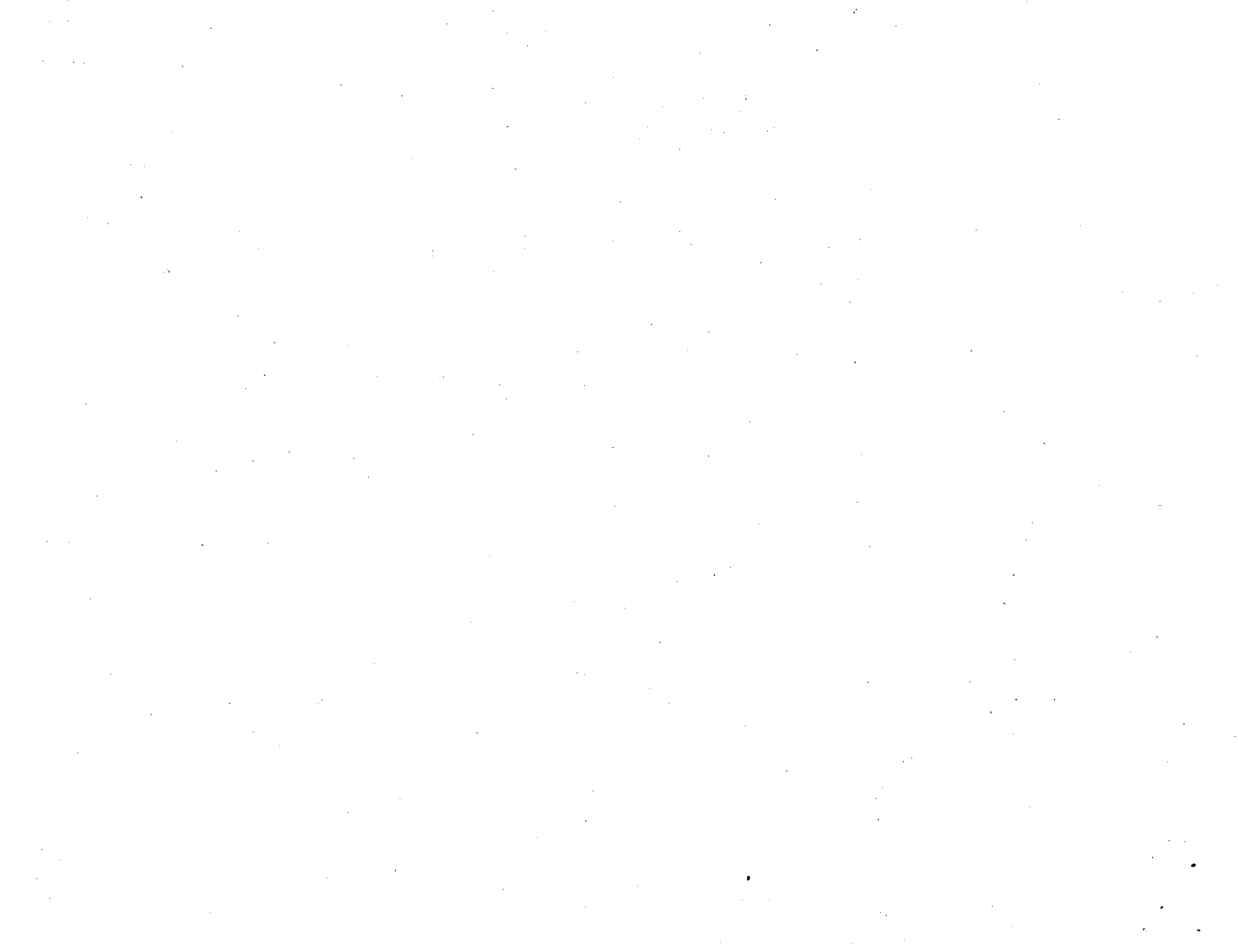
Conclusion

We have now developed the beginnings of a revised theory of common-pool resource management that integrates the speculations made by participants in the Annapolis conference about the variables that are conducive to the emergence, survival, and performance of local organizations in CPR situations. At the Annapolis conference, participants shared a view of the type of policies that donors and the governments of developing countries should adopt which is consistent with the theory developed above. We recommended to donors and policymakers in LDCs that they abandon current presumptions that local rules and customs are lacking for most common-pool resource systems. Instead, we urged that the burden of proof should rest with donors and policymakers to demonstrate the absence of local customs and rules regulating common-pool resources before intervening to impose external rules on existing systems. Our advice in a nutshell was:

- If a people have lived in close relationship with a relatively small common-pool resource system over a long period of time, they have probably evolved some system to limit and regulate use patterns.
- Before one imposes new rules on local systems, inquiries should be made to determine if some rules and customs do not already exist.
- If some customs and rules do exist, study these carefully in order to understand how they affect use patterns over time.
- Propose new rules only after you have convinced yourself that either:
 - (1) no rules and customs exist,
 - (2) the rules and customs that do exist are not effective in achieving regulation or produce substantial inefficiency and/or inequity, and
 - (3) you are thoroughly familiar with the configuration of institutions in existence in a polity that may affect how new rules operate in practice.
- Maintaining and enforcing new rules will depend upon people finding those rules to be an acceptable way of ordering their relationships with one another as a community.
- New rules cannot vary dramatically from the existing repertoire of rules in use or they will exist only on paper and not in the minds of those who must understand rules to make them work.

Since many CPR situations involve relatively small, resident user groups living near well-defined and easily understood CPRs, one would expect such groups to develop local rules and customs for coordinating strategies whenever the CPR is itself a valuable resource necessary for the survival of the user group. On the other hand, one would not predict from this revised theory that user groups who live in disparate locations and who utilize large and at times amorphous CPRs, such as an ocean fishery, would be as likely to develop UGOs in which coordinated strategies could be developed.

Much more needs to be done. One of the tasks already started is to code the case studies prepared by this group in a systematic fashion so that propositions derived from this revised theory can be empirically examined. The results of this effort will be reported as soon as possible. A second task is to examine in depth other recent theoretical and empirical work on CPRs and to integrate the many useful contributions of other scholars into our own theoretical work. A third task is to examine the experimental literature on the commons dilemma to evaluate the empirical warrantability of some of our propositions.



Notes

¹This paper is based on the closing comments that I gave at the Conference on Common Property Resource Management. Given the importance of developing a set of technical terms that scientists trained in many different disciplines (biology, political science, economics, anthropology, sociology, forestry, management, and history) could use to communicate with one another about common-property resource management, I circulated several versions of some of the definitions and propositions contained herein. During the conference I received thoughtful and critical responses to these initial efforts from Fikret Berkes, Piers Blaikie, Ed Connerley, David Feeny, Tim Jessup, Ron Oakerson, Pauline Peters, Emery Roe, and Ford Runge. Since the conference, I have had the opportunity to think rather deeply about the origins of institutions for collective action and to revise some of the oversimplified statements made in my final remarks.

²Destroying a commons is not in and of itself always a tragedy. If the short- and long-term individual and collective benefits of "using-up" a common-pool resource system exceed the short- and long-term individual and collective costs of regulating its use, such results are not tragic. However, when individuals are led by self-interest and the rules in use to destroy a resource system that could produce a flow of future benefits exceeding the flow of future costs, then the process leading to this outcome is indeed tragic.

³This definition is based on the terminology supplied by Fikret Berkes to the National Research Council Panel in November 1984. See also Gulland (1974) and Holt and Talbot (1978).

⁴See Blomquist and E. Ostrom (1986) for a discussion of the distinction between the general class of commons situations and the more specific class of commons dilemmas where maximum sustained yield is approached or exceeded.

⁵The distinction between Users, Claimants, and Proprietors was not developed at the Annapolis meetings, but rather reflects many long discussions with William Blomquist and James Wunsch in our joint effort to construct a valid coding instrument for use in coding the cases presented in this volume.

⁶See Bromley, et al. (1980) for a review of literature about irrigation associations in many different Third World countries. Most of these irrigation associations would be included within the concept of a UGO. See also Oakerson (1985b).

⁷The variables listed in Table 1 were mentioned by participants as being important as either enhancing or hindering efforts to achieve organized coordination of some sort. None of them was identified as either a necessary and sufficient condition for or against the emergence of a UGO. Cultural divisions are not, for example, a sufficient condition for not achieving organization. Many successful UGOs include membership that crosses ethnic and linguistic barriers.

On the other hand, when individuals from cultural groups who are deeply suspicious and antagonistic to one another try to solve CPR problems, they have more to overcome in developing mutual trust than when a set of individuals all come from the same cultural background (see discussion in Bromley, et al., 1980).

⁸Nor do any "impossibility" assertions appear warrantable regarding the emergence of a UGO (e.g., it is impossible for a UGO to emerge when one or more variables are above or below a particular bound).

⁹See Buchanan and Tullock (1962) for an important general theory of constitutional choice and V. Ostrom and E. Ostrom (1977) for an earlier effort to apply the theory of constitutional choice to the analysis of CPRs. See also V. Ostrom (1982; 1985) and Roumasset (1985).

¹⁰I do wish to stress that there are many forms of organization that accomplish this rough correspondence. Robert Wade (1986) has shown how local organization based on a village structure in India is able to encompass most of the affected irrigators even though the organization is village-based rather than irrigation channel-based.

¹¹The proposition that log-rolling leads to an over-investment in a public sector has been systematically developed in several recent articles by Kenneth Shepsle and his colleagues (see in particular Shepsle and Weingast, 1984).

References

- Alchian, A. A. 1950. Uncertainty, evolution, and economic theory. *Journal of Political Economy*. 58 (June).
- Ashby, W. R. 1956. *An Introduction to Cybernetics*. New York: John Wiley.
- Bender, J. and D. Mookerjee. 1985. Institutional structure and the logic of ongoing collective action. Stanford, California: Stanford University, School of Business.
- Berkes, F. 1984. Ecology and resource management terminology. Paper prepared for the Panel on Common Property Resource Management.
- Blomquist, W., and E. Ostrom. 1986. Institutional capacity and the resolution of a commons dilemma. *Policy Studies Review* (forthcoming).
- Breton, A., and R. Wintrobe. 1982. *The Logic of Bureaucratic Conduct*. Cambridge, England: University of Cambridge Press.
- Bromley, D. W. 1984. Property rights and economic incentives in resource and environmental systems. *Agricultural Economics Staff Paper Series*, No. 231. Madison: University of Wisconsin.
- Bromley, D. W. 1985. Closing comments at the conference on common property resource management. Prepared for the Panel on Common Property Resource Management.
- Bromley, D. W., D. Taylor, and D. Parker. 1980. Water reform and economic development: Institutional aspects of water management in the developing countries. *Economic Development and Cultural Change*. 28 (2) (January): 365-367.
- Buchanan, J., and G. Tullock. 1962. *The Calculus of Consent*. Ann Arbor: University of Michigan Press.
- Cordell, J. 1985. Sea tenure in Bahia. Paper prepared for the Conference on Common Property Resource Management, sponsored by the Board on Science and Technology for International Development (BOSTID), National Academy of Sciences, National Research Council, Annapolis, Maryland, April 1985.
- Gilles, J. L., and K. Jamtgaard. 1981. Overgrazing in pastoral areas. The commons reconsidered. *Sociologia Ruralis*. 21 (September): 129-141.
- Gulland, J. A. 1974. *The Management of Marine Fisheries*. Bristol: Sciencetechnica.

- Hamilton, A. 1982. The unity of hunting-gathering societies: Reflections on economic forms and resource management. Pp. 229-248 in *Resource Managers: North American and Australian Hunter-Gatherers*, N. M. Williams and E. S. Hunn, eds. Boulder, Colorado: Westview Press.
- Hardin, G. 1968. The tragedy of the commons. *Science*. 162 (December): 1343-1348.
- Hardin, R. 1982. *Collective Action*. Baltimore: Johns Hopkins Press.
- Holt, S. J., and L. M. Talbot. 1978. *New Principles for the Conservation of Wild Living Resources*. Wildlife Monographs No. 59.
- Jacobs, J. 1961. *The Death and Life of Great American Cities*. New York: Random House.
- Kiser, L. L., and E. Ostrom. 1982. The three worlds of action. A meta-theoretical synthesis of institutional approaches. Pp. 179-222 in *Strategies of Political Inquiry*, E. Ostrom, ed. Beverly Hills: Sage Publications.
- Lewis, T. R., and J. Cowens. 1983. *Cooperation in the commons: An application of repetitious rivalry*. Vancouver: University of British Columbia, Department of Economics.
- McKean, R. 1975. Economics of trust, altruism, and corporate responsibility." In *Altruism, Morality and Economic Theory*, E. S. Phelps, ed. New York: Russell Sage.
- Oakerson, R. 1984. A model for the analysis of common property relations. Paper prepared for the Common Property Steering Committee, Board on Science and Technology for International Development (BOSTID), National Academy of Sciences/National Research Council.
- Oakerson, R. 1985a. Reciprocity, its general relevance to politics. Working Paper. Huntington, W. Virg.: Marshall University, Department of Political Science.
- Oakerson, R. 1985b. The meaning and purpose of local government: A Tocqueville perspective. Washington, D.C.: ACIR Working Paper.
- Olson, M. 1965. *The Logic of Collective Action. Public Goods and the Theory of Groups*. Cambridge, Mass.: Harvard University Press.
- Ostrom, E. 1985a. Formulating the elements of institutional analysis. Paper prepared for a conference on Institutional Analysis and Development, Washington, D.C., May 21-22.
- Ostrom, E. 1985b. Are successful efforts to manage common-pool problems a challenge to the theories of Garrett Hardin and Mancur Olson? Working paper. Bloomington, Ind.: Indiana University, Workshop in Political Theory and Policy Analysis.

- Ostrom, V. 1980. Artisans and artifact. *Public Administration Review*. 40(4) (July-August): 309-317.
- Ostrom, V. 1982. A forgotten tradition: The constitutional level of analysis. Pp. 237-252 in *Missing Elements in Political Inquiry: Logic and Levels of Analysis*, J. A. Gillespie and D. A. Zinnes, eds. Beverly Hills: Sage Publications.
- Ostrom, V. 1985. Constitutional considerations with particular reference to federal systems. In *Guidance, Control and Evaluation in the Public Sector*, F. X. Kaufmann, G. Majone, and V. Ostrom, eds. Berlin, New York: de Gruyter, forthcoming.
- Ostrom, V., and E. Ostrom. 1977. A theory for institutional analysis of common pool problems. Pp. 157-172 in *Managing the Commons*, Garrett Hardin and John Baden, eds. San Francisco: W. H. Freeman.
- Posner, R. A. 1980. A theory of primitive society with special reference to law. *Journal of Law and Economics*. 23 (April): 1-54.
- Roumasset, J. 1985. Constitutional choice for common property management: The case of irrigation associations. Paper prepared for the National Academy of Sciences "Workshop on Common Property Resource Management in Developing Countries."
- Runge, C. F. 1981. Common property externalities: Isolation, assurance, and resource depletion in a traditional grazing context. *American Journal of Agricultural Economics*. 63 (November): 595-606.
- Runge, C. F. 1984. Strategic interdependence in models of property rights. *American Journal of Agricultural Economics*. 66 (December): 807-813.
- Shepsle, K., and B. Weingast. 1984. Legislative politics and budget outcomes. Pp. 343-367 in *Federal Budget Policy in the 1980's*, G. Mills and J. Palmer, eds. Washington, D.C.: Urban Institute Press.
- Uphoff, N. 1984. Experience with people's participation in water management: Gal Oya, Sri Lanka. In *Participation in Development Planning and Management*, J. C. Garcia-Zamor, ed. West Hartford, Conn.: Kumarian Press.
- Wade, R. 1986. *Peasants and Politics*. Cambridge, Mass.: Cambridge University Press.
- Wilson, R. K. 1985. Constraints on social dilemmas: An institutional approach. *Annals of Operational Research*. 2: 183-200.