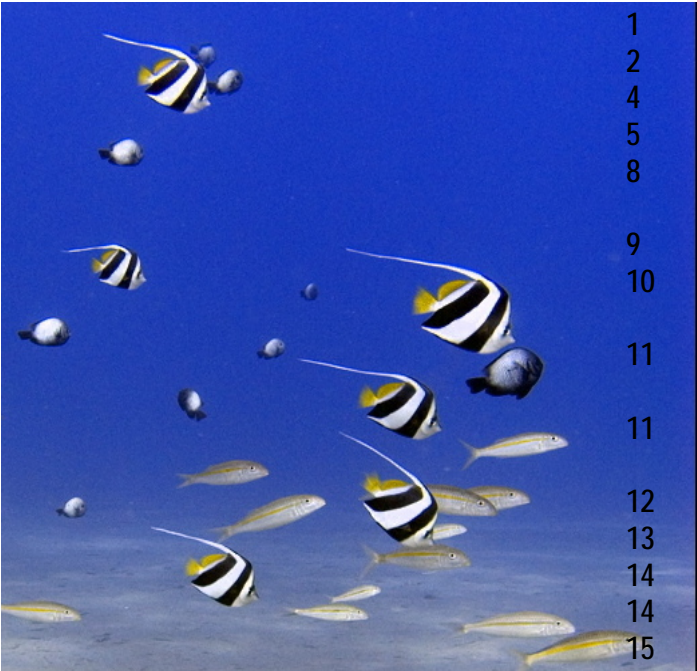


Appendix 7. Carrying Capacity: A guidebook for managers based on the Limits of Acceptable Change (LAC) model

**Carrying Capacity:
A guidebook for managers based on the Limits of Acceptable Change (LAC) model**

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Introduction

The traditional way of approaching resource management problem solving has been the rational comprehensive (or top-down) process, where decisions are made by scientific experts and agency personnel who often discount local knowledge (McCool, Guthrie and Smith 2000). There is a need, instead, for transactive planning, which puts the emphasis on learning from one another, the local citizens as well as the experts, scientists, and agency personnel (Krumpe and McCool 1997; Friedmann 1973). The Limits of Acceptable Change (LAC) model is a values-driven process relying on a transactive planning process involving the community as well as scientists and managers. It is resource-based, comprehensive, and flexible, and addresses the fundamental concerns underlying the notion of recreational carrying capacity without being overly simplistic. It is recognized as a concept that surpasses the older idea of recreational carrying capacity; it moves beyond numbers and better encompasses the critical interaction between human and natural systems at every level (Howard and Potter 2002).

The LAC model was developed in 1985, deriving from the Management by Objective approach (Stankey et al. 1985). The National Park Services Visitor Experience and Resource Protection (VERP) protocol serves a similar function to the LAC model. Another spin-off of this idea is the National Parks and Conservation Association Visitor Impact Management (VIM) (National Park Service 2005).

This model was first applied in North American terrestrial wilderness settings and its use is becoming more widespread. Its first full application was in the Bob Marshall Wilderness in Montana in 1987 (Cole and Stankey 1997). The LAC model was first tested in the national park system in Utah at Arches National Park (National Park Service 1995). It has also been used in Hawaii to help resolve boating issues in Hanalei (Staff Writer, *Environment Hawaii* 1997).

Today the LAC model is being used nationally and internationally, although has not yet experienced widespread use in Hawaii. Managers in Hawaii may therefore not be familiar with this model. This guidebook is meant to familiarize DLNR managers with the LAC model.

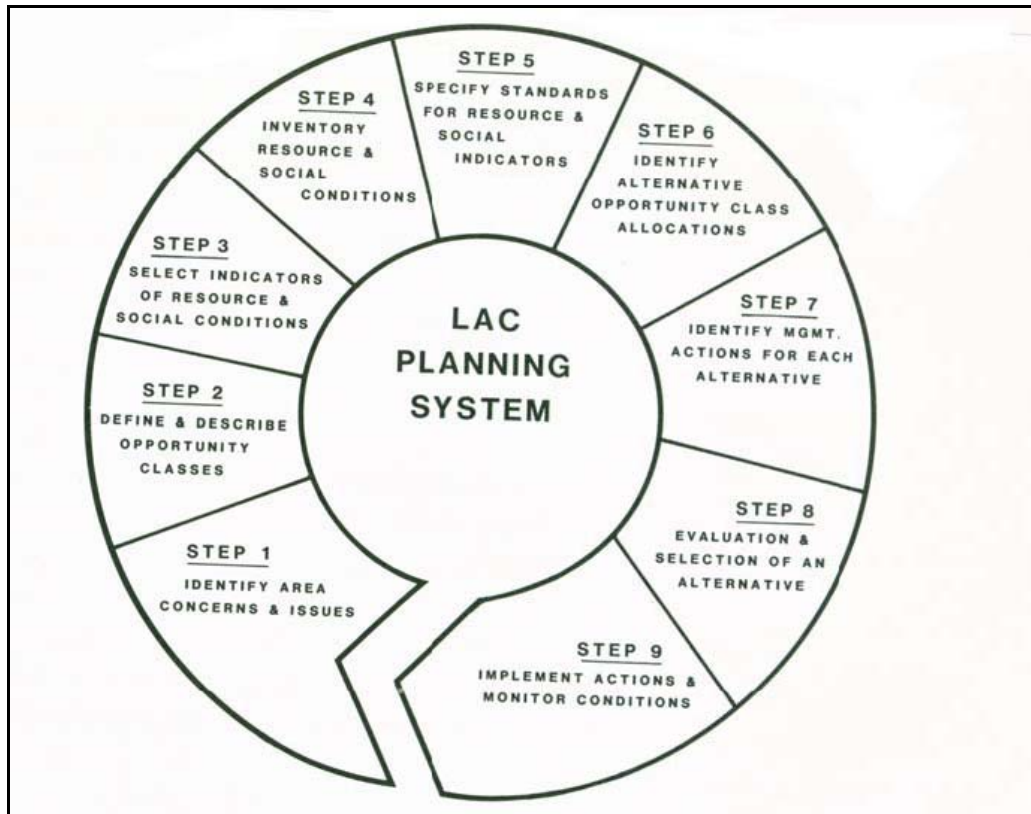
The LAC framework has four major components (Stankey et al. 1985):

- (1) The specification of acceptable and achievable resource and social conditions,
- (2) An analysis of the relationship between existing conditions and those judged acceptable,
- (3) Identification of management actions necessary to achieve those conditions, and
- (4) A program of monitoring and evaluation of management effectiveness.

These four major components are further subdivided into nine steps. The nine-steps of the model are the focus of this guidebook.

- Step 1 defines the social and natural and cultural resource values to be achieved
- Step 2 defines three opportunity classes for the management area based on desired future conditions
- Step 3 identifies two social and ten resource indicators pertaining to conditions within the management area
- Step 4 inventories the range of existing conditions of these indicators
- Step 5 assigns standards of minimally acceptable conditions to these indicators

- Step 6 identifies where opportunity classes could be allocated within the management area
- Step 7 identifies a continuum of management actions for each of the indicators and implementation constraints
- Step 8 suggests guidelines for finalizing opportunity class allocations and for identifying a specific management program to achieve the desired conditions
- Step 9 suggests guidelines for implementing the management actions and conducting ongoing monitoring.



Nine Steps of the LAC Model (From Stankey et al. 1985)

Recreational Carrying Capacity

The concept of Recreational Carrying Capacity (RCC) derives from the oldest concept of resource management (Mann 2003). It has its roots in range management, where carrying capacity is defined as the maximum number and density of animals a given unit of land can support on a sustained basis without destruction of the resource base (Mann 2003). The purpose of carrying capacity is to define the level of use an area can tolerate. In 1978, the General Authorities Act (U.S. Public Law 95-625) required each National Park to develop visitor carrying capacities, due to the concern of resource destruction from overuse (Cole and Stankey 1997). This model was used in the 1980s for the management of natural resource areas (Mann 2003). Some scientists, however, found that the limitations of RCC were “becoming increasingly apparent” (Cole and Stankey 1997). There was concern that capacities would be developed in places where they were

not needed and in ways that were neither productive nor defensible (Washburne 1982). Also, carrying capacity approaches often "...did not explicitly link use limit policies to improvements in desired or acceptable conditions" (McCool and Cole 1997). They also often confused establishing a use limit with allocating a resource to a specific type of recreation opportunity (Schreyer 1976).

The major assumptions of the carrying capacity concept are that the amount of impact is related to the amount of use, that decreasing the amount of use will decrease the impacts, and that it is possible to calculate the number of users, below which impacts will be acceptable (Mann 2003). The problem is that recreation impacts differ with the type of use, timing of use, distribution of use, environmental setting, management actions, and with people's expectations and norms (Mann 2003).

In essence, RCC focuses on the wrong question. Decreasing the number of users may not lessen impacts. In fact, research has shown that many problems of recreational use are a function not so much of the numbers of people, but of their behavior (McCool 1996). A large number of people can be accommodated in an area if there is enough education and access management (or other directive) in place to properly manage those numbers (McCool 1996).

Use limit policies are only one of a number of potential management actions available to address visitor impacts, and use limit policies are one of the most intrusive actions that managers could deploy. They are controversial and have historically created a host of problems, including the problem of determining appropriate allocation and rationing techniques (McCool and Ashor 1984). Since recreation is a voluntary, pleasurable, free choice process, the principles of recreation management are that management should be sensitive, and should involve only the minimum regulation necessary using the minimum amount of tools necessary (Mann 2003). Indirect or "lightheaded" methods are preferable to direct management (such as regulations and enforcement) that can lead to conflict between managers and recreational users (Mann 2003).

User fees are one management tool that may or may not actually limit use. If fees are low enough, the fee in and of itself will not likely be the deciding factor for people deciding not to visit the area. Implementing user fees is still controversial, but can be one good way to raise funds to support long-term protection efforts in wilderness and other natural and cultural resource areas.

The Limits of Acceptable Change (LAC) model differs from RCC in that it seeks to address these two questions:

- Given recreational use, what are the acceptable resource and social conditions in the protected area?
- What are the appropriate and effective actions needed to maintain those conditions?

By focusing management and planning effort on these questions, the LAC process addresses the fundamental concerns underlying the notion of recreational carrying capacity without being overly reductionistic (Schultz, McCool and Kooistra 1999). The Limits of Acceptable Change model better encompasses the critical interaction between human and natural systems at every level (Howard and Potter 2002). The LAC model is considered by McCool and Cole (1997) to be the simplest available approach for effectively dealing with the complexity of the real world. Management actions, therefore, stem from an informed awareness of the resource condition after establishing a hierarchy of values upon which to base those decisions. This process helps managers avoid making the mistake of implementing decisions that are not reflective of clearly defined values, or

that do not address the problem. It is also a comprehensive model that is an adaptable form of management. Management actions change as needed (as indicated by the resource through monitoring).

Step 1: Identify Area Concerns and Issues

Purpose: The purpose of step 1 is to identify the values of the area to be maintained or achieved. The rest of the steps in the LAC model, including the establishment of management objectives, rely on this values identification. Specific locations of concern should be identified in this step. This will help facilitate the distribution of the management area into different opportunity classes in step 2.

Process: A transactive planning process involving the state, landowners, Hawaiians, commercial operators, recreational users, and other stakeholders within the community will be initiated in this step. The idea is to come to a consensus (loosely defined as a “grudging agreement”) on the important values that represent the management area. Issues raised during prior public involvement will be identified. These include concerns raised by resource managers, planners, scientists, and policymakers. Agency policy and land use laws will be reviewed. Regional supply and demand should be discussed, along with the opportunities available in the area from a regional and national perspective.

Product: The product of step 1 is a narrative write-up which identifies unique values and special opportunities that will be featured in the area’s management, and which outlines problems that will require special attention.

One way to determine the unique values for the management area is to first identify the public issues and management concerns that relate to (1) the distinctive features and characteristics of the management area, and (2) the relationship of the management area to the larger region.

Matters to consider include:

- Does the area contain outstanding historic, ecological, conservation, recreational, cultural, scientific, or educational values that warrant special attention?
- Does the area provide critical habitat for threatened or endangered species?
- Has public input identified areas or issues that merit special attention?
- Do land uses on contiguous areas represent situations requiring special management attention?
- Are there existing or potential nonconforming uses in the area that will require special attention?
- What is the availability of wilderness and dispersed recreation opportunities in the planning region?
- What is the regional demand for wilderness and dispersed recreation?
- Are the physical and biological features of the area found elsewhere in the region or does it possess unique features?
- Are the types of recreation opportunities offered by the area available elsewhere or does the area offer unique opportunities?

Answers to these questions will help managers, scientists, and the community identify the important values of the area.

Cultural preservation values include the archaeological sites, features, and trails that are an important part of Hawaii's cultural heritage, the cultural knowledge that can be gained from the study of these sites, and the place-based traditional uses tied to specific locations and features within the landscape.

Nature conservation values include the existence of healthy, high functioning ecosystems within the management area, the presence of native and endemic plant and animal species that are an important component of Hawaii's natural history and biodiversity, the unique lava and other landscape features, and the capacity to learn more about the functioning of these natural systems.

Recreation values include a diversity of recreational opportunities (including a wilderness, or semiwilderness experience), the capacity for both commercial and non-commercial recreational experiences, and a safe, clean environment in which to recreate.

Step 2: Define and Describe Opportunity Classes

Purpose: The purpose of step 2 is to define a series of opportunity classes for the management area based on desired future conditions. Desired here refers to what would be considered acceptable, not necessarily what would be ideal (e.g. while the maximum level of resource integrity may be ideal, what is acceptable is a high level of resource integrity). The kinds of resource and social conditions that are acceptable within each of these classes are defined. A diverse number of opportunity classes will allow for a diversity of experience within the management area and will target those natural and cultural resources needing special protection.

Process: In a transactive community meeting setting, the values and other information collected in step 1 will be reviewed. Then the opportunity classes will be created: the number of classes, the name of each, the value-based goal of the class, and their individual resource, social, and managerial settings.

Product: A narrative description of the resource, social, and managerial conditions defined as appropriate and acceptable for each opportunity class.

When formulating opportunity classes, the idea is not that social values and recreational uses are separate from and in conflict with resource protection. Rather, both a high level of social quality (e.g. uncrowded conditions) and a high level of resource integrity (e.g. protected wetlands) can be accommodated within one class (Cole 2005). The opportunity classes represent a sliding scale of compromise between low access and low resource compromise to high access and high resource compromise. Another way to say this is that desired conditions vary between a) a high level of social quality and resource integrity and b) uninhibited access and recreational use opportunities. The purpose of the opportunity classes is to generally describe these differences in desired (i.e. acceptable) access and protection levels. The specificity of allowed uses and required protection measures will be outlined in the indicators (step 3) and standards (step 5).

Choosing the names of the opportunity classes can be a difficult task. In the late 1970s and early 1980s the designation of opportunity classes followed the basic Recreation Opportunity Spectrum (ROS) system (Buist and Hoots 1982; Clark and Stankey 1979; Driver and Brown 1978). The ROS defined six classes: Primitive, Semiprimitive Non-motorized, Semiprimitive Motorized, Roaded Natural, Rural, and Urban.

An example of three simple opportunity classes to use is given below (Vann 2005). Note that some goals (such as the protection of important natural and cultural resources) are consistent within all three classes, but many goals vary between classes.

Opportunity Class 1: A high level of resource integrity and a low level of crowding will receive top management priority in this opportunity class. The social factors being protected in this opportunity class are solitude, freedom from user conflicts, and access for cultural/traditional uses. The resources being protected include beaches, wetlands, anchialine ponds, coral reefs, native plants, geological/lava landscape features, threatened and endangered species, and cultural resources (archaeological sites, features, and trails).

This will require a willingness, where necessary, to restrict access. Access restrictions, if warranted by violated standards (step 7), may include the fencing off (or barricading) of important natural or cultural resources, or the implementation of use limitations. One example of a use limitation is that vehicles may be restricted from this area. Another example is that only guided tours may be allowed in some areas. While people would be limited in that they could only access this area through a tour, these guided tours could potentially allow for more people to use the area than would otherwise be allowed since their behavior would, to some extent, be controlled. Data collection and monitoring activities will be allowed. Sites providing opportunities for in-depth archeological research concerning subjects such as traditional Hawaiian fishing techniques and water use, patterns of domestic activity and variations, and similarities among ahupua'a will be prioritized for scientific research. Management could also include educational outreach efforts, including signage, to promote a stewardship ethic. Patrols in this area will be conducted as necessary to monitor conditions and achieve management objectives.

This area is likely to be remote and rugged. It allows for a wilderness-like (or semi-wilderness) recreation experience. The topography and ocean conditions are likely to be rough, providing hardy and experienced hikers and divers the opportunity for some challenge and risk. Recreation in this area will cause minimal impacts natural and cultural resource integrity. Crowding and negative social interactions will be minimal. Inter-party contacts will likely be infrequent and other kinds of recreational uses seen will be few. Types of appropriate recreational uses may include hiking, kayaking, snorkeling, SCUBA diving, boating, and low levels of fishing. If managers choose to provide for extended experiences of solitude in this opportunity class, then low levels of low-impact camping may also be allowed. Few, if any, structural modifications/improvements (such as paving or providing port-o-potties) will be made in this area.

Opportunity Class 2: Resource integrity and crowding will be balanced with providing a fairly diverse array of commercial and non-commercial recreational opportunities in a safe, clean environment. The protected social factors being balanced in this opportunity class are a certain degree of solitude and freedom from user conflicts, with a certain degree of freedom of choice and range of recreational and cultural/traditional uses to engage in. Protected resources include safe swimming beaches; sandy beaches; protected bays; good surfing, windsurfing, and boogie

boarding areas; well-marked trails; accessible fishing; desired species fishing; campsites; and easy/safe kayaking and snorkeling.

Management will focus on human safety (which may be of more concern in this opportunity class as a result of higher use levels) and will allow more lax restrictions on crowding and on some natural and cultural resources than in Opportunity Class 1. Natural resources that will not be compromised include threatened and endangered species, wetlands, anchialine ponds, rare native plants, unique geological features, and pristine coral reef. Cultural resources that will not be compromised include the most culturally significant archaeological sites, features, and trails (as determined by the Hawaiian community and archaeologists) that are in good to excellent condition (this needs to be further defined by archaeologists).

The protected areas would occur as restricted point zones within the larger opportunity class. Managing for the protection of these resources may require fencing or other barricades, use limitations (such as guided tours only or vehicles restrictions), archaeological site inventories, and archaeological stabilization and/or restoration work. Resources requiring a more substantial buffer for their protection would be allocated back to Opportunity Class 1 (Moisey 2005).

Vehicles and motorized vessels are less likely to be restricted from this opportunity class than in Class 1 (unless warranted by restricted point zones). Preventive protection efforts will likely include the use of signage and educational outreach to promote a stewardship ethic. Some archaeological sites and/or features may be selected by on-site naturalists to be referred to or shown as a component of cultural education outreach efforts. Research, data collection, and monitoring activities will be allowed. Patrols in this area will be conducted as necessary to monitor conditions and achieve management objectives.

This area is likely to be less remote and rugged than Opportunity Class 1, and more accessible to population centers. It may still allow for a semi-wilderness recreation experience, at least in some areas. Recreation impacts in this area will likely be greater than in Class 1, but crowding and negative social interactions will likely be less than in Class 3. Inter-party contacts may be frequent and many types of recreational uses may be occurring at once, within view of other users. Types of appropriate recreational uses may include hiking, kayaking, snorkeling, SCUBA diving, boating, camping, and fishing. Structural modifications/improvements (such as paving or providing port-o-potties) will likely be kept to a minimum.

Opportunity Class 3: The top priority of Class 3 is to provide a diverse array of commercial and non-commercial recreational opportunities in a safe, clean environment. Restrictions on access and behavior will be avoided as much as possible, or minimized to the extent possible. The social factors that are being protected are freedom of choice, availability of a wide range of recreational activities and cultural/traditional uses, and safety. Protected resources include safe swimming beaches; sandy beaches; protected bays; good surfing, windsurfing, and boogie boarding areas; well-marked trails; accessible fishing; desired species fishing; campsites; and easy/safe kayaking and snorkeling.

Management will focus on human safety (which may be of more concern in this opportunity class as a result of higher use levels) and will allow more lax restrictions on crowding and on some natural and cultural resources. Natural resources that will not be compromised include threatened and endangered species, wetlands, anchialine ponds, rare native plants, unique geological

features, and reefs. Cultural resources that will not be compromised include the most culturally significant archaeological sites, features, and trails (as determined by the Hawaiian community and archaeologists) that are in good to excellent condition (this needs to be further defined by archaeologists). The protected areas would occur as restricted point zones within the larger opportunity class. Managing for the protection of these resources may require fencing or other barricades, use limitations, archaeological site inventories, and archaeological stabilization and/or restoration work. Resources requiring a more substantial buffer for their protection would be allocated back to Opportunity Class 1 (Moisey 2005). Vehicles and motorized vessels are less likely to be restricted from this opportunity class than Class 2 (unless warranted by restricted point zones). Management will likely include educational outreach efforts and signage to promote a stewardship ethic. Data collection and monitoring activities will be allowed. Patrols in this area will be conducted as necessary to monitor conditions and achieve management objectives.

This area is likely to be easily accessible from population centers. Recreational opportunities that are appropriate in this opportunity class may include fishing, camping, sunbathing, boogie boarding, and the following commercial and/or non-commercial activities: boating, SCUBA, snorkeling, kayaking, hiking, horseback riding, surfing, and windsurfing. Structural improvements may include paved parking lots, picnic tables, trash receptacles, and either portable or permanent restroom facilities.

In summary, step 2 allows the community and managers to decide together what the desired future conditions for the management area should be, as defined in a series of opportunity classes that provide a sliding scale of compromise between high social and resource integrity on the one hand, and high freedom of choice, opportunity, and access on the other.

Step 3: Select Indicators of Resource and Social Conditions

Purpose: The purpose of step 3 is to identify easily measurable (and preferably quantifiable) indicators that reflect resource and social conditions. These indicators will be used to guide the inventory process in step 4 and will ultimately provide the basis for identifying where and what management actions are needed.

Process: In a transactive community meeting setting, all the stakeholders will review the opportunity classes as outlined in step 2, and will review the issues and concerns identified in step 1. Broad categories of issues or concerns (i.e. factors) will be developed. Then, indicators will be selected that will directly address these factors.

Product: A list of measurable resource and social indicators, which are, preferably, responsive to management control.

Some scientists argue that the LAC model is not appropriate for archaeological sites because there is zero tolerance for disturbance at these sites (Cole and McCool 1998). The criteria for implementing the model are that some degradation of the resource will be allowed, and in general this is not acceptable for archaeological sites. If they are to be absolutely protected, then they fall outside the framework of compromise that the LAC model provides. Archaeological sites are being included in this LAC application in the recognition that for decades many of these sites have

already, through neglect and vandalism, been compromised, and many others have not yet been inventoried. Under current management, total protection is not feasible for all archaeological sites and features found within the management area. Therefore, the highest priority sites need to be selected to receive available protection measures.

There is also zero tolerance for a take of threatened or endangered species protected under the Endangered Species Act (ESA). With unlimited funding and personnel, this could conceivably be achieved in practice. However, these animals have, on occasion, been harassed in South Maui. Spinner dolphins (protected under the Marine Mammal Protection Act) and endangered humpback whales (protected under the ESA) have been approached closely by snorkelers and kayakers, and threatened green sea turtles have been accidentally hooked by fishermen and released (Friends of Keone'ō'io and Hawaii Wildlife Fund 2004). In recognition that their protection is imperfect, an indicator for protected animal species will be included in this example LAC application.

Marine environments, in general, pose unique problems to developing indicators. Cause and effect relationships are often very complex and many factors affecting marine environments result from outside influences, such as storms. A number of indicators could be measured, including coral reef damage, water quality, fish species and abundance, and the presence or absence of protected species. Since conducting these types of studies is costly and time-consuming, initial efforts may need to rely more on qualitative data.

In summary, in step 3 of the LAC process, important factors and indicators of social and resource conditions are identified and specifically defined. While indicators are preferably quantifiable, less costly qualitative methods may also, at least initially, serve to provide important information. In step 5, specific standards of acceptable change will be set for these indicators, and it will be explained how exceeded standards trigger an immediate management response.

Step 4: Inventory Resource and Social Conditions

Purpose: The purpose of step 4 is to inventory the range of existing conditions of the resource and social indicators identified in step 3. This provides managers with the range of conditions of the indicators and enables the establishment of meaningful standards in step 5. The inventory also helps determine how areas should be allocated to different opportunity classes in step 6. Finally, the inventory provides a critical step in understanding where and what management actions will be required, as outlined in the seventh step of the LAC process.

Process: Management agencies and scientists will conduct a field inventory of the conditions of the resource and social indicators selected in step 3. The data need to be collected in an objective and systematic fashion to be of value. Information is ideally recorded directly onto base maps, which facilitates the comparison in step 6 of existing conditions and those defined as acceptable for an opportunity class (Stankey et al. 1985). Resource inventories can be conducted at different levels of detail. It is often the case that managers have some inventory data from previous fieldwork, as will be detailed below. If existing data is not current, then the data limitations should be clearly documented, and the monitoring plan in step 9 should prioritize creating an improved database (Stankey et al. 1985).

Product: A map of the existing conditions of each indicator throughout the management area.

Some of the indicators will be more quantifiable than others, and the amount of information currently available for each will also vary. Further research will most likely be required to more accurately define current conditions of some indicators.

Step 5: Specify Standards for Resource and Social Indicators

Purpose: The purpose of step 5 is to assign standards (highly specific quantitative measures) to the indicators defined in step 3. These standards provide the basis for evaluating where and what management actions are needed by permitting comparison of existing conditions with those defined as acceptable for each indicator in each opportunity class (Stankey et al. 1985). These standards indicate minimally acceptable conditions, not necessarily those that are desirable. Violation of these standards requires immediate management action.

Process: The DLNR, and other professionals as needed, will review the opportunity class descriptions developed in step 2 and analyze the inventory data collected in step 4 for each indicator. Then, they will create standards for the indicators defined in step 3, for each of the opportunity classes to which that indicator pertains. Standards are not just idealistic goals; they are conditions managers feel can be achieved over a reasonable time period. They should be stringent enough to be meaningful, but not so stringent that they cannot be attained. In some cases, standards may merely reflect current conditions. In other cases, standards can be written to purposefully direct the modification of conditions towards the desired outcome. There needs to be a balance between these two, based on professional judgment and public input. While setting standards is a judgmental process, the process is logical, traceable, and subject to public review. Another feedback loop is the monitoring in step 9. If monitoring shows that the level of sensitivity of the standard is not accurately reflecting resource change, the standard can be adjusted as needed.

Product: A table of specific (quantified where possible) measures of acceptable conditions for each indicator in each opportunity class.

Standards based on social and resource indicators can specify that no change beyond current conditions will be allowed. The phrase “current conditions” can be interchanged with “baseline conditions”. Baseline information can be used to set standards, or standards can be determined based on current inventories. In some cases, current conditions may already be degraded beyond the standard, requiring immediate management action.

In summary, standards should describe a range of conditions that are minimally acceptable and achievable. Standards may specify current conditions (i.e. status quo) as acceptable, they may allow some further degradation of the resource (e.g. 5%), or they may specify a needed improvement over current conditions. Standards are often best expressed as probabilities (e.g. visitation levels of a maximum of 700 people/day for at least 90 percent of the surveys) since specific, absolute standards are unrealistic. On occasion, the standards set for an indicator might be shared by two or more opportunity classes (but these classes will still be distinguishable from one another as defined in step 2). Indicators and standards can be revised based on monitoring and as new information becomes available.

Step 6: Identify Alternative Opportunity Class Allocations

Purpose: The purpose of step 6 is to identify where the opportunity classes should be allocated within the management area, and to identify at least one alternative allocation plan. The placement of these opportunity classes should address area issues and concerns, as well as existing resource and social conditions. It is a prescriptive step, concerned with establishing what should be.

Process: This is an important step in the transactive planning process. Both managers and the public need to review the issues and concerns identified in step 1 and the opportunity class descriptions in step 2, and balance these against the realities of existing conditions within the management area (from the inventory map produced in step 4). The public will also play an important role in reviewing and evaluating alternative plans.

Product: In step 6, maps and summaries of alternative opportunity classes will be completed.

In summary, in step 6 alternative opportunity classes are allocated within the management area. When other alternatives are developed through the transactive process, one alternative may show a preference towards unlimited access and a wide array of recreational opportunities, while another may show a preference towards a high level of social and resource integrity. The selection of the preferred alternative occurs in step 8 and will depend, among other things, upon management constraints that are outlined in step 7.

Step 7: Identify Management Actions for Each Alternative

Purpose: In step 7, managers identify management actions and evaluate the implications (costs, benefits, and constraints) of implementing each alternative. This is an important step towards selecting the preferred alternative in step 8.

Process: Using the alternative opportunity class allocations defined in step 6, managers need to identify the differences, if any, that exist between current conditions inventoried in step 4, and the standards developed in step 5. There will likely be a number of possible management actions that could be undertaken to achieve the standards. The managerial guidelines given in the opportunity class descriptions in step 2 will help define what kinds of management actions are appropriate.

Product: The product of this step is a list or map of all the places (for each alternative) where existing conditions are worse than the standard. In addition, the management actions that would bring conditions up to standard should be identified.

A continuum of management actions is available to managers, ranging from the least restrictive and most preventive (such as education and outreach) to the most restrictive and corrective (such as limiting access). Education includes interaction with on-site naturalists and rangers, as well as signage. Enforcement powers reside primarily with the Police Department and the DLNR Division of Conservation and Resources Enforcement. The front line individuals who can call upon these two agencies for assistance include on-site Rangers, Naturalists, Citizen's Patrol, and other community members. Use levels may dictate management actions. For example, protecting a

wetland in a high use area may require fencing, whereas protecting a wetland in a low use area may not require fencing.

In summary, in step 7 managers identify a continuum of management actions for the social and resource indicators relevant to each of the three opportunity classes. The costs, benefits, and constraints of these potential management actions are also identified. Within this section, the difference between inventoried conditions (from step 4), and minimum standards (from step 5) is determined. Areas within the management area that are found to be substandard are ideally presented in map form for all of the alternatives, along with a list of the management actions needed to bring them up to standard.

Management actions suggested are reflective of the specific managerial conditions appropriate for each of the opportunity classes, as defined in step 2, for the purpose of protecting social and resource values identified in step 1. The continuum of potential management actions provided in this step offers both preventive and restrictive/corrective options. Management should draw on cultural knowledge when considering final management actions, as informed by cultural representatives. The area should be managed as one ahupua'a, and educational outreach efforts and signage should reflect the Hawaiian cultural heritage. For example, the use of Hawaiian words, such as "kapu" (taboo), should be considered for use in signage.

Step 8: Evaluation and Selection of An Alternative

Purpose: The purpose of step 8 is to finalize the opportunity class allocations and a specific management program to achieve the desired conditions.

Process: In this step managers analyze, and receive public input on, all the resource, social, and managerial costs as compared to the resource and social benefits. Public participation will play an important role in selecting the final alternative and will lend credibility to implementation efforts.

Product: The product of this step is the final allocation of opportunity classes and the selection of a management program.

Questions to ask that can guide managers through this step are (Stankey et al. 1985):

1. What user groups are affected and in what ways are they affected? Are certain groups restricted? Is the purpose of other groups furthered?
2. Which values are promoted and which diminished?
3. How does a particular alternative fit into the regional and/or national supply and demand considerations? Does the alternative contribute a unique kind of wilderness/recreational setting to the system?
4. What is the feasibility of managing the areas as prescribed, given budget, personnel, legal, and other constraints? What is the political climate?

A variety of costs need to be considered in this step. These include financial costs (personnel and materials), information costs (costs associated with acquiring information needed to implement actions), and opportunity costs associated with not carrying out a proposed action (Stankey et al.

1985). While some of these costs are difficult to quantify monetarily, the mere recognition of their existence will improve the ability of managers and the public to evaluate each alternative.

At this point in the LAC process the components of the alternative management plans have been defined to a level of specificity allowing for very focused public participation. Stakeholders will be better able to understand how the different alternatives affect their specific interests, so their comments can be focused on specific assumptions, actions, or areas in the alternatives.

Step 9: Implement Actions and Monitor Conditions

Purpose: The purpose of step 9 is twofold: 1) to implement a management program that will achieve the objectives of the selected alternative, and 2) to provide periodic, systematic feedback regarding the performance of the management program.

Process: Step 9 does not involve managers in a new process. Rather, it requires that managers periodically reassess existing conditions (step 4 inventory), and make a comparison of those conditions to the standards (as was done in step 7). Monitoring will guide when changes in management actions are warranted, and will provide feedback on the effectiveness of those actions.

Product: The product of step 9 is a summary of the relationship between existing conditions and standards for indicators in all of the opportunity classes (updated over time).

Monitoring gives managers early warning signs of potential problems and negative trends, and provides the hard data upon which to gauge when standards have been violated. Managers need to be alert to changes in external circumstances that could affect resource and social conditions within the management area. These include adjacent land uses, population growth, or the relative availability of alternative types of recreational opportunities (Stankey et al. 1985). Impacts from these adjacent uses may be resolved through management actions within the existing plan, or, in the case of major external changes, fundamental alterations in management objectives may be required.

Monitoring can also be used to evaluate the effectiveness of management actions and serve to improve future programs. If monitoring indicates that conditions remain better than standards, then current uses of the area can be maintained until monitoring shows that standards will likely be exceeded. If monitoring shows that conditions have deteriorated to below standards, then immediate management action to improve conditions is required. If these conditions do not improve over time under the new management actions, then these actions can be judged to be ineffective and replaced with more effective efforts. An action may prove ineffective for various reasons. The action itself may have been appropriate, but its implementation not effective or the program may not have been in place long enough to yield the desired result. Trends reflected in the monitoring data will be helpful in indicating where the problem lies (Stankey et al. 1985).

A major concern regarding monitoring is how frequently it should be done. The monitoring plan should attempt to balance the trade-off between the desire for more information with the reality of

limited financial resources. In general, monitoring priority should be given in situations where (Stankey et al. 1985):

1. Conditions were very close to standards at the time of the last assessment
2. Rates of resource or social change are judged to be the highest
3. The quality of baseline data is the poorest
4. The understanding of management action effects is the poorest
5. There have been unanticipated changes in factors such as access or adjacent land uses.

Strengths and Weaknesses of the Model

Two of the primary strengths of LAC are that management decisions resulting from this process are resource-based and comprehensive. Implementing this model is like putting the horse back in front of the cart. Desired future conditions are clearly defined and relevant indicators and standards are selected. Attention is focused on critical problems at specific locations (Stankey et al. 1985). The evaluation of management actions through monitoring makes management under the LAC process trackable and traceable (Krumpe 2005). The variety of alternative courses of action to follow also allows the manager a great deal of flexibility.

Two of the primary weaknesses of the LAC model are that it's tough to implement all the steps when budgets are declining, and some agencies lack the political will to implement the management actions (McCool and Cole 1997). In addition, the process is still complex, and even the most practiced public meeting facilitator will struggle with balancing multiple competing interests. These are all considerations to be taken into account before implementing the LAC model. Nonetheless, LAC offers a pathway to making reasoned decisions balancing interests while providing basic protection to the resource.

Implementing the LAC model in Hawaii

Agency culture affects how LAC is used (McCool and Cole 1997). For some protected management agencies these steps closely follow existing planning processes, while for others the LAC system may represent a significant departure. Implementing the LAC model does require some changes in bureaucracy, which brings up issues of training, knowledge transfer, longevity, and funding (McCool 1996).

Accountability is important in nurturing and maintaining the public's trust. By working through the LAC process, managers should be able to avoid restricting and regulating visitors and residents except when and where truly necessary (Stankey et al. 1985). Any management actions that are implemented will be based on common community values established in the beginning of the process and for the purpose of maintaining agreed-upon standards.

References

- Buist, Leon J. and Hoots, Thomas A. 1982. "Recreation opportunity spectrum approach to resource planning." *Journal of Forestry*. 80: 84-86.
- Clark, Roger N. and Stankey, George H. 1979. The recreation opportunity spectrum: a framework for planning, management, and research. General Technical Report PNW-98. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, 32p.
- Cole, David N. 2005. Personal communication. 10 Mar. 2005.
- Cole, David N. and Stankey, George H. 1997. "Historical Development of Limits of Acceptable Change: Conceptual Clarifications and Possible Extensions" In: McCool, Stephen F.; Cole, David N., comps. 1997. Proceedings—Limits of Acceptable Change and related planning processes: progress and future directions; 1997 May 20-22; Missoula, MT. Gen. Tech. Rep. INT-GTR-371. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Cole, David N. and McCool, Stephen F. 1998. "Limits of Acceptable Change and Natural Resources Planning: When is LAC Useful, When is it Not?" In: McCool, Stephen F.; Cole, David N., comps. 1998. Proceedings—Limits of Acceptable Change and related planning processes: progress and future directions; 1997 May 20-22; Missoula, MT. Gen. Tech. Rep. INT-GTR-371. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Driver, Beverly L. and Brown, Perry J. 1978. The opportunity spectrum concept and behavioral information in outdoor recreation resource supply inventories: a rationale. In: Lund, G. H.; La Bau, V. J.; Follitt, P. F.; Robinson, D. W., tech. coords. Integrated inventories of renewable natural resources. General Technical Report RM-55. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 24-31.
- Friedmann, J. 1973. *Retracking America: A theory of transactive planning*. Anchor Press/Doubleday, Garden City, NJ.
- Howard, Marion and Potter, Bruce. 2002. Wise Coastal Practices for Sustainable Human Development Forum. "Small islands: limits of acceptable change." In Response to: "Methodologies for carrying capacity in small island states, Indian Ocean." Posted on 10 May 2002. Accessed 10 Jan 2005. <<http://www.csiwisepractices.org/?read=420>>
- Krumpe, Ed and McCool, Stephen F. 1997. "Role of Public Involvement in the Limits of Acceptable Change Wilderness Planning System" In: McCool, Stephen F.; Cole, David N., comps. 1997. Proceedings—Limits of Acceptable Change and related planning processes: progress and future directions; 1997 May 20-22; Missoula, MT. Gen. Tech. Rep. INT-GTR-371. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

- Krumpe, Edwin E. 2005. "Limits of Acceptable Change Planning System" PowerPoint developed for Resource Recreation and Tourism Course RRT 287 at the University of Idaho, Moscow. Accessed 12 Jan 2005. <<http://www.cnr.uidaho.edu/rrt287/287lac7.pdf>>
- Mann, Carsten. 2003. "Concepts for Recreation Management: Carrying Capacity & Limits of Acceptable Change." July 2003. Institute of Forest Policy PowerPoint presentation. 30 slides.
- McCool, Stephen F. 1996. "Limits of Acceptable Change: A Framework For Managing National Protected Areas: Experiences from the United States." Paper presented at Workshop on Impact Management in Marine Parks, sponsored by Maritime Institute of Malaysia, August 13-14, 1996, Kuala Lumpur, Malaysia.
- McCool, Stephen F., and Ashor, J.L. 1984. "Politics and Rivers: Creating Effective Citizen Involvement in Management Decisions" In National River Recreation Symposium; 1984 Oct 31-Nov 4; Baton Rouge, LA. Baton Rouge, LA: Louisiana State University: 136-151.
- McCool, Stephen F., Guthrie, Kathleen, and Smith, Jane Kapler. 2000. "Building Consensus: Legitimate Hope or Seductive Paradox?" June 2000. Research Paper RMRS-RP-25. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- McCool, Stephen F. and Cole, David N. 1997. "Experiencing Limits of Acceptable Change: Some Thoughts After a Decade of Implementation" In: McCool, Stephen F.; Cole, David N., comps. 1997. Proceedings—Limits of Acceptable Change and related planning processes: progress and future directions; 1997 May 20-22; Missoula, MT. Gen. Tech. Rep. INT-GTR-371. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Moisey, Neil. 2005. Personal communication. 10 Mar. 2005.
- National Park Service. 1995. *Visitor Experience and Resource Protection Implementation Plan: Arches National Park*. Denver Service Center, National Park Service, Denver, CO.
- National Park Service. 2005. Accessed 12 Jan. 2005 <http://www2.nature.nps.gov/geology/monitoring/lib4/limits_of_acceptable_change.pdf>
- Schreyer, R. 1976. "Sociological and political factors in carrying capacity decision-making." In: Proceedings, Visitor Capacity Conference. 29-30 April 1976. Fort Worth, TX. National Park Service, Southwestern Regional Office.
- Schultz, Eric G., McCool, Stephen F. and Kooistra, David. 1999. *Management Plan Saba Marine Park*. April 1999. Prepared for Saba Conservation Foundation, The Bottom, Saba, Netherlands Antilles.
- Staff Writer. 1997. "Kaua'i Board Member Fast-Tracks New Rules for Hanalei Boating." *Environment Hawai'i, Inc.* December 1997. Volume 8 Number 6. <<http://www.environment-hawaii.org/1297cov.htm>>

Stankey, George H., Cole, David N., Lucas, Robert C., Petersen, Margaret E., and Frissell, Sidney S. 1985. *The Limits of Acceptable Change (LAC) System for Wilderness Planning*. USDA Forest Service General Technical Report INT-176.

Vann, Cheryl S. 2005. *An Application of the Limits of Acceptable Change (LAC) Model to Structure Long-Term Social and Resource Management for South Maui, Hawaii*. Professional paper submitted in partial fulfillment of the requirements for the degree of Masters of Science, Environmental Studies Department, the University of Montana, Missoula. March 2005. 141 pages.

Washburne, Randel F. 1982. "Wilderness recreational carrying capacity: are numbers necessary?" *Journal of Forestry*. 80:726-728.