RESOURCE MANAGEMENT PROGRAMS FOR OCEANIC ISLANDS

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CHAPTER THREE

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This chapter considers three problem areas that have a bearing on programs of resource management in oceanic islands. The first relates to the peculiar characteristics of islands that argue for special management approaches. The second deals with implications of longterm growth within a "closed" island system; while the third is addressed to the more immediate problems of market failure. Taken together, these problems present management with a formidable challenge.

A simple construct is developed with six constituents that are judged to be of key importance in a program for oceanic islands. It is suggested that a favorable longterm solution to island resource problems will depend, in part, on how successfully the key constituents are incorporated into management programs for island systems.[1]

Characteristics of Islands that Argue for Special Management

Within the context of coastal and marine resources, oceanic islands are seen to embody certain characteristics common to continental coastal and sub-littoral zones. For this reason, the coastal zone management concept is of considerable interest to island resource planners and environmental specialists. The existence of several important features

that are not held in common, however, argue for special resource management approaches when dealing with islands: (a) islands are discrete and finite in extent, with a fixed endowment of resources; and (b) they are ecologically fragile and concomitantly vulnerable to the destructive effects of modern-day development technology.

Finite in Extent

A basic feature of oceanic islands is the existence of a limited and fixed endowment of resources: land, fresh water, forests, and fauna. This underlying condition of scarcity applies equally to resources of the uplands, the coastal "plain," and the littoral and sub-littoral zones.

Land scarcity impresses one with the need for guidelines and criteria in allocating the land resource to various competing uses, while at the same time, maintaining its environmental integrity. This latter qualification is especially pertinent to oceanic islands which characteristically have limited waste assimilative capacity. Their watersheds generally disembogue directly into the sea. Little land is available as an environmental "sink" for waste disposal; few internal plains offering local base levels (or lakes) exist, which on continents serve to trap pollutants. All wastes tend to gravitate rapidly to the land/sea interface of the coastal zone.

Other resources are also in short supply. Fresh water is scarce, particularly on the smaller volcanic islands where rugged relief combines with the torrential nature of the seasonal rainfall to produce a high

run-off rate that limits storage and re-charge of underground water reserves. The case of the flat coral islands is more serious, for they lack even an initial supply of fresh water. Given the absence of orographically-induced rainfall, the construction of catchment basins to augment water supply is of marginal value.

Scarcity of marine resources of major commercial importance are a fact of life for many islands, dispelling the myth that most oceanic islands are set in a sea of unlimited bounty. A partial explanation for the somewhat modest fisheries resources of islands compared with those of the continental shelf lies in the difference in productivity of nutrients in the two areas.

Given the fact that inshore reef systems owe their modest primary productivity to the nutrient input of sporadic island run-off, it is not surprising to find a decrease in productivity as we move offshore. This is, in fact, the case with oceanic islands.[2]

The resources of flora and fauna, both marine and terrestrial, are likewise fixed by way of limits imposed by their habitats. The complex differentiation of marine and terrestrial life in the coastal zone provides a striking example of these operative limits.

Regarding the management of continental resources, there is mounting pressure to single out the coastal zone as an area of critical concern that deserves special management legislation (U. S. Senate, 1971). Notwithstanding reasons that could be advanced for emphasizing the

coastal zones of islands,[3] this paper chooses to examine resource management within the broader and more encompassing framework of the "island system."[4]

In the context of the continental coastal state that has much of its territory located away from the sea, where population and resource conflicts are concentrated, it is appropriate to deal with the coastal zone as a special entity separate from general land use planning.[5] When dealing with islands, however, it is more to the purpose to go beyond the notion of a single zone of scarcity, and recognize the presence of island-wide scarcity.[6] We think that such an approach is justified for all islands that exhibit high man:land ratios, regardless of their size.

Fragility of the Ocean Island Environment

Islands are ecologically fragile and consequently vulnerable to the destructive effects of modern-day development technology. Evidence of this abounds throughout the Caribbean Region. This aspect, coupled with the aforementioned resource limits, call for special management approaches.

One reason for island vulnerability derives from the fact that the historical element of remoteness and "isolation," serving to inhibit development is becoming inoperative. The revolution in transport and communications has spelled the end to this inhibitory factor. The Virgin Islands, for example, is now serviced by jet, sea planes,

hydrofoils, cruise ships (not requiring docks), passenger ferries, STOL aircraft, yachts, and television.

The barrier of "isolation" has further been transgressed by exogenous factors occurring far beyond the shores of the island itself. The oil pollution on the high seas that has affected the Virgin Islands twice in the past few months is a case in point.[7]

Such an occurrence of oil on the high seas surrounding island systems reinforces the conclusion reached by the BOR Report, Islands of America, that islands hold a special position with respect to "impact of uncontrolled and unplanned technological encounters."[8]

The second reason for island vulnerability arises from the fact that the traditional development barrier of resource scarcity -- or its complete absence -- is no longer of crucial import. Technology has overcome many of the constraints on development posed by physical resource deficiencies. The power of technology to surmount resource deficiencies is well illustrated by the example of St. Thomas, U. S. Virgin Islands. Because of poor agricultural resources, most foodstuffs are imported; fresh water scarcity necessitates that it be brought in by tanker and vast quantities manufactured in costly desalination plants; owing to the dearth of construction aggregate, sand is both imported and dredged from inshore areas; and finally, given a short supply of the land resource itself, more land is created by dredge and fill operations along the coast.

A third factor that pertains to island vulnerability can be attributed to the development phenomenon itself, which may occur with little or no forewarning. The stimulus underlying a development thrust is often capricious, unpredictable, and exogenous. With no anticipatory planning, an island's vulnerability is exacerbated. For example, the essential stimuli to the growth of the Virgin Islands was the foreclosure of Cuba as a tourist mecca by Castro's revolution, and the availability of a $200.00 duty free purchase allowance for Americans returning to the U. S. mainland. What planner could have predicted the effects of these actions upon the Virgin Islands in 1960?

The fourth element of island vulnerability arises out of the close geographic proximity of ecosystems which are both (a) diverse and (b) interdependent.

Diversity simply reflects the presence of heterogeneous conditions and habitats. Life forms that flourish within these several habitats tend to be environmentally specific. The occurrence of coral reef formations that fringe an island illustrates this well. In one locale, coral appears to flourish, while in another seemingly identical area, it barely holds its own or is absent altogether.[9]

These precarious growth localities offer other habitats that maintain diversity of the littoral and sub-littoral zones. To demonstrate this, we need only look at the beach areas behind the living reef, where coral rubble and sand offers protected habitats for numerous marine organisms not found within the living reef itself.

Interdependency is the first principle of the life web. This interdependency exists both within an ecosystem (as in the example of coral, with its algae and other floral and faunal associates) and between ecosystems.

As stated before, an island's vulnerability is accentuated by the close geographic proximity of the various subaerial and subaqueous ecosystems, such that an impact in one ecosystem will be rapidly transmitted to another. If any of the environmentally-specific parameters governing coral reef growth are seriously transgressed, then one may expect death of the reef.[10]

The maintenance of water circulation is the sine qua non of coral reef growth, as the coralline algae that cements together the reef fragments require a continual supply of oxygen.[11] This is demonstrated by the vigorous growth that occurs at the surf zone where both nutrients and oxygen are found in abundance.

The fact of interdependency in island ecosystems means that care and knowledge should be exercised in making land use decisions that affect the environmental status quo.

Land clearing for construction or other purposes that takes place in an upland ecosystem, can adversely affect an offshore reef through siltation which acts to smother it or by blocking sunlight vital to photosynthesis. In a similar vein, offshore construction or dredge and fill operations, that may occur far distant from a coral reef

ecosystem, can interfere with a pattern of water circulation on which its growth depends.

The degradation of zones of primary productivity around oceanic islands, owing to man's malpractices, provides yet another instance of the web of interdependency. The dredging of shallow embayments can destroy the intertidal water mass exchange (a characteristic of shallow areas) which in turn lowers the productivity of the area.

Further afield, upland deforestation, cultivation, and erosion, impoverish the littoral and inner sub-littoral zones by transforming the pre-existing permanent streams into intermittent zones of low nutrient carrying capacity. Such has been the experience of St. Thomas.[12]

The final element of "vulnerability" refers more narrowly to the biological resources of an island, and not to the island itself. The question is: how tolerant are the life forms to environmental change? Have life forms on islands evolved within constraints set by a more stable, less extreme, environment than that of continents?

If we have in mind the coastal fisheries resources of the Caribbean, the answer is that an island's marine biological resources <u>are</u> less tolerant to changes in the physical regime, and consequently more vulnerable, than marine resources of the continental margins.[13]

In sum, islands are seen to be extremely vulnerable to development stresses and outside influence. The section that follows considers the

adverse effects generated within the island system by some of these influences, and discusses the challenge they pose for management.

Managing Island Growth - Problems & Challenges

When looking at growth problems, it is useful to recognize two dimensions to the development process. On one level the problems are those that accompany the growth phenomenon whenever and wherever it takes place, irrespective of the operative economic system; on the other level, the problems are those that result from failures of allocation that commonly occur within the framework of a free enterprise system.

The point of recognizing these dimensions is to suggest that current management programs initiated at the local or regional level may be powerless to stem the tide of the worldwide development phenomenon of growth per se; while in the arena of market failure they can effectively counteract the consequences and process of misallocation.

Longterm Growth

Of the various aspects of longterm development that affect islands, we will limit ourselves to an examination of the stresses and strains manifest in an island whose population threatens to outstrip its resource base.

The desirability of stemming the tide of material growth is predicated on the view that an endless increase in population and/or

material goods will eventually lead to the impoverishment or destruction of the very qualities of the oceanic island that attracted residents to its shores in the first place. In short, an island can be thought of as having an optimum growth level -- beyond which its inhabitants will experience diminishing returns and a declining quality of life.[14]

Where this vague point of diminishing returns is to be found on a development continuum is now impossible to say. It remains in the realm of subjective opinion. A social consensus would be the only way of defining such an elusive "point." The task of management would then be to stay within the prescribed bounds. Staying within bounds is ultimately contingent on stabilizing the population at a predetermined level. Keeping growth under control would also be well served by recasting the capitalist growth ethic into an equilibrium, no-growth mold.[15]

For an island to resist both population and material growth, a radical departure in social, economic, and political thinking is demanded. Given the magnitude of the effort that will be required to neutralize present development trends, it is expected to cause painful repercussions. This eventuality, however, should not deter us from considering unlimited "growth" as a potential hazard to resource management programs.

Ocean Islands as Closed Systems - In keeping with the discussion of growth, attention will be diverted to examining some ramifications of growth within a closed system. Reference to a closed system model

gives us a better perspective of what is involved in resource management of islands.

The traditional free enterprise economy is, in the words of the economist Kenneth Boulding, a "through-put" economy which has as its emphasis the production and consumption of goods (Boulding, 1966).

In this economy with which we are familiar, there is a one-way flow of the materials stream from initial extraction, to production of goods, to their consumption, and finally to their being discarded as junk. Such an arrangement works satisfactorily in a world of ample resources and available space to dispose of the wastes; but it is inappropriate in an island "world" of fixed limits.

Within the context of a bounded earth, Boulding argues the relevance of an alternative economy that is "closed" -- "spaceship earth" -- where resources trace a circular stream from input, to output, and back to input. There are four revealing notions that we can identify in this closed economy idea, that bear repeating in the context of managing oceanic islands.

First, being "closed" it follows that there are a fixed number of components in the system. The addition of components from the outside (imported) will necessarily displace those already there. In the real world terms of St. Thomas, Virgin Islands, one is simply saying that the action of bringing in 15,000 vehicles (the number of operating vehicles for 1971) into an island of 32 square miles will generate

repercussions or impacts. Introductions in a closed system do not occur in a vacuum.

Second, given the circular flow of resources that exists, material goods are not "consumed" by the user in a traditional sense of "annihilation" (Ayers & Kneese, 1969); goods are only altered by the user, then discarded as waste or recycled for further use.

In keeping with the example of the 15,000 vehicles on St. Thomas, the problem that confronts island management is to know what to do with the 15,000 derelicts destined to blanket the countryside as the vehicles are retired from use over the next decade. Where does one put them? Knowing what to do with 75,000 tires (which are not biodegradable) is a big enough problem alone!

The third notion that derives from the closed economy idea is that the initial endowment of stock natural resources is fixed. If stock resources are squandered, they are then effectively -- at least within our lifetime -- lost. Depletion of stock resources through overexploitation or mis-management is irreversible, therefore, conserve them.

Finally, as Boulding points out, the goals of a closed economy are quite different than traditional goals of maximizing production/consumption. Success of the closed economy is judged by how well the "nature, extent, quality, and complexity of the total capital stock" is maintained.

In the long term, this last notion is probably the key to the success of any management program designed for oceanic islands. The chief operative principle must be the maintenance of the total capital stock.

The earlier argument, calling for a fixed ceiling on population and material growth within the island estate, is predicated on the validity of this stock maintenance principle.

The chief planner of the San Francisco Bay Conservation and Development Commission (B.C.D.C.) would echo this viewpoint. Referring to the direction of future planning efforts, Jack Schoop states that one's longterm objective is "to change the values and redress the legal, economic, and property system that is still dedicated primarily to taming, overcoming — indeed, obliterating -- the natural environment." Final success or failure is conditioned on a change in values "...of those substantial interests whose natural inclination is to put private rights above public rights and to put immediate growth ahead of the long-term implications of growth."[16]

The changing ethic relating to the use of the Nation's resources may soon be officially recognized at the Federal level of government in the guise of the new U. S. Water Resources Council "Standards."[17] The "Standards" document explicitly recognizes the desirability of diverting a portion of the Nation's resources from production of more conventional market-oriented goods and services to the task of accomplishing

environmental objectives.[18] Emergence of these new values is an encouraging development for island management as they contribute directly to the "principle of maintaining the total capital stock," discussed earlier.

Market Failure

President Nixon in his recent environmental message to Congress, states that "the temptation to cast technology in the role of ecological villain must be resisted -- for to do so is to deprive ourselves of a vital tool available for enhancing environmental quality."[19]

At this point in time, technology can hardly be viewed in the role of prospective ecological savior, or even as an enhancer of environmental quality as he would suggest, for on balance, more battles are being lost than won. It is more appropriate for us to view technology as being essentially neutral. We can then focus our attention on the broader picture of market failure,[20] within which technology has been permitted to exercise a "villanous" role.

The market failures of greatest importance in St. Thomas lie in the areas of spillovers in the form of water pollution, scenic degradation, and solid waste disposal; and in the underprovision of goods such as recreation that requires large initial investments, with little potential for profit until maximum capacity is reached. A third area of concern for St. Thomas lies in the fact that many private allocation decisions made in the coastal zone lead to results that are

inconsistent with the public interest, but no effective procedural mechanism exists to check this trend at the present time.

When focusing on the environmental components of market failure (spillovers and under-provision of non-material goods), it is clear that the problems are both multifarious and difficult to describe with precision because of the different value systems that people hold. Reference to the "environmental quality objective" of the proposed planning standards of the U. S. Water Resources Council, presents us with a useful framework for examining environmental values of an island that are frequently affected adversely through market failure.

Note, that the adverse effects of market failure (chiefly spillovers) are the obverse of the Water Resources Council list of beneficial effects. As an aid to exposition, these adverse effects (negative impacts) are separated into four categories. I will lead with them in turn, for they illustrate the non-monetary values that island management must consider in allocating and planning resources to mitigate the undesirable effects of market failure.

Adverse effects of the first category are those which "imperil, degrade, or destroy ... beaches and shores ... estuaries ... and other areas of natural beauty."[21]

To elaborate, the concern here is with the impacts that adversely affect "public aesthetic values and recreational enjoyment," in addition to the quality of "scenic shorelines." Estuaries are viewed --- beyond

their economic value -- as valuable for their intrinsic worth, as aesthetic attractions and "as marine ecosystems of special worth."

Some of the most important market failure problems in St. Thomas fall into this category. The rampant growth of the island has placed enourmous demands on the scarce coastal zone resources as sites for industrial, residential, hotel, and condominium development. A by-product of this growth has been the aesthetic degradation of the natural shoreline scenery through poorly designed or misplaced structures improperly installed.[22]

The second category of adverse effects identified in the environmental quality account are those resulting from the "alteration or degradation of specially valuable ... biological, and geological resources and selected ecological systems." Speaking of biological resources, an adverse effect of particular concern to those in environmental education, is the recognition that the foreclosure of opportunity to observe and study biological resources — terrestrial and aquatic -- will lead to diminished understanding and appreciation of the natural world as the habitat of man.[23]

Ecological systems are given a particularly explicit treatment in the environmental account which is based on attributes going far beyond the immediate economic utility of ecological systems as a resource base for man's material needs. These attributes are in the realm of science and aesthetics.[24] Adverse effects are those in which a

reduction or loss of opportunity of these attributes occurs, as a result of an implemented development plan.

An example close to home of an "especially valuable" biological resource/ecological system that would be accorded high (non-monetary) valuation in the Water Resources Council Standards, are the bioluminescent bays of Puerto Rico and Vieques Island. These bays are delicate fragile systems, rarely found in the world, and therefore, of international significance (National Park Service, 1968).

The third category of adverse effects are spillovers that act to degrade selected quality aspects of water, land, and air. No elaboration of these types of pollution need be pursued, as we all are familiar with them.

The final category of adverse effects results from the loss of freedom of choice to future resource users by actions that magnify or cause irreversible or irretrievable effects. This point is of consequence to islands that are scarcely endowed and ecologically fragile. It stresses that plans made in a world of uncertainty, should assume a cautious approach in environmental affairs and avoid irreversible commitments of resources to future users.[25]

A most striking example of foreclosure of future resource opportunities can be seen on the island of St. Thomas, where 90% of the beaches are effectively controlled by hotel and condominium developments.

In considering the problems incurred by development, the central point to be stressed is that specific problems that one can identify as a by-product of a development process -- air pollution emission, untreated sewage effluent sources, disappearance of recreation land, degradation of landscapes, the over-harvesting of coastal fish resources -- all owe their origin to fundamental imperfections of the market mechanism. Thus, a program of management should avoid a piecemeal problem-by-problem approach and instead address itself to the more encompassing task of resolving market failure. The B.C.D.C. experience demonstrates that such a task can be achieved successfully by a regional authority.

Islands, however, require more than market failure remedies. If we are ever to preside over an island's destiny, then we must enlarge our management view beyond market failure problems and accept the challenge of uncontrolled growth, spurred by forces beyond our control. The final section of the paper discusses some elements or "constituents" that are judged to be of key importance in furthering this aim.

Key Constituents of a Management Program for Islands

In our view, there are six key constituents that merit inclusion in management programs devised for oceanic islands. The first three elements pertain to the stewardship of limited resources within a fragile insular framework that is vulnerable to outside influence. The next two elements are addressed to the response of management to

market failure; while the final element (included in a postscript) is advanced in the spirit of an operative tenet.

1. Conservation:

   Acceptance of a conservation ethic is indispensable to the principle of maintaining the total capital stock. Both terrestrial and marine island resources are fixed in extent. Some of these island-wide scarcities can be circumvented through importation (fresh water), while others constrain absolutely (amount of available land). In either case there is a management imperative to conserve, and preferably, enhance, the original endowment. The fact of island vulnerability provides additional grounds for employment of a conservation ethic.

2. Interdependency:

   Recognition of the interdependencies that link the closely-knit subaerial and subaqueous ecosystems, is basic to the relevance of an artificially conceived management plan that must come to terms with the complex physical and biological interactions of the island regime.

3. Growth Limits:

   The realization that there are limits to growth, must be a feature of any long-range management program for islands. Ancillary to this notion of a growth ceiling is the notion

of an optimum growth level, that will occur somewhere along the development continuum in advance of the growth limit. An adjunct to ascertaining the maximum population that an island can support, should be the establishment of standards that reflect this optimum population/development level.[26]

4. Resource Allocation:

Islands require that special attention be paid to circumventing market failure in the allocation process. Islands are especially vulnerable to the adverse effects of technological spillovers; under-provision of non-material goods, and the over-exploitation of fish resources and other common property resources.

The use of multi-objective criteria, of which the Water Resources Council's standards is an example, insures that environmental values not represented in private market allocation will be accorded equal value in the arbitration procedure. Comparisons made between alternative projects that favor on the one hand, the economic efficiency account, and on the other, the environmental account, can assist in delineating difficult development/conservation dichotomies.

The criterion of "inherent dependency" is useful in determining "who" gets "what" and "where."[27]

Land uses that operate independently of the inherent resource base are more likely to affect the environment adversely than those uses which are subordinate to it. The dependency of a user on a given resource, will at least offer an incentive to maintain the environmental status quo, and, in some cases, improve it.

5. Management Structure:

There is need for a centralized management structure when dealing with island resources. Such a structure built around the concept of an island system will bring under one domain all the actions and interactions of resource use. In this way, specific localized activities can be viewed in terms of their overall impact (beneficial and adverse) on the island system. This, in economic terms, is what is meant by "internalizing the externalities."

In concert with the centralization of territorial jurisdiction, we would advocate a parallel centralization of administrative function, particularly with regard to island-wide planning, conservation, and environmental protection. One must avoid the dilution of authority that occurs by spreading environmental management across a dozen different departments, which is the situation currently in the Virgin Islands.

Market failure should be treated at the outset as an expected

element of the free enterprise system, and not as an aberration to be treated piecemeal after the fact. Too often market failure problems are neglected, until environmental deterioration reaches an advanced stage.

6. A Postscript- The Wisdom of Restraint:

A tenet that should underlie all island management decisions is that of restraint. Management in a world of uncertainty involves risks about future outcomes. The danger of making a wrong allocation decision in the environment sphere lies in the irreversibility of the bad decision. Most environmental resources, once committed, cannot be reclaimed for other alternative uses. It is a sensible insurance policy to guard against the foreclosure of future options. This vital concept -- which constitutes an admission that decision makers are fallible -- was previously mentioned in the discussion of the environmental account of the W. R. C. "Standards." The COAP guidelines[28] and the recommendations of the President's Panel on Oilspills, also recognize its importance.

In the latter instance, the Panel advocates use of an "escrow resource policy." It bears repeating in the context of the island situation. They point out that potential offshore resources are ill-served by dichotomizing resource allocations into "develop" or "preserve" categories. Instead, they

> recognize a class of escrow resources in which resources can be placed for fixed periods of time, in lieu of being exploited or placed permanently off limits.[29]
>
> Rather than limit this policy to the realm of offshore resources, we suggest it be incorporated into management programs of island systems. It offers clear advantages (by reason of its selectivity when putting a hold on a particular resource) in comparison with the use of a blanket "moratorium" on development which has been instituted in the coastal zones of some states.

To conclude: we suggest that a favorable longterm solution to island problems will depend, in part, on how successfully the key constituents are incorporated into their resource management programs.

CHAPTER THREE

NOTES

1. A model, based on the Virgin Islands case, will be the subject of a subsequent paper.

2. W. N. Brownell & W. E. Rainey, Research & Development of Deep Water Commercial and Sport Fisheries Around the Virgin Islands Plateau; VIERS No. 3, Caribbean Research Institute; St. Thomas, U.S.V.I., August, 1971; p. 4.

3. Two good reasons are: first, the coastal zone represents an important, although narrow, nutrient enrichment area of the marine environment; and second, it represents a higher proportion of the total island domain than is the case with continents (i.e. relative to continents, islands have a higher ratio of linear coastal exposure to the area of hinterland remote from the sea).

4. The "island system" as defined here, includes both the island landmass and its contiguous littoral and sub-littoral zones.

5. This is the position taken by advocates of the Coastal Zone Management Bill S. 582, in lieu of the National Land Use Policy Bill S. 992.

6. Common standards for defining the coastal zone, use as the limit of landward extent, the ridgeline of mountains that make up the watershed, or in some cases the most inland boundaries of the counties that stretch along the coast. Reference to either of these standards would place the entire island of St. Thomas within the coastal zone.

7. In the second week of December, 1971, a tanker in international waters travelling between St. Croix and St. Thomas cleaned out its tanks of heavy oil, which eventually washed up on the north coast of St. Croix, Buck Island National Reef, and the shore in the Christiansted area. See the Daily News editorial "Deliberate Pollution" of December 16, 1971. An almost identical situation occurred in mid-February with similar results to the coastline of St. Croix and Buck Island. See the Daily News of February 19, 1971.

8. Bureau of Outdoor Recreation, Department of the Interior, Islands of America; Washington, D. C., 1970; p. 38.

9. The precarious growth localities for coral are on (a) leeward coastlines, due to the salinity variations (evaporation from a semi-enclosed lagoon or the influx of fresh water off the land); and (b) on the landward side of reefs due to sedimentation in sheltered water and the lack of wave action which reduces nutrient and oxygen levels in the water. *(F. G. Walton Smith. Atlantic Reef Corals, University of Miami Press, Coral Gables, Florida, 1971; page 5.)

10. Conditions for optimal reef growth are temperatures within 73 to 77° F., water salinity around 35 parts per thousand, the presence of ample sunlight, and the unimpeded flow of water movement in the form of waves and currents to bring food and oxygen to the coral and its algae associate (Walton Smith, pp. 4-5).

11. A. E. Dammann, et al. Study of the Fisheries Potential of the Virgin Islands; VIERS No. 1, Caribbean Research Institute, St. Thomas, U.S.V.I., August, 1969; p. 21.

12. Dammann, et al., p. 6.

13. Dammann, et al., p. 24.

14. It can also be considered to have a maximum growth level which reflects the absolute physical limit to the number of inhabitants that the resource base can sustain.

15. N.b. The three preconditions for curing society's consumer "neurosis" would be the pre-existence of an equitable income distribution; the attainment of a sufficiently high per capita income level to obviate the craving for more and more goods; and perhaps a fundamental change in the value ethic of materialism itself.

16. His words carry weight, coming as they do from the planning headquarters of this celebrated and successful Commission that has been widely emulated in proposals for regional resource management. (v Jack E. Schoop. "The San Francisco Bay Experience," in Coastal Zone Resource Management, eds. J. C. Hite & J. M. Stepp; Praeger, N. Y., 1971; pp. 3-19.)

17. The "Standards," which is designed to replace the obsolete Senate Document 97, provides the basis for Federal participation in all water and related land resources programs. If approved by the President, its implementation will have far-reaching consequences. (U.S. Water Resources Council. "Proposed Principles and Standards for Planning Water and Related Land Resources," The Federal Register, Vol. 36, No. 245, Part 2, December 21, 1971.

18. "As income and living levels increase, society appears less willing to accept environmental deterioration in exchange for additional goods and services in the market place." Water Resources Council, pp. 24151-52.

19. The Executive. "President's 1972 Environmental Message to Congress," Office of the White House Press Secretary; February 8, 1972; p. 7.

20. For a lucid analysis of both causes and implications of market failure on resource allocation, interested readers are referred to: M.I.T. Economic Factors in the Development of a Coastal Zone; Cambridge, Mass.; September, 1970; pp. 20-33.

21. Water Resources Council, p. 24160.

22. Another feature of this urbanization of the coastal zone by private interests has been reduced public access to the beaches, which are a major public recreation resource. The heated controversy, presently unresolved, that surrounds the topic of free access to all beaches in the Virgin Islands is indicative of the high value that the public places on these aesthetic and recreation resource. Act No. 3063, recently enacted, is a sell-out of the public interest to the hotel and real estate interests. The Act is an anemic policy statement regarding the rights of the public to use and enjoy the shorelines of the Virgin Islands. It fails, however, to guarantee, promote, or otherwise legislate access through private holdings to the beaches.

23. Water Resources Council, pp. 24161-62.

24. Water Resources Council, p. 24161.

25. Water Resources Council, p. 24152.

26. Governor Evans of the U. S. Virgin Islands has called for limits to growth of the V. I. population, noting that without limits "we will develop the neuroses present in the big cities." Daily News, March 8, 1972.

27. This criterion is accorded a high place in the Comprehensive Ocean Area Plan (COAP) of California. (Proceedings of the 12th Meeting of the California Advisory Commission on Marine & Coastal Resources (CMC) Sacramento, California; Sept., 1971; pp. 31-40.)

28. CMC. "Reports on the 9th & 10th Meetings;" May, 1971; pp. 26-27.

29. Executive Offices of the President. "Offshore Mineral Resources 2nd Report of the President's Panel on Oilspills, Wash., D.C., 1969; p. 7.