

THE APPROPRIATION OF SHIFTING SANDS:
A CASE FOR TRANSFERRING INSTITUTIONS FROM THE DESERT TO THE COAST

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Abstract

In this paper we examine the physical and economic nature of beaches. We argue that these resources can be appropriated for private use in much the same way water is treated as marketable property in the arid regions of the United States. We show how rights to sand can be allocated according to the American Doctrine of Prior Appropriation, a rule for allocating water in the Western deserts. We develop a set of constitutional principles that facilitate the efficient allocation of nearshore sediment and submerged lands.

I. Introduction: An Institutional Analysis of Beaches.

The coast of the United States is characterized by a chain of sandy barrier islands and beaches which begin in New Hampshire and extend, with few breaks, South to Florida, around the peninsula and West along the Gulf of Mexico to Texas. These beaches constitute natural resources that are useful for satisfying many human wants, including residence, recreation, protection from storms, and scientific study. Their value is recognized by market and political agents who compete for ownership, regulation and control over beaches within the existing institutional framework of the American federal system.

The physical nature of beaches, and the economic, legal and political characteristics of the institutions for handling them constitute a fruitful field of scientific research. In this paper, we describe the basic characteristics of beaches, markets and governmental organizations in the United States. We compare and contrast these systems with the physical and institutional features of rivers in the American West. We argue that the use of beaches can be made more efficient by treating them according to rules and regulations similar to those used for owning and allocating fresh water in the western States.

II. The Physical System of Beaches.

Generally speaking, beaches are zones of unconsolidated material or sediment that extend towards the land from the low water line to a place where a marked change in material or physiography exists, or to a line of permanent vegetation. [1] The process-response system in operation along any beach is a constantly changing natural system.

Even a stable beach is one of constant change, with periods of erosion balanced by periods of deposition. The stability of a beach is determined by the amount and type of materials which comprise it, the magnitude of the natural forces responsible for changes, and sea level stability.

Beach sediments may be comprised of any material that is available in significant quantities and of suitable grain size. Most beaches of the temperate regions are composed principally of quartz and feldspar grains. They are ultimately derived from granites, gneisses, and schists, rocks abundant on the continents. Heavy minerals like hornblende, garnet and magnetite are also present, in smaller amounts.

Within the nearshore zone, waves often strike the shoreline at an angle due to wind direction or the configuration of nearshore topography. This ensures sediment transport alongshore, the direction of which is determined by the angle of wave approach to the shoreline. Sediment may be directed offshore via rip currents and thereby contribute to the process of sediment transport known as "littoral drift." Although the direction of longshore drift varies within and among coasts, a net movement of sediment in a general direction appears to exist, e.g., North to South along the Atlantic and Pacific coasts, and East to West along the Gulf coast.

It has been suggested that a major cause of beach erosion along the open coast shorelines is that of sea level rise. [2] The rising sea directly encroaches upon the shoreline, leading to an apparent shoreline recession, and contributes to the loss of sediment from the upper beach profile to a bottom, offshore profile.

Concomitantly, severe erosion may occur on shorelines during storms. Complete recovery of the lost sediment may never occur through natural forces alone. Similarly, accretion of sediment due to natural or man-made changes along the shore can become permanent additions to the beach. In short, the face, shape and size of a beach is constantly undergoing change or reconstruction by natural forces with or without the intervention of man.

The physical system of beaches in the nearshore shares important natural attributes with a river. Both systems transport a commodity desired by man originating in disparate sources in a dominant direction along courses which are relatively narrow but stable. The river flow is made up of water from precipitation as rain or snow, other surface runoff, and underground sources along the river bed. A beach is composed of particles from the ocean

bottom, eroding shoreline and from sources inland brought to the coast by rivers. The concentrations of water or sand vary along a river or shore. A valley is analogous to a beach in that both phenomena represent high concentrations of a desirable resource, water in one case, sediment in the other.

The fugitive or shifting nature of water and sand confront man with difficult institutional challenges. To this problem we now turn.

III. The Economic System of Beaches.

Beaches are resources encompassed within a coastal economy and a larger national or international economic system. Coastal economies face questions of scarcity, particularly of land, including beaches. There is not enough land to produce or consume all the goods and services possible in the coastal zone. This requires choices concerning what, where, how, and when to produce or consume with the use of coastal land. The making of these decisions allocates coastal lands among the various competing uses of value to man. These decisions are made in market and government institutions through which the independent actions of a multitude of actors come together.

The demand for beach sites is not uniform along a coast line. Neither is it coterminous with the physical availability of sand or sediment. The natural processes of erosion and build-up do not always put the sand where it is most valued by man. In some areas, too little sediment may be deposited or the rate of erosion may be too fast relative to the demand for construction sites or other uses. This problem may be aggravated by the fact that construction can itself contribute to erosion. On the other hand, too much sediment may be deposited in an area, such as an existing or potential channel for ships or boats.

These divergences between the natural and economic systems induce modifications of coasts and beaches with the tools of engineering by private parties and government agents. Works are constructed to divert sediment and to prevent or slow down erosion from an area. Beach nourishment or reclamation projects replace sediment lost from natural or man-made causes. Dredging widens or opens up cuts and channels for waterborne traffic; the creation of artificial islands is made possible by the displaced sediment. This activity continually reshapes the shoreline according to the changing wishes of man.

Market institutions consist of trades among producers and consumers who independently decide what to do with their property in response to changing land prices and government regulations. In the United States, the political system consists of a number of bureaus and agencies with autonomous grants of authority which make and implement policy in response to changes in majority opinion in legislatures, executive and judicial councils, and elections at three levels of government. Coastal lands near or with access to fresh water and beaches are very scarce. Hence they command a high market price and figure prominently as an object of public policy.

In general, the coastal land market covers a

well defined commodity from mean high tide inland to the minimum land parcel desired by the producer or consumer of the demanded good or service. Since government owns or controls all land beyond the mean high tide line, no market exists for submerged land. However, structures built on piers, jetties and other works of engineering, and landfill extend the market into coastal waters. These actions are capitalized by the market in the form of changes in the relative prices of alternative land parcels along the shoreline.

Efforts to modify the shoreline in specific places or areas by market firms or government agencies interact with the physical system to produce externalities. These are the offsite costs incurred by another person or property not included in the project calculus. The individual coastal landowner, or the coalition backing a government beach or navigation project, is usually not directly concerned with the external costs of actions to protect, extend, or otherwise enhance the value of the area of interest to him or the group. Market or political agents alter the distribution or flow of sediment in response to changing prices or political pressures which indicate such alterations are desired by those who keep them in business or public office. But because of the physical interdependency of sediment, alterations of the shore at one place can impose costs at other places not considered by the promoters of the project. These may include erosion of the landbase of downdrift property, increased pollution of the waters, and greater susceptibility to hurricane damage.

These costs interact in complex ways; they are difficult to perceive initially because the sediment system is not readily visible and there are time lags before the full effects are felt. But once they are realized, political pressures mount by the affected parties for immediate government action to protect their property. Support grows for building moratoriums, zoning regulations, construction set-back lines, prohibitions of certain structures, and public planning or ownership of long segments of coastline. Such appears to be the case in the United States, where government at all levels has become increasingly active in regulating or abolishing markets in coastal lands during the last two decades. State and federal governments, in particular, have increased their control over coastal decisions by market actors and local government, at least partially in response to increased support for policies to protect properties from natural or man-induced erosion.

The substitution of government for market decision-making and the transfer of choice from local to state and federal governments is not, however, a proven remedy to the problem of coastal externalities. Lack of coordination, if not outright conflicts, between bureaus and agencies generates externalities within the government system, too. These arise due to unclear, overlapping or simply incompatible grants of authority among offices. Bureaus and agencies spend a great amount of time, money, and energy fighting one another for power or control over resources. No agency likes to have its prerogatives impinged upon by rival bureaus. Hence agencies often pursue their objectives with as little regard for their impact on

other agencies as the coastal landowner has for his downdrift neighbor. The conflicts between the Corps of Engineers and the National Park Service over coastal construction and beach use, battles between the states of California and Arizona over the Colorado River, and between soil conservation and wildlife agencies, are sufficient to illustrate our point. In short, government is just as susceptible to externalities as is the market. It is not a solution to the problem.

To complicate matters, government decisions take place in response to signals which are far less efficient than prices in revealing the preferences of consumers. [9] In the market, coastal land is divided into innumerable parcels of many different sizes, shapes and locations, and each sells for its own separate price. While the prices of similar land parcels tend to rise or fall together, not all parcels change price in the same proportions. This variability in prices, price changes, and land parcels means that the market tends to accommodate a very large variety of consumer wants simultaneously. Even very unusual preferences get some satisfaction. Thus, the market operates toward the greater satisfaction of all consumers.

In contrast, public policy takes shape in response to changes in majority opinion as expressed in elections, the legislature, and executive and judicial decisions. This opinion changes more slowly and is expressed much less frequently and clearly than market demand. Moreover, it is but a composite of a multitude of individuals who as consumers choose very different baskets of market goods and services. The binary or discontinuous nature of many political decisions bring them together on the same side of an election or referendum. But this agreement breaks down as the level of choice becomes more and more specific. A majority vote in favor of State coastal planning offers very little guidance for policy decisions that involve many thousands of individual properties and millions of dollars in land values.

Since government does not price its output, citizens often have the incentive to hide their preferences in order to enjoy goods and services at someone else's expense. Suppose a policy problem involves what to do about an updrift sand diversion by a private party or local agency. If downdrift owners believe their taxes will be affected by stating their true preferences to stop up-shore diversions, they will undervalue their preferences to the extent of the perceived tax cost. If they believe their taxes will not be affected they will overvalue their preferences beyond the damages. An additional incentive is to be a "free rider" on other owners' willingness to pay or influence the government to correct the diversion problem if they believe the others or the government will implement a corrective program.

Public policy at all levels necessarily treats highly heterogeneous areas and populations as if they were made up of only a few gross categories of parcels and uses. This is particularly true of the federal and state governments, with their larger jurisdictions. What the market divides almost infinitely, government consolidates into convenient administrative units. While special interest in-

fluence, individual exemptions, judicial nullifications, and black markets in bribery and favors ameliorate the most costly mistakes of public policy, the system generally operates at a relatively low level of precision. And, since decisions are binding on everyone, including the opposing or recalcitrant minority, conflicts and quarrels between the various sides of an issue wastes resources which the market does not.

It is practically impossible for most governments to set public policy in other than very general and vague language. The greater the scope and centralization of policy, the more it has to be written and explicated in detail to many people who stand to gain or lose as a result. A vast volume of rules and regulations is produced. This ever-growing material of official pronouncements cast in legal language has to be read, understood, interpreted, clarified, and integrated into decisions the affected parties, including the officials charged with enforcement, will be motivated to obey. Contrast this process to a coastal market, where prices readily available daily quickly summarize the relative value of the many thousands of parcels available to investors who risk the loss of their capital if they make mistakes about what consumers want.

In terms of equality of results, it is not obvious that the government confers benefits more widely than the market. The gains from trade accrue to all participants. But in government, the net benefits of public policy accrue mostly to those who specialize in influencing and managing the government. Everyone shares the burden of inefficient government. But it is the persons, families and friends of elected officials, bureaucratic managers, lawyers, other professionals who spend part of their career in the bureaucracy or legislature, party regulars, interest group leaders and staff, and the active clientele of projects who appropriate most of the benefits for themselves. Their "iron triangles," as Lowi [7] puts it, are very difficult to penetrate by the non-specialist, e.g., the average citizen or taxpayer. Moreover, the coercive nature of taxation and the governmental hierarchy result in gradations of rank and status which are not evidently more egalitarian than market differences of wealth and class.

Our view is that markets constitute the most efficient mechanism for allocating resources to competing uses. Politics is fundamentally a process for redistributing the gains from production. It responds to majority opinion. It can, under certain constitutional conditions, be used to protect the property of persons. Where coastal externalities result from the interdependency of the littoral drift, government can enact and enforce just laws for appropriating the sediment. It is to solve this problem that we devote the last two sections of the paper.

IV. A System of Sand Rights.

The interdependencies among property owners and governments along a coast are very similar to those experienced by water users in the arid regions of the United States. There water is very scarce relative to land, leading to investment by private parties and governments to capture or appropriate

it for specific use. With the exception of instream uses, this is accomplished by diverting water from its natural course for irrigation, municipalities, industry, and mining. The water, once used by the appropriator, returns to the hydrologic cycle for additional use. Upstream diversions usually reduce the volume and quality of water downstream. Some water is lost through evapotranspiration; pesticides, filings, bacteria, and salts are among pollutants added during the process of diversion and use.

Economically, these "environmental" effects are simply part of the cost of producing the goods to which water is an input. Their presence has to be weighed against the benefits of additional agricultural and industrial products, lawns, flowers, and from cleaner cities. In order to estimate or price this cost, it is necessary to have a system of property rights. The law of water in the West illustrates what can be done in this regard.

In the arid portions of the United States, water is treated as property according to the American Doctrine of Prior Appropriation. [3,5] This body of law assigns individual rights to divert a specified volume of water from its natural watercourse. Following Locke's philosophy [6], priority is given according to the rule "first in time, first in right," provided the water is put to beneficial use and not allowed to go to waste.

The rule apparently originated in 1850 among California miners competing for gold. What worked for mining claims was later extended to water and grass. [8] Subsequently, state constitutions, legislation, and courts incorporated these principles in what Webb described as a "revolution" in water law. [12]

Locke, as well as contemporary economists like Anderson and Hill [1], argue that the origin of the appropriation doctrine lies in the relative scarcity of water, which induces miners, irrigators, and cattlemen to make more efficient use of it. Trading in water rights becomes mutually beneficial to buyers and sellers alike.

Today these rights are bought and sold within states and irrigation districts for a great variety of purposes, including the supply of vast metropolitan areas. If a downstream user - be it a city or an irrigator - finds it more profitable to use water on his land than the upstream appropriator does on his, he leases or buys all or part of this right for his own use. Differences in productivity lead to differences in the price users are willing to pay for water in different areas or for different purposes. In response to price differentials, water is physically transported in canals from areas of low to areas of high productivity of water. In California, aqueducts and canals extend for hundreds of miles, from the Arizona border to Los Angeles. Throughout the West, private and government dams capture flood water for use at more productive use later in the growing season. State water codes and offices enforce the annual distribution of the "water crop" among appropriators and local governments. Interstate compacts divide the water of large rivers, like the Colorado and Rio Grande in the Southwest. Treaties apportion rights to water between the United States and Mexico. [3,5]

Engineers, historians, economists, lawyers, and social scientists have for decades studied various aspects of this institutional system. [3,5,8,10] Few remain unimpressed by the remarkable ingenuity of these legal adaptations to arid conditions. This is not to say that the system is without flaws. [3,5] But it appears to have worked remarkably well in appropriating and marketing a commodity which, in the humid East, was until recently too plentiful to warrant such elaborate institutions.

We suggest that a transfer of Western water institutions to the coast would increase the efficiency of beach use as sand becomes more scarce relative to demand. We observe no physical obstacle to the appropriation and regulation of sediments along the same principles used for water in the West. All that is required is the adoption of constitutional rules of property and government for the coast that are already at work in the desert.

In the case of beaches, submerged land and the right to capture and dispose of sediment are the commodities most feasibly appropriated. What is required are state and federal policies for turning over their coastal domains to private appropriators and local units.

We conclude our paper with a list of suggestions for a new constitution for the coast. We confine applications only to beaches. However, the same principles can be applied to other resources, including oil and gas, ocean minerals, and fisheries, which would be beyond the scope of this paper to examine in detail. [4]

V. A Suggested Constitution for the Coast.

A constitution assigns rights of ownership and authority. It divides claims to resources between and within the government and market systems.

Rights to Property

(a) A right to capture, alter the course of or dispose of a body of sand is a property of individuals and other legal entities like local, state, or federal governments. This right is defined in terms of volume of sand. Individuals and governments are free to capture or dispose of sand provided the property of others is not violated.

(b) The right to dig or deposit sand from or on the continental shelf of the United States is a property of individuals or governments. This right is defined in terms of square feet, kilometers, or miles of submerged land.

(c) All individuals and governments currently handling sand in disposal, diversion, beach protection, restoration, preservation, and development have as much right to capture, divert, dispose, etc., as the volume they now control.

(d) In cases where rights to sand exceed the available volume, conflicts are settled by priority. If, for example, the dredging of a channel up the coast has the physical effect of reducing the volume of sand which another individual claims for his beach, the right to handle or possess sand is determined by priority. Who owns the prior right? Inevitably, any rule for assigning prior rights is arbitrary. In the West, the first to divert water

from a stream acquired a higher or senior right to subsequent appropriators. Later, state governments introduced qualifying criteria which assigns priority among uses otherwise equal in time, e.g., domestic use takes precedence over irrigation, which in turn has a higher right than industry. In California, riparian owners have a claim to water independent of time. Along the coast, similar combinations of rules might be adopted. For example, all developed riparian coastal property may be assigned an equal right to appropriate a given volume of sand regardless of priority. These claims may be pooled together for the purpose of cooperative or corporate projects to protect or nourish the beach.

(e) Individuals, corporations, governments, and other legal entities are free to trade sand rights. Sand rights are marketable commodities subject to laws and regulations as any other.

These rules of property would induce individuals and governments to invest in beaches, protecting existing beaches and constructing new ones along the coast or further offshore. The technical power of engineers can reshape beaches in much the same manner it has changed the landscape of the West.

Rights of Authority.

(a) The States exercise sovereignty over sediment within their borders and over submerged lands twelve miles beyond the high tide water mark.

(b) Sand and submerged land rights are registered with the State or county and treated in the same manner as real-estate or other form of property. A state agency, such as Florida's Bureau of Beaches and Shores, can be entrusted the task of apportioning rights among existing appropriators and local units subject to court resolution. The Bureau shall continue to recognize new rights until the entire volume of sand is appropriated. It shall investigate the engineering feasibility of sand transfers, importation, or manufacture. It shall recommend to the State what policy shall be implemented in settling county jurisdictions over sand as well as relations with other States. And it shall exercise whatever other responsibilities over sands the legislature grants it.

(c) A majority of property owners in an area within a certain distance from the high tide water line, e.g., 1000 feet, can vote to form a special beach district with the power to tax and issue bonds for the purpose of beach protection, nourishment, and replenishment. The constitutions of California's many local water districts can be used as examples.

(d) In case of large sand systems flowing through more than one state, interstate agreements, contracts, or treaties shall divide jurisdiction among the states so that each has a fixed share of the volume of sediment in the littoral drift. Interstate compacts dividing the waters of the Colorado, Rio Grande, and other rivers can serve as models.

(e) Federal agencies who are owners of sand rights along navigation channels, national parks, harbors, etc. are subject to state sand laws, subject to federal court resolution.

(f) The federal government, by virtue of its ownership of the continental shelf, has an additional share of sand rights. The courts shall determine what this share shall be, but in no case shall it exceed 10 percent of the available volume.

(g) The federal government is free to regulate the sand market as any other market subsumed under the commerce clause of the constitution.

The legal work that the adoption of this constitution would require is formidable. The cost of such labors, however, stand to be well compensated by the new private and government benefits that will be generated from the greater efficiency of coastal and beach economies. The history of 19th century United States was largely one of private appropriation of a new continent. The closing of the 20th century could revive these policies for the new colonization of the continental shelf and the deep ocean beyond.

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