ECONOMIC CONSIDERATIONS AFFECTING WILDLIFE HABITAT RECLAMATION IN FLORIDA'S PHOSPHATE MINING INDUSTRY[1]

by

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Abstract. Phosphate mining in Florida is a major industry affecting thousands of acres of fish and wildife habitat each year. Reclamation has traditionally favored the creation of simple grassland or forest plantation systems that are relatively inexpensive to create and in tune with the principal land uses in each of two distinct mining districts. However, international market conditions have set the industry on an economic decline that will likely result in increased emphasis on reclamation cost savings and recreational land uses. It is expected that this will positively influence habitat reclamation in the industry. This paper describes the present economics and costs of reclamation in the Florida phosphate industry and presents a scenario of how habitat-specific reclamation might be improved in response to the changing economic setting.

Additional Key Words: economics, wildlife, habitat, reclamation.

Introduction

Florida's phosphate mining industry has a major influence on habitat changes taking place over extensive areas of land in its central and north Florida mining districts. The Florida mining industry accounts for about 76% of U.S. phosphate rock production and this has accounted in recent years for about 15% to 20% of total world production (Stowasser 1986). Florida reserves are mined from open pits at a rate that ranged from 5,000 to 6,000 acres per year during the mid-1970's to mid-1980's (Fla. Dept. of Natural Resources 1989). However, a recent economic downturn and ensuing changes in the international fertilizer market reduced U.S. operations in 1986 to 63% of capacity. The result was a period of mine closures, sales, mergers, and product shifts, some of which continue to this day.

While the expectation is for the industry to again peak in 1990, the depletion of the high grade reserves most in demand on the new international market should bring about a steady drop in Florida production to about 30% of the 1990 peak by the year 2010 (U.S. Bureau of Mines 1989). This decline in production will likely stimulate industry promotion of environmental and land use values of reclaimed land, while adding additional incentives to reduce reclamation costs. These emerging economic trends could have a positive effect on habitat reclamation in the state by encouraging more low-cost, higher-relief landforms and hunting and fishing land use options that are attractive to the public for recreational purposes.

Phosphate Mine Reclamation

Recreational Potential

The recreational potential of phosphate mined lands in Florida has been well

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demonstrated and publicized. Based on our own survey, there are presently 12 state, county, and municipal parks and reserves on mined lands totaling 11,295 acres. Most of the smaller parks are used for fishing, picnicking and team sports, while the larger parks and state reserves include hunting, hiking, camping and nature study in their land use plans. Of the 11 companies presently in operation, 6 have private sportsmen's clubs controlling recreational access which is generally limited to mine company employees or their guests. Public hunting or fishing areas have, however, been operated in both mining districts. In each instance, public demand for hunting or fishing opportunities far exceed their availability.

While phosphate companies have shown their ability to create attractive recreational lands and would likely want to expand public use and appreciation of their holdings as reserves are depleted, it becomes a question of how to meet the recreational land use demand under the regulatory and economic constraints under which the reclamation programs must operate. In other words, is the demand compatible with environmental regulations, and can it be achieved at a cost and potential return on investment sufficient to be an economically viable option?

Reclamation Regulations

Of the various administrative rules covering reclamation practices of the Florida phosphate mining industry, the two that most explicitly affect the extent of post-reclamation habitats are the requirements that wetlands be replaced on an acre-for-acre basis and that upland forest be established over at least 10 percent of the total upland area. The state's pre-mining regulatory review process also requires either preservation or full replacement of critical habitats - especially river or stream channels, floodplains, and unique, xeric (dry and sandy) scrublands.

Protection of Florida's natural lakes and streams also has brought about an increased regulatory demand for whole watershed planning aimed at minimizing mining-induced changes in the quality or quantity of site runoff or discharge. Implicit in these regulatory objectives is an emphasis on replacement of pre-mining watershed boundaries and topographies. However, except for those instances where a site's design might affect regulated water quantity or quality goals, there are no requirements on how land uses must be arranged on the landscape. However, the state does encourage creation of greenbelts and wildlife corridors, and the incorporation of lake, wetland and stream projects into the comprehensive design for a whole watershed.

One other important reclamation regulation from a fish and wildlife standpoint is the "wildlife areas" rule. This rule would allow a landowner to designate specific areas of a mine as wildlife habitat, and include a plan for the reclamation and management of sites so designated in the usual state reclamation application. For such areas, slopes, revegetation and erosion control requirements may be waived or modified on a case-by-case basis where such changes will benefit the overall plan for production of wildlife. The intent of the rule is to allow a mine owner the option of retaining environmentally compatible, but obviously mining-induced landforms that might inherently offer greater habitat or recreational values than those resulting from other regulations aimed at replacing pre-mining landforms.

Reclamation Costs

Earthmoving is the most energy demanding and most costly aspect of reclamation. Based upon formulas used for the reimbursement of reclamation costs in the state-funded, abandoned lands program, on-site earthmoving can be 7 times more costly than revegetation. Where fill also must be pumped in from elsewhere in the mine to replace mining voids, this can add substantially to the total reclamation costs. However, backfilling is usually accounted for as a production cost since it may be considered as part of the mine waste disposal process.

In Florida, sand and clay tailings from ore beneficiation are suitable materials for use in backfilling. These materials are pumped into a reclamation site at a cost determined by the number of kilowatt-hours needed per ton-mile pumped. As a scenario based on figures from one central Florida company, backfilling with sand tailings can average almost $12,000/acre. This is based on a mining void that typically requires 15 acre-feet of material to reach pre-mining grade, an acre-foot of sand tailings that weighs 2,393 tons, 2.2 kilowatt-hours/ton-mile

that is required for pumping, the cost of a kilowatt-hour that can run up to $0.05, and a reclamation site that averages about 3 miles from the mine plant. From this, it can be seen that a requirement that pre-mining topography be restored in remote areas of a mine can be a costly reclamation objective.

While revegetation costs cannot match earthmoving costs, they can represent a considerable per acre expenditure depending upon the complexity of the vegetation type being targeted. Obviously, it will cost more to reclaim a multi-layered forest than a simple grassland or timber plantation, and each technique used to establish the stand will add to the total reclamation cost. Generally, the greater the regulatory demand for a particular community type and the more extreme the soil moisture conditions under which it must be established, the more subsidy required to create the stand and the more costly the revegetation program.

Grassing is the most widely used revegetation practice in central Florida, with costs reported at between $75 and $150 per acre (from an informal survey of several leading companies). In north Florida, where pasture is not a common reclamation goal, grassing costs can run considerably higher. Establishment of a stabilizing ground cover may be required in any revegetation program and thus, grassing may be an additive cost even in projects aimed at self-managing communities.

Establishment of native herbaceous species also is required of most permitted habitat creation efforts, although the standards for success are generally negotiated on a case-by-case basis. The methods used are either direct planting, topsoiling, or sometimes both. Transplanting of herbaceous wetland species acquired from off-site habitats is the typical method of obtaining plant material for wetland reclamation. Costs are reported to range from approximately $100/acre to $750/acre. Transplanting costs for upland species would fall within the same broad range, although too few such projects have been completed to provide an industry-wide estimate. Mulching with topsoil is regarded as a more effective method of introducing vegetation, but it is more expensive. Reported costs range from $800/acre to $2000/acre.

For successful forest establishment, 200 trees/acre are required for uplands while 400 trees/acre are required for wetland forests. Twice as many trees are usually planted to assure adequate survival with reported costs ranging from $500/acre to more than $1600/acre. Tree planting costs in the forestry-dominated northern district tend to be significantly less. However, in both mining districts, higher mortalities on harsh wetland or xeric sites often can require costly replanting.

A final element of reclamation costing is the program design work. Here, the cost does not depend upon the site's final layout. Yet a site design can have considerable influence over the wildlife habitat values achieved in any particular program. Given any land use acreage goal, there may be any number of site design options, each having some distinct value to a particular fish or wildlife assemblage. Design considerations for the "cost-free" enhancement of reclaimed habitat values have been developed for the industry (King et al. 1985), and, based upon comparison of earlier plans with more recent plans submitted to the state for approval, incorporation of these design enhancements is occurring (Marion and King 1988). Wildlife travel corridors, valuable community edge combinations, and isolation of proposed habitats from areas with high land use potential can help increase fish and wildlife values while minimizing conflicts with developing, post-reclamation land uses.

Incentives for Habitat Reclamation

Beyond incentives offered by the state's regulatory processes, the extent and quality of habitat reclamation in Florida depends upon its economic justification to the company or private landowner holding the mined lands. Either the necessary habitat infrastructure must be a non-interfering, low-cost part of a viable economic sub-system, or it must be capable of generating its own financial return.

In central Florida, native rangeland and forest habitats are declining in the post-reclamation landscape (Table 1) because the potential return on investment of reclaiming to these vegetation types has not met the demonstrated costs. Cattle ranching is a leading land-use in the region; and, in reclaimed by habitat/land use type in Florida the pre-mining situation, native range provides grazing land that needs little management. On

Table 1. Reclamation in Florida's phosphate mines by habitat/land use type, 1975-1989.

Habitat/Land Use Type	Acreage Reclaimed
Forested Uplands	5,232
Non-Forested Uplands	19,739
Herbaceous Wetlands	2,025
Forested Wetlands	2,510
Lakes	4,188

Source: Florida Department of Natural Resources (1989 pers. comm.)

the other hand, reclaiming to a similar rangeland vegetation type requires either topsoiling or intensive herbaceous plantings (or both), and can be considerably more costly than reclaiming to pasture. It has yet to be shown whether any long-term savings in land management expenses for reclaimed rangeland can fully offset the increased reclamation costs.

Timber sales might provide an added incentive to reclaim to forest or multiple-use (e.g. cattle/timber/game), although volume yield tables for typical reclaimed sites in the central district have not yet been developed. There have, however, been numerous tree plots established over the years for demonstration or research purposes. These plots demonstrate the ability to establish stands of commercial pines over most reclaimed sites and the potential of establishing hardwood stands on clay or sand/clay mix tailings ponds that cover a majority of the post-mining landscape. While hardwood timber is not currently grown in sufficient volume to be a viable commercial product in central Florida, there are many local buyers that presently rely on shipments of hardwoods from the north. If yields from these unique but extensive clay sites should prove sufficient to offset the cost of transporting needed timber into the region, then the incentive to reclaim to forest land might be sufficient to overcome the decline in forested habitats presently occurring in the area.

But, management cost savings and potential timber harvests are not the only incentives that can be applied to rangeland and forest reclamation. Leasing land for hunting purposes is a growing practice in the south and southeastern U.S., with over 50% of the privately owned land in Florida leased for hunting (Wiggers and Rootes 1987). Based on a survey of hunting lease arrangements in Florida (Marion and Gates 1988), average returns for hunting leases were $2.29 in 1984, but average returns of up to $5.00/acre/year are not uncommon. The highest lease returns in the state occur near the central mining district (Table 2). A diverse rangeland or forest community can offer more hunting potential than a pasture, and hunting lease arrangements can be compatible with grazing and timbering schedules. Given the growing

Table 2. Average prices per acre for leasing access for hunting in Florida, 1984.

District	Average lease prices/acre
Florida Panhandle	$1.69
North Florida	$1.32
Central Florida	$2.73
South-Central Florida	$2.34
South-West Florida	$1.74

Source: Marion and Gates (1988).

demand for outdoor recreational opportunities in the state, and the potentially increasing incentive within the industry to promote a wider range of land use options, it may be that consideration of hunting lease returns could justify further development of cost-effective rangeland, forest or multiple-use options for reclaimed uplands.

Reclaimed lakes and wetlands, on the other hand, have proven to be attractive, sought-after hunting and fishing areas in both regions of the state. The extensive areas of open water that typify active clay ponds and unfilled mine cuts, maintain large populations of waterfowl and sportfish that can support some of the best hunting and fishing in the state. They also can support a level of recreational use that is attracting local entrepreneurs. At one recently closed mine, the corporate landowner is leasing 1400 acres of former mine pits for bass fishing at a rate comparable to local grazing leases, and two- to three-times greater than the average hunting lease return (Marion 1989). The lessee, in turn, is offering access to the site to the fishing public for a daily fee. At another 540-acre abandoned mine pit area, a sportsmen club has purchased the site from the corporate landowner and is having it reclaimed to private hunting and fishing through the state's abandoned lands program. These are but the initial examples of what may be a growing trend toward fish and wildlife habitat reclamation for recreational use in Florida's changing phosphate mining economy.

Outlook for Habitat Reclamation

Habitat reclamation in Florida has shown improved sophistication in planning accuracy, implementation technique and impact mitigation potential over the past decade (Marion and King 1988). Nevertheless, substantial habitat and land use changes have been an inherent part of the traditional mine economic setting. Whether a higher future proportion of land is devoted to fish and wildlife use will depend on incentives that emerge in a changing economic setting. These incentives would need to either increase the regulatory requirement for habitat acreage or value, lower habitat reclamation costs, or provide a higher return on investment for habitat objectives.

The outlook for mining and reclamation permits requiring greater habitat reclamation in the future is not overly promising. Critical habitats are either being preserved or restored on an acre-for-acre basis under the current regulatory structure. While there is consideration being given to requiring more than even compensation for some wetland mitigation projects, this is meeting considerable opposition and would likely conflict with the existing regulatory emphasis on restoring pre-mining drainage patterns and rates.

The outlook for lowering habitat reclamation costs seems more promising. Experience in habitat reclamation has grown in the industry since the first wetland habitat projects were undertaken in the late 1970's. With this experience has come improved program design, better planting success, and a more cost-effective set of reclamation practices.

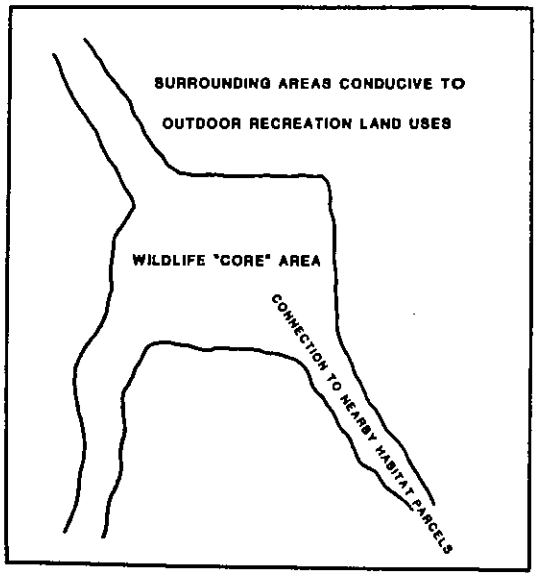
Taking further advantage of habitat values that can be gained from an effectively planned program design also can occur. Computational algorithms that assess the habitat value inherent in a site's landscape design are beginning to emerge in the literature and soon could be employed in the industry to help optimize the planning of individual programs for wildlife.

Beyond the cost savings from added experience and expertise in optimizing habitat reclamation programs, there could be a cost saving and financial return incentive from any trend toward increased recreational land use. Although hunting and fishing leases are not, in themselves, a high return land use, they are compatible with forestry or cattle grazing under multiple use scenarios. The added return from hunting and fishing leases could help justify the added expenses of reclaiming to the forest and rangeland vegetation types most in decline in the state due to mining. In addition, most of the recreational use of phosphate mined lands is water-oriented, or located on the more aesthetically pleasing lands surrounding waterbodies. If more of this type of opportunity is desired, then this will undoubtedly translate into a reclamation objective calling for more waterbodies and wetlands. The potential savings from not having to backfill mined lands to pre-mining grades could be considerable.

A possible scenario for the future might be for the industry to take greater advantage of the state's "wildlife areas" rule to create large tracts of relatively inexpensive, publicly-owned, recreational lands. Such tracts would

need to be situated in areas where they complement a region's natural drainage patterns, and be of a size sufficient to justify their acquisition and management as public lands. Surrounding lands could, in turn, be reclaimed as a habitat priority, land use buffer allowing private, recreation-oriented enterprises and supplying connections to other significant habitats in the region (Fig. 1). Whether the industry undertakes the scale and degree of land planning necessary to justify and implement this scenario will depend, in the end, on social demand and economics.

Fig. 1. An aerial view of an area showing beneficial wildlife habitat features.



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