A STUDY OF VOTER ATTITUDES TOWARD
DIFFERENT PROPOSALS FOR THE USE
OF AN UNDEVELOPED ISLAND*

Milton D. Seekins
Research Assistant
School of Forest Resources
University of Maine

David A. Storey
Professor
Department of Food and Resource Economics
University of Massachusetts at Amherst

Introduction

Public concern with decisions about the use of land, particularly
if it is undeveloped, is an increasing phenomenon in our society. This
is especially true in the coastal zone, where land and water resources
are extremely limited in quantity and subject to strong and growing
demand, and where there are not only direct interrelationships among
the ways adjacent parcels of shoreland and water are used, but also
indirect interrelationships among various land and water uses that
are effected through complex coastal ecosystems.[1]/ Since the coastal
waters are largely common property resources, there is a particularly
strong rationale for concern about the impact of human activities
upon their availability, quality, and viability within the ecosystem.

Public decisions that affect the use of coastal land and water
resources are made at the local, state, and national levels. In New
England, much of the power to make public land use planning decisions

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1/ Numerous writings have discussed the coastal zone resource alloca-
tion problem. For examples, see Allbee and Storey [1], Devanney
et al [2], and Ketchum [5].

resides at the local level.[2] Citizens of local communities and their
elected or appointed town officials are increasingly faced with both
the right and the necessity to determine the total range of effects of
various land development proposals. Often, the determinations must be
made in the face of conflicting claims from pro- and anti-developmental
groups and in the absence of conclusive scientific studies of the im-
pacts of the proposed developments.

This study deals with voters' perceptions of the impacts of vari-
ous developmental alternatives for a case study tract of coastal wild-
land at one particular point in time, their resulting attitudes toward
the alternatives, and the dollar valuations associated with those
attitudes. An attempt is made to evaluate relationships between socio-
economic characteristics of individuals and the above measures. Thus,
the purpose is to try to "explain" variations in attitudes and valua-
tions by variations in population characteristics, as an aid to the
planning process in other times and other places.

The study area consists of the two towns of Searsport and Stockton
Springs, Maine. They are located at the northern tip of Penobscot Bay.
Lying within the jurisdication of the town of Searsport is a thousand
acre privately-owned island called Sears Island. This island is unin-
habited and contains a population of birds, small mammals and deer.
It has been used as a camping site and hiking area, a picnic area, a
clam digging site and a hunting area. It also provides a scenic view
to both towns.

In 1971, meetings were held in Searsport and other towns in the
area to discuss an oil refinery that had been proposed for the island
by Maine Clean Fuels Company. This proposal initiated a great deal of
controversy throughout Waldo County, in which the towns are located,
and the rest of the state as well. Facts concerning the refinery and
its potential effects on the bay and the safety measures that the
company was prepared to take to prevent pollution were presented to
the Maine Environmental Improvement Commission. The information
brought out led to a refusal by the Environmental Improvement Com-
mission to allow the refinery, because it could not guarantee that
there would not be serious pollution damage caused by the location
of the plant on Penobscot Bay. Maine Clean Fuels appealed the de-
cision. The refusal was reviewed and finally upheld in the Maine
courts.

2/ Under the National Coastal Zone Management Act of 1972, most
   states are developing comprehensive state-level management
   programs for coastal zone resources. However, the actual pro-
   grams in New England states may consist largely of local manage-
   ment subject to state review.

The controversy also brought forth suggestions for alternative uses for the island. Among those suggested were that the towns seek another industry that would be "clean," that the area be turned into a park and recreation area, and that it be set aside as a wildlife refuge. However, at the time that empirical data were collected for this study (1973-74) the refinery was still a possibility, and no alternative proposal was in concrete form.[3]

This area provided a case where a piece of undeveloped land had been proposed as a site for several types of development, so that prior to the study the people had already had an opportunity to do some thinking about what was a good use for such a piece of land. The tract of land was well-defined, and any use would be plainly visible to the communities. For these reasons, the area seemed a good choice for a case study.

Research Procedure

A random sample of 100 people was selected from lists of registered voters in the two communities. Interviews were conducted to obtain data on the variables described in Table 1. Usable responses were obtained from 77 voters. Then Chi-square and linear regression analyses were used in an attempt to discover statistically significant relationships.

Basically, the model used in the study asserts that people's values and attitudes toward natural resource uses are related to their social and economic situations as well as to their general attitudes and opinions (see Rostron [8] for further discussion of this view). In equation form, the model is:

(1) $Y_j = a_j + b_{1j} X_1 + b_{2j} X_2 + \ldots + b_{17j} X_{17} + u_j$

where Y_j = one of the dependent variables described in Table 1

$j = 1, 2, 3, 4$

X_i = one of the independent variables described in Table 1

a_j = the intercept for the jth equation

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[3] Subsequent to the conduct of the empirical portion of this study, a nuclear power plant was proposed for Sears Island. This is discussed in the postscript at the end of this article.

Table 1

Description of Variables Included in Sears Island Study

Variable number	Description of Variable	Unit of Measure
Y_1	Vote on a proposal to allow an oil refinery on Sears Island	Yes or no
Y_2	Vote on a proposal to allow other, non-polluting industry to locate on Sears Island	Yes or no
Y_3	Vote on a proposal to purchase Sears Island for use as a park or wildlife refuge	Yes or no
Y_4	Willingness to pay increased property taxes so that town could purchase Sears Island for use as a park or wildlife refuge	Annual dollars
X_1	Age	Years
X_2	Education completed	Years
X_3	Length of residence in area	Years
X_4	Income	Annual dollars
X_5	Property taxes paid	Annual dollars
X_6	Dependency of income on Penobscot Bay region environment	Yes or no
X_7	Distance of residence from Sears Island	Miles
X_8	Distance of place of work from Sears Island	Miles
X_9	Expected effect of oil refinery on property taxes	Up, down, or no change
X_{10}	Expected effect of oil refinery on property value	Up, down, or no change
X_{11}	Expected effect of oil refinery on income	Up, down, or no change
X_{12}	Expected effect of oil refinery on Penobscot Bay environmental quality	Good, bad, or no change
X_{13}	Estimate of percent of town population that would vote in favor of oil refinery	Percent
X_{14}	Estimate of percent of town population that would vote in favor of other, non-polluting industry	Percent
X_{15}	Estimate of percent of town population that would vote in favor of purchase of Sears Island for use as a park	Percent
X_{16}	Estimate of percent of town population that would vote in favor of purchase of Sears Island for use as a wildlife refuge	Percent
X_{17}	Estimate of percent of town population that would vote in favor of zoning Sears Island for non-industrial, non-commercial use	Percent

b_{ij} = the unknown parameters associated with the ith explanatory variable in equation j

u_j = the stochastic error term in equation j

Prior to conducting the regression analyses which would quantify the a's and b's in the above model, the Chi-square test for independence was conducted on all possible pairs of variables. In addition, Chi-square analysis was used to test the difference between the responses of the two towns. The differences were not found to be significant, and therefore the towns were treated as a single population in the subsequent analysis.

The Chi-square analysis showed which variables were interdependent and the direction of the association. The independent variables that showed significant relationships with at least one of the dependent variables were then used in the linear regression analysis. In other words, the Chi-square analysis resulted in reformulation of equation (1) so that not all the X_i's were included.

Empirical Results: Voting Preferences and Willingness To Pay

The sample data collected for Sears Island in 1973-74 indicated that about 40 percent of the voters in Searsport and Stockton Springs favored the development of an oil refinery, about 80 percent of the sample was in favor of some kind of use of the island as long as it would not involve any major pollution threats to the bay and the surrounding area, and about 56 percent of the sample from the two towns was in favor of the purchase of Sears Island by the towns for use as a park or a wildlife refuge. If voting was to be the basis for decision making, the refinery was not a viable proposal for Sears Island in 1974, but other, non-polluting development was favorably viewed, and a park or wildlife refuge was approved by a slight majority of the voters.

The average amount each individual indicated he or she was willing to pay in additional property taxes for the land purchase was $16.63 per year over a 20 year period.[4/] Based on this, the total willingness to pay of the resident voter population of the two towns was estimated to be about $31,766 per year for 20 years. This value corresponds to a discriminating monopolist's revenue; i.e., it is the revenue that a monopolist would receive if the monopolist charged each person the exact amount that he or she would be willing to pay for a specified use of the island. The discriminating monopolist's

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4/ The average is for all 77 individuals in the sample, including 34 with zero willingness to pay and 43 with a positive willingness to pay.

revenue is an estimate of the total area under the demand curve, is conceptually equivalent in this case to consumers' surplus, and permits an economic comparison with other possible uses of the area (for further discussion of this, see, for example, Lerner [7].) This indicates that in 1974 if the towns could have purchased the island for $31,766 annual cost or less, the purchase would have been economically justifiable. Of course, the figure would be more fully meaningful if the values associated with other uses were available for comparison. It is possible, for example, that the oil refinery value to the towns would have been higher, although the oil refinery was not an acceptable proposal if the use of Sears Island was to be consistent with the majority vote.

Another caveat deserving of mention is that the sample included only voting residents of the two communities adjacent to Sears Island. Not included were non-voting permanent or summer residents of the two towns, residents of surrounding towns, visitors, or anyone else with interest or concern about what happens in Penobscot Bay. At least some of these people had opinions and associated willingness to pay that were not uncovered in this study.

Relationships Between Population Characteristics, Voting Preferences, and Willingness to Pay

As would be expected, the dependent variables Y_1, Y_3 and Y_4 were revealed to be strongly interrelated by the Chi-square analyses. As might be expected, many independent variables also were also revealed to be strongly interrelated by the Chi-square analyses, some to the point that they were possible substitutes for one another in the regression analyses.

When the three dependent variables Y_1, Y_3 and Y_4 were compared individually to each of the independent variables and Chi-square tests for independence were performed, a number of marginally significant (.1 level to .25 level) relationships resulted, but relatively few were significant at the .05 level or better. The strongest relationships noted were between Y_1 and X_2, X_3, X_9, X_{10}, and X_{12}, between Y_3 and X_2, X_8, and X_{12}, and between Y_4 and X_{12}.

The vote on the proposal to allow other, non-polluting "light industry" to locate on Sears Island (variable Y_2) was also compared to the other variables. However, no statistically significant relationships resulted. Apparently the question was so general that it meant different things to different people. Since the "light industry" proposal did not give any meaningful results in the Chi-square analyses, it was not included in the regression analysis.

The multiple linear regression analysis was begun by regressing each dependent variable against all independent variables that the Chi-square analyses had shown to be significantly related at the .25 level or better. Then those variables that were noted as

being substitutes for one another were grouped and used one at a time
in the regressions. The variables with regression coefficients that
were not significantly different from zero at the .05 level or better
were then generally eliminated.5/ The remaining variables were tried
in several combinations, and the "best fit" equations were chosen from
these by examination of the R^2, F, and Durbin-Watson statistics. Only
linear formulations were attempted. The "best fit" equations are sum-
marized in Table 2.

The coefficients of determination (R^2) for the three "best fit"
equations were relatively low, as they ranged in value from .36 to
.52. Part of the reason for the relatively low R^2's in the equations
for voting outcomes (Y_1 and Y_3) is the discrete nature of the data.
The values given for the dependent variables Y_1 or Y_3 are limited to
zero or one in each case, whereas the functions represented by the
regression equations are continuous and can take on any value.6/
More generally, it should be noted that low R^2 values are fairly
typical of cross-section household analyses, because of large differ-
ences among individual people that cannot be explained by conventional
socio-economic theory (for an example of comments on this, see Klein
[6]).

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5/ The shortcomings of this kind of "exploratory data analysis" have
    been cogently described by Freund [3] and Freund and Debertin [4].
    In the latter, it is pointed out that " ... if enough variables are
    initially used in a data-dredging operation, ultimately a model will
    be obtained in which most, if not all, of the estimated parameters
    are 'significant'" [p. 722]. However, no acceptable alternative was
    known to us, and, as Freund and Debertin noted, the t-values are
    still useful as indicators of relative contributions of associated
    variables even though their actual values are distorted.

6/ A second limitation of the approach which belatedly came to our
    attention is that ordinary least squares is not strictly appro-
    priate when the dependent variable takes on a "yes-no" form which
    is quantified as either one or zero. In this case, the disturbance
    term in the regression is not normally distributed, hence the ordi-
    nary least squares estimators of the regression coefficients are
    not normally distributed, and therefore significance tests based
    on the t-distribution are invalid. One alternative is use of a
    technique called Probit analysis. However, the results of Probit
    compared to ordinary least squares are unlikely in most cases to
    be drastically different (see Willis and Crawford [9]).

Table 2

"Best Fit" Regression Equations for
Vote on Refinery, Vote on Land Purchase,
and Willingness to Pay Additional Property Taxes
for Land Purchase.

Item	Dependent Variable		
	Y_1 Vote on Refinery (No = 0, Yes = 1)	Y_3 Vote on Land Purchase (No = 0, Yes = 1)	Y_4 Willingness to Pay Additional Property Taxes (Dollars)
	(Regression Coefficients and Standard Errors [in parentheses])		
Independent Variables			
X_2 Education (Years)	-.0840 (.0180)	+.0669 (.0180)	+2.7900 (1.2700)
X_5 Property Taxes Paid (Dollars)		-.0006 (.0001)	+.0500 (.0100)
X_6 Dependence of Income on Environment (Yes or No)			+19.9800 (7.8200)
X_7 Distance of Residence from Sears Island (Miles)			+2.7300 (1.3500)
X_{10} Effect of Refinery on Property Value (Decrease or no Decrease)	-.2409 (.1200)	+.1980 (.1240)	
X_{13} Expected Percent Voting Yes on Refinery	+.0060 (.0020)		
X_{15} Expected Percent Voting Yes on Land Purchase		+.0055 (.0019)	-.4100 (.1500)
Other Statistics			
Constant	+1.3290	-.3870	-18.5600
R^2	.366	.360	.519
F	14	10.1	7.95
Durbin-Watson	2.26[a]	1.99[a]	1.71[a]
n	77	77	43

[a] Indicates no autocorrelation at .10 level of significance.

The signs of the regression coefficients were generally in accordance with *a priori* expectations (with the exceptions noted below) and consistent with the results of the Chi-square analyses. The signs of the regression coefficients in the equation for Y_1 indicate that the likelihood of a yes vote for the refinery decreases as education increases, decreases if the individual expects the refinery to reduce the value of his property, and increases as the individual's estimate of the percent voting yes for the refinery increases. In the equation for Y_3, the signs indicate that the likelihood of a yes vote for the land purchase for a park or wildlife refuge increases as education increases, decreases as property taxes paid increases, increases if the individual expects the refinery to reduce the value of his property, and increases as the individual's estimate of the percent voting yes for the land purchase increases. A consistent pattern emerged from the results of these two regressions, as an opposite type of relationship occurred for independent variables X_2 and X_{10} with respect to the two different dependent variables.

Education was also positively related to Y_4 (willingness to pay additional property taxes for the land purchase); that is, the coefficient indicates that willingness to pay increases as education increases. The positive signs on the regression coefficients for X_5, X_6, and X_7 indicated that willingness to pay increases as property taxes paid increases, as the distance of the residence from the island increases, and as the individual answers yes rather than no to the question of whether his income is dependent on environmental quality. While two of these relationships seem straightforward, the increased willingness to pay on the part of people living further away from the island requires further explanation. The Chi-square analysis had indicated that willingness to pay was lowest for those people in the two mile zone (the zone which included the centers of both communities) and increased as you moved in either direction from this zone. There is no apparent logical explanation for this, as the initial hypothesis was that the closer a person lived to Sears Island, the more likely that he or she would be willing to pay larger amounts to keep the island in a relatively undeveloped state. The negative relationship between the individual's estimate of the percent voting yes for the land purchase and willingness to pay also is contradictory to the original hypothesis.

It should also be noted that the coefficient for property tax is negative in the regression equation for the land purchase vote, yet it is positive in the equation for willingness to pay. This phenomenon is a result of a relationship noted in the Chi-square analysis of willingness to pay and property taxes paid. As property taxes increased, the percentage of the individuals who were in favor of the land purchase and were therefore willing to pay something decreased. Among those who were willing to pay something, however, the amount they were willing to pay increased as the level of taxes paid increased. The coefficient for the land purchase

question, then, reflects the tendency in the yes/no vote and therefore
is negative. The coefficient for the willingness to pay equation, how-
ever, represents only those who voted 'yes' and therefore is positive.

The regression equations for Y_1 and Y_3 would generally yield es-
timated values of Y, given particular values of X, that lie between
0 and 1, although a value outside this range is possible in a few
cases. In actuality, of course, the vote must be either a 0 (no) or
a 1 (yes). It seems reasonable at the individual level to interpret
the estimated value of Y_1 or Y_3 as the probability that the individual
would vote "yes" on the proposal. Thus, for instance, a value of .4
for Y_1 would indicate a 40 percent probability that the individual
characterized by the particular values of the X's would vote "yes" on
the refinery proposal. When the results are used with mean values of
the X's to estimate the vote of the population, the Y_1 or Y_3 value
would be interpreted as the percentage of the population that would
be likely to vote yes for the particular proposal.

The linear regression analysis helped to clarify the relation-
ships between population characteristics and population attitudes
about different proposals for the use of the island. However, the
apparent non-linear form of relationships between the dependent
variables and such independent variables as age, income and length
of residence made them difficult to quantify in this manner, even
though possibilities of interdependencies had been indicated in the
Chi-square analyses. For example, young people tended to be against
the refinery and in favor of the land purchase, old people were
against both the refinery and the land purchase, and middle-aged
people were fairly evenly split on both proposals. Thus, age differ-
ences existed, but they were not revealed by the linear regression
model.

Generally, education and expectations about effects of the re-
finery on property value were the most important "explanatory" vari-
ables. Property taxes currently paid also had significant coefficients
in two of the three regression equations. Also, people tended to feel
that the majority of other people had views similar to their own.

More socio-economic characteristics were discarded than retained
in the final equations, and only education appeared as a significant
variable in all three equations. As mentioned, non-linearity of re-
lationships may be part of the explanation. However, we conclude
that to a large degree differences among individuals (call it "Yankee
individualism" if you will) overshadowed differences among groups of
individuals.

Postscript

On July 22, 1974 (shortly after data collection for this study was completed), the voters of Searsport in a special town meeting approved a shoreland zoning plan by a 90 to 25 vote. The zoning was required by state law. Included in the plan was a general development district for all of Sears Island except one 1200 by 125 foot beach section.

On July 24, 1974, (two days after approval of the shoreland zoning) the Central Maine Power Company announced plans to construct a weather monitoring tower on the island. This was the first step toward possible construction of an 1150 megawatt nuclear power plant on the island. By September 1, the tower was visible on the island. After considerable discussion in the ensuing months, the voters of Searsport were given the opportunity to vote in favor or disapproval of the plant at their March 10, 1975 town meeting. The results were 532 in favor and 182 opposed. As of 1976, the plant had not yet been built, and questions about the geological suitability of the site for a nuclear plant and the possible environmental effects of the proposed cooling system were still unresolved.

The 78 percent vote in favor of industrial zoning and the 75 percent vote in favor of the nuclear power plant by the Searsport voters are consistent with the 80 percent of the sample in this study that were in favor of some type of development on the island as long as it would not involve any major pollution threats to the bay and surrounding area. Of course, the "as long as" clause is the key one. Apparently most voters in Searsport do not associate nuclear power plants with environmental degradation or hazards. Unfortunately, the vote on non-polluting development in this study apparently meant different things to different people. Thus, the outcome on this vote was not related to any population characteristic in a statistically significant way, and no further comparisons can be made to the actual 1974 and 1975 town meeting votes. The authors of this study did not know about the power plant proposal, nor apparently did most of the voters of the town, until after the July 1974 industrial zoning of Sears Island.

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