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Interactions between Human Communities and Estuaries in the Pacific Northwest: Trends and Implications for Management

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ABSTRACT: This paper explores social and economic aspects of coastal communities crucial to the management of estuaries in the Pacific Northwest. These aspects include the changing demographics and economies of coastal communities, and the public perceptions, attitudes, and values pertaining to estuarine ecosystems. Information from Willapa Bay and Grays Harbor in Washington and Tillamook, Yaquina, and Coos Bays in Oregon shows that the coastal communities are growing more slowly than the states overall, that the populations are relatively old, and that, although the local economies continue to rely on them, the extractive natural resource industries (fishing, aquaculture, agriculture, forest products) are declining in importance relative to tourism, recreation, and retirement industries. These trends suggest that human uses of the estuaries are changing in character, and altering the management problems. Coastal residents choose to live in these communities to enjoy the views and scenery, to experience rural living, to be near the ocean, and to recreate outdoors. People express coherent perceptions of risks to the estuaries, especially the threats of declining fish habitats, oil spills, shoreline development, invasive species, and logging in upland areas. Residential land values are enhanced by the presence of wetlands and forests and are diminished by the presence of hazardous waste sites. We conclude that, if recent trends in population age structure, income sources, and employment status continue, public attitudes and values will move towards stronger environmental protection. Because ecosystem management involves local public participation and collaboration, estuarine managers will be faced with both increased demands and opportunities.

Introduction

Human communities and estuarine ecosystems are interconnected in essential ways, with feedbacks between the socio-economic and ecological systems occurring in both directions. Human communities affect estuaries through resource use. Residential housing development, agriculture, commercial fisheries, dredging for shipping channels, and upland logging affect the functions and processes of estuaries. Coastal estuaries, in return, influence human communities by affecting which industries are viable, where people live, how property is valued, and what recreation opportunities are available. Scientific knowledge of estuarine conditions and effects of human activities is crucial, because it provides the basis for predicting the outcomes of management actions. Changes in estuaries are largely driven by human uses of the ecosystems, and these uses are driven by values that, along with perceptions of ecosystem conditions and human effects, shape the rules for using and conserving estuarine ecosystems.

From the viewpoint of social science and policy analysis, estuary management is heavily influenced by public perceptions, attitudes, and values. Management occurs through a complex decision making process that requires national, state, and local governments to interact with each other and with citizen committees, land owners, industrial interests, and environmental activists (DePhelps 1996; Imperial and Hennessey 1996; Huppert et al. 1998; Hanna 1999; Curran et al. 2002). Estuary managers attempt to shape and modify the interactions between the social system and ecosystem by regulating economic development, establishing a variety of laws and informal rules for using estuarine resources, informing the public of problems and opportunities, and modifying incentives for conservation. Depending upon circumstances, understanding the status and trends in the human communities may be as crucial to successful estuary management as understanding the estuary ecosystem. Recognition of this dependency explains the increasing support for transdisciplinary studies and integrated coastal management (Cicin-Sain and Knecht 1998).

Placing the roles of natural and social systems in perspective is a crucial first step in integrating social and estuarine sciences. A simple version of the integrated system (Fig. 1) notes that both systems can be described statically (What are the current

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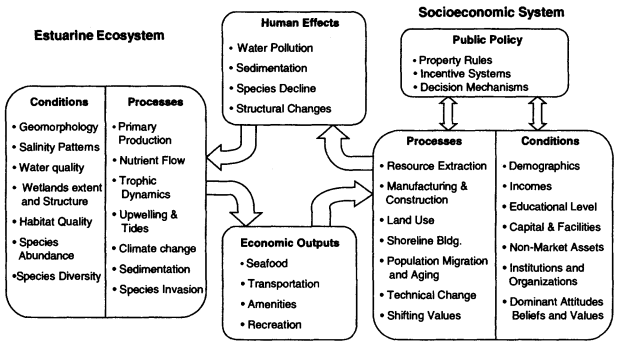

Fig. 1. Schematic of the interacting estuarine ecosystem and socioeconomic system.

conditions of the main system components?) and dynamically (What are the processes controlling trends in the conditions?). Estuaries are characterized by physical dimensions, water quality, habitats, and species abundance and diversity. Human communities are characterized by age distributions, incomes and occupations, educational attainment, capital assets (roads, buildings, machines), natural assets (farmland, timber, fish stocks, beaches), institutions (legal systems, customs), and prevailing attitudes, beliefs, and values. Dynamic processes that control estuarine conditions over time (primary production, nutrient flows, trophic dynamics, sedimentation, climate change, and human effects) have counterparts in the socioeconomic system (resource extraction, land use, migration, technological change, shifting values). Economic activities often cause human effects on ecosystems (pollution, decline in marine species, shoreline structural changes), but they also generate economic goods and services for use by people (seafood, water transportation, visual amenities, protection from storm surges, and recreation). Estuarine science emphasizes careful description of ecosystem components (Smith et al. 2002), the physics and ecology of estuary dynamics, and human effects on ecosystems (Abood et al. 1999; Bilen et al. 2001). Social scientists carefully describe human communities and economies, develop models to predict change, and study the outcomes of a variety of social decision systems. Understanding the linkages between these two systems is a key to effective management.

The socioeconomic system's unique component, here called Public Policy, represents collective decision processes. Important decisions often concern property law, the operation of markets, and rules for resource use and preservation. The decision processes are extraordinarily complicated, because they involve people and organizations at many levels and with conflicting interests, beliefs, and values (McCreary and Adams 1995; Huppert et al. 1998). Social scientists studying marine and coastal resource management are increasingly focused on participatory processes, grounded on common perceptions of problems and understanding of values, that are variously labeled collaborative management (Cortner and Moote 1999; Wondolleck and Yaffe 2000), or community-based management (Gregory and Wellman 2001), or self-governance (Ostrom 1990). Scientific knowledge, of both ecosystems and social systems, helps to inform the policy process to the extent that the participants believe the information is correct and relevant. Before either branch of science can assist in decision making, it must have a well-structured description of system components, a means of assessing the current status of those components, and a plausible explanation of how policy can achieve desired outcomes.

As noted by Good et al. (1999) and Jennings and Jennings (2001), the institutional context for estuary management includes many state and federal laws and agencies. Some key federal laws are the Coastal Zone Management Act (CZMA) administered by the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) through grants to state agencies; the Clean Water Act (CWA), administered by the U.S. Environmental Protection Agency (EPA), and U.S. Army Corps of Engineers; and the Endangered Species Act, administered for marine and anadromous species by NOAA's National Marine Fisheries Service. In Washington, the federal entities work in collaboration with the State's Department of Ecology on water quality standards and enforcement. The Department of Ecology also administers a federally approved coastal zone management plan under the authority of the State's Shoreline Management Act of 1971. In Oregon the Department of Environmental Quality is responsible for monitoring and controlling water pollution. The Oregon Department of Land Conservation and Development is the lead agency for coordinating state ocean-resource management, and it oversees other state agencies for compliance with statewide planning goals, including estuary management plans. In both Washington and Oregon the state governments have devolved some planning authority to local groups of stakeholders in watershed councils. In addition to these institutions, there is a National Estuarine Research Reserves (under EPA) in Coos Bay, and a National Estuary Program (under EPA) in Tillamook Bay. This sample of local, state, and federal entities reflects the complexity of estuarine resource management institutions. All of these management efforts will be, to some extent, driven and shaped by the social and economic trends and interactions described in this paper.

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Our purpose is to analyze the interactions between human communities and the estuarine ecosystem, and to show how changing social trends may impact those interactions and influence future estuary management. Four specific goals are to summarize broad trends in human communities and economies near the estuaries, to describe a range of estuary-based values, perceptions, and activities of coastal residents, to explore the linkages between people and the ecosystem by analyzing survey data on attitudes and perceptions and personal characteristics of residents, and to document links between land prices and surrounding environmental conditions. Using the demonstrated trends and relationships, we can anticipate future trends in perceived estuary management problems and social pressures for protective measures.

Data and Methods

The information used in this research is of three main types: data collected by federal, state, and local governments aggregated over geographic areas such as counties, metropolitan areas, and census tracts; individual data collected directly through surveys and interviews of coastal residents and knowledgeable experts in the region; and property value and characteristics information derived from county property tax assessors offices and from geographical information system (GIS) data coverages. The first type of data, often termed secondary data, is used to document demographic and economic trends in communities near estuaries, and to compare trends between coastal communities and noncoastal populations. The individual data, our primary data, is used to document economic and demographic characteristics of people living in the five coastal areas and to delve more deeply into the attitudes, perceptions, and values of people connected to the estuarine resources. The third type is a hybrid of primary and secondary data developed specifically to support a statistical model of land-use values in Grays Harbor County.

Secondary Data

Demographic and economic trends are documented using secondary data available from the U.S. Census Bureau, the U.S. Bureau of Economic Analysis, Oregon and Washington State Departments of Employment, Departments of Fish and Wildlife, Agricultural Statistics Services, and others. Most of these data are reported in official government reports or through Internet websites. A subcontractor to the Pacific Northwest Coastal Ecosystems Study (PNCERS) project compiled and summarized much of the demographic and economic information and disaggregated the fish harvest and aquaculture production data through interviews of experts (Radtke and Davis 1994, 1999). The resulting data are processed using standard descriptive and other statistical methods.

Survey Data

Public attitudes, perceptions, and values were assessed through the PNCERS Coastal Resident survey, which obtained coastal resident's demographic and economic status, attitudes, perceptions, activities, and values on a range of subjects. Among the objectives of the survey were to assess how residents value specific aspects of their communities and surrounding natural landscapes, to understand what aspects of the communities and landscapes are perceived as changing for better or worse, to determine what residents' perceive as threats to local ecosystem conditions, and to record residents' level of outdoor recreation activities that are tied to the natural environments of the bays. During the winter-spring of 2000, mailback surveys were sent to 5,000 addresses located within 30 miles of the five PNCERS estuaries: Coos Bay, Yaquina Bay, and Tillamook Bay in Oregon, and Willapa Bay and Grays Harbor in Washington. A modified Total Design Method was used to maximize response rate (Dillman 1978). Briefly, that method involves pre-surveys to check language and structure of the questionnaire. The questionnaire is mailed with a signed cover letter, and a self-addressed, stamped return envelope. A follow-up reminder postcard is sent to nonrespondents after two weeks, and a second questionnaire is sent to continuing nonrespondents. We achieved a total usable sample of 2,117 completed questionnaires, representing 55% percent of the 3,928 surveys successfully delivered to valid addresses.

Three kinds of responses were solicited, each generating a specific kind of data.

Simple Check-off Responses of the Yes/No or Categorical Types

A series of four yes/no questions concerning resident's outdoor recreational activities are included in the survey. These ask whether respondents, during the past year, had participated in salmon or steelhead fishing, clamming, crabbing, or bird watching. Data from responses of this sort are termed dichotomous. The survey also collected yes/no responses concerning membership in environmental organizations, membership in sports clubs, and respondent's gender. Check-off questions offering more than 2 categories are used to determine respondent's current employment status among the categories of student, employed full-time, employed part-time, retired, employed at home, homemaker, and unemployed.

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Subjective Ratings of Specific, Defined Conditions or Prospects

Most of these are constructed using a 5-point Likert scale, in which the respondent rates the degree of importance, or threat, or value inherent in a particular factor of condition. We use this approach to determine which community characteristics are important to individual's decisions to live in their current community, which environmental risks are believed to be most threatening to estuary ecosystems, and which causes are believed to be most instrumental in the decline of coho salmon in coastal rivers. The ratings reveal the perceived relative importance of environmental threats, community characteristics, or causes of salmon decline. A variant on the 5-point scale is used to solicit broad attitudes regarding the trade-offs between environmental protection and economic development.

Open-ended Questions for Continuous or Categorical Responses

Open-ended questions ask respondents to indicate the number of years they have lived in their coastal county, their age, the size of their households, and the number of outdoor recreational trips they have taken in the past year.

The statistical analysis of all three types of data includes simple descriptive statistics and histograms of population characteristics. Where distinct differences are apparent in these simple displays and are expected from existing theory and understanding, we seek confirmation using χ^2 tests of homogeneity for categorical responses among subclasses (Powers and Xie 2000). We explore associations among ordinal ratings, such as the environment-economy scale and the perceptions of threats to the bay ecosystem, with Spearman rank correlation coefficients. We use logistic regressions to search for causal factors in discrete categories of responses.

Hybrid Property Value Data

Besides secondary information and survey data, we assembled residential property value data for the Grays Harbor area. In theory, residents' preferences for surrounding conditions are reflected in their choice of residential locations. When these preferences are transmitted to the housing market, housing prices will reflect the preferences for land attributes including structural characteristics, environmental quality, and locational amenities and dis-amenities. Hedonic price models, regression models with price as dependent variable, are a standard method to quantify the relationship between the market price of a heterogeneous good and the good's characteristics (Rosen 1974). Hedonic models have been used to examine the magnitude of residents' willingness to pay for specific landscape characteristics (Geoghegan et al. 1997; Acharya and Bennett 2001) and for levels of environmental quality (see Palmquist 1991). Grays Harbor County was chosen because parcel-level GIS data are available for this county. These data document the specific locations of land parcels and facilitate the assembly of data suitable for a hedonic property value study.

Data were compiled on a range of explanatory variables that could influence residential property values. Data on the residential property transactions were acquired directly from the Grays Harbor County Department of Assessment Taxation. The county's land parcel assessment data provided several important explanatory variables: transaction price, assessed value of the structure, assessed value of the land, date of transaction, and lot size. Additional data were collected or estimated using GIS data on land use, road networks, city and town locations, sewage treatment plants, pollution emission sites, and superfund sites. The final sample included 3,100 market transactions of residential properties from 1994 to 1998.

After creating a GIS database of these parcels, several other variables were estimated using Environmental Systems Research Institutes (ESRI) Arc/Info software. These include distance to the nearest major road, distance to the nearest central business district (Aberdeen or Olympia), distance to the nearest small town or city, distance to the nearest sewage treatment plant, distance to the nearest site listed in the National Pollutant Discharge Elimination System (NPDES) or Toxic Release Inventory (TRI) facility, distance to the nearest National Priority List (NPL) Superfund site, distance to the coast, distance to Grays Harbor, and surrounding land uses. Surrounding land uses were measured by drawing a circle with 0.75 mile radius around each parcel and identifying the different types of land within those circles. U.S. Geological Survey land use and land cover data were used to describe established land use types falling within the circles.

Results

Recent trends in human population and economies around estuaries, which set the stage for ecosystem changes and management concerns, are best reviewed in the context of broader trends in rural communities of the western U.S. (Beyers and Lindahl 1996; Power 1996; Ohman 1999a; Reichert 2002). Rural economies in much of the American West have been undergoing transformations due to the decline of natural resource industries (forest products, fisheries, mining, grazing) relative to

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TABLE 1. Human population and trends in coastal Pacific Northwest states and counties. Source: U.S. Census Bureau websites (http://www.census.gov/main/www/cen2000.html and http://www.census.gov/main/www/cen1990.html).

Area	Population (2000 Census)	Proportion of Population >50 yr Old (2000 Census)	Change in Population Size (1990–2000)	Change in Proportion >50 yr Old (1990–2000)
Oregon	3,471,700	28.6%	20.4%	2.0%
Coos County (Coos Bay)	62,950	38.8%	4.2%	5.6%
Lincoln County (Yaquina Bay)	44,650	39.9%	14.4%	3.6%
Tillamook County (Tillamook Bay)	24,600	39.8%	12.5%	1.5%
Washington	5,974,900	26.3%	21.1%	2.2%
Pacific County (Willapa Bay)	21,000	43.4%	11.1%	4.7%
Grays Harbor County (Grays Harbor)	68,500	32.7%	4.7%	2.8%

newer economic sectors such as high technology, recreation and tourism, retirement living, and producer services (communications, data processing, shipping, advertising; Rasker 1995; Power 1996). This transformation strongly influences the location of industries. While the mining, logging, ranching, agriculture, and manufacturing industries of the Old West needed to locate near sources of raw material or major transportation centers, the service industries of New West are less dependent on such resources. Power (1996) and others apply the term footloose industry to high-tech and producer services companies, because they can locate where employees would like to live rather than near customers or key resources. Also, many migrants to rural areas have footloose income, nonemployment incomes from pensions and financial investments. Footloose firms and people with footloose incomes can be attracted to the less crowded conditions, scenic and unspoiled landscapes, and outdoor recreation opportunities of rural areas. For regions growing in this new way, maintenance of functioning natural ecosystems can be viewed as an economic investment, providing an economic motive for environmental preservation.

While most work on the New West has focused on the arid West to the east of the Cascade and High Sierra mountain ranges, the trends discovered there may be repeated in areas near the coast. All five coastal areas studied in this paper are largely rural, with the biggest towns barely reaching 10,000 in population, and there are some clear similarities in the economic trends among the PNCERS area counties. Strickland and Chasan (1989) notes the historic dependence of Pacific and Grays Harbor counties in Washington on forestry, commercial and recreational fisheries, and shellfish culture. Ohman (1999b, p. 7) notes the increased prevalence of residential and resort developments in Oregon coastal communities, the declining employment in wood manufacturing and extractive industries between 1970 and 1990 (Ohman 1999a, p. 31), and prevalence of retirees who seek to live away from cities among new migrants to these communities.

These general trends in coastal populations and economies suggest that interactions between estuarine ecosystems and coastal residents and visitors will be changing. Declining production in fisheries and forest products could mean lower impacts on the estuaries from those industries, but increased tourism and residential development can also impact estuary shorelines, water quality, and wildlife in different ways. Changes in the perceptions and values of coastal residents may be linked to shifting economic connections between people and the estuarine ecosystems. A challenge for this research is to establish specific trends for our five communities, to link these trends to changes in public attitudes and values, and to project changes in estuary management problems and social pressures for solutions into the future.

Demographic Trends

The demographic data show that human populations in counties surrounding the five estuaries have been growing more slowly and aging more rapidly than the populations of the corresponding states. Table 1 shows that all five of the county populations grew more slowly than the state populations during the 1990s, and the proportion of people older than 50 years increased more rapidly in four of the five counties. Radtke and Davis (1999) noted that episodes of out-migration are especially pronounced in these counties because they are more impacted by downturns in the economy. For example, Coos and Grays Harbor lost 6–8% of their population during the 1980s recession. The age distributions of residents in these coastal counties confirm that populations are aging and that retirees are migrating to the coast (Fig. 2). As compared with the U.S., or Oregon and Washington, the coastal counties have relatively more people in the 65+ category and fewer in the 18–29 year old group. Pacific County's age profile differs most

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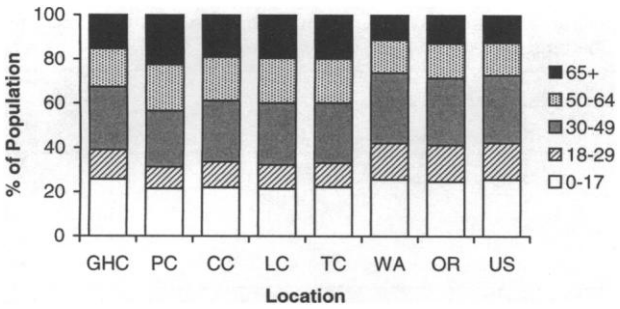

Fig. 2. Age distribution of residents in coastal counties in 2000 (U.S. Census). GHC = Grays Harbor County, PC = Pacific County, CC = Coos County, LC = Lincoln County, TC = Tillamook County, WA = Washington, OR = Oregon, and US = United States.

dramatically from that of its state (4.3% fewer young people and 11.4% more older people).

These demographic trends suggest that increased demands upon estuarine ecosystems may be largely driven by in-migration or retirees, and economic growth is likely to center on services to residents and visitors. Further, the greater prevalence of retired people reduces direct reliance on natural resource extraction as a source of income. While retired residents are not employed in resource-based industries, they may rely on the natural features of their communities for amenities such as scenic beauty, a sense of community character, and recreation. The correlation between demographic characteristics and linkages to the estuarine environment are explored in our analysis of survey data below.

Economic Trends

Radtke and Davis (1999) show that in the 1970s Coos County was heavily dependent on the timber and fishing industries, and the county has suffered reduced employment in the last 20 years due to the decline in these industries. Lincoln County, on the other hand, has had a recreation and tourism industry for many years to complement the timber and fishing industries. In Lincoln County, timber employment has been reduced by 82% in the last 20 years, yet overall employment has grown as a new industry mix has emerged. Employment in fishing has tended to be cyclical in nature, manufacturing has declined from 20% to 7% of the industry mix over the past 20 years, and tourism accounts for about a quarter of current employment, about the same as 20 years ago (Rooney 2000). Tillamook County is unique among the five estuaries because of the presence of a strong agricultural sector, mainly in the dairy industry. While timber and fishing have declined in recent years, lumber and food products (dairy and meat) continue to be important in the local economy. Recreation and tourism have also increased in importance in Tillamook.

In Washington, Pacific County (Willapa Bay) has many natural resource-based industries including timber, fishing, oysters culture, and, to a lesser extent than Tillamook County, agricultural products (meat, dairy, and cranberries). Even though timber, fishing, and aquaculture have declined, they are still expected to be the mainstay of the local economy in the future. Grays Harbor County (Grays Harbor) has traditionally been dependent on the timber and fishing industries. The city of Aberdeen has an important seaport, which provides opportunities for other marine industries. The recreation and tourism industries have slowly begun to increase, but timber and fishing are expected to continue to be important to the local economy (Radtke and Davis 1999).

In Oregon, Coos and Lincoln County have experienced high unemployment rates (between 7–9%) for most of the 1990s. Tillamook County, however, has had unemployment rates near state levels (5.8%). Unemployment rates in the Washington counties, Pacific and Grays Harbor, are usually much higher than state levels (10.5% versus 5.9%). The gap has been increasing in recent years, especially in Washington. Radtke and Davis (1999) attribute the higher unemployment rate to downward trends in resource-based economies. With some exceptions, these counties are not attracting sufficient new industries to keep unemployment rates down or to attract and hold younger workers.

The percentage of total personal income from five natural resource industries: marine (fishing and other seafood), agriculture, timber, tourism, and other resource based industry (paper and paperboard mills, water transportation, marine cargo, ship building, and state and federal government activities related to natural resources) varies widely across areas (Table 2) and is closely connected to employment for obvious reasons. The income from natural resource based industries range from 21.3% to 37.8% of total incomes. Tillamook's major industry is agriculture, while Grays Harbor, Pacific, and Lincoln Counties all continue to have a high reliance on timber resources. The greatest reliance on tourism for personal income is found in Oregon's Lincoln County.

Just as elsewhere in the rural West, an increased proportion of total personal incomes in the coastal counties is falling into the category of transfer payments: Social Security, pensions, and other nonwage or nonsalary incomes. According to data from the U.S. Bureau of Economic Analysis, Regional Economic Information System, during 1969–1995 transfer payments increased from 22–

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TABLE 2. Percent of total personal income in county by economic sector. Data for all but Lincoln County are from Radtke and Davis (1999) based on 1995 data. Data for Lincoln County is from Radtke and Davis (1994) based on 1991 data.

	Oregon-Washington Counties				
Economic Sector	Coos	Lincoln (Yaquina Bay)	Tillamook	Grays Harbor	Pacific (Willapa Bay)
Marine	2.3	9.2	1.0	3.9	10.1
Agriculture	2.5	0.7	12.4	1.2	2.4
Timber	6.6	12.2	6.0	11.2	13.9
Tourism	4.0	10.0	3.8	3.9	3.1
Other Resource-related	5.9	5.8	0.2	5.6	0.1

28% of total personal incomes to 42–52% in Grays Harbor, Pacific, Tillamook, and Coos Counties. This exceeds the national trend in which transfer payments increased from 24% to 34% of personal income. The significantly higher proportion of transfer payments in the coastal counties is consistent with the observations that the population is aging and that retired people are a relatively large portion of recent migrants to the coastal communities.

Linkages between Demographics, Economics, and the Environment

The PNCERS resident survey provides detailed demographic and economic information (length of residence, age, educational level, employment status, occupation, household income) combined with attitudes and preferences regarding the natural environment. This rich data set allows us to estimate how demographic and economic variables are correlated with the strength and type of connection to the environment. Based upon those connections we assess the implications of demographic and economic trends, described in previous sections, for estuary management.

Table 3 provides a brief summary of some of the survey data. It shows that 38% to 55% of the respondents have lived in coastal communities for 30 or more years, with Yaquina Bay being the exception with more newcomers (less than 16 years of residence) and fewer long-time residents than the others. Employment categories for Table 3 were constructed from the survey data by combining reported occupational categories into groups as follows: unemployed and retired, employed at home and homemaker, employed in a natural resource

TABLE 3. Demographic-economic summary from the coastal resident survey, 2000. All entries represent the percent of respondents in each category.

	Coos Bay	Yaquina Bay	Tillamook Bay	Grays Harbor	Willapa Bay
Length of residence (years)					
<16 yr	27.6	44.1	30.5	23.2	35.6
16 to 30 yr	29.7	32.4	29.0	22.0	26.0
>30 yr	42.7	23.5	40.5	54.9	38.4
Educational level (%)					
Some high school	7.4	3.9	7.2	8.9	9.2
High school diploma	25.0	27.2	32.9	26.9	27.9
Some college	33.1	32.7	32.2	32.8	35.0
College diploma	18.9	17.9	15.5	18.0	15.4
Post-graduate	13.8	18.1	11.3	11.1	9.9
Other	1.9	0.3	0.9	2.2	2.6
Employment status (%)					
Unemployed or retired	68.0	52.0	51.3	44.8	48.5
Employed at home	8.2	7.0	6.7	5.2	9.2
Natural resource industry	5.5	10.3	14.7	16.2	16.2
Other industry	4.9	9.4	10.3	12.6	5.2
White collar job	13.4	21.3	17.0	21.2	20.9
Household income (%)					
Under $10,000	7.4	6.4	7.6	6.2	6.1
$10,000–$30,000	33.5	32.1	31.7	30.5	33.8
$30,000–$50,000	23.7	25.1	30.7	27.9	34.0
$50,000–$100,000	26.5	30.0	23.1	30.5	20.8
Over $100,000	8.8	6.4	6.9	5.0	5.3
Sample size	499	412	355	411	440

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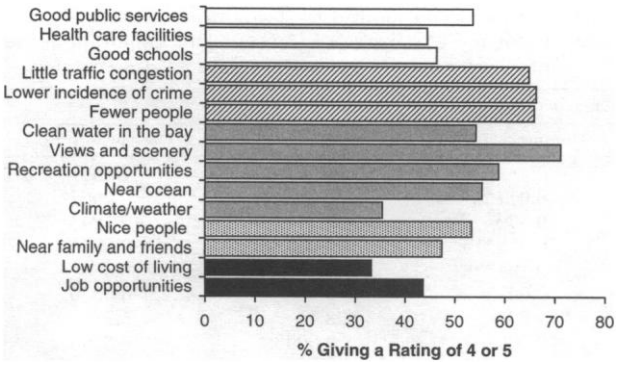

Fig. 3. Ratings of 15 community characteristics as very or extremely important to respondent's choice of living in current coastal community, categorized as economic (black), rural lifestyle (stippled), environment-related (gray), people and family (striped), and community service (white).

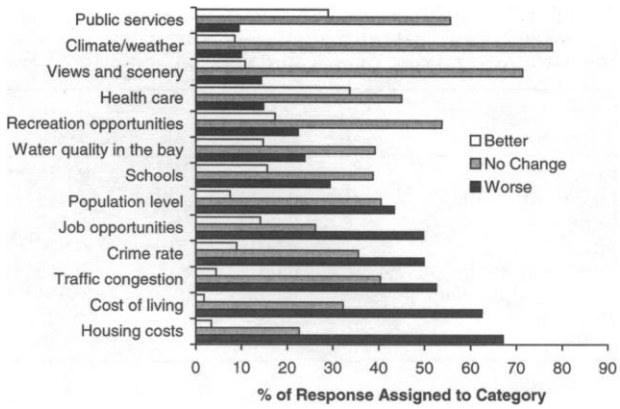

Fig. 4. Community characteristics categorized as getting worse, getting better, or no change.

industry (forest products, fishing, agriculture, marine tourism and recreation), employed in other industry, (manufacturing, construction, mining, and transportation), and employed in a white collar job (finance, insurance, communications, retail or wholesale trade, real estate, other services, and government). The proportion of survey respondents in the unemployed or retired category is surprisingly high, roughly 39–46%. Not shown in the table is our finding that residents are active in outdoor recreation related to the estuary and coastal ecosystems: clamming, crabbing, salmon fishing, and bird watching.

To assess the influence of community characteristics on residents' choice of living location, the survey asked each respondent to indicate the importance of 15 characteristics in their decision to live near a bay. Each community characteristic was rated on a scale of 1 (not important) to 5 (extremely important). The fifteen community characteristics (Fig. 3) were grouped into 5 categories: Economic Motivations (low cost of living, job opportunities), People and Family (near family and friends, nice people), Environment-related (climate-weather, clean water in the bay, near ocean, recreation opportunities, views and scenery), Rural Lifestyle (lower incidence of crime, fewer people, little traffic congestion), and Community Services (health care facilities, good public services, good schools). The percent of respondents assigning a rating of 4 and 5 (Fig. 3) shows that views and scenery, a characteristic tied to quality of the environment, is the highest rated characteristic overall. Views and scenery was the highest rated characteristic in Coos, Tillamook, and Yaquina Bays. The three next highest rated characteristics are all in the Rural Lifestyle group. Interestingly, low crime and fewer people were each ranked as one of the top four items in every bay. Job opportunities was tied for first (with low traffic congestion) in Grays Harbor, and it was the second ranked characteristic in Coos Bay. Characteristics tied more closely to the estuary (recreation opportunities, near ocean) were ranked 5th and 6th overall. Being near the ocean was ranked as high as second in Yaquina Bay. People and Family and Public Services ranked next, followed by economic motivations. Low cost of living was more highly rated in Grays Harbor and Tillamook Bays than in the others. The climate-weather rating exhibited a north-south trend, with the lowest importance ratings (10–11%) in Washington and the highest ratings (24%) in Coos Bay, a result that may reflect the warmer winters on the southern Oregon coast.

Respondents were also asked to note whether they believe these same community characteristics are getting worse, getting better, or staying the same. The trends perceived by survey respondents, again for the five bays combined, are depicted in Fig. 4. For the most part, the communities are getting worse in those aspects related to economic conditions and congestion: higher housing costs, higher costs of living, more traffic congestion and crime, and fewer job opportunities. Most of the survey respondents perceived the characteristics associated with the bay ecosystems (views and scenery, and water quality in the bay) as generally not changing over time. About a quarter of the respondents thought that public services and health care facilities were improving. Tillamook residents had the greatest perception of worsening crime rate (12% above the average), and Coos Bay had by far the greatest perceived worsening of job opportunities (73% versus the overall average of 48%). Traffic congestion was perceived less as a worsening problem in Willapa and much more of an increasing problem in Tillamook and Yaquina

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TABLE 4. Coefficients resulting from logistic regressions to explain the most important motives for living near each estuary. For each of the five models, the sample size is 1,749 and the degrees of freedom for the χ^2 statistic is 5. * coefficient significant at the 10% level ($p < 0.1$), ** coefficient significant at the 5% level ($p < 0.05$), and *** coefficient significant at the 1% level ($p < 0.01$).

	Categories of Motivations				
Individual Attributes	Economic	People and Family	Environment-related	Rural Lifestyle	Community Services
Intercept	0.159	1.15***	−0.433	0.186	−1.99***
Length of residence	0.0051**	0.014***	−0.017***	−0.008***	0.0067*
Gender	−0.0651	0.127	−0.079	−0.141	−0.124
Age	−0.0010***	−0.020***	0.012***	−0.0092**	−0.0011
Education level	0.0418	−0.113**	0.191***	0.0007	0.080
Household income	0.049**	−0.054*	0.0015	−0.009	−0.0030
Model χ^2	18.56	64.72	71.86	23.11	5.22
$p > \chi^2$	0.0023	<0.0001	<0.0001	0.0003	0.389

Bays. Finally, while water quality was perceived as worsening by 25% of the overall respondents; more Tillamook residents (38%) and fewer Coos Bay residents (15%) registered this concern. Whether these perceptions accord with actual water quality measurements or health-related risks is unclear. The heightened concern by Tillamook residents accords with the priorities placed on water quality, fish habitat, and flooding in the comprehensive plan for the bay (Tillamook Bay National Estuary Program 1999).

In a follow-up question, we asked each survey respondent to list the three community characteristics that were most important to their decision to move to their community. We used responses to this question to examine the connections between motivations for living in coastal communities and individual's attributes. For each of the five motivation categories described earlier, we created a binary indicator of importance, where 0 means the individual did not name the motivation as one of his or her top three reasons, and 1 means the motivation was ranked among the top three. So, for example, a respondent who rated low cost of living or job opportunities as one of the top three reasons for choosing to live in his or her community would be assigned a 1 for Economic Motivations. We then used each of these five new variables as dependent variables in a logistic regression procedure. Using personal attributes as independent variables, the logistic regression determines which attributes significantly affect the probability that a motivation class is important to an individual (that is, will the individual be assigned a 1 rather than a 0 for that motivation category; Powers and Xie 2000, p. 49). The first column of logistic regression coefficients in Table 4 shows that the likelihood of highly ranked economic motivation increases with length of residence, decreases with age, and increases with income level. These effects are statistically significant at the 10% or 5% confidence levels. Education level and gender (1 = male, 2 = female) were not related to incidence of strong economic motivations at statistically significant levels. The results for the remaining four categories of community choice motivations can be read similarly. Of particular interest is the third equation, which shows that strong environment-related motivation is negatively related to length of residence, positively related to age, and positively related to education level. Also of interest is that length of residence was a significant explanation for all five motivation categories. These results are consistent with the notion that recent migrants to the coast (especially older and retired migrants) place more emphasis on environmental conditions and rural characteristics in choosing a community.

The Environment-Economy Trade-off

As noted above, attitudes towards the economy versus environmental protection were explored in a survey question asking respondents to indicate where they place themselves on a 1 to 5 scale, with 1 being "highest priority given to protecting environmental conditions" and 5 being "highest priority given to economic considerations." This is a broad indicator of public commitment to environmental protection or ecosystem management that has been used in past surveys in the Pacific Northwest (Smith et al. 1997; Wright and Shindler 1999).

We summarized the results by collapsing the first two ratings into a favors environment category, and the last two categories into a favors economy category. Generally, the residents of all five PNCERS study areas expressed balanced views of the environment-economy trade-off (Fig. 5). For all five bays combined, those falling into the favors environment category were 27% of the sample, while 22% favored the economy. Fifty-one percent placed equal weight on environment and economy. The environment-economy attitudes in the five bays were much less environment-focused than, for example, those of the Colorado communities surveyed by Brunson et al. (2002), where 60% placed highest priority on the environment. On the other hand, the coastal residents are generally more en-

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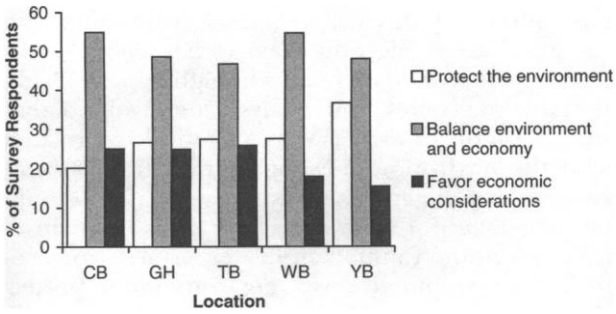

Fig. 5. Differences among bays regarding preferences for environment-economy trade-offs in resource management. CB = Coos Bay, GH = Grays Harbor, TB = Tillamook Bay, WB = Willapa Bay, and YB = Yaquina Bay.

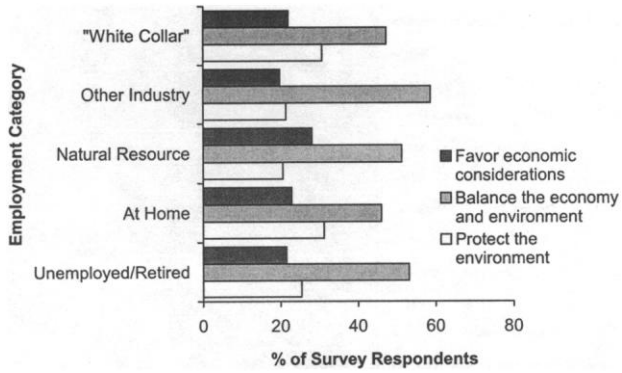

Fig. 6. Differences among employment categories regarding preferences for management trade-offs between environmental protection and economic considerations.

vironment-focused than the residents of the Blue Mountains, where Shindler and Toman (2001) found only 19% of the residents placing highest priority on the environment. Among the five study areas, it is clear that Yaquina Bay residents were more inclined to protect the environment and Coos Bay residents were slightly more inclined to lean in the opposite direction—towards economic considerations.

Differences among employment categories are displayed in Fig. 6. Although people from all employment categories are strongly centrist in their leanings, those employed in natural resource industries (fisheries and shellfish culture, forest products, agriculture) place a relatively low weight on environmental protection (although a more detailed breakdown reveals that those employed in fishing are more inclined to favor the environment). People working at home or working in white collar jobs place somewhat higher weight on environmental considerations. This suggests a moderate divergence in views between people in the resource-based industries and those working elsewhere. Also, shorter-term residents (less than 20 years living in local community) more heavily favored the environment over the economy than longer-term residents (Fig. 7). This finding is consistent with the work of Ohman (1999a), who found that long-term residents tend to support traditional economic development in their communities, while migrants, especially retired people, seek to preserve the local environment, presumably to maintain the qualities that attracted them to the community from more urban areas. Older citizens are divided between those with long-term ties to resource-dependent economic sectors and those who moved to the coast to get away from the city and to enjoy a more rural and natural environment. Other findings (not shown in the tables or graphs) are there is no real difference between people of high and low income classes in the priority placed on environmental and economic objectives, and women favored the environment at higher percentages than men.

Threats to the Estuary

Residents' perceptions of environmental threats to the estuaries are reflected in responses to a question asking each respondent to rate 12 threats to the bay ecosystem on a scale of 1 (not a threat) to 5 (extremely severe threat). While none of the indicated threats were rated as very severe (rating of 4 or 5) by a majority of the respondents, five threats (decline in fish habitat, oil spills, shoreline development and erosion, the spread of green crabs, and logging in upland areas) were considered serious by 39% or more of the respondents in the five bays (Fig. 8). As would be expected, perceptions of these threats varied widely among bays. For example, the invasive species, green crabs and *Spartina,* were rated as strong threats by over 60% of respondents in Willapa Bay, by about 40% in Grays Harbor, but by only 20–33% of residents

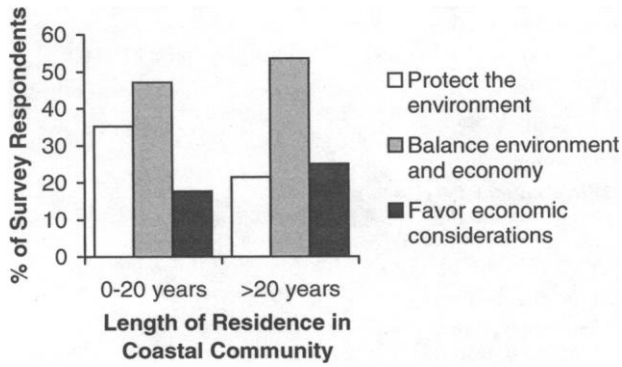

Fig. 7. Differences between long-term and short-term residents in coastal communities regarding preferences for management trade-offs between environmental protection and economic considerations.

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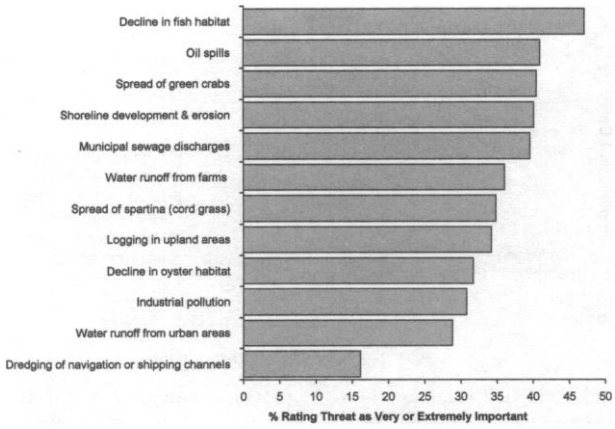

Fig. 8. Residents' rating of selected threats to the bay ecosystem. This is the percent of survey respondents who rated each threat as very or extremely severe.

in the Oregon bays. That pattern of concern coincides with the ongoing problem of *Spartina* control on mudflats in Willapa Bay and recent publicity in Washington concerning the spread of green crabs northward from California. Also, all the threat ratings were generally lower in Coos Bay than in other estuaries. Upland logging and shoreline development and erosion were most strongly rated as threats in Yaquina Bay and least strongly indicated by Coos Bay residents.

A set of Spearman rank correlation analyses determined that ratings for all 12 threats were highly and positively correlated to each other ($p < 0.0001$, data not shown). This suggests great coherence in the way survey respondents perceive environmental threats, i.e., those who rank one threat relatively high on the 1 to 5 scale are likely to rank other threats relatively high as well. Additional rank correlation analyses determined that ratings for all 12 threats were negatively correlated with the environment-economy rankings (11 correlation coefficients had better than 99% confidence, data not shown). Since higher environment-economy ranking indicates priority for economic development over environmental protection, the negative correlations suggest that people who favor the environment are likely to rate the listed threats more highly than do people who favor the economy. Whether there is causation from threat perception to environmental priorities, or vice versa, is unclear. It does suggest that, as migrants to the bays are environmentally oriented, they may perceive the threats as more serious and demand more intensive management.

A more detailed breakdown for two threat categories, water pollution and upland logging, is displayed in Tables 5 and 6. For each threat category, we divided the full sample (all five bays combined) three ways: length of residence, environment-economy preferences, and employment category. For both threats (water pollution in Table 5 and logging in Table 6) and for each of the three categorizations, the χ^2 tests indicate that the distribution of threat levels varies significantly across categories. For the water pollution threat (Table 5), it is clear that shorter-term residents rate the threat higher than longer-term residents. Those giving higher priority to environmental protection (a rating of 1 or 2 on the environment-economy scale)

TABLE 5. Perceived threat from water pollution for different categories of residence length, environment-economy attitude, and employment. Water pollution threat is average of ratings for municipal sewage, industrial pollution, run-off from urban areas, and run-off from farms.

	No Threat at All 1	2	Somewhat Severe Threat 3	4	Extremely Severe Threat 5
Length of residence		Percent responses to pollution threat			
0–15 yr	2.7	15.0	27.7	34.1	20.6
16–30 yr	3.5	14.6	32.8	32.8	16.4
31 or more yr	4.6	24.4	36.1	25.0	10.0
$\chi^2 = 40.63$	$p < 0.0001$	$n = 1,087$			
Environment-economy scale					
Environment 1st (1 or 2)	0.7	7.4	25.7	33.0	28.2
Even balance (3)	3.5	20.4	36.3	30.3	9.5
Economy 1st (4 or 5)	7.4	28.3	32.8	20.2	12.0
$\chi^2 = 115.23$	$p < 0.0001$	$n = 1,087$			
Employment category					
Unemployed or retired	4.2	16.7	31.3	26.3	21.5
Employed at home	2.7	26.0	35.6	24.7	11.0
Natural resource industry	4.3	21.3	34.8	30.5	9.2
Other industry	2.3	27.5	32.3	27.5	9.8
White collar job	2.8	16.0	32.8	39.2	9.2
$\chi^2 = 47.2$	$p < 0.0004$	$n = 1,087$			

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TABLE 6. Perceived threat from upland logging for different categories of residence length, environment-economy attitude, and employment. Upland logging threat is the rating on the 5-point Likert scale.

	No Threat at All 1	2	Somewhat Severe Threat 3	4	Extremely Severe Treat 5
Length of residence		Percent responses to logging threat			
0–15 yr	10.9	13.4	20.1	19.8	35.9
16–30 yr	14.0	19.2	22.6	19.5	24.7
31 or more yr	20.5	26.2	21.9	15.3	16.2
$\chi^2 = 73.2$	$p < 0.0001$	n = 1,263			
Environment-economy scale					
Environment 1st (1 or 2)	5.4	8.9	18.2	23.9	43.6
Even balance (3)	9.6	23.9	26.0	15.7	20.2
Economy 1st (4 or 5)	31.4	25.2	15.2	15.5	12.8
$\chi^2 = 190.75$	$p < 0.0001$	n = 1,263			
Employment category					
Unemployed or retired	13.9	15.7	23.8	15.9	30.8
Employed at home	15.4	20.9	16.5	23.1	24.2
Natural resource industry	22.9	30.2	19.0	15.6	12.3
Other industry	26.1	21.7	18.3	11.3	22.6
White collar job	11.1	22.9	21.3	24.3	20.7
$\chi^2 = 72.79$	$p < 0.0001$	n = 1,263			

rate water pollution as a significantly greater threat than do others (28.6% to 11.4%). This corroborates the Spearman rank correlations noted above. Among the employment categories, the water pollution threat is given a clearly higher rating (combining level 4 and 5) by unemployed or retired people and people with white collar jobs.

For the threat from upland logging (Table 6), the results for the length of residence and environment-economy scale categories are very similar to those for the water pollution threat. The threat is rated as more severe by shorter-term residents and those giving higher priority to environmental protection. For employment categories, the distinctions are less clear, with about the same high threats rankings across the categories. We infer from these observations that migration of retired and older people to the coastal communities and increasing reliance on white collar employment will tend to increase the prevalence of people concerned about environmental threats to the estuaries. This will likely be reflected in increasing priority given to environmental protection over economic development, where the two are in conflict.

Land Valuation in Grays Harbor

Linear regression models of residential property values in Grays Harbor County were used to explore the significance of certain ecological attributes in explaining price differentials and to characterize general preferences of residents regarding location. We consider the impact of different surrounding land-use types on property values as well as the influence of specific dis-amenities such as sewage treatment plants, hazardous waste sites, and industrial plants. The data described in Data and Methods, including the variables constructed from GIS data (e.g., distance to central business district—CBD, distance to an NPDES or TRI site, and land use within 0.75 mile), are summarized in Table 7. Note that the average lot size is relatively large (1.2 acres) as befits a rural county; and that few lots are close to an industrial emitter, sewage treatment plant, or hazardous waste site. The land surrounding the 3,100 parcels included in the analysis was most frequently developed land, following by wetland (11%), agriculture (7.8%), and forest (6.5%). Since only 4.4% of the 0.75 mile area around our land parcels was identified as water, the parcels sold in Grays Harbor were not typically next to the bay or ocean.

Regression equations for the property value model were calculated using linear and semi-log functional forms that are commonly employed when estimating hedonic models (Table 8). For each regression, the property price is the dependent variable. As indicated by R^2 of 0.78 to 0.9, a considerable amount of the variation in property values is explained with either functional form. The results are somewhat consistent across the functional forms and agree generally with other applied hedonic studies of residential values. Larger lot sizes, higher valued structures or improvements, and proximity to central business districts have a significant and positive influence on residential property values. In contrast, proximity to industrial and commercial sites that are permitted emitters of pollution (TRI and NPDES) and proximity to hazardous waste sites on the NPL had a significant and negative influence on residential

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TABLE 7. Definitions of variables and descriptive statistics for Grays Harbor hedonic land value model.

Variable	Description	Units	Mean	SD
Market price	Market price	U.S. dollars	80,584	48,354
Value of structure	Assessed value of structure	U.S. dollars	60,141	40,383
Lot size	Lot size	Acres	1.204	3.339
Distance to CBD	Distance to Aberdeen or Olympia	Miles	9.5	7.6
Industrial emitter	= 1 if residence is located within 0.5 miles of an NPDES or TRI site		0.079	0.269
Sewer treatment plant	= 1 if residence is located within 0.5 miles of a sewage treatment plant		0.042	0.199
Hazardous waste site (NPL)	= 1 if residence is within 0.5 miles of NPL hazardous waste site		0.117	0.321
Percent developed	Percentage of land within 0.75 mile that is developed (residential, commercial, etc.)		0.404	0.243
Percent agriculture	Percentage of land within 0.75 mile that is agriculture		0.078	0.144
Percent wetland	Percentage of land within 0.75 miles that is wetland		0.111	0.153
Percent forest	Percentage of land within 0.75 mile that is forest		0.065	0.121
Percent water	Percentage of land within 0.75 miles that is water		0.044	0.094
Distance to road	Distance to major road	Miles	0.638	1.161

property values. Since property values decline as distance to the nearest major road increases, proximity to a major road had a positive effect on residential property values. The suite of land-use variables had mixed effects on residential property values and the significance of these effects varied between functional forms. Greater amounts of surrounding land in wetland, water, and developed or built up uses consistently had a positive effect on residential property values. We believe the value of living near an estuary is captured partially by the water and wetland variables and find their positive signs encouraging.

The results of this property value model convey information about the preferences of Grays Harbor County residents over residential property characteristics. Residents are willing to pay more for properties with higher quality structures and desirable locations (i.e., access to employment centers and major roads). In contrast, proximity to industrial emitters and hazardous waste sites resulted in lower property values. These results bolster the concept that observable market values for property do embody some environmental values along with more commonly recognized utilitarian values. Beyond this, the research on property values is rather

TABLE 8. Hedonic land value models: dependent variable: market price. Parameter estimates, standard errors in parentheses below; *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

	Linear Model		Semi-log Model	
Variable	Coefficient	SE	Coefficient	SE
Intercept	6,145.8***	1,392.2	10.25***	−0.0251
Lot size	3,238.7***	140.8	0.0276***	−0.0025
Lot size^2	−25.7***	3.28	−0.0002***	−0.0001
Value of structure	1.0699***	0.007	0.000012***	0.0000
Distance to CBD	1,093.2***	167.8	0.0173***	0.0030
Distance to CBD^2	−42.4***	−7.1	−0.0006***	0.0001
Industrial emitter	−989.9	1,379.7	−0.0212	0.0248
Hazardous waste site (NPL)	−3,884.5***	1,071.9	−0.0638***	0.0193
Sewage treatment plant	150.2	3,459.3	0.0088	0.0622
Percent developed	5,042.9***	1,549.9	0.135***	0.0279
Percent agriculture	873.7	2,166.2	0.0631	0.0390
Percent wetland	5,325.3**	2,191.6	0.0585	0.0394
Percent forest	5,654.2**	2,503.1	0.0900**	0.0450
Percent water	4,957.5	3,653.7	0.2102***	0.0657
Distance to major road	−898.4***	267.3	−0.0187***	0.0048
R^2	0.903		0.778	
F value	2,050.6		775.4	
Observations	3,108		3,108	

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inconclusive and may deserve additional investigation.

Discussion

We have explored and documented some key elements of the socio-economic system, as depicted in Fig. 1, especially demographic and economic trends, residents' preferences for community characteristics, attitudes towards environmental protection, and perceived threats to the bay ecosystems. We also analyzed connections between demographic and economic variables and the resident's community preferences and perceptions of ecosystem threats. We applied a standard hedonic pricing model to quantify the connection between residential housing prices and surrounding environmental characteristics. This research finds important connections between people living near the five estuaries and the environment of the estuaries. An obvious connection is the economic link of employment and income to natural resource industries that affect the estuaries. But we also find that residential location choice, support for environmental protection, and perceived threats to the bay ecosystems reveal strong community-environment connections that will shape public expectations and demands for future estuary management.

Regarding demographic and economic trends, the five areas have similar recent histories, reflecting patterns prevalent in other communities in the rural western U.S. The five areas share trends of relatively slow population growth and increasing numbers of retired people. They are also experiencing a trend towards decreasing reliance on natural resource industries and other manufacturing, and increasing dependence on tourism, retail, services, and the footloose incomes of retirees. This trend suggests that protection of some elements of the estuarine ecosystems will be of increasing interest to the coastal resident communities.

Reasons for living in coastal communities, as reflected in responses to the coastal resident survey, featured views and scenery, rural characteristics (low crime, low population levels, little traffic congestion), recreation opportunities, and being near the ocean. In analyzing the links between important community characteristics and demographic or economic variables, we found that environment-related motivations for choice of residence location were negatively related to length of residence in the coastal community, and positively related to age and education level. Since many recent migrants to the coast are relatively older, retired people, our results suggest that newer residents are likely to seek places with environmental qualities (e.g., clean water, views and scenery, recreation opportunities) that require some protection. If new migrants to the coast (especially older and retired people) continue to place more emphasis on environmental conditions in choosing a community, they will probably support more environmental protections in the communities they have chosen.

Regarding preferences for environmental protection versus economic development, a substantial plurality of residents place themselves in the middle ground between the economy and environment. There are significant differences among the bays. On average, Yaquina Bay residents gave higher priority to the environment and Coos Bay residents gave higher priority to the economy. There are distinct differences among people of varying occupations, with especially low priority for environmental protection among those employed in the forestry and wood products industry, and especially high priority for environmental protection among government employees. Those with lower length of residence in their coastal community (less than 20 years) place a higher priority on environmental protection than those with longer time of residence. This demonstrates that people living in areas near Pacific Northwest estuaries are linked to estuary ecosystems in numerous and complex ways. They hold widely varied perceptions and values concerning the protection of estuaries and other elements on the environment.

Our examination of individual perceptions of threats to the bay ecosystems found declining fish habitats, oil spills, shoreline development and erosion, the spread green crabs, and logging in upland areas to be the highest rated threats. The perceived degree of threat varies with individual characteristics and attitudes. For example, concerning the threat of water pollution in the bay, shorter-term residents rate the threat more highly than do longer-term residents; those placing higher priority on environmental protection generally also perceive the water pollution threat to be greater; and retired people rate the threat more highly than do employed people. Concerning the threat from upland logging, a very similar but much less marked pattern appears. If recent demographic trends in coastal communities continue, the groups placing higher priority on environmental protection and viewing threat to the estuary ecosystems as severe will be an increasing portion of coastal populations.

We estimated a quantitative property value model (an hedonic price equation) to test for importance of environmental conditions, along with other property attributes in determining price. The results show that residents are willing to pay more for properties with higher quality structures and desirable locations (i.e., access to employment centers and major roads, and near to forests and wet-

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lands), but will pay less for properties in close proximity to industrial emitters and hazardous waste sites. This is an exploratory use of the property value model in a largely rural area to find whether environmental conditions are significant explanations of property sales prices, along with social and community characteristics. An advantage of using property values to uncover economic values of environmental conditions is that the model can be developed without directly surveying coastal residents, and can be used to assess economic value changes of management policies that alter estuary conditions.

The several research projects described in this paper all contribute to our understanding of how coastal residents connect to, are concerned about, or value various aspects of the bay and estuarine environments near their homes. These pieces of information do not contribute directly to a quantifiable assessment of specific environmental management strategies, nor do they point the way towards a proper mix of environmental protection versus economic development. These insights must be combined with biophysical understandings and models, and with intense collaboration between scientists, resource managers, and local interests to produce better long-term results in coastal estuary management. Where scientific perceptions of environmental conditions or protection needs differ significantly from those held by the public, additional educational and informational exchange may be needed. See Leschine et al. (2003) for a detailed comparison of public and scientists and manager's perceptions of threats to the estuarine ecosystems.

Although federal institutions (CZMA, CWA) set the stage for planning and regulation of estuarine waters and resources, state and local agencies are responsible for much of the execution. And local, consensus-based management partnerships, such as the watershed councils and Tillamook Bay's management plan process under the National Estuary Program, give local residents substantial influence on management of estuarine resources and coastal environments. Residents directly influence estuaries through working, living, and recreating there. Strong pressure to increase environmental protection will likely be met by resistance to further impediments to resource-dependent industries and traditional management. Although trends indicate that the desire for protection of environmental resources is likely to become more prevalent, this conflict will not disappear. While consensus is unlikely due to differing perspectives on the utility and use of coastal environments, all residents do have strong values regarding their estuarine resources. Balanced management approaches that protect the environment, while clearly accounting for and considering the local economic impacts are the most likely policies to draw support from coastal communities in the Pacific Northwest.

The research reported here is just a beginning. The short-term demographic and economic trends that we identified may change, and the implications of the continuing trends for individual and social choices concerning estuary management are as yet unclear. We have not determined how visitors might alter the picture we have developed based upon a survey of residents. Repeated collection of data from secondary and primary sources could provide a clearer picture of the interactions between the biophysical coastal environment, residents, and visitors. Improved knowledge of human activities and economic systems will enable us to better understand the socioeconomic component of the system, and this should result in better designed estuary management regimes.

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