Home Port Fidelity in the Groundfishery of Portland, Maine

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[1] Jennifer Brewer is currently employed at the National Research Council in Washington, D.C. This report, however, was initiated and completed independently, and has no relationship to any study conducted by the NRC.

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Abstract

This report summarizes findings from research conducted in the Portland, Maine groundfishery. It is one of two reports produced by a larger collaborative project, the other summarizing findings from parallel research conducted in Gloucester, Massachusetts. The following pages review the historical and economic context of the Portland research, outline methods of data collection and analysis, report and interpret empirical observations, and discuss broader implications. The research was driven by questions emerging from a collaborative team of scientific and fishing industry investigators, incorporating a range of working hypotheses among project participants. These hypotheses were aggregated into two broad questions: How mobile or immobile are the individuals and boats invested in the groundfishing industry and home-ported in Portland? What factors might help to explain such patterns of mobility or immobility? Findings suggest that Portland home-ported groundfishing firms have very place-based histories, in multiple respects on both long and short time horizons. Crew seem to have somewhat more diversified histories of place-based decision making.

Context of the Study

<u>Historical Context</u>

The port of Portland is placed among dozens of smaller harbors scattered along the Maine coast, and a handful of larger and smaller ports in more southern New England states. Among other differences, the history of Maine's fishing harbors differs from that of most other New England states in the geographic dispersion that has patterned periods of industry growth and decline. Permanent groundfishing villages were established on Maine islands by 1607, mostly in the mid-coast area. Efforts to monopolize the fishing industry began as early as the 1620s, but legal bans on independent operators produced widespread protest, proved unenforceable, and were soon rescinded (Churchill 1995).

Measured in tonnage, western Maine dominated the state's distant water groundfishing fleet until the early 1800s (O'Leary 1996). By the start of the Civil War, however, almost half Maine's codfishing tonnage was owned in one down east county. By 1880, the situation had again reversed, with harbors in western Maine holding two thirds of the state's deep sea fishing tonnage (O'Leary et al. 1995). Portland emerged as a dominant port during this latter period, attracting investors from outside the state, and controlling state-wide markets for fish packing, shipping, and fishing gear. Vertical integration of processing and vessel ownership, as well as costly technological shifts from tub trawls to heavier net trawls, exaggerated the shift away from smaller harbors, drawing many smaller boats and crew from eastern Maine to Portland (O'Leary 1996).

Maine's fishing industry diversified in the 19^{th} century. In addition to international and national markets for cod, new markets emerged for halibut, mackerel, pollock, hake, and haddock

(Vickers 1994; Lear 1998). In the late 19th and early 20th centuries, markets developed for herring, porgies, clams and lobster (Rathbun 1887; Johnson 1976; Lipfert et al. 1995; Acheson 2003). Later in the 20th century, lobster markets continued to rise, and new markets developed for additional species such as scallops, shrimp, mussels, quahogs, elvers and other finfish. These diversified markets sustained a more varied industry in Portland and other Maine harbors. In the 1970s and 80s, the mid-coast town of Rockland competed with Portland for status as the state's biggest fishing port, dealing primarily in groundfish but also supported by herring, scallops and other fisheries. The 1986 opening of the Portland Fish Exchange, the first all-display fish auction on the eastern seaboard, drew fish dealers, processors, and larger vessel owning firms to Portland from throughout the region, making it an active market hub. The high volume, high product quality, and price setting capacity of the Portland auction forced virtually all other Maine wharves to cease their groundfish buying operations. Since that time, the New England groundfish industry has undergone gradual but steady fleet shrinkage and geographic consolidation. Today, eastern Maine has few to no locally-based groundfishing operations. A handful of vessels groundfish out of mid-coast harbors, but rely heavily on markets in Portland and further south (Brewer 2007).

Economic Context

Among U.S. states in 2004, the dockside value of Maine's fisheries followed only the state of Alaska. Massachusetts placed a close third. The dispersed character of Maine's fishing industry is revealed when statewide data are broken down by port for the same year, however. Maine's highest earning harbor, Portland, ranked only 19th. Maine's second highest earning harbor that year, Stonington, ranked 32nd. By contrast, eight Alaska ports ranked in the top 20. Massachusetts had two of the top 20 ports, with New Bedford ranking first, and Gloucester 11th.

Figure.2: 2004 Top Ten State Fisheries Landings, Ranked by Landed Value
Source: National Marine Fisheries Service

Rank	*State*	*Value (\$ millions)*	*Weight (millions lbs.)*
1.	Alaska	1,202.5	5,354.6
2.	Maine	367.1	228.4
3.	Massachusetts	327.5	338.0
4.	Louisiana	274.8	1,096.5
5.	Florida	194.9	126.8
6.	Texas	166.2	85.6
7.	Washington	164.2	190.9
8.	Virginia	160.4	481.6
9.	California	137.4	373.4
10.	Oregon	101.2	294.9

Figure.3: Top Twenty Fishing Ports, Ranked by Landed Value
Source: National Marine Fisheries Service

Rank	*Port*	*Value ($ millions)*	*Weight (lbs. millions)*
1.	New Bedford, MA	207.7	175.4
2.	Dutch Harbor-Unalaska, AK	167.4	886.8
3.	Hampton Roads, VA	100.8	34.7
4.	Kodiak, AK	94.0	317.4
5.	Cape May-Wildwood, NJ	68.2	98.1
6.	Empire-Venice, LA	60.2	379.0
7.	Honolulu, HI	45.8	18.9
8.	Seward, AK	43.6	38.6
9.	Key West, FL	43.2	16.0
10.	Dulac-Chauvin, LA	42.8	40.4
11	Gloucester, MA	42.8	114.1
12.	Naknek-King Salmon, AK	42.5	92.6
13.	Brownsville-Port Isabel, TX	40.3	18.7
14.	Sitka, AK	40.1	37.3
15.	Port Arthur, TX	38.9	19.4
16.	Homer, AK	37.1	18.1
17.	Petersburg, AK	36.1	102.6
18.	Point Judith, RI	36.0	50.0
19.	Portland, ME	34.6	62.4
20.	Cordova, AK	31.8	40.5

Although value-added numbers are hard to come by, revenues generated by commercial fishing probably comprise less than 1% of Maine's Gross State Product (Roach 1999). Today, lobster is responsible for about three quarters of Maine's fishing profits, with more than 67 million pounds bringing more than $311 million at the dock in 2005. Salmon (farmed), groundfish and clams come in distant second, third and fourth place, each providing about 5% of total dockside profits. Herring and worms each comprise about 2%. Crabs, sea urchins, mussels, and quahogs each provide about 1%. Several other species make up a remaining 1%.

Regulatory Context

Many observers in fishing industry, scientific and environmental communities, blame regulation for groundfish declines in Maine and New England. The fishery has a complex regulatory history, which makes it difficult to pinpoint more and less effective regulatory policies. Throughout the 20th and 21st centuries, groundfish harvest controls have included gear restrictions (such as net mesh sizes), area closures (seasonally or year-round, and especially inshore), and minimum sizes for landed fish. Output restrictions in the form of catch quotas (calculated as aggregate catch for specific fleet subsectors over a specified period of time, not as individual catch quotas) were tried in the 1960s and 1970s. In the 1990s, vessel landing limits were set on a per trip basis and permit moratoriums were imposed for most of the fishery. Permits were denied for vessels unable to document minimum landings in specific years. Limitations on the allowed number of fishing days per vessel were set as annual "days-at-sea"

(DAS). DAS have since become a primary regulatory mechanism. Questions arise, however, as to the efficacy and impacts of this tool, with respect to both ecological and social-economic dimensions of the fishing industry.

Research Design

Collaboration in Quantitative and Qualitative Methods

Project participants had extensive prior experience in the sciences, fishing businesses, and fisheries policy/management arenas. We wished to fully utilize this existing foundation of collective knowledge, and scheduled numerous and extended opportunities for discussion throughout the development of research design and field data collection protocols. We spent some time discussing quantitative and qualitative methodologies, and determined that a combination of the two would yield the most robust and thoroughly supported project findings. The group considered multiple alternative sampling frames and survey formats before settling on the protocols described below. Those discussions included reviews of existing databases from both public and private sources.

Sampling Frames and Interviews

Multispecies Permit Holders

Survey interviews were conducted with a random samples of federal multispecies permit holders listing Portland, Maine as their vessel's home port. Permit holders were identified from a National Marine Fisheries Service (NMFS) database that had been updated by NMFS as of March 5, 2003. Letters explaining the project were sent to permit holding interviewees prior to contacting them. Although interviews were often difficult to schedule, many permit holders who committed to the interviews were then quite generous in contributing valuable time and information. A check for $50 was mailed to each interviewee, in partial recognition of these contributions.

Interviews of permit holders listing Portland as their home port were completed during the period of July 2005 – March 2006. These totalled 20, with a response rate of 83%. These were completed by telephone by an industry PI, with close supervision from a scientist PI. Supplemental samples were taken as necessary to replace some permit holders who declined to be interviewed, or could not be contacted after many repeated attempts.

Crew

A sample of crew members was generated from a list of names given in interviews with multispecies permit holders listing Portland as their home port. These names comprised crew members on boats previously fished by permit holders (as boat owners, crew, or managers), during a series of years specified in the survey. (The series of years is discussed below, in the section on survey design.)

Crew members known to be deceased, crew already interviewed as permit holders, and duplicate crew referrals were removed from the list. A random sample was taken, plus supplemental samples as necessary to replace crew who were deceased, who declined to be interviewed, for whom contact information could not be found, or who could not be contacted after repeated attempts.

Twelve crew interviews were completed by an industry PI during the period of April 2006 - July 2006, with close supervision by a scientist PI, and a response rate of about 36%. Letters explaining the project were not sent to crew interviewees prior to contacting them, due to the difficulty of developing a reliable contact list in advance of crew contact attempts. Although crew members were more difficult to find and contact, for reasons discussed below, once contacted, most were generous in contributing both time and information. A check for $50 was mailed to each interviewee, in partial recognition of these contributions.

Survey Design/Interviews

The two lead science PIs developed a draft survey instrument to collect both qualitative and quantitative information. The survey was based on extensive discussions with industry PIs preceding proposal development, during the course of proposal writing, and in multiple project meetings. The two industry PIs and the third science PI reviewed the survey draft, made comments, and corresponding revisions were made by the two lead science PIs.

The survey included questions about interviewees' personal fishing histories, and about activities and attributes of all boats with which the interviewee was affiliated during particular years of interest. In addition to basic documentation and descriptive information culled from the NMFS database, the survey asked about a dozen questions about the interviewee's personal background and fishing career. The survey also asked more than two dozen questions about each boat with which the interviewee was affiliated during each of five years of interest.

The years of interest were 1983, 1993, 2003 and (optionally) 1997 and 2004. The three primary years of interest were chosen to span the two decades preceding the intended beginning of survey data collection. Conveniently, they not only represent equivalent time periods, but coincide with major fishery management actions. 1983 was one year prior to implementation of the Hague Line. 1993 was the year before Amendment 5 to the federal multispecies Fishery Management Plan (FMP). 2003 preceded implementation of Amendment 13 to the multispecies FMP, and was the second year under which the multispecies fishery was managed according to a court ordered settlement agreement. The two optional years were chosen to achieve slightly better temporal resolution in the more recent decade. 1997 was the year multispecies Amendment 7 went into effect. 2004 was the first year Amendment 13 was implemented. In order to parallel changes in federal reporting, data collected for years 1983 and 1993 correspond to calendar years, while data collected for years 1997, 2003, and 2004 correspond to fishing years (starting May 1 of the listed year and ending April 30 of the following year).

Two versions of the survey were produced, with only slight modifications to accommodate anticipated differences between responses from permit holder interviewees and crew interviewees. Fewer than a half dozen survey questions were unique to permit holder or crew surveys, with all other questions being identical. Surveys included both closed questions intended to elicit short answers, and open questions intended to elicit long answers.

Database Construction

Databases were constructed to aggregate the vast majority of survey replies, both quantitative and qualitative. Many qualitative survey responses were coded into categories, for subsequent analysis as nominally and ordinally scaled quantitative data.[2]

Initial data entry for the Portland database was conducted by an industry PI, with supervision by a science PI. The database was reviewed, corrected, cleaned, reorganized, and initially coded by a scientific PI, with assistance from the industry PI, and from an additional fishing family member. The database was then reformulated into several secondary databases by the science PI to enable more extensive statistical analyses.

Data Analysis

Quantitative Analysis

As discussed below, quantitative analyses of the Portland data included frequency tables and graphs, descriptive statistics, correlation matrixes, factor analyses, and regressions. Both parametric and non-parametric statistics were used.

Qualitative Analysis

Qualitative analyses primarily involved reviewing interviewee's responses to open-ended survey questions. It also incorporated extensive conversations with the industry interviewer, who offered frequent contextual comments informed by her experience as a fishing family member. Contextual information from prior research by the science PI was also considered, as were her personal and professional experiences living in fishing-dependent households, and working with fishing-dependent businesses and organizations.

Notes on Samples and Possible Related Biases

Permit Holder Sample

After much discussion of possible units of analysis, we designed our sampling frame to randomly select holders of 2003 federal multispecies permits.[3] The federal database from which

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[2] Ordinally scaled data generally represent rank orders (such as 1st, 2nd, etc.). This contrasts with integer scale data, which describes specific quantities with clear mathematical relationships among them (such as one boat, two boats, etc.). Nominally scaled data are numbers representing non-numerical categories (such as male, female, etc.).

[3] We considered sampling boats, as the primary capital assets in most fishing businesses, but decided that this would be problematic, since boats are bought and sold over time and could be difficult to track down. Further, boats represent only the most tangible asset in a fishing firm, and are most profitable when the people running them contribute extensive ecological, technical, and business-specific knowledges. In most firms, permit holders are active decision makers when it comes to general business operations. In many firms, however, a hired captain or vessel manager may make many routine or highly strategic decisions, and may or may not be expected to consult

our sample was drawn lists individual permits and affiliated contact persons, boats, and other specifics. Because some individuals or firms held multiple multispecies permits, they were more likely to be selected randomly from the federal permit holder database compared to individuals or firms holding only one multispecies permit.[4] In fact, two individuals owning, part-owning or managing a number of fishing boats appeared twice in our sample. To complicate matters further, some permits were affiliated with boats that held them primarily for the purposes of leasing days-at-sea to other boats, owned by the same firm or a different firm. For these reasons, the present report generalizes more easily about permit holders and boat-years, and less easily about fishing boats, boat owners, or fishing businesses.

Our sample can be understood to represent individuals and firms with some ostensibly active interest in the groundfishery as of 2003. It does not necessarily represent active groundfishing firms or individuals. Some holders of multispecies permits maintain commercial groundfishing activities. Others do not. Some went commercially groundfishing in the past but do not have permits with sufficient DAS to continue in this fishery, or have left the fishery for other reasons. Some have never gone commercial groundfishing but might fish recreationally for some groundfish species. As noted above, in recent years, some individuals and firms hold permits and lease DAS to other firms. These variations in degrees of investment and activity in commercial groundfishing were considered and accounted for in data analyses and interpretations, as discussed in those sections below.

About half the businesses included in the Portland permit holder sample were incorporated. In some cases, these corporations are controlled entirely by the interviewed individual. In other cases, family members (including spouses, parents, children or others) are corporate partners. In yet other cases, some number of non-family business partners are involved. In all cases of corporate ownership, interviews were requested only from permit holding individuals listed in the NMFS database, or from individuals referred to at phone numbers listed for corporate permit holders in the NMFS database. In most cases of corporate ownership in the Portland sample, phone numbers listed were for private homes. Other corporate owners were not interviewed. Most interviewees did not voluntarily offer names of other corporate partners, except in some cases where they were immediate family members.

A concerted effort was made to contact and interview as many of the sampled permit holders as possible, even if it required multiple phone calls and repeated rescheduling. Once permit holders were able to set aside the necessary interview time, the vast majority were very forthcoming in their answers to most survey questions. Although some difficulties were encountered in the mechanics of data entry, multiple reviews of the data have eliminated those problems. For these reasons, we are confident in the randomness of the Portland dataset.

Crew Sample

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frequently with the permit holder. It is also the case that when boats and permits are held by a corporation, permit holders may be reluctant to discuss decision making arrangements in any details. It should not surprise us that fishing operations are inherent social entities; it just makes for difficulties in parsing apart variables for quantitative data collection and analysis.

[4] These duplicate permit holders could not be eliminated from the database prior to sampling because some held different permits under different corporate names. Further, the existing sample can be considered to reflect a level of industry consolidation that would be concealed if duplicate permit holders were removed.

Although the second set of Portland surveys is referred to here as a "crew" sample, this is something of a misnomer. It is difficult to obtain a random sample of crew members. Unlike permit holders, their names and contact information are not listed in publicly available databases. While many permit holders willingly provided names of crew members, some were reluctant to do so, or could not remember their names. We did not ask permit holders to check their records for crew names or contact information. Reasons for this were twofold: 1) most crew work on a contract, or lay, system, whereby boat owners divide profits from each trip and are not legally required to maintain employment records with names and contact information, and 2) we were reluctant to ask permit holders to expend additional time to check any existing records, especially those dating back several years.

Especially without checking any records, permit holders may have been more likely to recall names and contact leads for crew who worked with them over a longer time period, and/or more recently, compared to crew members who worked for a smaller number of trips and in the earlier years included in the survey. Further, some of the individuals in the crew sample were also multispecies permit holders themselves, either at the time that they worked as crew, or at some other time. Others may not have held multispecies permits, but owned commercial fishing boats that harvested other species.

It is possible that the Portland crew sample is biased toward individuals currently residing in the vicinity of Portland, Maine or New England, since contact information or leads were more likely to be known by referring permit holders, and more likely to be found easily in internet and word-of-mouth searches. Contact information could not be found for about a third of the crew sample, even after contacting family members and known previous residences.

Given the concerns stated above, the crew sample is not sufficiently large or representative to yield multivariate statistical analyses with high levels of external validity.[5] The twelve sampled individuals were referred from only half of the permit holder sample. More than half of the twelve were referred from a total of just three permit holders. Nonetheless, the sample is useful for making at least a few qualitative comments, supported with univariate measures.

Quantitative Data Analysis

Measurement Scales and Statistical Tools

Several statistical analyses are summarized below. More detailed tables are provided in the appendix. A substantial amount of survey data on Portland permit holders comprised normally distributed integer scale data, allowing parametric descriptive and multivariate analyses. Data on Portland boat-years included a large number of ordinal and nominal scale variables, requiring nonparametric analyses, as well as integer scale variables, allowing parametric analyses.[6] Crew

[5] External validity refers to the extent to which observations based on a studied sample can be generalized to the larger population of interest.

[6] Nonparametric statistics are "weaker" than parametric statistics in that they are somewhat less likely to detect meaningful relationships among variables. Parametric tools assume that variables are measured on an integer scale,

data was sufficient for tentative univariate analyses. The vast majority of statistics reported below are significant at $p < .05$.[7]

Portland Permit Holders

Descriptive Statistics

As a group, our sample of 2003 federal multispecies permit holders listing Portland as their home port are all male. They were born in a time period spanning from 1939 to 1976. They first fished at ages ranging between four and 29. They owned their first boat at ages ranging from nine to 41. They range from having no commercial fishing experience in their families, to being the fourth commercial fishing generation in their families. They hold federal commercial fisheries permits for from two to 11 different species or species groups. During the years of survey interest, they have participated in from one to four different fisheries, which may or may not include the groundfishery. They used from one to seven different harbors during the years of survey interest plus the harbor in which they first fished. They have used harbors in one to four different states and/or countries during the same time period.

Univariate statistical analysis enables us to say with 95% certainty that the average (mean) holder of a Portland based 2003 federal multispecies permit is male and was born between 1952 and 1960.[8] He is a 1.4^{th} to 2.6^{th} generation fisherman, and first went fishing between the ages of ten and 16. He owned his first boat between the ages of 20 and 28. He holds 5.7 to 8.2 different kinds of federal commercial fishing permits (defined by species or species group),[9] and participated in between 2.2 and 3.1 fisheries (generally as defined by federal permits for species or species group) during the years 1983, 1993, 1997, 2003 and 2004. He was active in the commercial groundfish industry during all of these years. He has used 2.4 to 3.8 harbors during these years (whether as boat owner, captain, crew or manager) plus the harbor from which he first learned to fish. He has used harbors in 1.7 to 2.4 states and/or countries during these same years, including where he first learned to fish.[10] (For a more detailed report in table format, see Appendix, Figure 1.)

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are normally distributed, and that sampled cases are randomly selected (though some parametric statistics are more or less tolerant to deviations from these assumptions). Datasets for which these assumptions cannot be met can sometimes be analyzed with nonparametric tools. Nonparametric tools are especially useful in social science, where small sample sizes are common, and many observations do not have integer values, but can be coded on an ordinal scale, by rank order.

[7] P represents the statistical possibility that a given statistic, calculated from a random sample, is not representative of the larger population from which the sample was drawn. (Population here can refer to a group of people, or any group of objects.) For example, a p of .05 indicates a 5% probability that a statistic cannot be used to describe the larger population. Inversely, it indicates a 95% confidence level.

[8] These means are stated as ranges to ensure validity at a 95% confidence level. Stating them as single number averages (such as "born in 1956") can misrepresent the measurement's precision, communicating a false sense of accuracy when generalizing to the larger population.

[9] This counts merely different types of permits held. It does not count the total number of individual permits held, since one owner might hold or lease more than one permit in a single fishery, either fishing them on different boats, or stacking multiple permits for the same fishery onto a single boat.

[10] For the purpose of the permit holder analyses, number of states/countries in fact represents only a number of states, as no non-U.S. countries were reported. In the crew sample, however, non-U.S. countries do appear.

Of the 20 interviewees, more than a quarter were born in Portland, more than half were born in southern or midcoast Maine, two were born elsewhere in New England, a quarter were born elsewhere in the U.S., and one was born overseas. A quarter of the interviewees grew up in families that fished out of Portland. More than a quarter grew up in families that fished out of other Maine harbors. A few grew up in families that fished in other states. Another quarter grew up in families that did not commercially fish. About half of the interviewees began their commercial fishing careers on lobster boats. More than a quarter of them first fished in Portland, three quarters of them first fished in Maine, another quarter first fished elsewhere in the U.S. More than a quarter of interviewees first fished in the same town where they were born, three quarters first fished in the same state where they were born. Fewer than a quarter first fished in states or countries different from where they were born. More than three quarters of the multispecies permits are on boats that hailed from Portland in 2003. Half the multispecies permits are associated with boats that hailed from the same harbor in which the interviewed permit holder first fished. All permit holders resided in Maine as of the interview date. About a quarter have worked for some period greater than a year outside the fishing industry. Almost a quarter of the interviewees were not employed in commercial fishing when the survey was conducted.

A small number of open-ended interview questions yielded data that is less conducive to statistical analysis, but assists in contextualizing and interpreting quantitative analyses. All 20 permit owners interviewed were asked the following question: "Have you moved around (or traveled) more or less than you would like in pursuing your fishing career? What kinds of things have caused you to move around or stay put?" Of the 20, five responded that they had moved and traveled more than they would like. Three responded that they had moved and traveled as much as they wished. None replied that they would have liked to move or travel more. Five responded that regulations had forced them to fish in different areas than they would otherwise. One responded that regulations forced him to target different species than he would otherwise. One responded that Maine's ban on landing dragged lobsters forced them to land in Massachusetts. One responded that the Portland auction is driving people to Massachusetts. One responded that he had made location decisions based on family considerations. Four responded with strong concerns about industry consolidation. Of these four, three complained that one firm is increasing its fishery access at the expense of others (all specifically and spontaneously naming the same single firm, and two specifically stating that permit purchases are the means of this consolidation), while one of the four also complained of a second firm doing the same.

Correlations

A Pearson's *r* correlation matrix revealed marked correlations between three pairs of permit holder characteristics.[11] The age at which permit holders first fished, as well as the age at which

[11] Correlations range between -1 and 1. A correlation of 0 would mean there is no association between the two variables. A correlation of 1 would mean that two variables are perfectly associated. A "marked" correlation is usually defined as a correlation greater than .6 or less than -.6. This means that more than 36% of the variation in each of the two correlated variables is associated with one another. A positive correlation indicates that high values of one variable are associated with high values of the other variable. A negative correlation indicates that high values of one variable are associated with low values of the other variable.

permit holders owned their first boat, correlated markedly (both negatively) with the number of species fished during the years for which survey questions were asked. The number of states/countries in which ports were used during the time periods for which survey questions were asked (including learning to fish and fishing activities in the years specified above) correlated markedly (positively) with the number of ports used during the same time periods. (See Appendix, Figure 2 for table.)

Factors

Five factor analyses were run on the permit holder integer data. Each used a different factor extraction method, and allowed up to four factors to be extracted, providing that any extracted factors have eigenvalues of at least 1.[12] Extraction methods included communalities, iterated communalities, maximum likelihood, centroid and principal axis.

Four factor methods each extracted two factors. One method (centroid), extracted three factors. The four methods extracting two factors each, produced cumulative eigenvalues that accounted for 49-51 % of total variance. The method extracting three factors produced cumulative eigenvalues that accounted for 67% of total variance.

In all five factor extraction methods, number of states/countries in surveyed years and number of fisheries participated in during surveyed years have marked factor loadings.[13] In four of the five extraction methods, age first fished has marked factor loadings. In three of the five extraction methods, age owned first boat has marked factor loadings. In one extraction method, number of types of permits held has a marked factor loading. In all five factor extraction methods, number of fishing family generations, number of ports used in years surveyed, and year born have zero marked factor loadings. In the four two-factor extraction methods, all variables with marked factor loadings have eigenvalues between 1.8 and 2.3. In the one three-factor extraction method, all variables with marked factor loadings have eigenvalues between 1.3 and 2.2. (See Appendix, Figure 3 for tables.)

Regressions

Four regressions were run on Portland permit holder data to explore the extent to which measured permit holder variables might explain number of ports used during the periods of interest, number of states/countries in which ports were used during the periods of interest, number of federal permits held, and number of federally permitted fisheries participated in during the years between 1983 and 2004 specified in survey questions.

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[12] Factor analysis can be used to explore the "dimensions" or underlying structure of a dataset by identifying groups of interrelated variables, as in this application. Factor analysis can also be used to reduce a large number of variables to a smaller, more manageable number of variables, for further analysis. Although factor analyses usually recommend larger datasets, with at least five cases for each extracted factor, similar results from five different factor extraction methods used here suggest that these analyses may be sufficiently robust. An eigenvalue represents the amount of variation among cases that is explained by each extracted factor. An eigenvalue of one represents the same explanatory usefulness as a single original variable in the dataset, and may not add significantly to data interpretation. Factor extraction methods differ in how they calculate relationships among variables.

[13] Factor loadings represent the correlation between a variable and a factor. Here, loadings of .7 or higher are considered marked.

The regression for number of ports yielded an adjusted R^2 of .39.[14] Beta weights were significant for two independent variables: 1) number of states/countries in which primary and secondary ports were used during the periods of survey interest (positive association), and 2) age at which he first owned a boat (negative association).[15]

The regression for number of states/countries in which ports were used during the periods of survey interest yielded an adjusted R^2 of .69. Beta weights were significant for three independent variables: 1) number of types of federal permits (positive association), 2) age at which he owned his first boat (positive association), and 3) number of states/countries in which primary and secondary ports were used during the survey time periods (learning to fish, plus five years between 1983 and 2004) (positive association).

The regression for number of fisheries participated in yielded an adjusted R^2 of .68. Beta weights were significant for two independent variables: 1) age at which he first went fishing (negative association), and 2) age at which he owned his first boat (negative association).

The regression for number of types of permits held yielded an adjusted R^2 of .63. Beta weights were significant for three independent variables: 1) number of states/countries in which primary and secondary ports were used (positive association), and 2) age at which he owned his first boat (negative association), and 3) year he was born (negative association). (See Appendix, Figure 4 for tables.)

Groundfishing Boat-Years

The analyses below are based on data reported for years 1983, 1993, and 2003. Although data was also collected for years 1997 and 2004, including those years could bias the results toward more recent years. Further, data collection for those years is missing a larger number of datapoints, since the survey designated responses for those years as optional.

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[14] R^2 is a number between 1 and 0 that describes the amount to which the variation in a dependent variable is reduced by (or might be explained in terms of) the independent variables included in the regression. An R^2 closer to 1 means that more of the variation in the dependent variable might be accounted for by the independent variables included in the regression. An R^2 closer to 0 means that less of the variation in the dependent variable might be accounted for by the independent variables included in the regression equation. R^2 is usually "adjusted" to account for "degrees of freedom" in the dependent and independent variable. Because R^2 is the square of a ratio of unaccounted for to total variation, even if the ratio is as high as .9, R^2 would only be .81, and is usually reduced further when adjusted for degrees of freedom (because this process entails dividing both the unexplained and total variation). Similarly, a if the ratio of .5, with half the total variation explained by the regression equation, and half remaining as unaccounted for, or "residual" variation, would yield an R^2 of .25, which might be reduced further after being adjusted.

[15] The beta weight for each independent variable explains the extent to which that individual independent variable accounts for the total variation in the dependent variable. Beta weights are "semi-partial" coefficients and differ from "partial" coefficients (such as Pearson's, Spearman's and gamma coefficients discussed above and below) in that beta "controls for" other independent variables in the regression equation. Beta weights measure the unique influence of a single independent variable after distinguishing such influence from that of other independent variables in the regression equation. Partial coefficients do not distinguish between influence unique to a single independent variable, and influence shared with other independent variables listed in a correlation matrix. Beta weights are generally reported as significant when they are higher than .5 or lower than -.5.

Descriptive Statistics

Data was analyzed for 61 fishing boat-years reported by 2003 permit holders to be actively fishing during the years 1983, 1993 and 2003.[16] As a group, the boat-years associated with 2003 permit holders during the years 1983, 1993 and 2003 ranged in number from zero to four boats per individual. The number of boats owned by individual per year ranged from none to three. Boat lengths ranged from 12 to 120 feet. Number of crew per trip ranged from none to ten. Trip length ranged from one to 16 days. Closest distance fished from shore ranged from zero to 180 miles. Farthest distance from shore ranged from zero to 300 miles. Number of species fished per boat-year ranged from one to six.[17] Number of primary and secondary ports used per boat-year ranged from one to three.[18]

On average, each permit holder reported owning one boat per year, and working on or managing one boat per year. With a 95% confidence level, the mean year fished was between 1992 and 1996. The mean number of boats fished was 1.5 to 1.9. The mean number of boat owned was 1.0 to 1.3. The mean boat length was 60 to 72 feet.[19] The mean maximum number of crew was between 3.5 and 4.1. The mean longest trip was between 4.9 and 6.7 days. The mean closest to shore fished was between 13.8 and 38.1 miles. The mean farthest from shore fished was between 98.7 and 140.1 miles. The mean number of species per boat-year was between 1.6 and 2.1. The mean number of primary and secondary ports used was between 1.3 and 1.6. (See Appendix, Figure 5 for tables.)

Ordinally and nominally ranked survey responses provide less precise information about metrics that are more difficult to measure using an integer scale. Calculated on the basis of 61 boat-years, more than half the boat-years were associated with permit holders maintaining permanent residences in southern or mid-coast Maine.[20] In thirteen boat-years, the interviewed permit holder maintained a permanent residence in Portland, in an additional 35 boat-years, the interviewed permit holder maintained a permanent residence in southern or mid-coast Maine, in

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[16] Permit holders provided data for a few more boat-years that were excluded from the analysis either because the boat was not fishing in those years, or data was insufficient to analyze. Boat-years reported by crew were excluded because the sample was not sufficiently random and many duplicated boat-years reported by permit holders (since permit holders were the reference source from which the crew sample was created). Boat-years for which fishing occurred only on species other than groundfish were included in the analysis, but coded separately to allow analysis of the impact of this variable on others.

[17] Commercially fished species other than groundfish included shrimp, scallops, lobster (all mentioned with some frequency), and whiting, monkfish, hake, tuna, herring and mackerel (each mentioned by only one or two permit holders).

[18] This statistic aggregates all harbors reported as primary or secondary ports used for tie up, landing, and sale. Note, however, that this does not necessarily reflect the total number of harbors used by each boat. Surveys only asked for primary and secondary ports. In many cases, these two levels of use incorporated all ports used. Some boats, however, used more than two ports for tie up, landing, and/or sale.

[19] Two boat-years were reported for boats 12' in length, one for a boat 20-29' long, four for boats 30-39' long, nine for boats 40-49', seven for boats 50-59', three for boats 60-69', 14 for boats 70-79', 13 for boats 80-89', three for boats 90-99', and four for boats 100-120'. The median was 70', with half the boats exceeding 70 feet and half smaller.

[20] Note that the associated permit holder is someone who held a permit in 2005 and therefore appears in our sample and reported fishing activities for that boat-year as owner, crew, or manager. It is not necessarily the person holding the groundfishing permit actively used by that particular boat in that particular year. Permit holders reporting data for multiple boat-years are counted per boat-year in this analysis, not as single individuals.

five boat-years, the interviewed holder maintained a permanent residence in inland Maine, in four boat-years, the interviewed permit holders maintained a permanent residence elsewhere in New England, and in two boat-years, the permit holders maintained a permanent residence outside New England. Only in two boat-years did any respondent maintain a temporary residence different from his permanent residence.

Two thirds of the boats tied up primarily in Portland (66%). About a fifth of the remaining boats tied up primarily in Maine (17%). The remaining fifth tied up elsewhere in New England (10%) or outside the region (6%). Almost half reported Portland as being their secondary tie up (44%). Another quarter reported secondary tie ups elsewhere in Maine (28%). The remaining quarter reported secondary tie ups elsewhere in New England (23%) or outside the region (3%). Similarly, two thirds landed fish primarily in Portland (70%). A handful landed fish primarily in other Maine ports (8%), and the remaining fifth landed primarily elsewhere in New England or outside the region (18%). More than half reported Portland as their secondary landing port (56%), with a fifth landing secondarily elsewhere in Maine (11%), and a remaining quarter landing secondarily elsewhere in New England (26%) or outside the region (3%). Again, two thirds sold fish primarily in Portland (69%), with another handful selling elsewhere in Maine (9%), and a fifth selling elsewhere in New England or outside the region (18%). Half reported Portland as their secondary sale port (49%), with a fifth selling secondarily elsewhere in Maine (13%), a third selling secondarily elsewhere in New England (30%) and a handful selling secondarily outside the region.[21]

Grounds reported fished in these boat-years included the Gulf of Maine, Georges Bank, and elsewhere on the east coast of the U.S. and Canada. Almost half of the boat-years reported fishing only or mostly in the Gulf of Maine (43%). Most of the remaining half reported fishing in the Gulf of Maine, Georges Bank and elsewhere in New England (41%). A few (5%) reported fishing grounds beyond New England, such as the Grand Banks or mid-Atlantic waters.

Correlations

A gamma correlation matrix revealed strong, very strong or perfect correlations between 35 pairs of boat-year characteristics.[22] Permanent residence correlated perfectly with temporary residence. Both permanent and temporary residences correlate very strongly with primary landing port, and primary sale port, and correlate strongly with primary tie up port, and secondary landing port. Primary landing port correlates perfectly with primary sale port. Both primary landing port and primary sale port correlate very strongly with secondary landing port, and strongly with secondary tie up port and secondary sale port. Primary tie up port correlates very strongly with primary landing port and primary sale port, and correlates strongly with secondary tie up port, secondary landing port, and secondary sale port. Secondary tie up port

[21] Some respondents reported Portland to be their primary and secondary tie-up port, primary and secondary landing port, and primary and secondary sale port.

[22] Gamma correlations are a nonparametric alternative to Pearson's r correlations. They differ from Pearson's r in that they tolerate ordinal and integer data, non-normal variable distributions, and ties among variables. Gamma statistics range between -1 and 1. A correlation of 0 would mean there is no association between the two variables. A correlation of 1 would mean that two variables are perfectly associated. A "strong" association is usually defined as a correlation of .6 or higher, or -.6 or lower. A "very strong" association is usually defined as a correlation of .75 or higher, or -.75 or lower.

correlates very strongly with secondary landing port and secondary sale port. Secondary landing port correlates very strongly with primary sale port and secondary sale port. Secondary sale port correlates strongly with number of ports for that boat-year. (All of these are positive associations. See Figure 6 in the Appendix for tables.)

Factors

Five factor analyses were run on the three years of boat-year data. Each used a different factor extraction method, and allowed up to four factors to be extracted, providing that any extracted factors have eigenvalues of at least 1.[23] Extraction methods included communalities, iterated communalities, maximum likelihood, centroid and principal axis.

Four factor methods each extracted one factor. One method (centroid), extracted three factors. The four methods extracting one factor, each produced cumulative eigenvalues that accounted for 32-33 % of total variance. The method extracting three factors produced cumulative eigenvalues that accounted for 55% of total variance.

In all five factor extraction methods, variables for boat length, maximum number of crew, and longest fishing trips have marked factor loadings. Variables for number of boats owned and number of ports used per year join that list in the centroid extraction of three factors.

Regressions

Two regressions were run on the three years of integer scale Portland permit holder boat-year data to explore the extent to which a series of boat-year variables might explain the number of ports used per year and the number of fisheries participated in per year. The adjusted R^2 for number of ports used was .14. The adjusted R^2 for number of fisheries participated in was .04. In the regression for number of primary and secondary ports used, only maximum number of crew had a beta weight approaching .5. In the regression for number of fisheries participated in, all variables had beta weights well below .5. (See Figure 8 in Appendix.)

Dummy variables were then added to include additional variables for which survey responses could not be easily measured on an integer scale. Five regressions were run, for dependent variables year, number of ports reported per year, permanent residence in Portland, an aggregate score for landings and sales ports, grounds fished, and boat length. Corresponding adjusted R^2s were .3 for year, .5 for number of reported ports, 1.0 for permanent Portland residence, and .9 for landings and sales ports, grounds fished, and boat length. (See Figure 9 in Appendix.)

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[23] Factor analysis can be used to explore the "dimensions" or underlying structure of a dataset by identifying groups of interrelated variables, as in this application. Factor analysis can also be used to reduce a large number of variables to a smaller, more manageable number of variables, for further analysis. Although factor analyses usually recommend larger datasets, with at least five cases for each extracted factor, similar results from five different factor extraction methods used here suggest that these analyses may be sufficiently robust. An eigenvalue represents the amount of variation among cases that is explained by each extracted factor. An eigenvalue of one represents the same explanatory usefulness as a single original variable in the dataset, and may not add significantly to data interpretation. Factor extraction methods differ in how they calculate relationships among variables.

Beta weights with absolute values over .5 for year included (in order of absolute value of weight) aggregate tie up score, secondary tie up Portland, number of boats owned, aggregate landing and sale ports, fishing grounds, permanent Maine residence, and secondary tie up in Maine.

Beta weights with absolute values over .5 for number of ports included (in order of absolute of value) aggregate tie up score, secondary tie up Portland, primary tie up Portland, farthest distance from shore, fishing grounds, permanent Portland residence, primary tie up in Maine, number of boats reported, Casco islands affiliation, longest trips, primary tie up New England, secondary tie up Maine, permanent residence southern or mid-coast Maine, number of boats owned, and permanent Maine residence.

Beta weights with absolute values over .5 for aggregate landings and sale score (in order of absolute value) included longest trips, primary Portland tie up, permanent Portland residence, farthest from shore, boat length, and boats reported.

Beta weights with absolute values over .5 for permanent Portland residence (in order of absolute value) included aggregate tie up score, primary tie up Portland, longest trips, farthest from shore, number of boats reported, fishing grounds, boat length, secondary tie up Portland, permanent residence southern or mid-coast Maine, Casco Bay islands affiliation, and number of boats owned.

Beta weights with absolute values over .5 for grounds fished (in order of absolute value) included aggregate tie up score, primary tie up Portland, farthest from shore, longest trips, secondary tie up Portland, permanent Portland residence, number of boats reported, and Casco Bay islands affiliation.

Beta weights with absolute values over .5 for boat length (in order of absolute value) included longest trips, primary tie up Portland, permanent Portland residence, farthest from shore, aggregate tie up score, number of boats reported, permanent residence southern or mid-coast Maine, fishing grounds, number of boats owned, Casco Bay islands affiliation, and aggregate landing and sales ports.

Crew

As noted above, without a larger and more representative sample, analysis of crew data is necessarily limited. Within these parameters, it does provide some rather suggestive information, however. Interviewed crew were all male. The birth year for crew interviewees ranges between 1949 and 1978, with a mean between 1954 and 1965.[24] The age of first fishing activity ranges from 8 to 30, with a mean between 15 and 23. They are members of first to third generations of fishing families, with a mean of 1 to 2. They participated in a range of one to five fisheries during the years of survey interest, with a mean of 1.6 to 3.4. They used a range of one to 12 ports during the years of survey interest (including where they learned to fish), with a mean of 1.8 to 5.4. Those ports were located in a range of one to 11 states or countries, with a mean of .8 to 4.3. States and countries reported included ports as far away as Alaska, Latin America and

[24] These are reported within 95% confidence levels.

Africa, although most non-New England ports were reported by a small number of interviewees with well-traveled histories. (See Figure 10 in the Appendix.)

A quarter of the "crew" interviewees were boat owners at some time. Three of the 12 owned boats at the time of the interview, one more had owned a boat previously. Two of these reported specific groundfishing or other fishing activities for boats they owned, the other two did not.[25] Thus, in the years of survey interest, two crew interviewees held positions as owner-operators, as well as holding other positions on other boats. Five other interviewees held positions as captains, as well as other crew positions, in the years of survey interest. Five interviewees worked only as mates, deckhands, cooks, or other crew in these years.

Crew were asked more open-ended survey questions than permit holders. Like permit holders, they were asked "Have you moved around (or traveled) more or less than you would like in pursuing your fishing career? What kinds of things have caused you to move around or stay put?" They were also asked about whether or not they had taken or turned down fishing jobs based on location considerations, how far they have traveled from a permanent or temporary residence for a fishing job, details about those decisions and outcomes, and advice for prospective crew and boat owners.

Three quarters of the crew interviewees responded that they had moved around as much as they wanted. Two responded that they had moved around more than they would like. None responded that they would have liked to move more. Three quarters reported making job related decisions in order to stay in Maine. Several mentioned turning down fishing opportunities outside Maine. Three quarters recommended that prospective crew members pursue a different occupation, most referencing poor prospects for career futures in the fishing industry at present. Two expressed optimism that crew jobs will improve in the future. Two noted that crew should be careful in their spending habits, and two mentioned a need for health insurance or other benefits.

Discussion

Different project participants approached data collection and analysis with slightly different working hypotheses. In the case of Portland data collection, these hypotheses were aggregated into two broad questions: 1) How mobile or immobile are the individuals and boats invested in the groundfishing industry and home ported in Portland? 2) What factors might help to explain such patterns of mobility or immobility? Factors preliminarily identified by project participants that might affect mobility or immobility included family and social ties, fishing regulations, markets, species diversification, capital investment, information networks, and other dimensions of household and business strategies.

Characterizing Permit Holders

[25] Fishing activities for one boat including groundfishing and several other fisheries. Activities for the other boat were limited to the tuna fishery. The other boats likely participated in commercial fisheries, but for shorter periods that were not encompassed by years of survey interest.

It is important to recognize that our picture of Portland home-ported permit holders is a snapshot, limited in temporal and spatial dimensions. Since the beginning of data collection in 2005, regulatory and ecological changes have caused some permit holders to sell their boats or permits, lease their permits, or shift their effort to other fisheries. There are many boats and fishermen landing, selling or tying up in Portland who did not claim it as their home port in 2003 and are therefore excluded from our sample. A few such boats are home-ported to the south, including Gloucester. Others claim home harbors as close as the Casco Bay islands, or as far east as Eastport. Some such boats have always visited Portland, whether for a wider range of services and products, better prices, or convenience. In recent years, however, as regulatory and ecological changes have consolidated the groundfish industry, Portland has become virtually the only Maine harbor in which groundfishing boats can sell their catch and buy necessary supplies. Without access to markets and fish stocks closer to home, some boats home-ported in other Maine harbors now tie up regularly in Portland. Conversely, some number of boats home-ported in more southern states formerly conducted some activities in Portland, but are now less likely to do so because of a reduced auction schedule and fewer shoreside services.

It is also important to recognize that some variables occur with greater or lesser variation within the study sample. For any give variable, it is often as important to recognize the breadth of variation across individuals surveyed, as to recognize the precise measurement at which individual measurements for that variable converge.[26] For example, none of the permit holders surveyed are female. That is a remarkable level of homogeneity, which deserves some comment (and qualification, as discussed below in relation to family ownership patterns of Portland fishing businesses). By contrast, within the 95% confidence parameters, we can only say that the mean holder of a Portland home-ported 2003 federal multispecies permit holds federal permits for a total of somewhere between 5.7 and 8.2 different fisheries. Although the average for this sample can be expressed as a single number, due to wide variation in our sample, if we want to be 95% confident that we are not misrepresenting the population as a whole, we can't say precisely what the mean is for the population of Portland home-ported 2003 multispecies permit holders as a population -- just that it is somewhere between 5.7 and 8.2.

Characterizing Boat-Years

Boat-year factor analyses suggest that boat length, crew numbers and fishing trip lengths are dominant variables in structuring the boat-year data. This is unsurprising, since bigger boats can travel to deeper and more distant waters, can hold more fish before returning to port, and can employ larger crews. A more detailed analysis, including clustering techniques, might yield a more nuanced description of variation within this dataset.

The Power of Place

One of the most striking patterns in the Portland permit holder data is the degree to which individuals and their fishing operations are "place-based." Gloucester, other New England states, Alaska, and more distant locales do appear in the dataset. Nonetheless, more than three quarters of the permit holders began their fishing careers in Maine, and three quarters began their

[26] The extent of the sample's variation from the mean can also be expressed as a standard deviation. These are more difficult to interpret in real-world terms, however.

fishing careers in the same state they grew up in. More than half come from families with commercial fishing backgrounds. Permit holders lived outside Maine for fewer than a third of the reported boat-years, almost none took up temporary residences to accommodate fishing activities during the years of interest, and all live in Maine as of the date they were interviewed.

Even though some permit holders have used several harbors during the period of interest, on average these harbors are in two or two and a half states, with those states being Maine and Massachusetts in the vast majority of cases. Clearly Portland-based fishing businesses utilized other ports, but they were remarkably consistent in returning to Portland, or to smaller Maine harbors. For a large minority of boat-years, Portland was reported to be the primary tie up, secondary tie up, primary and secondary landing port, and primary and secondary sale port. It would appear that in these boat-years, no ports other than Portland were used. A sizeable minority of boat-years used both Portland and another Maine harbor. A smaller number used Portland and another New England port. It is notable that boats were more likely to use a non-Maine port for landing and selling than for tying up, suggesting that when Portland boats land and sell elsewhere in New England, they have been likely to return to Maine between trips.

Perhaps by way of explanation, half the permits sampled are on boats that in 2005 hailed to the same harbor in which the permit holder owner learned to fish more than two decades prior. Portland-based permit holders seem to be exceptionally rooted in Portland and nearby Maine towns. None of the permit holders or crew members expressed a desire to travel more than they had done, and several expressed a desire to stay closer to home in Maine. In light of this discussion, it may not be surprising that fishing grounds reported by interviewees were mainly split between the Gulf of Maine and New England waters more generally. Fishing more distant waters would likely require moving other fishing operations away from Maine, at least temporarily.

Change Over Time?

To complicate the picture painted above, the place-based focus of Portland's groundfishing fleet may be changing somewhat. Boat-year regressions for year as a dependent variable did yield apparently significant beta weights for aggregate tie up score, secondary Portland tie up, number of boats owned, aggregate landing and sale ports, fishing grounds, permanent Maine residence, and secondary Maine tie up. This would initially seem to support the argument that in more recent years, boats have tied up in more places farther from Portland, have become more likely to tie up in places other than Portland, are owned by firms owning more boats, are more likely to land and sell product in places other than Portland, are more likely to fish farther from the Gulf of Maine, are less likely to live in Maine, and a less likely to tie up in Maine. The adjusted R^2 of this regression, however, (the amount of variance in the dependent variable year explained by the independent variables) is only .33. In other words, these apparent changes may be occurring, but not necessarily at significant levels, or in ways that were detected by our research design.

Further, regressions suggested no significant relationship between year of operations and indicators of spatial mobility such as number of ports used, or number of states/countries in which ports were used. It may be that Portland-based boats are not becoming more mobile overall, but that some activities are shifting slightly away from Portland and Maine. More detailed quantitative and qualitative scrutiny of the existing data, and possibly additional data collection, may be warranted since this issue is one voiced frequently by industry members and others interested in the future of working waterfronts of Portland and Maine more generally (Groundfish Task Force 2004). It is likely that a more vivid and detailed picture of changes over time could be described if a second, complementary sample of permit holders were interviewed – one comprising multispecies permit holders in some prior year, such as 1983.

<u>Business Ownership and Management</u>

Prior to beginning field research, it was apparent to project participants that although the stereotypical groundfish boat owner may be a single person or nuclear family, some boats are owned by corporations, in which any number of family members or other non-family associates may have some percentage ownership. It was also apparent that some individuals or corporations owned one boat, while others owned multiple boats, perhaps with different co-owners. Indeed, number of boats owned per permit holder, as reported by boat-year, scarcely exceeded a mean of one boat. Interview responses complicated this picture, however.

Two permit holders spontaneously described themselves as boat "managers" for specified boat-years, clearly defining this role as independent from boat ownership or skippering. One of the permit holders identified himself as a manager, part owner, and sometimes skipper for four boat-years, and as a manager and small shareholder in one boat-year. Another permit holder identified himself as a manager and not as an owner in six boat-years. No manager roles were reported for boat-years in 1983, only in years 1993 and later. Thus it would appear that there are Portland-based vessels that are largely managed by people other than their owners and captains. This presence of professional fishing operations managers is surely not new to New England fishing industry, but it suggests that the financial context in which Portland's groundfishing fleet operates may involve a level of corporate organization and capital access greater than we had previously assumed. Both boat managers reported being an owner or captain in several other boat-years, so these individuals have been personally involved in the industry for many years, and in diverse roles.

<u>Fishery Entry</u>

The number of fishing generations in a permit holder's family does not appear prominently in any of the analyses undertaken. Nor did regressions yield significant relationships between permit holder age and variables relating to spatial mobility. Instead, age of fishery entry and boat ownership merit further consideration. Both appear as prominent variables in permit holder factor analyses. Regressions show that age of first boat ownership has a significant negative influence on the dependent variables numbers of states/countries used, and number of species fished.[27] That is, permit holders who entered the fishing industry at a younger age seem to have participated in more fisheries, and used ports in more states/countries.[28] It may be that a younger age of fishery entry simply provides more possible years of fishing activity, and thus more

[27] Beta weights also figure in the regression for numbers of ports used, but with a total adjusted R^2 of only .4, compared to adjusted R^2s of .7 for the other two regressions.
[28] Because the variable of birth year was also included in these regressions, influence attributed to age of entry is distinguished from any influence by present age.

opportunities to enter a number of fisheries and travel to more distant ports. While this may seem to be an obvious statement, it does have some broader bearing. People who settle on a fishing career early in life are likely to have more future fishing options. People who enter fishing later in life may not encounter the same range of opportunities. This may have some bearing on the crew discussion below, since crew interviewees started fishing a few years later in life than permit holders. It may also have some bearing on the social and family environment in which one initiates a fishing career. Even if it might not matter how many past generations of one's family went fishing, the immediate presence of other fishermen during one's young adulthood may indeed matter.

Species Diversity

It was originally hypothesized by some project participants that species flexibility may be an alternative business strategy for individuals preferring not to diversify geographically. Although the data does not disprove this hypothesis, it does nothing to support it. Nonetheless, it may be notable that Portland home-ported 2003 multispecies permit holders hold a mean of six to eight federal permits, but participated in a mean of only two or three fisheries during 1983, 1993 and 2003. Additionally, half of the permit holders reported beginning their fishing careers in the lobster industry. Number of species/fisheries fished figured prominently in factor analyses intended to structure and characterize the permit holder data.

One explanation is that as regulatory barriers to fishery entry continue to rise in virtually all fisheries, it is in the interest of fishing firms to renew any permits they can imagine possibly using in the future. It is also true that multispecies permit holders who did not groundfish year round in past years were more likely to be eliminated from the fishery through regulations based on historical groundfish landings. Many boats participated in the groundfishery during some of those years, or seasonally for many years, but were forced out of the fishery because their historical landings were lower than others'.

Further, the regression for the dependent variable number of different permits held yielded significant beta weights for number of states/countries (positive), age owned first boat (negative), and year born (negative). Individuals whose fishing activities have been more geographically dispersed hold more different kinds of permits. It may be that they hold permits in some fisheries with fish populations or ex-vessel markets that are concentrated in waters and ports farther afield. Implications for the relationship between age of first boat ownership and number of permits are likely similar to those discussed above for number of fisheries participated in.

It is interesting that older individuals hold more different permits. One might have assumed that as permit holders age, and have fewer years left in which to fish, they would be less likely to renew unused permits. Younger permit holders might be expected to renew a larger number of permits to retain a larger number of future business options. The inverse seems to be true, and a more nuanced explanation is apparently needed. It may be relevant that older permit holders were more likely to enter fishing at a time when open access permits were available to any applicant at low cost. These individuals may have simply retained a number of permits they had held for years, by renewing them annually. By contrast, younger permit holders are less likely to have started fishing during the years of open access permit issues, and have spent more of their careers in the regulatory environment of limited entry, DAS cuts, and high market prices for many fishing permits. Permit purchases present a cost barrier to the accumulation of numerous permits, especially ones that might not be used.

This statistic linking age to diversity of permit holdings also seems to support observations made by a few interviewees (both permit holders and crew) that "we all" used to fish for more species, generally blaming regulatory constraints for narrowed species harvest options. This argument is heard frequently in more easterly parts of Maine, and often from smaller boat owners in the mid-coast and western parts of the state (Brewer and Alden 2003; Brewer 2007). Older permit holders spent most of their careers in a regulatory climate in which they were permitted more inter-species flexibility. Younger fishermen feel intense pressure to maximize their landings in a given fishery, to retain days-at-sea in the event of future DAS cuts, and to return investments in purchased fishing privileges. Maximizing effort in a single fishery is likely to generate more specialized business strategies (Brewer 2007). Making more confident statements about this apparent trend would require further research.

Crew

Compared to permit holders, crew seem to be slightly older and started fishing a few years later in life. The number of ports they have used, and the number of states and countries in which those ports are located, vary more widely than for permit holders. This is not to say that on average they have used more ports, or in more states/countries. While the upper range of the 95% confidence levels for crew ports used and states/countries are 5.4 and 4.3, compared to upper ranges for permit holders of 3.8 and 2.4, the lower range of the same confidence levels for crew are 1.8 and .8 compared to lower levels for permit holders at 2.4 and 1.7. The extent of variation in the crew sample is much higher than in the permit holder sample. Since the ranges of permit holder means at the 95% confidence level fall within the ranges of crew means, no statement can be made as to whether crew on average use more or fewer ports, or ports in more or fewer states/countries.[29] To the extent that some crew may have more spatially varied fishing histories compared to permit holders, other crew have less spatially varied fishing histories compared to permit holders.[30]

Crew seem to face no dearth of crewing opportunities outside Maine. Many mentioned turning down jobs in order to remain close to home. Some described particular aspects of Maine fisheries that appeal to them, including what one described as a uniquely Maine phenomenon of fishermen bringing their sons down to the waterfront to learn about fishing. Others described fishing in places as distant as Alaska and Africa, but eventually settling in Maine. Without a larger dataset, however, it is difficult to generalize from this sample, or to construct detailed comparisons with Portland-based permit holders. It might at least be surmised that fishing crew enjoy a very fluid job market. Because they can change jobs easily, crew members seem able to accommodate their personal preferences with respect to frequent travel, relocation or maintaining a stable residence.

[29] At a lower confidence level, such statements become possible, but are at greater risk of being incorrect.
[30] Only the clearest and most statistically defensible observations can be made about crew due to relative non-randomness of the crew sample, as discussed above.

Notable Absences

Fishing Activities Outside New England

It is worth noting some negative findings, or findings of absent relationships. Few to none of the 2003 permit holders reported significant fishing activities beyond the U.S. east coast in the boat-years of interest, and few reported any fishing outside New England. This is certainly an indicator of place-fidelity, but it may also indicate that primarily permit holders with more continuous New England groundfish landings histories can be expected to hold 2003 permits. Many previous permit holders who did not maximize their groundfish landings in recent decades were eliminated from the fishery through entry limitations and cuts in DAS. Given current ecological and regulatory conditions in the fishery, few individuals without New England groundfishing histories would be likely to purchase groundfish permits.

Eastern Maine

The virtual absence of eastern Maine harbors in interviewee responses is somewhat suggestive. None of the permit holders were born in eastern Maine or indicate living there at any time. Rockland and other mid-coast harbors appear roughly a half dozen times in the boat-year data, mostly as secondary tie ups. The only mention of eastern Maine harbors is one mention of Stonington as a secondary tie up. A couple of boat-years do mention working some down east fishing grounds. Eastern Maine is several hours from Portland by land, and might be assumed to have few socio-economic ties with the Portland/western Maine groundfishing industry. It may be, however, that surveying the few holders of 2003 groundfishing permits home-ported in eastern Maine harbors would yield a greater number of socio-economic links to western Maine, or perhaps to elsewhere in New England, especially in past years when groundfishing was an active enterprise in that part of the state.

Families

A comment should be offered on gender, families and business ownership. Although one or two permit holders mentioned their wives as boat co-owners, and several mentioned fathers, sons and other male family members as boat owners, mentors, and crew, the vast majority did not mention any female business partners. Permit holders were not asked specifically about wives' participation in their businesses, and doing so might have yielded a slightly different picture of fleet ownership and management. Female family members have traditionally played important roles in some groundfishing businesses, as bookkeepers, managers of shoreside operations during fishing trips, crew, part-owners, and partners in decision making. Even in families where women are not actively involved in the fishing business, some wives are named as co-owners on legal documents. An interesting question for further research is the extent to which family members' contributions enable or encourage place-based fishing business strategies. Related questions arose in the earliest stages of project proposal development, but were discarded in efforts to narrow and focus research questions. Although only a few interviewees specifically mentioned family considerations in the context of business and career decision making, with many permit holders (and crew) tracing multiple generations of fishing heritage, family may play roles that are more influential than is readily recognized by male fishermen who are often conscious of their reputations for self-reliance.

Commercial Groundfishing Activity

Boat-year regressions included an independent dummy variable for activity or non-activity in commercial groundfishing during the years of survey interest. (The vast majority of boats did have commercial groundfishing activity in each year of interest. Non-groundfish-active boats used in the analysis were active in some other commercial or recreational fishery. Boats that did no fishing at all in a given year were excluded from the analysis.) Interestingly, the commercial groundfishing variable did not significantly influence the seven dependent variables for which regressions were run, those being year, number of ports reported per year, permanent Portland residence, aggregate landings and sales ports score, grounds fished, and boat length. In most cases it produced beta weights of only .1 or .2. It may be that the number of non-commercial-groundfishing was sufficiently small, and sufficiently varied in its non-commercial-groundfishing activities, that it could not produce a significant influence on the dependent variables. On the other hand, with respect to the dependent variables, in a given year the non-commercial-groundfishing boats that were worked on or owned by 2003 groundfish permit holders might not be substantially different from boats that are actively commercial groundfishing.[31]

Conclusion

Findings indicate that Portland home-ported groundfishing firms have very place-based histories. Even firms traveling away from Portland for some activities maintain established operations in Portland and Maine. It is possible that this pattern is attenuating slightly with some shifts away from Portland. Any such trend is not sufficiently pronounced to make definitive statements based on the present analyses, however. It would appear that crew have more diversified histories with respect to place-based decision making.

[31] It should be noted that for some of these variables, such as sale ports and fishing grounds, boats not engaged in some kind of commercial fishing would have reported no data and therefore be excluded from the regression calculations.

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Appendix: Statistical Tables (Portland)

Figure 1

Portland permit holders -- univariate statistics from integer scale data

	Valid N	Mean	Confid. -95%	Confid. +95%	Median	Min	Max	Range	Std.Dev.	Skew	Kurtosis
yr born	20	56.0	51.6	60.4	53.5	39	76	37	9.3	0.5	0.2
age first fished	20	12.9	9.8	15.9	11.5	4	29	25	6.6	0.6	0.1
age first own boat[32]	19	24.1	19.7	28.4	26	9	41	32	9.0	0.1	-0.7
fishing generation[33]	20	2.0	1.4	2.6	2	0	4	4	1.2	0.4	-1.0
# sp permits	20	7.0	5.7	8.2	7	2	11	9	2.7	-0.2	-1.0
# sp overall	20	2.7	2.2	3.1	2.5	1	4	3	1.0	0.1	-1.0
# ports[34]	20	3.1	2.4	3.8	3	1	7	6	1.6	0.7	0.3
# states, countries[35]	20	2.1	1.7	2.4	2	1	4	3	0.8	0.5	0.2

[32] Some respondents interpreted this question to ask about ownership of a commercially viable fishing boat, while others interpreted it to ask about a boat of any size/purpose.
[33] Generation includes maternal or fraternal antecedents who commercially fished, and excludes family members in fishing dependent shoreside businesses, recreational fishing, or other maritime occupations.
[34] Number of ports includes harbors used by the individual in the survey years, and harbor where the interviewee learned to fish, and excludes harbors where other family members fished.
[35] Indicates number of states or countries in which above-named ports are located.

Figure 2

Portland permit holders -- integer scale correlations -- Pearson *rs*

	yr born	age first fished	age first own boat	generation	# sp permits	# sp overall	# ports	# states, countries
yr born	1.000							
	N=20							
	p= —							
age first fished	-0.011	1.000						
	N=20	N=20						
	p=.963	p= —						
age first own boat	-0.244	0.528	1.000					
	N=19	N=19	N=19					
	p=.315	p=.020	p= —					
generation	0.312	-0.301	-0.174	1.000				
	N=20	N=20	N=19	N=20				
	p=.180	p=.197	p=.477	p= —				
# sp permits	-0.247	0.184	-0.061	0.334	1.000			
	N=20	N=20	N=19	N=20	N=20			
	p=.293	p=.439	p=.805	p=.150	p= —			
# sp overall	-0.006	**-0.797**	**-0.677**	0.088	-0.046	1.000		
	N=20	N=20	N=19	N=20	N=20	N=20		
	p=.981	**p=.000**	**p=.001**	p=.713	p=.847	p= —		
# ports	0.153	-0.054	-0.202	-0.027	0.257	0.259	1.000	
	N=20	N=20	N=19	N=20	N=20	N=20	N=20	
	p=.519	p=.822	p=.408	p=.909	p=.274	p=.271	p= —	
# states, countries	0.069	0.156	0.153	0.105	0.586	0.023	**0.679**	1.000
	N=20	N=20	N=19	N=20	N=20	N=20	N=20	N=20
	p=.774	p=.513	p=.532	p=.659	**p=.007**	p=.925	**p=.001**	p= —

Figure 3

Portland permit holders -- factor analyses

Each factor analysis allowed up to four factors, cutting off factor extraction at a minimum Eigenvalue of one and with bolded loadings >.7000. Each extraction is without rotation.

Extraction by communalities

	Factor 1	Factor 2
yr born	0.2023	0.0229
age first fish	**-0.8236**	0.2052
age own boat	**-0.7806**	0.0419
generation	0.3043	0.2073
# sp permits	-0.0176	**0.7399**
# sp overall	**0.8764**	-0.0225
# ports	0.2705	0.6350
# states, countries	-0.0057	**0.8966**
Explained Var	2.2629	1.8424
Proportion Total	0.2829	0.2303
Eigenvalue	2.2629	1.8424
% Total Variance	28.2867	23.0305
Cumulative Eigenvalue	2.2629	4.1054
Cumulative % Variance	28.2867	51.3172

Extraction by principal factors (minres iterated communalities)

	Factor 1	Factor 2
yr born	0.1360	0.0286
age first fish	**-0.8153**	0.2039
age own boat	**-0.7089**	0.0556
generation	0.2307	0.1299
# sp permits	-0.0107	0.5681
# sp overall	**0.9303**	-0.0171
# ports	0.2655	0.6142
# states, countries	0.0109	**0.9949**
Explained Var	2.1751	1.7525
Proportion Total	0.2719	0.2191
Eigenvalue	2.1751	1.7525
% Total Variance	27.1890	21.9062
Cumulative Eigenvalue	2.1751	3.9276
Cumulative % Variance	27.1890	49.0952

Extraction by maximum likelihood

	Factor 1	Factor 2
yr born	-0.0670	0.0049
age first fish	-0.1467	**-0.8116**
age own boat	-0.1399	-0.6894
generation	-0.1061	0.1027
# sp permits	-0.5865	-0.0649
# sp overall	-0.0353	**0.9864**
# ports	-0.6847	0.2396
# states, countries	**-0.9941**	-0.0128
Explained Var	1.8591	2.1793
Proportion Total	0.2324	0.2724
Eigenvalue	1.8591	2.1793
% Total Variance	23.2383	27.2415
Cumulative Eigenvalue	1.8591	4.0384
Cumulative % Variance	23.2383	50.4799

Extraction by centroid (principal factors)

	Factor 1	Factor 2	Factor 3
yr born	0.2665	0.3247	**0.6428**
age first fish	0.5590	-0.5958	-0.1028
age own boat	0.3338	-0.6120	-0.0713
generation	0.3225	0.5241	0.5735
# sp permits	0.4163	0.2274	-0.2710
# sp overall	-0.6012	**0.7854**	-0.1741
# ports	0.3104	0.4905	-0.3834
# states, countries	**0.7604**	0.4266	-0.5618
Explained Var	1.8084	2.2008	1.3242
Proportion Total	0.2260	0.2751	0.1655
Eigenvalue	1.8084	2.2008	1.3242
% Total Variance	22.6044	27.5097	16.5519
Cumulative Eigenvalue	1.8084	4.0091	5.3333
Cumulative % Variance	22.6044	50.1141	66.6660

Extraction by principal axis

	Factor 1	Factor 2
yr born	-0.1350	0.0359
age first fish	**0.8271**	0.1594
age own boat	**0.7134**	0.0198
generation	-0.2248	0.1405
# sp permits	0.0397	0.5617
# sp overall	**-0.9231**	0.0317
# ports	-0.2329	0.6214
# states, countries	0.0415	**1.0135**
Explained Var	2.1716	1.7766
Proportion Total	0.2714	0.2221
Eigenvalue	2.1716	1.7766
% Total Variance	27.1446	22.2074
Cumulative Eigenvalue	2.1716	3.9482
Cumulative % Variance	27.1446	49.3521

Figure 4

Portland permit holders – regressions -- Non-stepwise, with pairwise deletion of missing data

Dependent variable: # ports

R= .79188494 R^2= .62708176 Adjusted R^2= .38977015

F(7,11)=2.6424 p<.07264 Std.Error of estimate: 1.2408

	BETA	St. Err. BETA	B	St. Err. of B	t(12)	p-level	Valid N
yr born	-0.1106	0.2924	-0.0189	0.0499	-0.3784	0.7123	20
age first fish	0.0713	0.3897	0.0171	0.0934	0.1830	0.8581	20
age first boat	**-0.4679**	0.3365	-0.0828	0.0595	-1.3907	0.1918	19
generation	-0.0262	0.2864	-0.0342	0.3742	-0.0914	0.9288	20
# sp permits	-0.3735	0.3729	-0.2175	0.2172	-1.0016	0.3381	20
# sp overall	-0.0386	0.4130	-0.0620	0.6630	-0.0935	0.9272	20
# states, countries	**0.9699**	0.3036	1.8633	0.5833	3.1944	0.0085	20

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	**28.4758**	7.0000	4.0680	2.6424	**0.0726**
Residual	**16.9342**	11.0000	1.5395		
Total	45.4100				

Iependent variable: # states, countries

ℓ= .89956561 R^2= .80921829 Adjusted R^2= .68781175
:(7,11)=6.6654 p<.00300 Std.Error of estimate: .46192

	BETA	St. Err. BETA	B	St. Err. of B	t(12)	p-level	Valid N
r born	0.3368	0.1844	0.0299	0.0164	1.8266	0.0950	20
ge first fish	-0.0526	0.2787	-0.0066	0.0348	-0.1886	0.8538	20
ge first boat	**0.5664**	0.1973	0.0522	0.0182	2.8707	**0.0152**	19
eneration	-0.1451	0.2002	-0.0987	0.1361	-0.7247	0.4838	20
! sp permits	**0.6475**	0.1988	0.1963	0.0603	3.2572	**0.0076**	20
! sp overall	0.2801	0.2832	0.2340	0.2366	0.9890	0.3439	20
! ports	**0.4962**	0.1553	0.2583	0.0808	3.1944	0.0085	20

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	**9.9554**	7.0000	1.4222	6.6654	**0.0030**
Residual	**2.3471**	11.0000	0.2134		
Total	12.3025				

Dependent variable: # species fished

R= .89522869 R^2= .80143440 Adjusted R^2= .67507448
F(7,11)=6.3425 p<.00367 Std.Error of estimate: .56401

	BETA	St. Err. BETA	B	St. Err. of B	t(12)	p-level	Valid N
yr born	-0.1267	0.2113	-0.0135	0.0224	-0.5995	0.5610	20
age first fish	**-0.6232**	0.2141	-0.0930	0.0320	-2.9115	0.0142	20
age first boat	**-0.4571**	0.2278	-0.0504	0.0251	-2.0066	0.0700	19
generation	-0.1337	0.2051	-0.1088	0.1670	-0.6517	0.5280	20
# sp permits	-0.1117	0.2822	-0.0405	0.1024	-0.3956	0.6999	20
# ports	-0.0206	0.2199	-0.0128	0.1370	-0.0935	0.9272	20
# states, countries	0.2915	0.2948	0.3489	0.3528	0.9890	0.3439	20

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	14.1233	7.0000	2.0176	6.3425	0.0037
Residual	3.4992	11.0000	0.3181		
Total	17.6225				

Dependent variable: # species permits

R= .88122800 R^2= .77656278 Adjusted R^2= .63437546
F(7,11)=5.4615 p<.00659 Std.Error of estimate: 1.6492

	BETA	St. Err. BETA	B	St. Err. of B	t(12)	p-level	Valid N
yr born	**-0.5360**	0.1605	-0.1570	0.0470	-3.3391	**0.0066**	20
age first fish	0.3764	0.2800	0.1549	0.1152	1.3442	0.2060	20
age first boat	**-0.5593**	0.2265	-0.1699	0.0688	-2.4688	**0.0312**	19
generation	0.4432	0.1770	0.9944	0.3971	2.5046	**0.0293**	20
# sp overall	-0.1256	0.3176	-0.3463	0.8754	-0.3956	0.6999	20
# ports	-0.2238	0.2234	-0.3843	0.3837	-1.0016	0.3381	20
# states, countries	**0.7583**	0.2328	2.5017	0.7680	3.2572	0.0076	20

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	**103.9837**	7.0000	14.8548	5.4615	**0.0066**
Residual	**29.9188**	11.0000	2.7199		
Total	133.9025				

Figure 5

Portland boat-years -- univariate statistics from integer scale data

	Valid N	Mean	Conf. -95%	Conf. +95%	Median	Min	Max	Range	Std.Dev.	Skew	Kurtosis
year[36]	105	13.70	12.31	15.10	14	1	21	20	7.19	0.70	-0.62
# boats reported[37]	105	1.69	1.52	1.85	1	1	4	3	0.87	0.08	1.02
# boats owned[38]	98	1.11	0.93	1.30	1	0	3	3	0.93	0.09	0.56
boat length	100	65.02	60.36	69.68	70	12	120	108	23.50	2.35	-0.07
crew max[39]	90	3.29	2.90	3.68	3	0	10	10	1.84	0.19	1.37
longest trips[40]	88	5.64	4.90	6.37	6	1	16	15	3.47	0.37	0.33
closest to shore[41]	87	24.26	15.70	32.83	3	0	180	180	40.20	4.31	2.33
farthest from shore[42]	86	116.29	100.10	132.48	100	0	300	300	75.51	8.14	0.17
# species per yr/boat[43]	96	1.76	1.56	1.97	2	1	6	5	1.01	0.10	1.99
# ports per yr[44]	100	1.48	1.37	1.59	1	1	3	2	0.56	0.06	0.61

[36] Year for which data pertains (coded as 1983 =1, 1993 = 10, 1997 = 14, 2003 = 20, 2004 = 21)
[37] Number of boats with which interviewed permit holder was directly involved in fishing activities, including boats owned, crewed, or managed (but not boats interviewee was involved with for purposes of shoreside maintenance alone).
[38] Number of boats reported as owned, or part owned, by the interviewee during that year.
[39] Based on reports of total crew numbers per trip, using highest number given.
[40] Based on survey reports of range of trip lengths, measured in days.
[41] Based on survey reports of fishing activity closest to shore, measured in miles.
[42] Based on survey reports of fishing activity farthest from shore, measured in miles.
[43] Number of species reported harvested by that boat.
[44] Number of harbors reported that year by that boat.

Figure 6

Portland boat-years – ordinal scale correlations – gammas
(Missing data pairwise deleted, all bolded gammas have $p < .05$)

	year	boats report	boats owned	perm res	temp res	boat length	crew max	primary tie up	secondary tie up	primary land	second land	primary sale	second sale	longest trips	close shore	far from shore	fish ground	species per yr	ports per yr
year	1.00																		
# boats reported	0.03	1.00																	
# boats owned	0.34	0.42	1.00																
permanent residence*	0.18	0.00	0.41	1.00															
temporary residence**	0.18	0.00	0.41	**1.00**	1.00														
boat length	0.05	0.23	0.17	0.20	0.20	1.00													
crew # max	-0.05	0.41	0.12	-0.05	-0.05	**0.69**	1.00												
primary tie up	-0.41	-0.22	-0.09	**0.70**	**0.70**	0.09	-0.11	1.00											
Second tie up	-0.28	-0.10	-0.13	0.28	0.28	0.12	-0.06	**0.72**	1.00										
primary landing	-0.40	-0.13	-0.12	**0.86**	**0.86**	0.18	0.01	**0.96**	**0.65**	1.00									
second landing	-0.24	0.10	0.15	**0.59**	**0.59**	0.29	0.25	**0.74**	**0.85**	**0.78**	1.00								
primary sale	-0.48	-0.15	-0.18	**0.75**	**0.75**	0.20	0.06	**0.98**	**0.69**	**1.00**	**0.76**	1.00							
secondary sale	-0.22	-0.01	0.05	0.54	0.54	0.37	0.35	**0.70**	**0.79**	**0.74**	**0.97**	**0.72**	1.00						
longest trips	0.01	0.40	0.11	0.11	0.11	**0.69**	**0.76**	-0.12	0.05	0.01	0.26	0.01	0.30	1.00					
closest shore	0.06	0.41	-0.04	0.08	0.08	0.35	0.44	0.01	-0.16	-0.01	0.01	0.07	0.09	0.37	1.00				
farthest shore	0.10	0.42	0.40	0.21	0.21	**0.55**	**0.65**	-0.11	0.00	0.07	0.17	0.06	0.24	**0.62**	0.35	1.00			
fishing grounds	0.27	0.06	0.17	0.32	0.32	**0.71**	**0.77**	0.04	-0.09	0.31	0.18	0.29	0.28	**0.75**	0.36	**0.86**	1.00		
species	0.12	-0.21	0.18	0.32	0.32	-0.21	-0.24	0.02	-0.05	0.04	-0.23	-0.02	-0.29	-0.30	-0.29	-0.10	0.14	1.00	
# ports	-0.33	-0.24	-0.04	-0.26	-0.26	0.24	0.38	0.04	0.45	-0.05	0.46	-0.03	**0.56**	0.19	-0.01	0.19	0.06	-0.17	1.00

Figure 7

Portland boat-years -- factor analyses

Each factor analysis allowed up to four factors, cutting off factor extraction at a minimum Eigenvalue of one and with bolded loadings >.7000. Each extraction is without rotation.

Extraction by communalities

	Factor 1
year	0.008
# boats reported	-0.395
# boats owned	-0.326
boat length	**-0.823**
crew max	**-0.792**
longest trips	**-0.861**
closest to shore	-0.450
farthest from shore	**-0.773**
# sp fished per yr	0.362
# bus ports/yr	-0.195
Explained Var	3.277
Proportion Total	0.328
Eigenvalue	3.277
% Total Variance	32.772
Cumulative Eigenvalue	3.277
Cumulative % Variance	32.772

Extraction by principle factors (minres - iterated communalities)

	Factor 1
year	0.008
# boats reported	-0.375
# boats owned	-0.295
boat length	**-0.824**
crew max	**-0.796**
longest trips	**-0.872**
closest to shore	-0.439
farthest from shore	**-0.775**
# sp fished per yr	0.353
# bus ports/yr	-0.182
Explained Var	3.253
Proportion Total	0.325
Eigenvalue	3.253
% Total Variance	32.526
Cumulative Eigenvalue	3.253
Cumulative % Variance	32.526

Extraction by maximum likelihood

	Factor 1
year	0.008
# boats reported	-0.338
# boats owned	-0.241
boat length	**-0.862**
crew max	**-0.759**
longest trips	**-0.897**
closest to shore	-0.471
farthest from shore	**-0.745**
# sp fished per yr	0.356
# bus ports/yr	-0.174
Explained Var	3.230
Proportion Total	0.323
Eigenvalue	3.230
% Total Variance	32.302
Cumulative Eigenvalue	3.230
Cumulative % Variance	32.302

Extraction by centroid

	Factor 1	Factor 2	Factor 3
year	-0.045	-0.271	0.076
# boats reported	0.450	-0.378	0.135
# boats owned	0.346	**-0.757**	-0.145
boat length	**0.791**	0.188	0.263
crew max	**0.806**	-0.056	-0.079
longest trips	**0.816**	0.137	0.310
closest to shore	0.454	0.253	0.215
farthest from shore	**0.748**	-0.200	**0.089**
# sp fished per yr	-0.352	-0.166	-0.151
# bus ports/yr	0.380	0.377	**-0.864**
Explained Var	3.299	1.120	1.039
Proportion Total	0.330	0.112	0.104
Eigenvalue	3.299	1.120	1.039
% Total Variance	32.995	11.202	10.393
Cumulative Eigenvalue	3.299	4.420	5.459
Cumulative % Variance	32.995	44.197	54.590

Figure 8

Portland boat-years – integer regressions -- Non-stepwise, with pairwise deletion of missing data

Dependent variable: # ports per year

R= .55915200 R^2= .31265096 Adjusted R^2= .14081370
F(10,40)=1.8195 p<.08835 Std.Error of estimate: .49729

	BETA	St. Err. of BETA	B	St. Err. of B	t(40)	p-level	Valid N
year	-0.253	0.143	-0.017	0.010	-1.762	0.086	61
# boats reported	-0.283	0.152	-0.161	0.086	-1.863	0.070	61
# boats owned	-0.032	0.170	-0.018	0.097	-0.190	0.850	58
boat length	0.163	0.238	0.004	0.005	0.686	0.497	60
crew max	**0.464**	0.204	0.118	0.052	2.270	0.029	58
longest trips	-0.307	0.255	-0.047	0.039	-1.208	0.234	56
closest to shore	-0.209	0.153	-0.002	0.002	-1.359	0.182	56
farthest from shore	0.042	0.209	0.000	0.001	0.201	0.842	56
# sp fished per yr	-0.215	0.146	-0.105	0.071	-1.476	0.148	61
commercial groundfishing	0.084	0.167	0.125	0.251	0.500	0.620	61

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	4.499	10.000	0.450	1.819	0.088
Residual	9.892	40.000	0.247		
Total	14.391				

Dependent variable: # species fished per year

R= .48005817 R^2= .23045584 Adjusted R^2= .03806980
F(10,40)=1.1979 p<.32141 Std.Error of estimate: 1.0737

	BETA	St. Err. of BETA	B	St. Err. of B	t(40)	p-level	Valid N
year	-0.176	0.155	-0.025	0.022	-1.133	0.264	61
# boats reported	-0.182	0.165	-0.211	0.192	-1.099	0.278	61
# boats owned	0.159	0.178	0.185	0.207	0.896	0.376	58
boat length	0.023	0.253	0.001	0.012	0.091	0.928	60
crew max	0.068	0.230	0.035	0.119	0.297	0.768	58
longest trips	-0.214	0.272	-0.066	0.084	-0.786	0.436	56
closest to shore	-0.178	0.164	-0.004	0.004	-1.087	0.283	56
farthest from shore	0.018	0.221	0.000	0.003	0.082	0.935	56
# ports/yr	-0.240	0.163	-0.491	0.332	-1.476	0.148	61
commercial groundfishing	-0.132	0.176	-0.404	0.539	-0.749	0.459	61

Analysis of Variance

	Sums of Squares	df	Mean Squares	F	p-level
Regress.	13.810	10.000	1.381	1.198	0.321
Residual	46.113	40.000	1.153		
Total	59.923				

Figure 9

Portland boat-years – regressions with dummy variables -- Non-stepwise, with pairwise deletion of missing data

Dependent variable: year

R= .79055128 R^2= .62497133 Adjusted **R^2= .33030594**

F(22,28)=2.1210 p<.03075 Std.Error of estimate: 6.3518

	BETA	St. Err. BETA	B	St. Err. of B	t(28)	p-level	Valid N
boats reported	-0.292	0.517	-2.397	4.248	-0.564	0.577	61
boats owned	**0.624**	0.395	5.134	3.251	1.579	0.125	58
perm res ptld	0.150	0.686	2.798	12.792	0.219	0.828	60
perm res so/midcoast me	-0.284	0.436	-5.455	8.381	-0.651	0.520	60
perm res me	**0.540**	0.302	13.823	7.729	1.788	0.085	60
boat length	0.101	0.520	0.033	0.169	0.194	0.847	60
crew max	-0.335	0.238	-1.345	0.953	-1.410	0.169	58
prime tie ptld	0.248	0.932	4.062	15.260	0.266	0.792	61
prime tie so/midcoast me	-0.205	0.456	-4.262	9.468	-0.450	0.656	61
prime tie new england	0.298	0.367	9.258	11.388	0.813	0.423	61
second tie ptld	**0.673**	0.815	10.375	12.574	0.825	0.416	61
second tie so/midcoast me	**-0.534**	0.346	-9.337	6.038	-1.546	0.133	61
aggregate tie score	**0.949**	1.753	2.836	5.239	0.541	0.593	61
aggregate land sale	**-0.590**	0.450	-0.879	0.670	-1.311	0.200	60
longest trips	-0.187	0.842	-0.412	1.853	-0.222	0.826	56
closest to shore	-0.133	0.175	-0.023	0.030	-0.756	0.456	56
farthest from shore	-0.224	0.723	-0.023	0.073	-0.310	0.758	56
fishing grounds	**0.580**	0.617	7.176	7.640	0.939	0.356	55
# species caught	-0.221	0.230	-1.564	1.628	-0.961	0.345	61
# ports	-0.245	0.205	-3.540	2.965	-1.194	0.243	61
ne comm gfshg	0.119	0.230	2.370	4.606	0.515	0.611	61
casco islands	0.128	0.450	3.976	13.967	0.285	0.778	61

Dependent variable: # ports per year

R= .83460549 R^2= .69656632 Adjusted **R^2= .45815414**
F(22,28)=2.9217 p<.00408 Std.Error of estimate: .39491

	BETA	St. Err. BETA	B	St. Err. of B	t(28)	p-level	Valid N
yr	-0.198	0.166	-0.014	0.011	-1.194	0.243	61
boats reported	**-1.227**	0.406	-0.697	0.231	-3.023	0.005	61
boats owned	**0.537**	0.357	0.306	0.203	1.507	0.143	58
perm res ptld	**1.266**	0.569	1.632	0.734	2.224	0.034	60
perm res so/midcoast me	**-0.753**	0.369	-1.000	0.490	-2.042	0.051	60
perm res me	**0.523**	0.269	0.926	0.476	1.944	0.062	60
boat length	-0.127	0.467	-0.003	0.010	-0.273	0.787	60
crew max	-0.046	0.221	-0.013	0.061	-0.210	0.835	58
prime tie ptld	**-2.116**	0.738	-2.395	0.835	-2.867	0.008	61
prime tie so/midcoast me	**-1.246**	0.338	-1.788	0.485	-3.688	0.001	61
prime tie new england	**-0.840**	0.294	-1.802	0.630	-2.859	0.008	61
second tie ptld	**-2.190**	0.616	-2.335	0.657	-3.555	0.001	61
second tie so/midcoast me	**-0.791**	0.287	-0.955	0.347	-2.751	0.010	61
aggregate tie score	**-5.021**	1.269	-1.037	0.262	-3.956	0.000	61
aggregate land sale	-0.174	0.416	-0.018	0.043	-0.419	0.679	60
longest trips	**0.903**	0.739	0.137	0.112	1.222	0.232	56
closest to shore	-0.266	0.151	-0.003	0.002	-1.760	0.089	56
farthest from shore	**1.818**	0.553	0.013	0.004	3.286	0.003	56
fishing grounds	**-1.543**	0.483	-1.321	0.413	-3.198	0.003	55
# species caught	0.166	0.208	0.081	0.102	0.800	0.431	61
ne comm gfshg	-0.178	0.205	-0.246	0.284	-0.868	0.393	61
casco islands	**-0.994**	0.359	-2.134	0.771	-2.769	0.010	61

Dependent variable: aggregate landing sales score

R= .96837985 R^2= .93775953 **Adjusted R^2= .88885630**
F(22,28)=19.176 p<.00000 Std.Error of estimate: 1.7389

	BETA	St. Err. BETA	B	St. Err. of B	t(28)	p-level	Valid N
yr	-0.098	0.075	-0.066	0.050	-1.311	0.200	61
boats reported	**-0.541**	0.185	-2.987	1.024	-2.916	0.007	61
boats owned	0.397	0.150	2.194	0.831	2.640	0.013	58
perm res ptld	**0.628**	0.253	7.871	3.174	2.480	0.019	60
perm res so/midcoast me	-0.373	0.165	-4.818	2.125	-2.267	0.031	60
perm res me	0.062	0.129	1.069	2.224	0.481	0.635	60
boat length	**-0.581**	0.181	-0.127	0.040	-3.207	0.003	60
crew max	-0.040	0.100	-0.108	0.269	-0.400	0.692	58
prime tie ptld	**-0.867**	0.343	-9.540	3.774	-2.528	0.017	61
prime tie so/midcoast me	-0.175	0.184	-2.437	2.560	-0.952	0.349	61
prime tie new england	-0.008	0.151	-0.161	3.154	-0.051	0.960	61
second tie ptld	0.074	0.336	0.770	3.481	0.221	0.826	61
second tie so/midcoast me	-0.362	0.130	-4.254	1.523	-2.793	0.009	61
aggregate tie score	-0.134	0.717	-0.270	1.441	-0.187	0.853	61
longest trips	**0.946**	0.293	1.400	0.433	3.230	0.003	56
closest to shore	-0.066	0.071	-0.008	0.008	-0.935	0.358	56
farthest from shore	**0.610**	0.272	0.041	0.018	2.245	0.033	56
fishing grounds	-0.346	0.247	-2.876	2.054	-1.401	0.172	55
# species caught	0.150	0.091	0.716	0.432	1.657	0.109	61
# ports	-0.036	0.085	-0.347	0.830	-0.419	0.679	61
ne comm gfshg	-0.236	0.083	-3.166	1.117	-2.836	0.008	61
casco islands	-0.252	0.177	-5.265	3.698	-1.424	0.166	61

Dependent variable: permanent residence Portland

R= .98568043 R^2= .97156592 Adjusted **R^2= .94922485**
F(22,28)=43.488 p<.00000 Std.Error of estimate: .09376

	BETA	St. Err. BETA	B	St. Err. of B	t(28)	p-level	Valid N
yr	0.011	0.052	0.001	0.003	0.219	0.828	61
boats reported	**0.703**	0.053	0.310	0.024	13.168	0.000	61
boats owned	**-0.527**	0.054	-0.233	0.024	-9.694	0.000	58
perm res so/midcoast me	**0.579**	0.052	0.596	0.053	11.186	0.000	60
perm res me	-0.195	0.080	-0.267	0.109	-2.445	0.021	60
boat length	**0.611**	0.085	0.011	0.001	7.222	0.000	60
crew max	0.159	0.061	0.034	0.013	2.617	0.014	58
prime tie ptld	**1.159**	0.134	1.017	0.118	8.619	0.000	61
prime tie so/midcoast me	0.251	0.117	0.280	0.130	2.152	0.040	61
prime tie new england	0.280	0.087	0.466	0.146	3.200	0.003	61
second tie ptld	**0.595**	0.197	0.492	0.163	3.016	0.005	61
second tie so/midcoast me	0.237	0.088	0.222	0.083	2.673	0.012	61
aggregate tie score	**1.542**	0.388	0.247	0.062	3.974	0.000	61
aggregate land sale	0.287	0.116	0.023	0.009	2.480	0.019	60
longest trips	**-1.111**	0.099	-0.131	0.012	-11.246	0.000	56
closest to shore	0.123	0.043	0.001	0.000	2.884	0.007	56
farthest from shore	**-0.886**	0.108	-0.005	0.001	-8.187	0.000	56
fishing grounds	**0.688**	0.113	0.457	0.075	6.066	0.000	55
# species caught	-0.260	0.041	-0.099	0.016	-6.300	0.000	61
# ports	0.119	0.053	0.092	0.041	2.224	0.034	61
ne comm gfshg	0.157	0.056	0.168	0.060	2.788	0.009	61
casco islands	**0.549**	0.068	0.914	0.113	8.083	0.000	61

Dependent variable: boat length

R= .97490848 R^2= .95044655 Adjusted **R^2= .91151169**
F(22,28)=24.411 p<.00000 Std.Error of estimate: 7.1147

	BETA	St.Err. BETA	B	St. Err. of B	t(28)	p-level	Valid N
yr	0.013	0.069	0.041	0.212	0.194	0.847	61
boats reported	**-0.752**	0.124	-19.054	3.152	-6.046	0.000	61
boats owned	**0.582**	0.102	14.762	2.580	5.722	0.000	58
perm res ptld	**1.065**	0.147	61.214	8.476	7.222	0.000	60
perm res so/midcoast me	**-0.663**	0.099	-39.265	5.865	-6.694	0.000	60
perm res me	0.175	0.111	13.839	8.756	1.581	0.125	60
crew max	-0.157	0.084	-1.941	1.043	-1.861	0.073	58
prime tie ptld	**-1.132**	0.263	-57.083	13.286	-4.296	0.000	61
prime tie so/midcoast me	-0.051	0.166	-3.265	10.625	-0.307	0.761	61
prime tie new england	-0.165	0.131	-15.806	12.555	-1.259	0.218	61
second tie ptld	-0.251	0.296	-11.939	14.074	-0.848	0.403	61
second tie so/midcoast me	-0.185	0.126	-9.970	6.790	-1.468	0.153	61
aggregate tie score	**-0.820**	0.621	-7.555	5.723	-1.320	0.197	61
aggregate land sale	**-0.462**	0.144	-2.121	0.661	-3.207	0.003	60
longest trips	**1.452**	0.136	9.845	0.924	10.656	0.000	56
closest to shore	-0.103	0.061	-0.054	0.032	-1.677	0.105	56
farthest from shore	**0.921**	0.197	0.285	0.061	4.663	0.000	56
fishing grounds	**-0.652**	0.192	-24.878	7.310	-3.403	0.002	55
# species caught	0.304	0.062	6.639	1.364	4.868	0.000	61
# ports	-0.021	0.076	-0.928	3.400	-0.273	0.787	61
ne comm gfshg	-0.194	0.076	-11.964	4.664	-2.565	0.016	61
casco islands	**-0.492**	0.135	-47.109	12.893	-3.654	0.001	61

Figure 10

Portland crew -- univariate statistics from integer scale data

	Valid N	Mean	Confid. -95%	Confid. 95%	Median	Min	Max	Range	Std Dev	Std. Error	Skew	Kurt.
yr born	12	59.7	53.9	65.4	58.0	49.0	78.0	11.5	9.0	2.6	0.8	-0.1
age first fished	12	19.2	15.0	23.3	17.5	8.0	30.0	10.5	6.5	1.9	0.2	-0.6
generation	12	1.5	0.9	2.1	1.0	1.0	3.0	1.0	0.9	0.3	1.3	-0.3
# sp overall	12	2.5	1.6	3.4	2.0	1.0	5.0	2.0	1.4	0.4	0.9	-0.5
# ports	12	3.6	1.8	5.4	3.0	1.0	12.0	2.0	2.9	0.8	2.6	7.7
# states, countries	12	2.6	0.8	4.3	2.0	1.0	11.0	1.5	2.7	0.8	3.1	10.0