University of Massachusetts Amherst
Department of Resource Economics
Working Paper No. 2004-10
http://www.umass.edu/resec/workingpapers

An Economic Valuation of Recreational Shellfishing On Cape Cod

David T. Damery[1] and P. Geoffrey Allen[2]

Abstract:

Estimated total value for recreational shellfishing on Cape Cod was $7.4 million in 2002, based on results of a survey of 233 shellfish permit holders, a figure that has roughly kept pace with inflation based on a similar study conducted in 1975. The total value is made up of two components, the actual permit fees collected ($387,000) and an estimate of consumer surplus, which was based on willingness to accept compensation to give up a fishing permit and hence is unbounded by the survey respondents' income.

An estimate based on willingness-to-pay (WTP) gave a total value estimate of $1.0 million in 2002. Additionally, participation in recreational shellfishing has fallen precipitously from 19,068 resident permits sold in 1975 to the 10,639 permits sold in 2002. The decline in the total number of resident shellfishers is counteracted, in part, by rises in the number of senior and nonresident permit holders in 2002 to 2,766 and 2,704 respectively.

An individual's valuation of recreational shellfishing appears to be significantly influenced by a number of factors including: the distance traveled to the shellfishing flats, the number of shellfishing trips in the prior year, the number of years a permit has been held, the permit fee paid and the individual's income level.

Keywords: outdoor recreation, contingent valuation, recreational fishing, willingness-to-pay

JEL Classification: Q26, Q28, H42

[1] David T. Damery, Department of Natural Resource Conservation
University of Massachusetts, Holdsworth Hall
Amherst, MA 01003-9285
E: ddamery@forwild.umass.edu P: 413-545-1770 F: 413-545-4358

[2] P. Geoffrey Allen, Department of Resource Economics
University of Massachusetts, 201A Stockbridge Hall
Amherst, MA 01003-9246
E: allen@resecon.umass.edu P: 413-545-5715 F: 413-545-5853

March, 2004

An Economic Valuation of Recreational Shellfishing On Cape Cod

David T. Damery
Department of Natural Resource Conservation
University of Massachusetts-Amherst
ddamery@forwild.umass.edu

P. Geoffrey Allen
Department of Resource Economics
University of Massachusetts-Amherst
allen@resecon.umass.edu

Abstract

Estimated total value for recreational shellfishing on Cape Cod was $7.4 million in 2002, based on results of a survey of 233 shellfish permit holders, a figure that has roughly kept pace with inflation based on a similar study conducted in 1975. The total value is made up of two components, the actual permit fees collected ($387,000) and an estimate of consumer surplus, which was based on willingness to accept compensation to give up a fishing permit and hence is unbounded by the survey respondents' income.

An estimate based on willingness-to-pay (WTP) gave a total value estimate of $1.0 million in 2002. Additionally, participation in recreational shellfishing has fallen precipitously from 19,068 resident permits sold in 1975 to the 10,639 permits sold in 2002. The decline in the total number of resident shellfishers is counteracted, in part, by rises in the number of senior and nonresident permit holders in 2002 to 2,766 and 2,704 respectively.

An individual's valuation of recreational shellfishing appears to be significantly influenced by a number of factors including: the distance traveled to the shellfishing flats, the number of shellfishing trips in the prior year, the number of years a permit has been held, the permit fee paid and the individual's income level.

Acknowledgements

This work was made possible through the excellent help from William Burt of Barnstable County Cooperative Extension. Americorps volunteers Chris Huskey and Tony Gill, who were assigned to Barnstable County Cooperative Extension, were instrumental in data gathering. UMASS- Amherst student, Ben Kriete provided additional assistance. We thank Barnstable County Cooperative Extension for financial support.

An Economic Valuation of Recreational Shellfishing On Cape Cod

1 Introduction and Project Overview

Recreational shellfishing is a significant contributor to the economy of Barnstable County and Massachusetts as a whole. The work presented herein estimates the consumer demand for recreational shellfishing on the Cape and provides a comparison with a similar study conducted in 1975. We hope that the economic data presented can be used by planners, government officials, and the general public to make informed decisions regarding management of this resource.

The research work followed closely the methodology used in a previous study, " An Economic Valuation of Recreational Clamming in Massachusetts", by Richard W. Smith, Jon M. Conrad and David A. Storey, Massachusetts Agricultural Experiment Station, Research Bulletin No. 654/April, 1978.

At the outset, specific project goals were identified including:

- Develop and conduct a survey of current recreational shellfishers in Barnstable County
- Report summary statistics of the survey data
- Derive demand curves for estimating the value of shellfishing
- Statistically analyze the importance of variables thought to influence value
- Project the survey results to estimate total Consumer Surplus value for all of Barnstable County

The focus of the survey covers the 15 towns of Barnstable County, Massachusetts. The types of data collected included:

- Town Shellfish permit statistics – Resident and Non-resident licenses sold and price of licenses
- Identifying any unusual features of shellfishing activity relevant to the year studied.
- Individual shellfisher data including: town of residence, residence status, number of people using permit, frequency of use, number of years of shellfishing, travel distances, harvesting effort, catch statistics, and estimates of the value of shellfishing.

The 1975 study covered specifically: softshell, quahog, surf/sea and razor clams. This research added oysters and scallops to this list.

Section 2 of this report describes the conceptual basis of the analysis. The survey data are summarized in section 3. The next three sections contain the estimation of aggregate demand curves, investigation of factors causing differences in valuations across individuals, and calculations of consumer surplus leading to estimates of the total value of recreational shellfishing on Cape Cod.

2 Conceptual Basis and Research Methodology

2.1 Survey Design

The survey instrument used in the 1975 study of Recreational Clamming in Massachusetts was modified for use in the 2002 study detailed in this report. The new survey was reviewed and tested by the Barnstable County Cooperative Extension shellfish team. The final document is included as Appendix 1.

2.2 Survey Population

One goal of this work was to estimate the value of recreational shellfishing activity for all of Cape Cod. The survey technique employed initially was a phone survey, intended for a random sample of shellfish permit holders across Cape Cod. Listings of shellfish permit holders were requested from all 15 Cape Cod communities, but were not obtained for at least two towns, Chatham and Mashpee. Valid responses were obtained from 12 of the 14 towns that issue Shellfish permits (Sandwich does not issue town shellfish permits). Bias resulting from omission of two towns is not expected to materially alter the results presented.

The phone survey technique involved a one-time mailing to randomly selected shellfishers including an explanatory cover letter and a return post card indicating acceptable dates and times that the respondent might be contacted. The 1975 study included two such mailings. Phone surveys obtained 45 survey responses.

Due to cost and time constraints involved in the telephone survey method, it was decided to augment this collection method with written surveys, handed out through town shellfish offices to renewing shellfish permit holders and new permit purchasers, and through field surveys administered on clam flats. Eighty-five additional survey responses were obtained from surveys handed out through shellfish offices and 103 responses were collected through field surveys resulting in a total of 233.

2.3 Analysis Methodologies

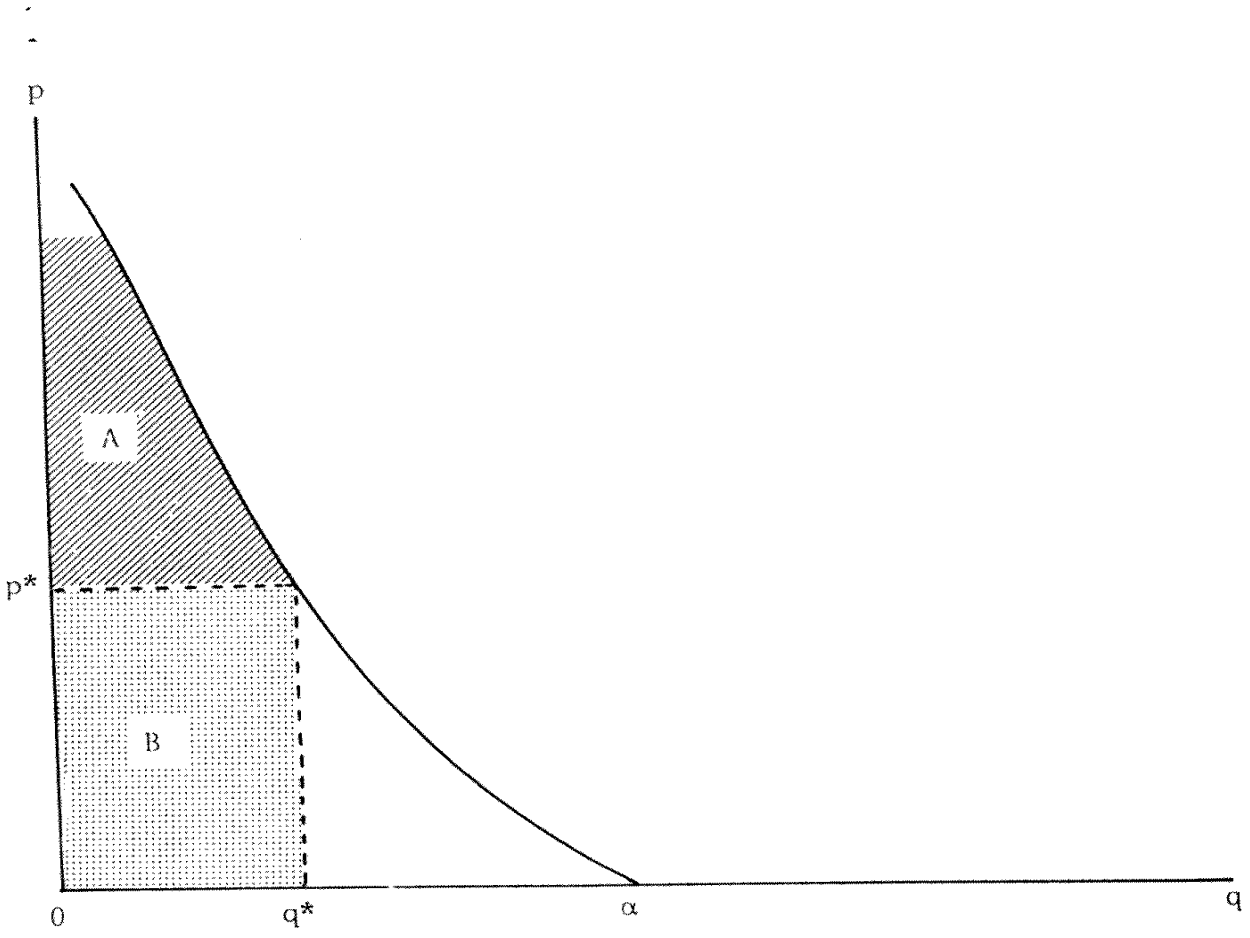
A primary goal of this work was to estimate the value of recreational shellfishing on Cape Cod. The most easily obtained measure of this is to simply sum the purchase price of every shellfish permit sold. Shellfishing permit sales data for each Cape Cod town are presented in Section 6. However, this measure, by itself, leaves off any additional value that individuals place on the shellfishing activity. In the course of a purchase decision, the rational consumer will choose to proceed with a purchase only if the perceived value of the product exceeds the price charged. A purchase simply indicates that the consumer places a value on the product or service *at least as large as* the purchase price. Values exceeding the purchase price are known as consumer surplus, see Figure 2.1.

Figure 2.1 Demand Curve for Shellfish Permits

Figure 2.1

A Graph of the Function

$q = \alpha e^{\beta p} \quad \alpha > 0, \beta < 0$



Two questions included in both the 1975 and 2002 surveys attempt to provide an estimate of this consumer surplus. These questions were posed to elicit the shellfisher's willingness-to-pay (WTP) to obtain the right to shellfish, and, alternatively, their willingness-to-accept-payment (WTA) to give up their right to shellfish (in a case where they already own a shellfish permit).

2.3.1 Data collection and aggregation

Respondents were posed with the following questions:

"In the next two questions, we are asking you to give an opinion on the value of a shellfish permit. When giving your estimate **you should assume** that: a) the shellfishing conditions will be the same as this year, and b) if you choose to surrender a permit you already own, you will not be able to go shellfishing for the remainder of the year, and c) the answers you give will have no effect on future pricing of shellfish permits.

14) Suppose you already hold a permit for next year. How much would you have to be paid to give it up? _____

15) Suppose you have not yet purchased next year's permit. What is the MOST you would be willing to pay for the permit? _____"

Considering the entire population of residents of the 14 towns, each household either purchases a single shellfishing permit or does not. We have sampled only from that part of the population that actually purchased a permit at the posted price. They were asked at what price they would still be willing to purchase (WTP) and also willing to give up a permit acquired at a lower price (WTA). The response to each question was cumulated separately over the entire sample, starting with the highest offer price, at which only one permit would be purchased (or given up), $q = 1$. When the price is dropped to the second-highest offer price, then two permits would be purchased (or given up) at that price, $q = 2$. The process was repeated through the entire sample and that quantity of permits is demanded at the lowest offer price. If the respondents are rational, the lowest offer price will be no lower than the actual price in the town with the cheapest permits.

The process just described traces out a demand curve similar to that in Figure 2.1. This empirical demand curve could have been used directly to arrive at the value of shellfishing on Cape Cod. We did not take this direct approach for two reasons (1) the sample is small relative to the population and so would be unlikely to include the small proportion of people on the end of the distribution, those willing to pay or accept the highest prices, and conversely (2) if the sample does include a member of the end of the distribution, that individual will have excessive influence when the conclusions from the sample are scaled up to the entire population. By removing any highly unusual responses that would lead to situation (2), then smoothing the empirical demand curve with a fitted regression line, we expect to achieve a more accurate estimate of value.

Empirical demand curves were derived for residents separately for WTP and WTA. The process was repeated for non-residents and seniors.

2.3.2 Aggregate Demand Curve estimation

The functional form for the demand curve used for the 1975 analysis was log-linear, in the following form:

$q = \alpha e^{\beta p}$,

where, q = quantity demanded, p = price, and α and β are parameters to be estimated in the regression equation that follows, after applying the logarithmic transformation to both sides of the equation.

$Ln(q) = \gamma + \beta p + \varepsilon$,

where $\gamma = \ln(\alpha)$, ε = random error term. Expected signs are $\gamma>0$, $\beta<0$.

Our analysis included an investigation of the fit for three alternative functional equations. First, in addition to the functional form used in the 1975 study, we ran an alternative form adding a squared price term to the equation as follows:

$q = \alpha e^{\beta_1 p + \beta_2 p^2}$

and

$Ln(q) = \gamma + \beta_1 p + \beta_2 p^2 + \varepsilon$,

where $\gamma = \ln(\alpha)$ and expected signs are $\gamma>0$, $\beta_1<0$, $\beta_2>0$.

Secondly, we re-formulated the demand equation swapping the p and q variables. That is, we tested the demand form where p is a function of q, in both a simple log-linear form, and using a squared term as above.
$P = \alpha e^{\beta q}$,

yielding a formula for regression:

$Ln(p) = \gamma + \beta q + \varepsilon$,

where $\gamma = \ln(\alpha)$. And the last form:

$p = \alpha e^{\beta_1 q + \beta_2 q^2}$,

yielding a formula for regression:

$Ln(p) = \gamma + \beta_1 q + \beta_2 q^2 + \varepsilon$,

where $\gamma = \ln(\alpha)$.

2.3.3 Regression of explanatory variables on Willingness-to-Pay and Willingness-to-Accept-Payment

The demand curve estimation can be used as input to the calculation of consumer surplus, and an overall value of recreational shellfishing, but in itself provides little insight into the factors that might impact how individuals value the activity. The 1975 study included a log-linear model with the dependent variable being the responses to the WTP or WTA questions and including 10 different independent (explanatory) variables. These variables were: distance to flats, average catch per trip, total harvest, age, number of

additional recreational activities engaged in while clamming, clamming trips per year, number of years permit has been purchased, fee paid to obtain permit, town expenditure on shellfish program and annual family income.

The 1975 analysis performed three separate regressions, one for willingness to surrender (accept) for all respondents combined, and two willingness-to-pay regressions, one for residents and a second for non-residents. Each variable was found to be significant at the 10% level or better for one or more of the models, but only three variables were found to be significant in all models. These three were number of trips per year, years permit was purchased, and annual income.

We performed a similar analysis with 2002 survey data, dropping some of the variables covered in the 1975 study, as these data were not collected. The model used the following form:

$$Y_p = \alpha_0 X_1^{\alpha 1} X_2^{\alpha 2} \ldots X_6^{\alpha 6} U_p ,$$

where Y_p = WTP or WTA
α are parameters to be estimated
X_1 - X_6 are the independent variables
X_1 = LEN, Travel Distance (miles)
X_2 = QUA, Total Quahog Catch in 2002 (bushels)
X_3 = TRIP, Number of trips per year
X_4 = YRS, Number of years permit has been purchased
X_5 = FEE, Permit fee paid ($)
X_6 = INC, Reported Household Annual income ($1,000s), and
U_p is a randomly distributed error term.

This yields a formula for regression:

$$\text{Ln}(p) = \gamma + \alpha_1 \ln(X_1) + \alpha_2 \ln(X_2) + \ldots + \alpha_6 \ln(X_6) + \varepsilon ,$$

where $\gamma = \ln(\alpha_0)$ and ε is a randomly distributed error term.

Expected signs for parameter estimates are as follows:

Travel Distance (+) In concert with travel cost analysis, we hypothesize that the greater the travel distance, the higher the value of the shellfishing permit.

Quahog Catch (+) We hypothesize that individuals with higher catch levels, place a higher value on the permission to shellfish.

Number of Trips (+) Similar to the catch size hypothesis, the more trips made, the higher the value.

Number of Years Permit purchased (+) The longer an individual has been purchasing a permit is expected to be positively correlated with value.

Fee Paid (+, ?) The fee paid may be positively correlated with WTP estimates (individuals currently paying high fee may make higher WTP estimates vs. individuals paying lower fees) but should not influence WTA estimates as these are not bound by any income constraints.

Income (+, ?) Again, WTP estimates are expected to be positively correlated with Income levels, but this may not hold for WTA.

2.3.4 Estimating Total Consumer Surplus

With an estimated demand curve one can next develop a measure of the consumer surplus, Area A, in Figure 2.1, measures the excess value that shellfish permit buyers place on their permit above and beyond its purchase price. Consumer theory points out that buyers will not purchase an item unless they perceive that its value is at least as great as its selling price.

As will be discussed in section 4, the functional form selected for analysis was of the following form:

$q = \alpha e^{\beta_1 p + \beta_2 p^2}$.

The estimate of consumer surplus is made by calculating the area under the curve above the permit price, as follows:

$A = \int_{P^*}^{\infty} \hat{\alpha} e^{(\hat{\beta}_1 p^* + \hat{\beta}_2 * p^{*2})} dp$,

with p* being the actual permit price, and α, β_1 and β_2 being the estimated parameters.

One characteristic of this functional form is that for $\beta_1 < 0$ and $\beta_2 > 0$ the integral becomes indeterminate due to the squared term. For large values of p, the squared term dominates and the demand curve begins to bend outward from the y-axis. As discussed in section 4 we discovered that the formulation including the squared p term provided a better fit for the data over the observed range. We chose to truncate the integral for estimating the area A of Figure 2.1 at the point where the function of p is minimized.

Minimize

Ln (q) = $\gamma + \beta_1 p + \beta_2 p^2 + \varepsilon$

$$\frac{\partial f(p)}{\partial p} = 0$$

$$0 = \hat{\beta}_1 + 2\hat{\beta}_2 p$$

$$p_{\min} = \frac{-\hat{\beta}_1}{2\hat{\beta}_2}$$

Next, to provide town-wide estimates of consumer surplus, the areas calculated using the sample data are scaled up by the ratio of the actual number of permit holders in the town divided by a fitted n*. This represents an estimate of the number of survey respondents in the sample population who are willing to pay a given permit price p. That is

$n^* = \hat{q} = \hat{\alpha} + \hat{\beta}_1 * p + \hat{\beta}_2 * p\text{^}2$

So for a given town and residency type,

Consumer Surplus estimate = A * (N / n*)

Where A is calculated by the integral above, N is the actual number of permit holders in that town of that residency type, and n* is the fitted n from the sample data.

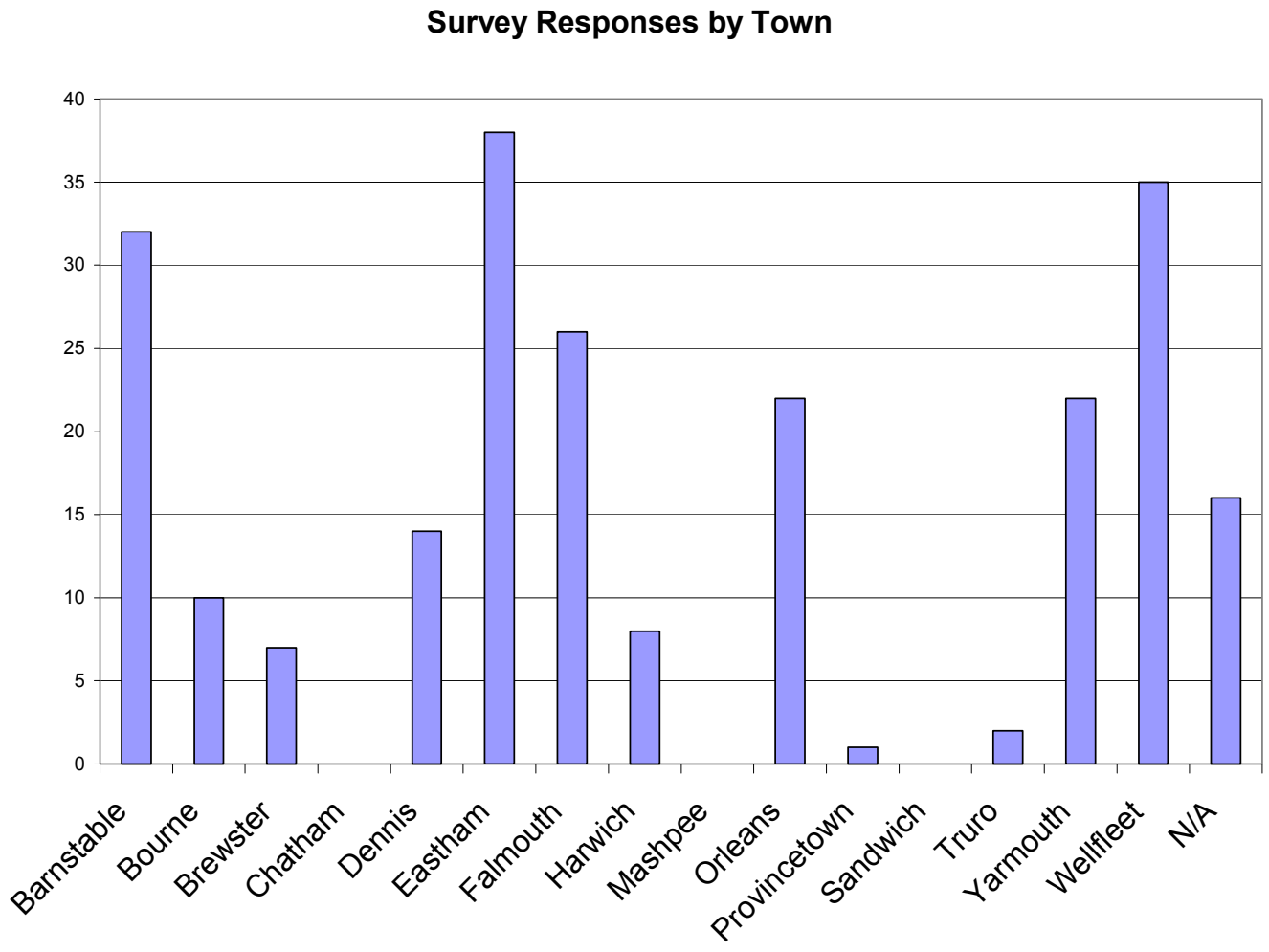
The Mathematica ™ software program was used evaluate the estimate of A for each of the sample populations (Resident, non-resident, and senior permit holders).

3 Survey Results – Summary Statistics

Results from each of the survey questions are presented in this section. Refer to Appendix 1 for a copy of the survey instrument.

3.1Town in which the permit is held

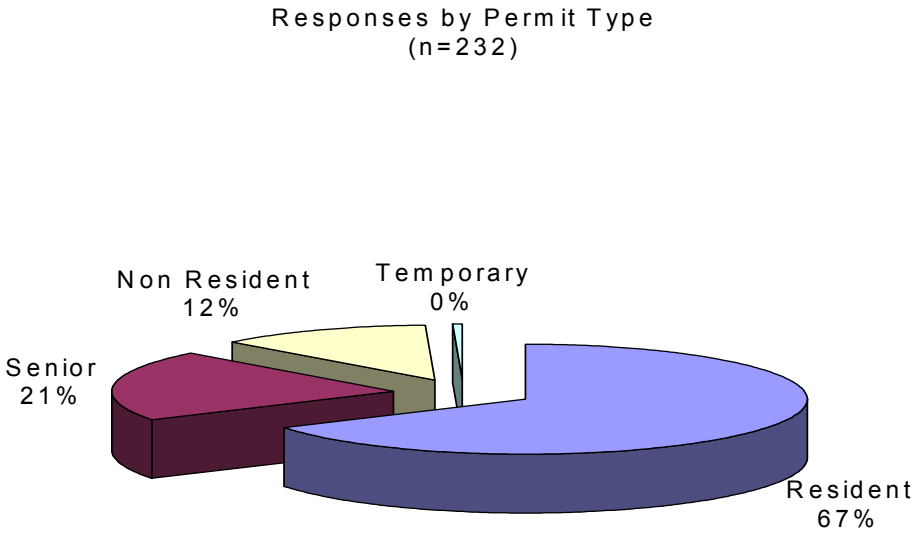
Figure 3.1



With the exception of the lack of respondents from Chatham and Mashpee, the distribution compares reasonably with the 2002 distribution of permits sold.

3.2 Type of permit held: Resident, Nonresident, Temporary or Senior

Figure 3.2



3.3 Other summary statistics

Figure 3.3

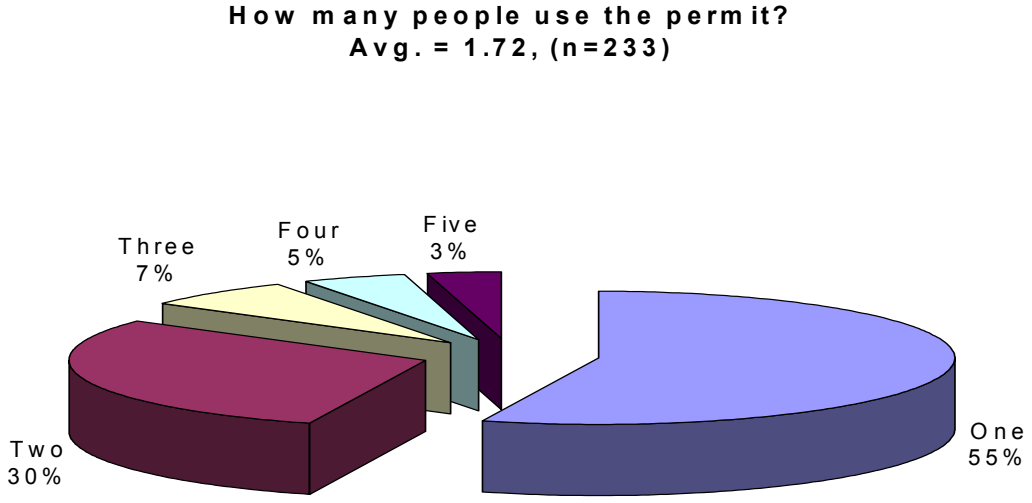


Figure 3.4

On an average trip how many people go shellfishing?
Avg. = 1.72, (n=230)

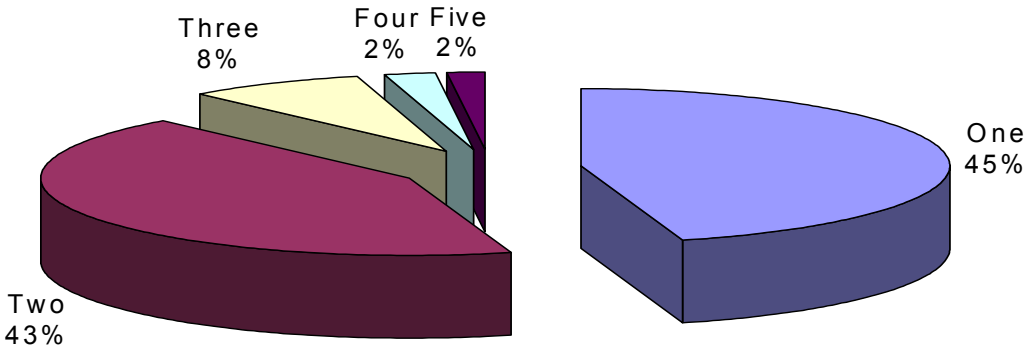


Figure 3.5

How many years have you purchased a permit?
(n=230, Average = 15 years)

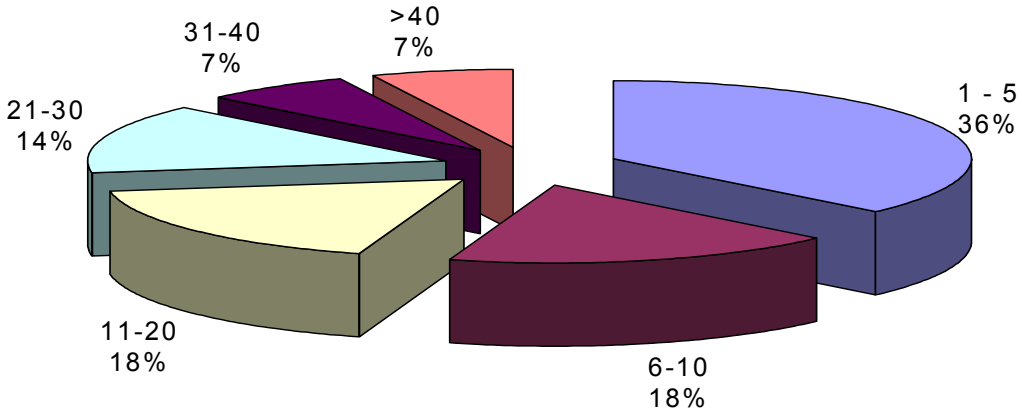


Figure 3.6

How far do you travel to shellfish?
(n=228, Average = 5 miles)

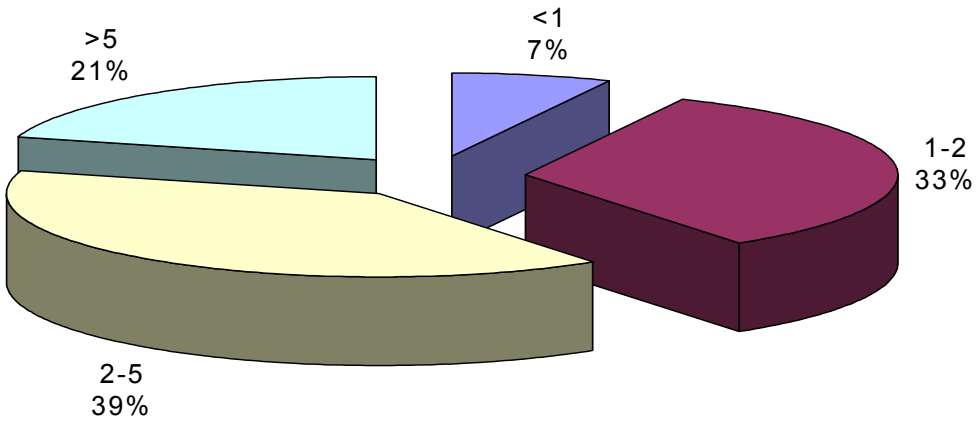


Figure 3.7

How many times did you shellfish in 2002?
(n=221, Average = 11.7)

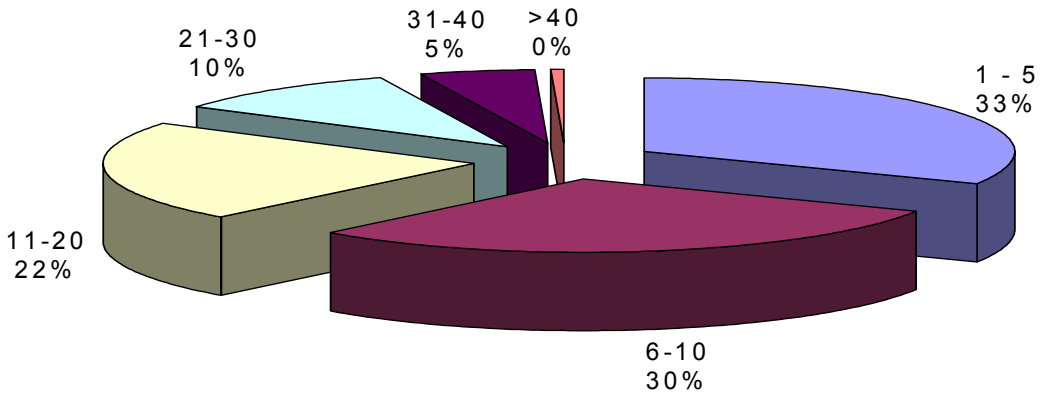


Figure 3.8 Percentage of shellfishing effort spent on digging/harvesting each species, by number of respondents.

	Total	Percentage Level of Effort Reported			
Species	Responses	0 to 25	25+ to 50	50+ to 75	75+ to 100
Soft-shell clams	105	53	28	9	15
Quahogs	205	28	45	18	114
Oysters	61	32	17	4	8
Mussels	33	28	3	0	2
Scallops	15	12	2	0	1
Surf Clams	10	9	1	0	0
Razor Clams	9	8	1	0	0

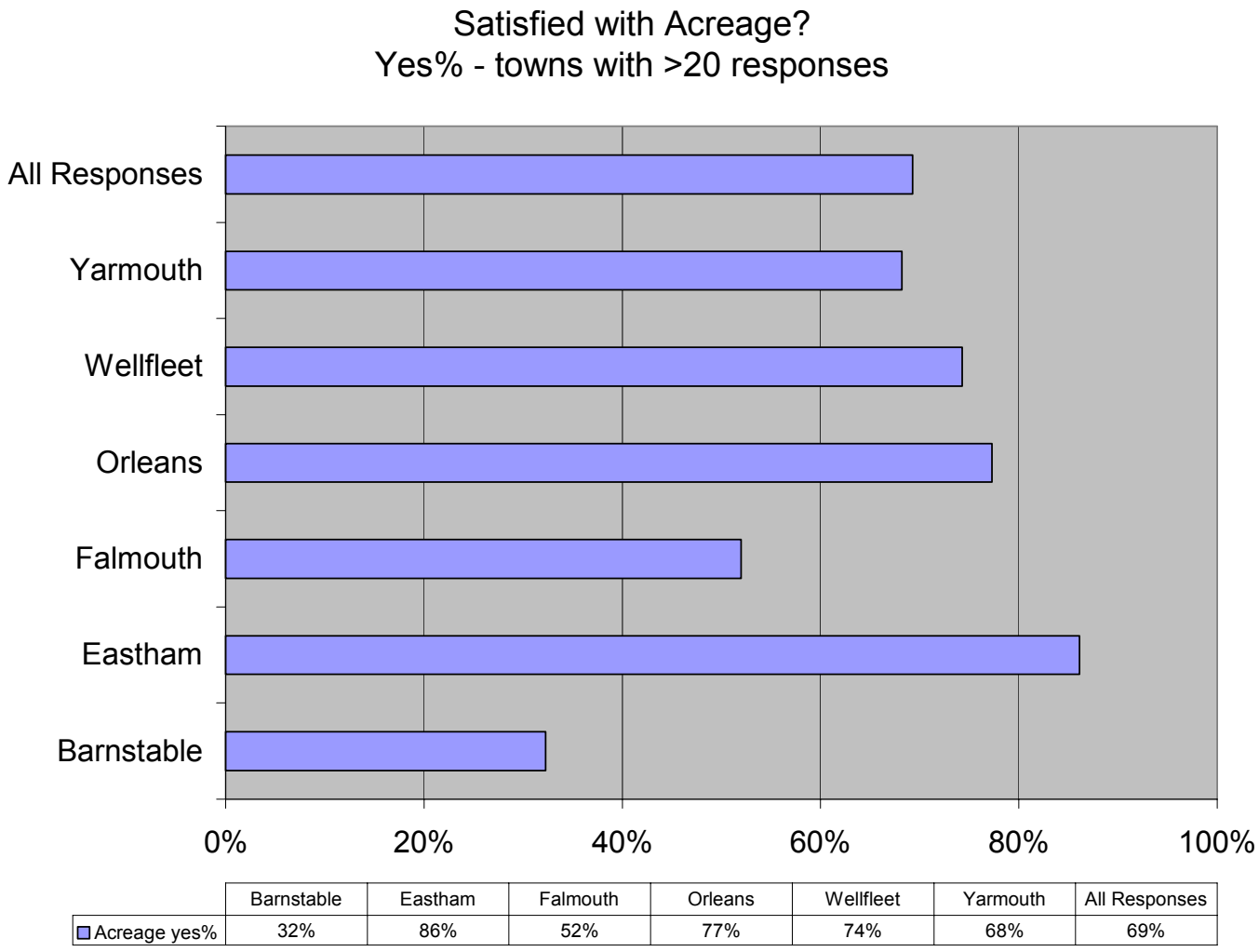
Figure 3.9 Total catch of each species per year, by respondent.

	Total	Number of respondents reporting annual catch in bushels of:				
Species	Responses	<1	1 to 2	2+ to 5	75+ to 100	Average
Soft-shell clams	96	38	47	9	2	1.5
Quahogs	189	28	93	46	22	2.6
Oysters	59	18	24	12	5	2.3
Mussels	34	11	17	5	1	1.6
Scallops	13	2	9	1	1	1.9
Surf Clams	9	4	4	1	0	1.0
Razor Clams	5	4	1	0	0	0.6

Two additional questions regarding shellfisher satisfaction were added to the 2002 survey. The first question was focused on the area available for recreational shellfishing. Shellfishers were asked:

Are you satisfied with the amount of acreage available for recreational shellfishing? Results showed that, across all survey respondents, 69% answered "Yes" to this question, indicating they were satisfied with the acreage available. Six of the towns were represented by at least 20 responses to this question. Among these 6 towns, Eastham residents appeared most satisfied with their acreage and Barnstable least.

Figure 3.10



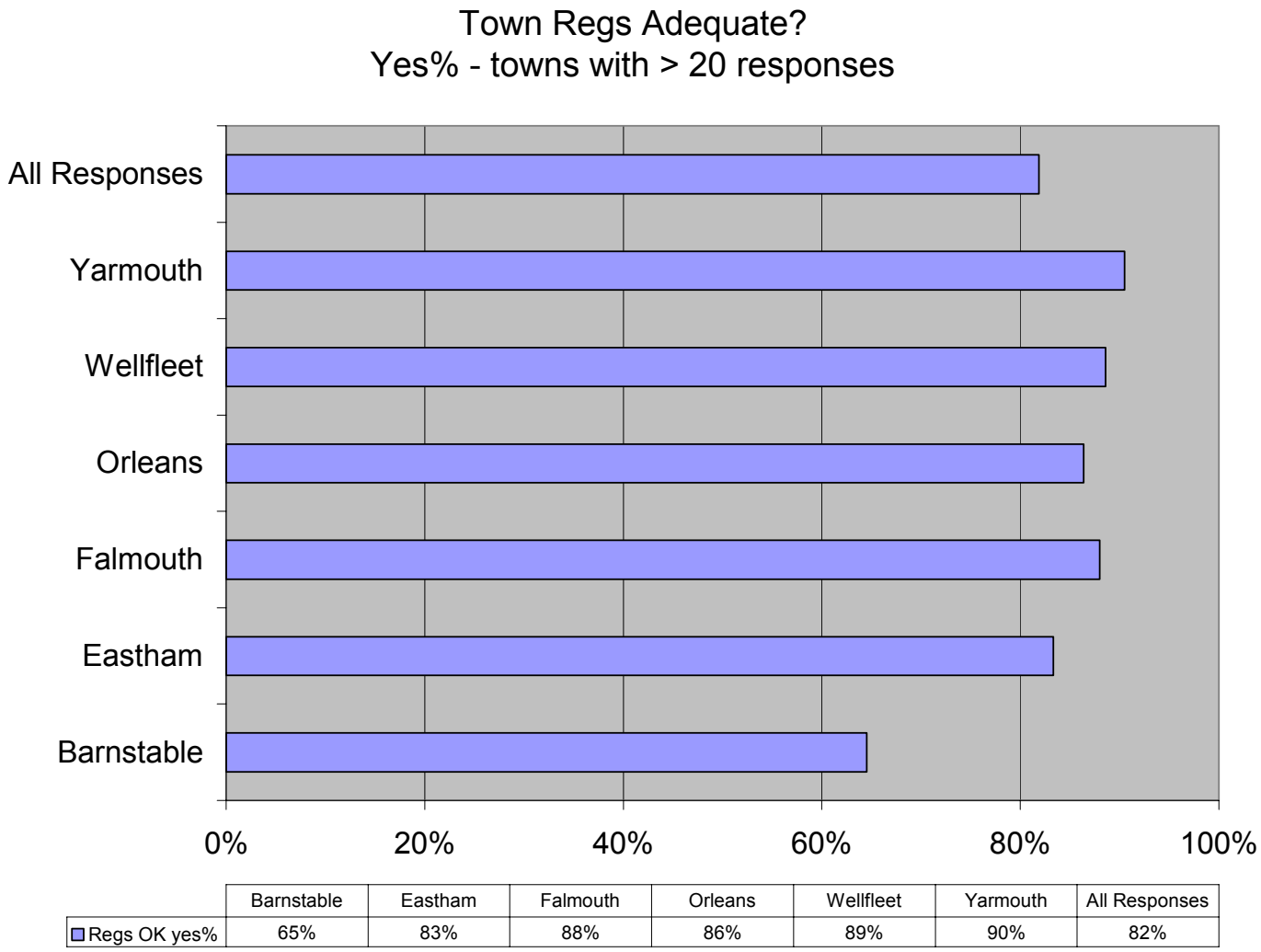
	Barnstable	Eastham	Falmouth	Orleans	Wellfleet	Yarmouth	All Responses
Acreage yes%	32%	86%	52%	77%	74%	68%	69%

The second opinion question focused on the adequacy of town shellfish regulations. The question read:

Do you feel that the town regulations governing shellfish are adequate?

A Yes/No response was solicited for this question, as well as a space for open-ended comments. Across all respondents 82% chose Yes indicating they were satisfied. Again, 6 towns recorded at least 20 responses, with Yarmouth indicating the highest satisfaction rating, 90% choosing Yes, and Barnstable lowest of the 6 with 65%.

Figure 3.11



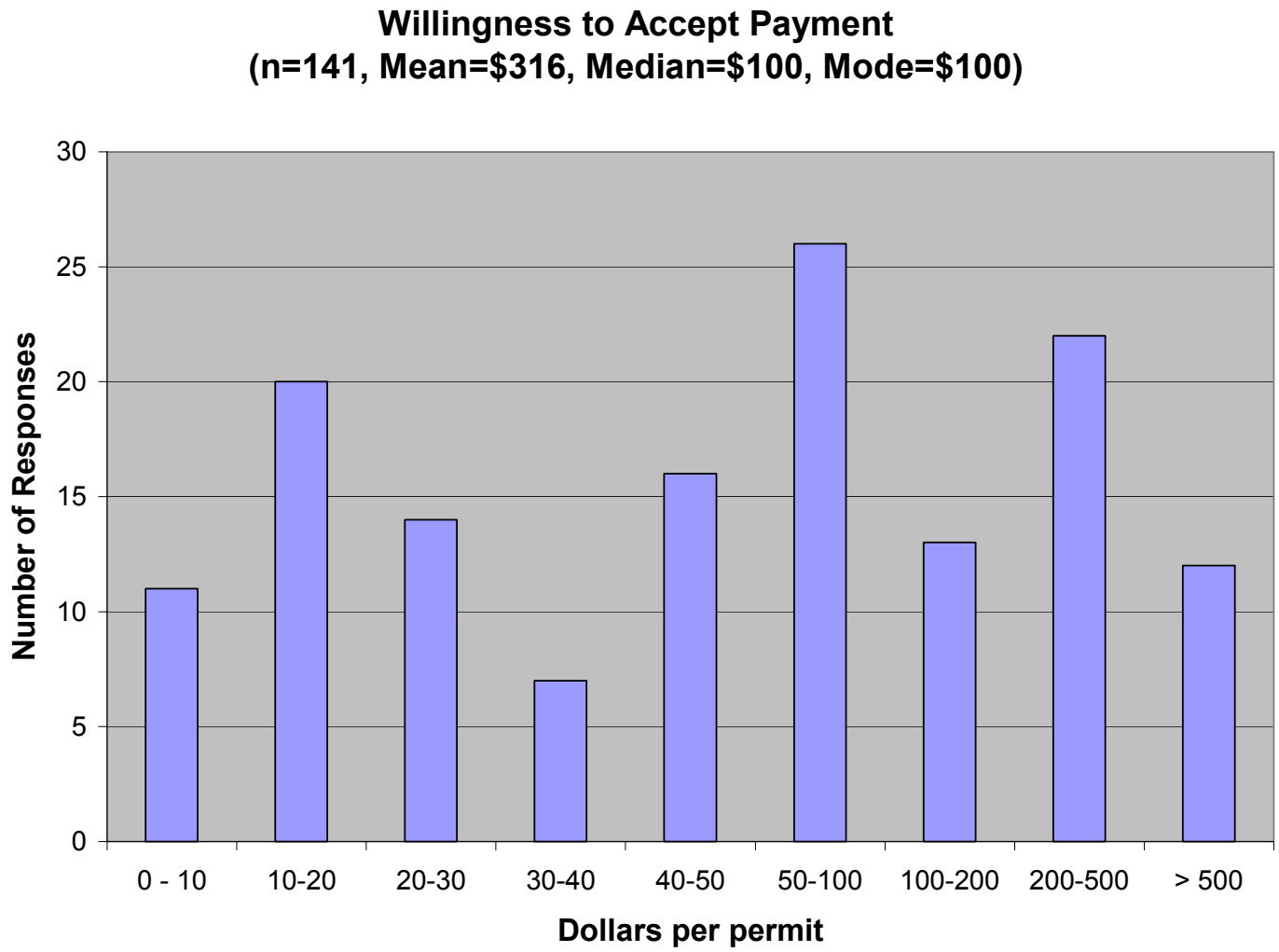
	Barnstable	Eastham	Falmouth	Orleans	Wellfleet	Yarmouth	All Responses
Regs OK yes%	65%	83%	88%	86%	89%	90%	82%

Shellfishers were asked two questions concerning the value of a shellfish permit. As discussed in section 2.0 consumers often place a value higher than the purchase price for any given product or service. The first question posed focused on WTA as follows:

14) Suppose you already hold a permit for next year. How much would you have to be paid to give it up? _____

A total of 145 people responded to this question, and 4 of these were dropped as outliers, in excess of 3 standard deviations from the mean response. The remaining 141 useable responses had a mean value of $316 and median and mode values of $100.

Figure 3.12



The second question focused on the WTP.

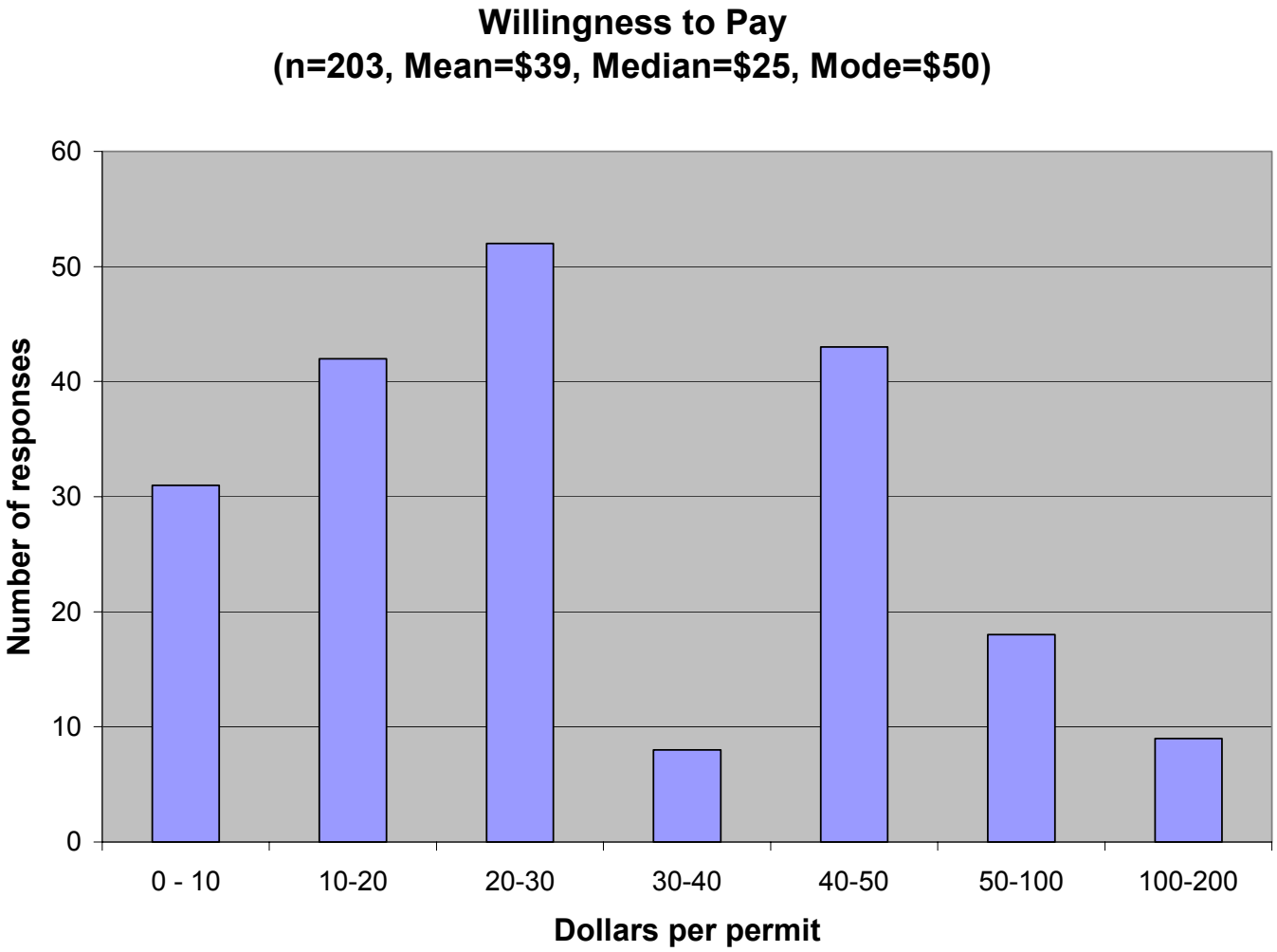
15) Suppose you have not yet purchased next years permit. What is the MOST you would be willing to pay for the permit? _____"

This question solicited a total of 203 responses including 1 outlier, yielding 202 useable responses. This indicates that compared with the WTA question, the WTP question was more easily understood by the survey takers.

The literature indicates that responses to WTA and WTP questions are subject to change based on the question delivery technique, and the degree to which preparatory explanation is given. The preparatory information provided as part of this study was limited to the paragraph presented in section 2.0. This level of preparatory information was consistent with what was provided in the 1975 survey.

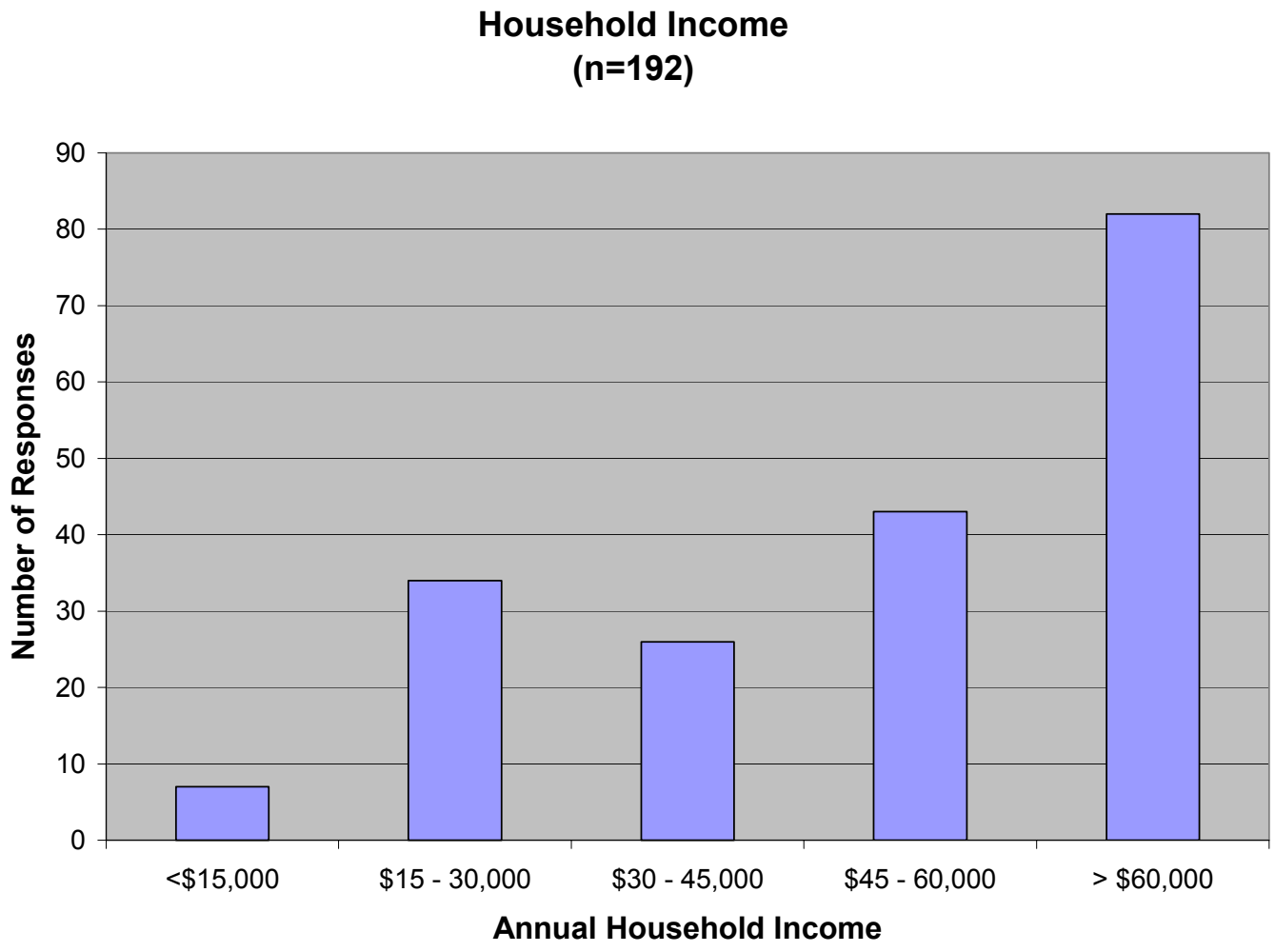
Mean response to the WTP question yielded a value of $39, with a median of $25 and mode of $50.

Figure 3.13



Finally, survey respondents were asked to indicated their household income, in a fixed set of ranges. Responses are listed below in Figure 3.14.

Figure 3.1



4 Estimating Demand Curves

Willingness to pay data was analyzed using four different functional forms as follows:

Model 1 – Ln (q) = $\gamma + \beta p + \varepsilon$, where $\gamma = \ln(\alpha)$ (which is the same form used in the 1975 study).

Model 2 - Ln (q) = $\gamma + \beta_1 p + \beta_2 p^2 + \varepsilon$, where $\gamma = \ln(\alpha)$

Model 3 – Ln (p) = $\gamma + \beta q + \varepsilon$, where $\gamma = \ln(\alpha)$

Model 4 - Ln (p) = $\gamma + \beta_1 q + \beta_2 q + \varepsilon$, where $\gamma = \ln(\alpha)$

Regressions were performed using SAS®. First, Resident WTP data was used to generate parameter estimates with results as shown in Table 4.1.

Table 4.1 Comparison of demand function estimates based on willingness to pay, residents subsample, dependent variable is quantity.

Variable	Model 1	Model 2
Constant	4.994	5.280
	(-0.0254)	(0.0402)
	< .0001	< .0001
Price	-0.0254	-0.0379
	(0.00064)	(0.00141)
	< .0001	< .0001
$(Price)^2$		0.000074 6
		(0.00000 785)
		< .0001
Sample size	142	142
Adjusted R-squared	.918	.950
Root MSE	0.270	0.211

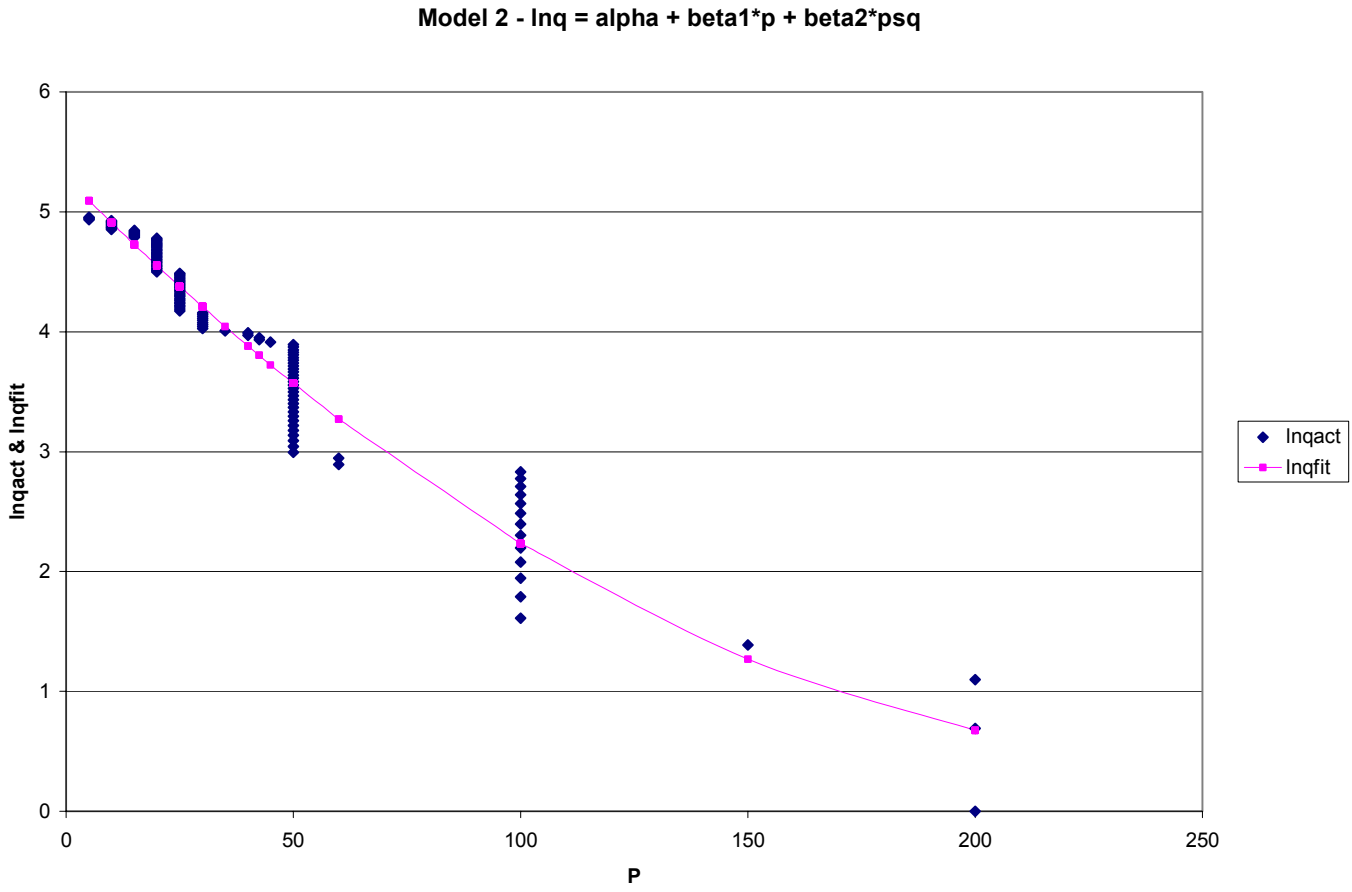
Standard errors in parentheses, followed by significance level

Based on the comparison of RMSE the model 2 clearly fits the data better. All signs are as predicted and the magnitude of parameter estimates are consistent with the results of the 1975 analysis.

Figure 4.1 shows the data set and the fitted curve. You can observe that survey respondents tended to group their WTP estimates around "benchmark" price points including $20, $25, $30, $50 and $100.

Hypothesis testing of ordinary least squares regression results is performed with an assumption of normality of the residuals resulting from the regression. The model results were tested for normality of the residuals and the hypothesis of normality was rejected, due to both skewness and kurtosis of the residuals. Due to the nature of the data, in particular grouping around the benchmark prices noted above, it is unlikely that any techniques can be applied to correct for this result. However,we do not anticipate that this lack of normality will detract from the general results of this research.

Figure 4.1
Demand curve – q as a function of p

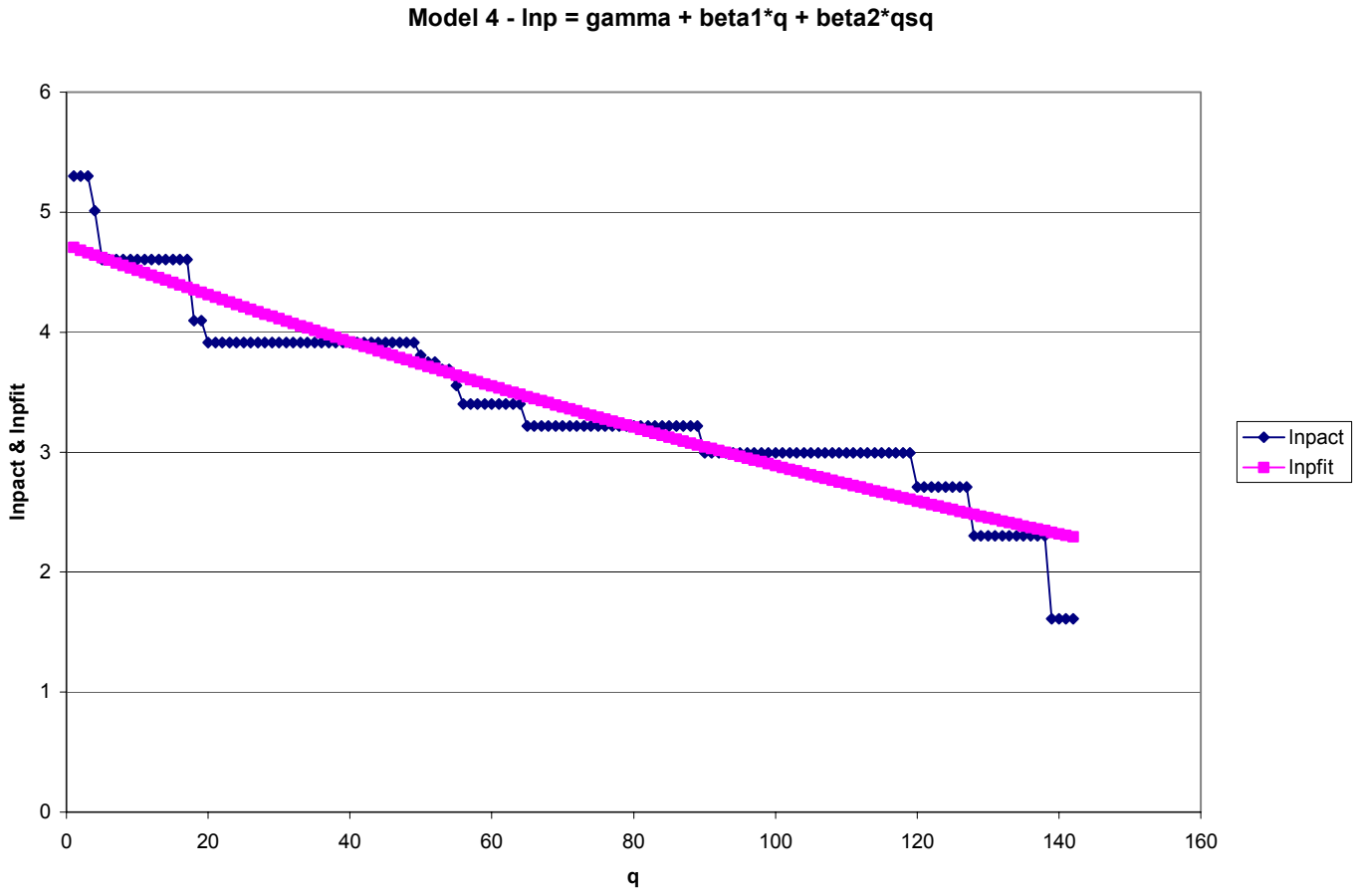


An alternative formulation of the demand equation, placing q as a function of p, as shown in models 3 and 4 were analyzed. Again, the model 4 incorporating the squared term outperformed the simpler model.

Figure 3.2 shows the model 4 fitted and actual data. By observation, the model 4 fitted curve lacks the curvature at both high values of p and low p values such that it tends to underestimate p at high values and overestimate p at low values.

We also note that in using model results to estimate consumer surplus, the model 1 and 2 formulations were internally consistent, as were the model 3 and 4 results. However, the model 3 and 4 results consistently provided a lower estimate of the area of consumer surplus when compared to the model 1 and 2 results.

Figure 4.2
Demand curve p as a function of q



Parameter estimates were generated for resident, non-resident, and senior permit holders separately. As with in the 1975 study, we performed a test to determine whether the data could be pooled, that the behavior of residents, non-residents and seniors was identical. The following hypothesis test was proposed:

H_0 : γresident = γnon-resident = γsenior
$\beta_1$resident = $\beta_1$non-resident = $\beta_1$senior
and $\beta_2$resident = $\beta_2$non-resident = $\beta_2$senior

and

Ha : the parameters are different across resident types

A restricted model (using pooled data) was estimated as was an unrestricted model allowing all parameters to vary by residency type. Results of an F-test rejected the null hypothesis of similarity across residency types, and therefore parameters were estimated for WTP and WTA for each separate residency type. Results of the WTP regressions using Model 2 are shown in Table 4.2.

Table 4.2 Comparison of demand function estimates based on willingness to pay, dependent variable is quantity.

Variable	Resident	Non-Resident	Senior
Constant	5.2801	3.6695	3.6825
	(0.0402)	(0.1782)	(0.0622)
	< .0001	<.0001	(<.0001
Price	-0.0379	-0.0304	-0.0517
	(0.00141)	(0.00657)	(0.00290)
	< .0001	.0001	<.0001
$(Price)^2$	0.0000746	0.0000554	0.00167
	(0.0000079)	(0.0000449)	(0.000015)
	< .0001	0.23	<.0001
Sample size	142	26	33
Adjusted R-squared	.950	.902	.948

Standard errors in parentheses, followed by significance level

Results are significant (α < 1% level) for all parameter estimates with the exception of the p-squared term for the non-resident data. All parameter estimates have the expected signs and magnitudes are consistent with the previous study results. The insignificant result of the parameter estimate for the squared term in the nonresident data may be due to the grouping of data around the benchmark price points. This group also had the smallest sample size.

WTA Regression results are shown in Table 4.3.

Table 4.3 Comparison of demand function estimates based on willingness to accept compensation, dependent variable is quantity.

Variable	Resident	Non-Resident	Senior
Constant	4.1108	2.7590	2.8920
	(0.0456)	(0.0795)	(0.0554)
	< .0001	<.0001	<.0001
Price	-0.00253	-0.00554	-0.00233
	(0.00015)	(0.00078)	(0.00016)
	< .0001	.0001	<.0001
$(Price)^2$	0.00007461	0.00000290	0.000000204
	(0.00000036)	(0.00000085)	(0.000000015)
	< .0001	0.003	<.0001
Sample size	97	21	23
Adjusted R-squared	.835	.896	.943

Standard errors in parentheses, followed by significance level

All parameter estimates are significant at the 5% level and with the expected signs. As with the 1975 study, the survey respondents WTA values were consistently higher than their stated WTP. This also resulted in more spread in the data with the WTP values ranging from $3 to $200, and the WTA values ranging from $5 to $10,000.

5 Analysis of Individual Responses

The questionnaire used for the 2002 survey included many of the same questions used in the 1975 study. Similarly, we are able to test the effect of a number of causal variables on the respondents Willingness-to-pay and willingness-to-accept payment estimates. The model used for 2002 included the following causal variables:

Explanatory Variable	Description	Summary Data
LEN	Distance traveled to clamming area. (miles)	Figure 3.6
QUA	Quahog Annual Harvest (bushels)	Figure 3.9
TRIP	Number of Trips per year	Figure 3.7
YR	Number of Years purchasing shellfish permits	Figure 3.5
FEE	Permit Fee paid 2002	Table 7.2
INC	Stated Household Income	Figure 3.14

The dependent variables used were the responses to WTP and WTA. All variables were transformed into logarithms.

5.1 Willingness-to-Pay - Explanatory Regression Results

Figure 5.1 shows the regression results for the WTP analysis. A test for pooling across residency types failed to reject the hypothesis that responses from Resident, Non-resident and seniors were similar. All the significant variables were consistent with their expected sign, that is higher levels of each of the variables translated into a higher stated WTP. Overall the model is rather weak in explaining the level of an individual's willingness to pay.

Table 5.1 Individual willingness-to-pay estimates, all data.

Variable	Coefficient	Standard error	Prob. value
Constant	0.4684	0.5596	0.404
Distance traveled	0.0176	0.0674	0.795
Quahog annual harvest	0.1544	0.0783	0.051
Trips per year	0.1908	0.0928	0.042
Years purchasing permits	0.0317	0.0603	0.600
Permit fee paid 2002	0.3967	0.0797	<.0001
Household income	0.3283	0.1010	0.002

R^2 =.301, n = 135.

All variables showed a positive relationship with WTP as predicted. Results from the 1975 study also found significance for quahog catch (non-residents), number of trips, fee paid, and income level.

The 1975 study also conducted two separate WTP regressions, one for Residents and another for Non-residents. In 1975 catch was found to be positive and significant only for non-residents. Number of trips, fee paid, and income level were all found to be positive and significant for both types.

The variables representing distance traveled to flats, and years permit was held, were found not to be significant in the current, 2002, analysis. The 1975 analysis did find significance for distance traveled for

non-residents, but with a negative sign. Number of years the permit was held was found to have a negative influence on WTP values in the 1975 study.

5.2 Willingness-To-Accept Compensation– Explanatory Regression Results

Significant variables resulting from the WTA analysis were:

- Distance traveled to flats (residents, seniors)
- Number of shellfishing trips in the prior year (residents)
- Years permit held (seniors)
- Income level (residents, seniors)

Differing from the WTP analysis, the WTA data and test for ability to pool across residency types rejected the null hypothesis of similar parameters across residency types. Therefore an unrestricted model was specified allowing parameter estimates to vary by residency type. This model is sensitive to the specification of outliers. As noted in the next section, outliers were defined as being at least 3 standard deviations distant from the mean of all responses. For WTA, this still left one senior estimate of $10,000 which was notably higher than the next highest estimate of $1,500. Dropping the $10,000 data point from the analysis would have resulted in a failure to reject a null hypothesis of similarity.

Table 5.2 Individual willingness-to-accept compensation, by residency type.

Variable	Resident	Non-resident	Senior
Constant	3.7211*	-1.3426	-3.2992
Distance traveled	-0.0974*	0.7722	1.5379*
Quahog annual harvest	-0.0930	0.9345	0.1287
Trips per year	0.0706*	-1.2020	-0.3067
Years purchasing permits	-0.00358	-0.5140	1.1444*
Permit fee paid 2002	-0.0282	2.5077	2.0612
Household income	0.0160*	-0.5089	-0.2767*
Sample size	70	14	14

* Indicates significant at 10% level

None of the parameters was significant for the non-resident data. This may be due to the small number of usable responses to the WTA category for non-residents, though three variables were significant for senior responses with an identical n=14. The senior equation shows that distance from the flats was a significant and positive factor, as predicted. This variable was also significant for residents, however the sign was negative, contrary to predicted, though the value of the parameter was small in comparison to the Senior estimated parameter (-0.0974 vs. 1.5379).

Seniors also showed that the number of years a permit was held had a positive and significant effect, though this was not a significant factor for the other two residency groups. Lastly, seniors indicated a negative income effect, contrary to the predicted insignificance of income as a factor in WTA. Residents also showed significance though the relationship had the opposite sign. The power of the WTA explanatory regression analysis, as was the case with WTP, was relatively weak.

6 Estimating Total Consumer Surplus for Barnstable County

Consumer surplus was first estimated for each town. Using the town's actual permit price, p*, we estimated the number of people out of the total sample who would have purchased a permit at that price, n*, then found the consumer surplus corresponding to this permit price using the formula in section 2.4.4. The sample consumer surplus value was then scaled to the town's consumer surplus value by the ratio of permits actually sold, N, to the sample number, n*. Results for each town are shown in table 6.1. By adding the actual revenues from permit sales to the consumer surplus estimate, the total value of shellfishing is obtained.

6.1 Willingness-To-Pay Estimates

Table 6.1 details the permit revenue and the estimate of consumer surplus for each town selling recreational shellfish permits. Total estimated annual value for recreational shellfishing was $1.035 million which included $387,417 raised in permit revenue and an estimated $647,369 in consumer surplus. Four towns, Chatham, Bourne, Barnstable and Falmouth accounted for 60% of the total.

Table 6.1 Estimates of Willingness-to-pay and total value of shellfish permits, 2002 survey.

Town	Permit Revenue	Consumer Surplus Estimate	Total Value
Barnstable	$37,340	$67,469	$104,809
Bourne	$76,135	$114,145	$190,280
Brewster	$10,945	$23,786	$34,731
Chatham	$94,905	$131,112	$226,017
Dennis	$8,997	$21,852	$30,849
Eastham	$28,840	$53,296	$82,136
Falmouth	$36,845	$67,631	$104,476
Harwich	$5,155	$15,353	$20,508
Mashpee	$10,715	$22,115	$32,830
Orleans	$33,600	$45,605	$79,205
Provincetown	$1,275	$4,965	$6,240
Truro	$1,845	$5,810	$7,655
Wellfleet	$24,380	$37,725	$62,105
Yarmouth	$16,440	$36,505	$52,945
Totals- Cape	$387,417	$647,369	$1,034,786

The consumer surplus estimate was based on the survey respondents' answers to the question:

"Suppose you have not yet purchased next years permit. What is the MOST you would be willing to pay for the permit?"

Smith, Conrad and Storey (1978) reviewed a number of critiques of Willingness-to-pay (WTP) and Willingness-to-accept (WTA) payment estimation techniques. The way that a question is posed and the amount of information provided to the survey taker can influence their response. Respondents can be accused of under-stating their WTP as a strategic move in the hopes that policy makers will keep permit

prices low. Perhaps most importantly, responses to the Willingness-To-Pay question are thought to be constrained by the respondents income.

6.2 Willingness-To-Accept Payment Estimates

Differences often occur between WTP and WTA results. This was the case both in this study, and in the 1975 study. One possible explanation, as noted above, is presence or absence of income constraints. In the case of WTP, the respondent may bias their estimate of WTP downward to fit their perceived income constraint, whereas their response to the equivalent WTA question has no constraint. (Krutilla & Fisher, 1975)

Differences between WTP and WTA can also be argued as stemming from a difference in property rights. From the perspective of a town that previously had not allowed recreational shellfishing, the right to shellfish may be perceived as belonging to the town. In this instance the WTP question may provide a better estimate of true consumer surplus. However, as argued by Smith, Conrad and Storey (1978), where towns have had a long history of permitted recreational shellfishing, and an alternative use of the shellfish flats is being considered, the appropriate value to use might be the WTA value. This value may more closely estimate the perceived loss-of-value that current permittees will experience if the right to shellfish is taken away by a competing use.

Table 6.2 shows consumer surplus estimates resulting from the answers to the WTA question:

"Suppose you already hold a permit for next year. How much would you have to be paid to give it up?"

The total value was estimated at $7.4 Million, which included actual permit revenues of $387,417 and an estimate of consumer surplus of $7.0 million.

Table 6.2 Willingness-To-Accept Payment estimates, permit revenue and total value of the shellfishing resource.

Town	Permit Revenue	Consumer Surplus Estimate	Total Value
Barnstable	$37,340	$912,859	$950,199
Bourne	$76,135	$1,036,098	$1,112,233
Brewster	$10,945	$311,269	$322,214
Chatham	$94,905	$1,044,254	$1,139,159
Dennis	$8,997	$314,753	$323,750
Eastham	$28,840	$665,800	$694,640
Falmouth	$36,845	$880,168	$917,013
Harwich	$5,155	$207,134	$212,289
Mashpee	$10,715	$321,732	$332,447
Orleans	$33,600	$358,688	$392,288
Provincetown	$1,275	$75,045	$76,320
Truro	$1,845	$73,731	$75,576
Wellfleet	$24,380	$299,626	$324,006
Yarmouth	$16,440	$500,435	$516,875
Total Cape Cod	$387,417	$7,001,591	$7,389,008

7 Comparison with 1975 Study

The results of the 2002 survey match closely with the 1975 results, both in overall magnitude and in the differences between WTP and WTA estimates.

Table 7.1 compares 1975 and 2002 WTP estimates for each residency type. Both actual and inflated results are presented for 1975. The actual results are taken from the Smith, Conrad and Storey (1978) paper. These were inflated to 2002 dollars using the Consumer Price Index – All Items – Urban, which resulted in an inflation factor of 3.37276. That is, $1 worth of goods in 1975 would be priced at $3.37 in 2002.

Total value of $1.0 million in 2002 compares with the 1975 estimate of $1.1 million ($2002). However the relative proportion of permit revenue to consumer surplus shifted slightly. In 1975 consumer surplus represented 79% of the total estimated value. In 2002, the percentage of total value attributed to consumer surplus is only 63%.

Another notable change between 1975 and 2002 is the relative importance of residents as a factor in the estimate of total value. Tables 7.2 and 7.3 detail the make-up and pricing of shellfish permits by town and residence type for 1975 and 2002 respectively. In 1975 resident permittees accounted for an estimated 83% of the total value of the shellfishery. The corresponding estimate for 2002 shows residents accounting for only 55% of total value, non-residents accounted for 37% and seniors 8%. This shift might be due to a number of factors. First, the number of towns issuing senior licenses increased from only 1 in 1975 (Orleans), to 11 towns in 2002 and the corresponding number of senior license-holders rose from 206 to 2,704. This may reflect the general aging of our population, and the increasing popularity of Cape Cod as a place to reside in retirement.

The number of non-resident permits issued almost doubled from 1,435 in 1975 to 2,704 in 2002. This is perhaps a reflection of the growth in popularity of Cape Cod as a summer tourist destination over this time frame.

Consistent with the drop in the importance of residents in the overall estimated value of shell-fishing is a precipitous drop in the number of resident licenses issued. 19,068 resident licenses were issued in 1975 compared with only 10,639 issued in 2002. This drop reflects similar trends in licensing for other traditional outdoor activities including fishing and hunting.

Like the Willingness-to-pay results, the estimates of consumer surplus based on the Willingness-to-accept data are quite consistent between 1975 and 2002, and show similar trends in demographic shifts across residency type. Total value estimates using WTA were $7,389,008 in 2002 vs. $6,463,904 in 1975 (inflated to $2002). As with WTP results, the proportion attributed to residents fell wheras the non-resident and senior proportions increased. In particular, the estimate for recreational shellfish values attributable to senior permit holders increased from $41,250 in 1975 ($2002) to $1,333,649 in 2002. Part of this rise may be due to differences in the way "outliers" in responses to the Willingness-to-accept payment question were handled in the 1975 and 2002 studies. In 1975 "… approximately 20% of the willingness-to-surrender (accept) responses were extremely high and as such were considered outliers." Smith, Conrad and Storey (1978). Their data set was truncated at the $1,000 level ($1975) with any responses above that being left out. This study defined outliers using a 3 standard deviation rule. That is, any responses greater than 3 standard deviations from the mean were dropped. There were 2 responses placing the willingness-to-accept payment value at $500,000 and another 2 at $1,000,000, which were dropped from the analysis set. However, this still left one senior response at $10,000, which may bias the

estimate of consumer surplus upward when compared with the 1975 analysis. The magnitude of this potential bias, however, is not expected to alter the research results in any substantial way.

Table 7.1 Comparison of 2002 to 1975 Willingness-to-pay consumer surplus and total value estimates by residency type.

2002	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$197,450	$371,939	$569,389
Nonresident	$171,920	$206,513	$378,433
Senior	$18,047	$68,916	$86,963
Total	$387,417	$647,369	$1,034,786

1975 ($1975)	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$53,188	$227,530	$280,718
Nonresident	$17,784	$37,164	$54,948
Senior	$0	$2,016	$2,016
Total	$70,972	$266,710	$337,682

1975 ($2002)	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$179,390	$767,405	$946,795
Nonresident	$59,981	$125,345	$185,326
Senior	$0	$6,798	$6,798
Total	$239,372	$899,548	$1,138,920

Table 7.2 2002 Town Permit Statistics

Town	Permit fee and number issued						Total Values			
	Resident		Senior		Non-resident		Resident	Senior	Non-resident	Total
	Price	No.	Price	No.	Price	No.				
Barnstable (1)	$20	1329	$10	576	$100	50	$26,580	$5,760	$5,000	$37,340
Bourne	$25	1625	$5	406	$120	279	$40,625	$2,030	$33,480	$76,135
Brewster	$15	582	$5	51	$35	56	$8,730	$255	$1,960	$10,945
Chatham	$15	1591			$60	1184	$23,865	$0	$71,040	$94,905
Dennis	$15	500	$3	159	$60	17	$7,500	$477	$1,020	$8,997
Eastham (2)	$20	856	$10	428	$30	248	$17,120	$4,280	$7,440	$28,840
Falmouth	$20	1266	$5	505	$50	180	$25,320	$2,525	$9,000	$36,845
Harwich (3)	$10	340	$3	75	$30	51	$3,400	$225	$1,530	$5,155
Mashpee	$20	425	$5	248	$65	15	$8,500	$1,240	$975	$10,715
Orleans	$20	520			$50	464	$10,400	$0	$23,200	$33,600
Provincetown	$10	115	$0	42	$25	5	$1,150	$0	$125	$1,275
Sandwich	$0	0	$0	0	$0	0	$0	$0	$0	$0
Truro	$5	119	$0	25	$50	25	$595	$0	$1,250	$1,845
Wellfleet (4)	$25	310	$5	251	$125	123	$7,750	$1,255	$15,375	$24,380
Yarmouth	$15	1061			$75	7	$15,915	$0	$525	$16,440
Total	$15.67	10639	$4.25	2766	$58.33	2704	$197,450	$18,047	$171,920	$387,417

(1) Barnstable also issued Seasonal licenses $50 (13 issued)
(2) Eastham has Tenant ($30 (231 issued)) and Nontenant ($50 (17 issued)) licenses these were combined as Nonresident at the $30 rate.
(3) Harwich also issued one-day Non-resident licenses $15 (19 issued)
(4) Wellfleet also had two additional Seasonal permit categories, Resident-seasonal $15 (169 issued), and Nonres-seasonal $40 (150 issued)

Table 7.3 1975 Town Permit Statistics (in 1975$)

Town	Permit fee and number issued						Total Values			
	Resident		Senior		Non-resident		Resident	Senior	Non-resident	Total
	Price	No.	Price	No.	Price	No.				
Barnstable	$2	3856			$25	54	$7,712	$0	$1,350	$9,062
Bourne	$5	2343			$25	92	$11,715	$0	$2,300	$14,015
Brewster	$3	902			$10	232	$2,706	$0	$2,320	$5,026
Chatham	$2	1487			$15	290	$2,974	$0	$4,350	$7,324
Dennis	$3	1579			$25	14	$4,737	$0	$350	$5,087
Eastham	$3	1006			$10	97	$3,018	$0	$970	$3,988
Falmouth	$2	1972			$5	251	$3,944	$0	$1,255	$5,199
Harwich	$2	845			$15	26	$1,690	$0	$390	$2,080
Mashpee	$3	434			$7	92	$1,302	$0	$644	$1,946
Orleans (1)	$4	639	$0	206	$11	151	$2,556	$0	$1,735	$4,291
Provincetown	$2	456			$15	1	$912	$0	$15	$927
Sandwich	$2	123					$246	$0	$0	$246
Truro	$2	602			$15	72	$1,204	$0	$1,080	$2,284
Wellfleet	$3	724			$15	55	$2,172	$0	$825	$2,997
Yarmouth	$3	2100			$25	8	$6,300	$0	$200	$6,500
Total	$2.73	19068	$0.00	206	$15.61	1435	$53,188	$0	$17,784	$70,972
Inflated to 2002$	$9.22				$52.64					

Note: (1) Orleans had two categories of non-resident licenses, in-state - 106 issued @ $10, and out-of-state - 45 issued @ $15

Table 7.4 Comparison of 2002 to 1975 Willingness-to-accept payment consumer surplus and total value estimates by residency type.

2002	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$197,450	$5,004,661	$5,202,111
Nonresident	$171,920	$681,329	$853,249
Senior	$18,047	$1,315,602	$1,333,649
Total	$387,417	$7,001,591	$7,389,008

1975 ($1975)	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$53,188	$1,665,347	$1,718,535
Nonresident	$17,784	$167,954	$185,738
Senior	$0	$12,230	$12,230
Total	$70,972	$1,845,531	$1,916,503

1975 ($2002)	Permit Revenue	WTP-CS Estimate	Total Value
Resident	$179,390	$5,616,814	$5,796,204
Nonresident	$59,981	$566,469	$626,450
Senior	$0	$41,250	$41,250
Total	$239,372	$6,224,533	$6,463,904

Additional detail on individual town permit numbers, prices, and consumer surplus estimates are provided in Appendix 2.

8 Conclusions and Recommendations

8.1Value of Recreational Shellfishing

Following the results from the Willingness-to-accept (WTA) payment, to give up their right to shellfish, an estimate of total value for recreational shellfishing on Cape Cod is $7.4 million in 2002. This has roughly kept pace with inflation based on a previous study conducted in 1975 that resulted in a value estimate of $1.9 million (nominal 1975 dollars) using similar assumptions.

An alternative formulation, willingness-to-pay (WTP), which is based on an individual's stated estimate of their willingness-to-pay for a permit, and is generally constrained by the individuals income, was also calculated. The total value estimate of WTP drops to $1.0 million in 2002 and again, seems to have kept pace with the rate of inflation, when compared with a 1975 estimate of $338,000 (nominal 1975 dollars).

Of the total values, $387,000 is represented by actual permit fees collected. The remainder represents estimates of consumer surplus, which is the additional value that individuals place on shellfishing above and beyond the permit price.

The discrepancy between WTA and WTP estimates, though not unexpected, represents a problem for policymakers. Interpreting and using these results needs to be viewed in the context of the policy issue being considered. In cases where traditional fishing rights are being considered for transfer from their historic use as an open shellfishery governed by the use of town permits to some other use, then the WTA results may be the appropriate estimate of value to the community. However, in the alternative case, where new flats are being considered to be opened for shellfishing, the value of such opening of these flats may best be estimated using the WTP results.

8.2 Factors influencing an individual's estimate of the value of shellfishing

The regression analyses undertaken in both this 2002 study and in the previous 1975 study provided only weak explanation of the factors that influence an individual's valuation process for recreational shellfishing. The current study indicated that, for some resident types, significant factors influencing WTA value were:

- Distance traveled to flats (residents, seniors)
- Number of shellfishing trips in the prior year (residents)
- Years permit held (seniors)
- Income level (residents, seniors)

Values resulting from the WTP question were influenced by a slightly different mix of factors including:

- Prior years Quahog Catch
- Number of shell-fishing trips in the prior year
- Fee paid
- Income level

8.3 Demographic Shifts

Results from this research indicate a precipitous drop in the number of Cape Cod residents participating in recreational shellfishing. In 2002, a total of 10,639 permits were reported sold to residents of the Cape which is roughly half of the 19,068 sold to residents in 1975. This points to a significant shift in the rate of participation in shellfishing, which is mirrored in the decline of other outdoor consumptive recreational activities such as fishing and hunting.

The decline in the total number of resident shellfishers is counteracted, in part, by rises in the number of senior and nonresident permit holders. The number of towns issuing senior licenses increased from only 1 in 1975 (Orleans), to 11 towns in 2002 and the corresponding number of senior license-holders rose from 206 to 2,704. This may reflect the general aging of our population, and the increasing popularity of Cape Cod as a place to reside in retirement.

The number of non-resident permits issued almost doubled from 1,435 in 1975 to 2,704 in 2002. This is perhaps a reflection of the growth in popularity of Cape Cod as a summer tourist destination over this time frame.

More could be learned about the nature and impact of these demographic shifts through a detailed comparison of census and other demographic data in 1975 vs. 2002. Population numbers, residency types, income, and age distribution shifts could be studied to determine their effect on permits sold and influence on the value of shellfishing. This type of analysis might also be useful in developing a forecasting model for future trends.

Reference

Smith, Richard W., Jon M. Conrad and David A. Storey, *An Economic Valuation of Recreational Clamming in Massachusetts*, Massachusetts Agricultural Experiment Station Research Bulletin No. 654, April, 1978.

Appendices

Appendix 1: Survey Instrument

Survey of Recreational Shellfishing

1) What was the town that you held your shellfish permit in for 2001?
2) What type of permit did you hold?
    a) Resident
    b) Nonresident
    c) Temporary
    d) Senior
3) Residental Status
    a) Year-round
    b) Seasonal resident (property owner)
    c) Seasonal resident
    d) Visitor
    e) Nonresident
4) How many people use the permit?
5) On the average trip, how many people go shellfishing?
6) On the average, how far do you travel to shellfish?
7) Number of years you and/or your family have purchased a permit and shellfished in this town?
8) For the last season (2001) how many times did you and/or your family use the permit to go shellfishing?
9) What percentage of your shellfishing effort did you spend digging for the following:
    a) Soft-shell clams
    b) Quahogs
    c) Oysters
    d) Mussels
    e) Scallops
    f) Surf Clams
    g) Razor Clams
10) What was your catch for the previous year (in bushels) for the following shellfish:
    a) Soft-shell clams
    b) Quahogs
    c) Oysters
    d) Mussels
    e) Scallops
    f) Surf Clams
    g) Razor Clams
11) Are you satisfied with the amount of acreage available for recreational shellfishing?
    a) If 'No', Why?
12) Do you feel that the town regulations governing shellfishing are adequate?

a) If 'No", Why?

13) The town of _____ spent $_____ on shellfish enforcement and $_____ shellfish enhancement programs in 2001.
   a) Do you feel that the amount for Enforcement is
      i) Too little
      ii) Too much
      iii) Just right
   b) Do you feel that the amount for enhancement is
      i) Too little
      ii) Too much
      iii) Just right

In the next two questions, I am going to ask you to give your own opinion on the value of a shellfishing permit. For the first question, we will assume that you already own a permit and will be asked how much you would need to be paid to give it up. Second, we assume that you do not yet have a permit and you are asked how much you are willing to pay to purchase one.

When giving your estimate you should assume that:

a) the shellfishing conditions will be the same as this year and

b) if you choose to surrender a permit you already own, you will be unable to shellfish in any other town for the duration of the year.

c) The answers you give will have no effect on future pricing of shellfish permits.

14) . Suppose you already hold a permit for next year. How much would you have be paid to give it up? $_____

15) Suppose you have not yet purchased next year's permit. What is the MOST you would be willing to pay to purchase one? $_____

16) What was your household's total income for 2001?
   (1) 0-15K
   (2) 15K-30K
   (3) 30K-45K
   (4) 45K-60K
   (5) 60K +

Appendix 2: Willingness-to-Pay and Willingness-to-Accept Payment Calculations by Town

Willingness-to-Pay Estimates - 2002

	Actual permit price, (p*)	Number of permits purchased in town, given n* (N)	Estimated number in sample purchasing at p*, (n*)	Area under sample demand curve (Fig 2.1) (A)	Consumers Surplus = A(N/n*)	Consumers' expenditure (Fig 2.1) B = N*p*	Total value
Barnstable							
Resident	20	1329	92.1	3252.88	$46,939	$26,580	$73,519
Nonresident	100	50	1.9	212.799	$5,600	$5,000	$10,600
Senior	10	576	23.7	614.319	$14,930	$5,760	$20,690
				Totals	$67,469	$37,340	$104,809
Bourne							
Resident	25	1625	76.2	2818	$60,095	$40,625	$100,720
Nonresident	120	279	1	158.138	$44,121	$33,480	$77,601
Senior	5	406	30.7	750.823	$9,929	$2,030	$11,959
				Totals	$114,145	$76,135	$190,280
Brewster							
Resident	15	582	111.3	3770.83	$19,718	$8,730	$28,448
Nonresident	35	56	13.6	684.987	$2,821	$1,960	$4,781
Senior	5	51	30.7	750.823	$1,247	$255	$1,502
				Totals	$23,786	$10,945	$34,731
Chatham							
Resident	15	1591	111.3	3770.83	$53,903	$23,865	$77,768
Nonresident	60	1184	6.4	417.349	$77,210	$71,040	$148,250
Senior	0	0	0.1	0	$0	$0	$0
				Totals	$131,112	$94,905	$226,017
Dennis							
Resident	15	500	111.3	3770.83	$16,940	$7,500	$24,440
Nonresident	60	17	6.4	417.349	$1,109	$1,020	$2,129
Senior	3	159	34.1	815.664	$3,803	$477	$4,280
				Totals	$21,852	$8,997	$30,849
Eastham							
Resident	20	856	92.1	3252.88	$30,233	$17,120	$47,353
Nonresident	30	248	15.8	762.541	$11,969	$7,440	$19,409
Senior	10	428	23.7	614.319	$11,094	$4,280	$15,374
				Totals	$53,296	$28,840	$82,136
Falmouth							
Resident	20	1266	92.1	3252.88	$44,714	$25,320	$70,034
Nonresident	50	180	8.6	504.854	$10,567	$9,000	$19,567
Senior	5	505	30.7	750.823	$12,351	$2,525	$14,876
				Totals	$67,631	$36,845	$104,476
Harwich							
Resident	10	340	134.5	4390.05	$11,098	$3,400	$14,498
Nonresident	30	51	15.8	762.541	$2,461	$1,530	$3,991
Senior	3	75	34.1	815.664	$1,794	$225	$2,019
				Totals	$15,353	$5,155	$20,508

	Actual permit price, (p*)	Number of permits purchased in town, given n* (N)	Estimated number in sample purchasing at p*, (n*)	Area under sample demand curve (Fig 2.1) (A)	Consumers Surplus = A(N/n*)	Consumers' expenditure (Fig 2.1) B = N*p*	Total value
Mashpee							
Resident	20	425	92.1	3252.88	$15,011	$8,500	$23,511
Nonresident	65	15	5.5	380.85	$1,039	$975	$2,014
Senior	5	248	30.7	750.823	$6,065	$1,240	$7,305
				Totals	$22,115	$10,715	$32,830
Orleans							
Resident	20	520	92.1	3252.88	$18,366	$10,400	$28,766
Nonresident	50	464	8.6	504.854	$27,239	$23,200	$50,439
Senior			0.1	0	$0	$0	$0
				Totals	$45,605	$33,600	$79,205
Provincetown							
Resident	10	115	134.5	4390.05	$3,754	$1,150	$4,904
Nonresident	25	5	18.4	851.332	$231	$125	$356
Senior	0	42	39.7	926.163	$980	$0	$980
				Totals	$4,965	$1,275	$6,240
Sandwich	No permits						
Truro							
Resident	5	119	162.5	5133.09	$3,759	$595	$4,354
Nonresident	50	25	8.6	504.854	$1,468	$1,250	$2,718
Senior	0	25	39.7	926.163	$583	$0	$583
				Totals	$5,810	$1,845	$7,655
Wellfleet							
Resident	25	310	76.2	2818	$11,464	$7,750	$19,214
Nonresident	125	123	0.9	147.234	$20,122	$15,375	$35,497
Senior	5	251	30.7	750.823	$6,139	$1,255	$7,394
				Totals	$37,725	$24,380	$62,105
Yarmouth							
Resident	15	1061	111.3	3770.83	$35,947	$15,915	$51,862
Nonresident	75	7	4	319.318	$559	$525	$1,084
Senior			0.1		$0	$0	$0
				Totals	$36,505	$16,440	$52,945

Willingness to Accept Payment Estimates

	Actual permit price, (p*)	Number of permits purchased in town, given n* (N)	Estimated number in sample purchasing at p*, (n*)	Area under sample demand curve (Fig 2.1) (A)	Consumers Surplus = A(N/n*)	Consumers' expenditure (Fig 2.1) B = N*p*	Total value
Barnstable							
Resident	20	1329	58	27295.6	$625,446	$26,580	$652,026
Nonresident	100	50	9.1	2416.24	$13,276	$5,000	$18,276
Senior	10	576	17.6	8376.42	$274,137	$5,760	$279,897
			Totals		$912,859	$37,340	$950,199
Bourne							
Resident	25	1625	57.3	27007.5	$765,920	$40,625	$806,545
Nonresident	120	279	8.1	2238.39	$77,100	$33,480	$110,580
Senior	5	406	17.8	8465	$193,078	$2,030	$195,108
			Totals		$1,036,098	$76,135	$1,112,233
Brewster							
Resident	15	582	58.7	27587.4	$273,524	$8,730	$282,254
Nonresident	35	56	13	3131.85	$13,491	$1,960	$15,451
Senior	5	51	17.8	8465	$24,254	$255	$24,509
			Totals		$311,269	$10,945	$322,214
Chatham							
Resident	15	1591	58.7	27587.4	$747,727	$23,865	$771,592
Nonresident	60	1184	11.3	2830.03	$296,527	$71,040	$367,567
Senior	0	0	0.1	0	$0	$0	$0
			Totals		$1,044,254	$94,905	$1,139,159
Dennis							
Resident	15	500	58.7	27587.4	$234,986	$7,500	$242,486
Nonresident	60	17	11.3	2830.03	$4,258	$1,020	$5,278
Senior	3	159	17.9	8500.73	$75,509	$477	$75,986
			Totals		$314,753	$8,997	$323,750
Eastham							
Resident	20	856	58	27295.6	$402,845	$17,120	$419,965
Nonresident	30	248	13.4	3201.72	$59,256	$7,440	$66,696
Senior	10	428	17.6	8376.42	$203,699	$4,280	$207,979
			Totals		$665,800	$28,840	$694,640
Falmouth							
Resident	20	1266	58	27295.6	$595,797	$25,320	$621,117
Nonresident	50	180	12	2947.46	$44,212	$9,000	$53,212
Senior	5	505	17.8	8465	$240,159	$2,525	$242,684
			Totals		$880,168	$36,845	$917,013
Harwich							
Resident	10	340	59.5	27882.9	$159,331	$3,400	$162,731
Nonresident	30	51	13.4	3201.72	$12,186	$1,530	$13,716
Senior	3	75	17.9	8500.73	$35,618	$225	$35,843
			Totals		$207,134	$5,155	$212,289

	Actual permit price, (p*)	Number of permits purchased in town, given n* (N)	Estimated number in sample purchasing at p*, (n*)	Area under sample demand curve (Fig 2.1) (A)	Consumers Surplus = A(N/n*)	Consumers' expenditure (Fig 2.1) B = N*p*	Total value
Mashpee							
Resident	20	425	58	27295.6	$200,011	$8,500	$208,511
Nonresident	65	15	11	2773.57	$3,782	$975	$4,757
Senior	5	248	17.8	8465	$117,939	$1,240	$119,179
				Totals	$321,732	$10,715	$332,447
Orleans							
Resident	20	520	58	27295.6	$244,719	$10,400	$255,119
Nonresident	50	464	12	2947.46	$113,968	$23,200	$137,168
Senior			0.1	0	$0	$0	$0
				Totals	$358,688	$33,600	$392,288
Provincetown							
Resident	10	115	59.5	27882.9	$53,891	$1,150	$55,041
Nonresident	25	5	13.7	3269.64	$1,193	$125	$1,318
Senior	0	42	18	8554.62	$19,961	$0	$19,961
				Totals	$75,045	$1,275	$76,320
Sandwich	No permits						
Truro							
Resident	5	119	60.2	28182.1	$55,709	$595	$56,304
Nonresident	50	25	12	2947.46	$6,141	$1,250	$7,391
Senior	0	25	18	8554.62	$11,881	$0	$11,881
				Totals	$73,731	$1,845	$75,576
Wellfleet							
Resident	25	310	57.3	27007.5	$146,114	$7,750	$153,864
Nonresident	125	123	7.9	2193.11	$34,146	$15,375	$49,521
Senior	5	251	17.8	8465	$119,366	$1,255	$120,621
				Totals	$299,626	$24,380	$324,006
Yarmouth							
Resident	15	1061	58.7	27587.4	$498,641	$15,915	$514,556
Nonresident	75	7	10.4	2664.92	$1,794	$525	$2,319
Senior			0.1		$0	$0	$0
				Totals	$500,435	$16,440	$516,875