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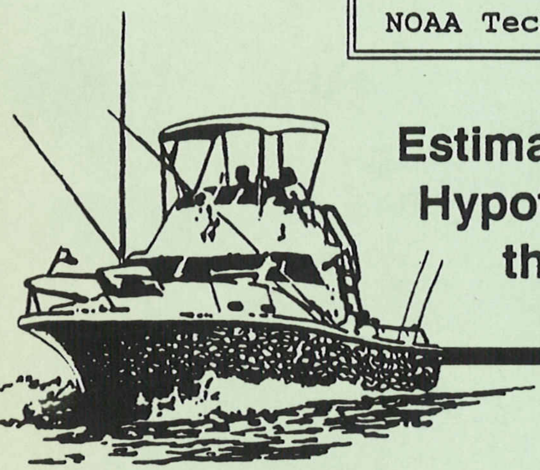

Estimating the Economic Impacts of Hypothetical Grouper Bag Limits in the Destin/Panama City, Florida Charterboat Fishery

by:

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*Notes: - Tables C1, C2, D1, D2, D3 are taken from Arndorfer/Bockstael (1986).

EXECUTIVE SUMMARY

The purpose of this study was to measure short-run economic impacts of hypothetical reef fish bag limits upon the charterboat industry in the Panama City and Destin ports of northwestern Florida using a 1985 survey of charterboat anglers conducted by Arndorfer and Bockstael (1986).

To obtain this goal, a Tobit individual Travel Cost demand model was developed which produced estimates of short-run economic impacts on both recreational demand (annual number of trips) and recreational value (annual consumer surplus).

Analytical results indicated a median of 1.69 trips and $78 per angler per year without regulation. Bag limits of 5, 2, and zero (closure of the recreational grouper fishery) were further considered. It was found that a bag limit of 5 did not affect demand and only dropped value by one dollar per year, a bag limit of two reduced demand to 1.63 trips and value to $72 annually, and a closure of the grouper fishery reduced demand to 1.55 trips and $66 annually.

The impact of one more and one less grouper per trip was also considered. This is what economists refer to as marginal or incremental analysis. For one additional grouper per trip, median demand increased to 1.74 trips and $83 per angler per year. Conversely, for one less grouper per trip, demand declined to 1.61 trips and $71 per year.

Given the results of this study, it is important to understand its limitations.

- **Scope** - The scope of the database was limited to the study of 1985 charterboat anglers in the Panama City and Destin ports of western Florida. It is not possible to state with any assurance that these results are applicable to other charterboat ports. It is even less realistic to expect these results to be indicative of other fishing modes, be they in Panama City and Destin or elsewhere.
- **Reef Fish** - While the original intent of the study was to study the impacts of bag limits on major reef fish species, the final models only allowed for the analysis of groupers. To further generalize the analysis, it was not possible to focus in upon specific species of grouper. Critical catch data was collected under the generic category of "grouper" (recall the original emphasis of the Arndorfer and Bockstael study was King Mackerel).
- **Aggregation** - Estimates of demand and value are presented for the representative angler. Aggregated estimates across all relevant anglers are not possible without knowledge of the number of charterboat anglers using the region. Angler estimates were not available.
- **Weather** - Two hurricanes hit the region during the sampling period. It is unclear as to the direction of any bias this may create since hurricanes can lead to both improvement and deterioration in fishing conditions.

INTRODUCTION

Two primary goals of fishery management are to maintain healthy species populations (conservation) while simultaneously attempting to ensure adequate allowable commercial and recreational catches (extraction). These goals, while superficially conflicting, are not mutually exclusive. Maintenance of healthy fish populations, while imposing possible constraints in terms of bag limits, size limits, etc. in the short run, provides long-term benefits to all anglers through avoidance of species extinction, both biological and economic.[1] By avoiding economic extinction, fishery management helps in maintaining the species for future generations.

The impetus behind this study is the Gulf Management Council's current interest in reef fish. Regulations in terms of bag limits,[2] size limits, etc. are presently being considered on various reef fish.

This project utilizes a database derived from a survey of charterboat customers. The survey was conducted from the western Florida harbors of Panama City and Destin during the fall and summer of 1985. The database was developed under a National Marine Fisheries Service contract prepared for the Southeast Fisheries Center, Miami, Florida. The principal investigators were David Arndorfer (Environmental Resource Management) and Nancy Bockstael (University of Maryland). Environmental Resource Management was contracted to collect the data while Dr. Bockstael performed the modelling and analysis.

Arndorfer and Bockstael used the database to develop economic models for estimation of the impacts of King Mackerel recreational bag limits. They constructed demand functions based upon an individual Travel Cost Method. For a review of the models and results of the Arndorfer and Bockstael (1986) study, see appendices B, C, and D.

A fundamental difference between the Arndorfer and Bockstael (1986) study and the current study lies in the general focus of each. The current project focuses upon reef fish whereas Arndorfer and Bockstael (1986) focused on King Mackerel. With information on a cross section of generic fish species, the database allows for this flexibility.

To be accurate, the current study is based from the same raw data as the Arndorfer/Bockstael project. Unfortunately, the final database (post adjustment) used by

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1 Economic extinction relates to the cost of extracting fish. Should the species population fall to the point where it becomes too expensive to pursue (not cost effective), the species becomes essentially extinct for extraction purposes.

2 Impacts as measured by changes in visitation (demand) and value (consumer surplus).

Arndorfer and Bockstael was unavailable. This researcher had to re-adjust the database before model estimation. As a result, differences between the final databases in each project are likely to exist.

Despite the database differences, both projects utilized the same estimation methodology, namely the Tobit based Individual Travel Cost Method. The present study did attempt to expand upon the Arndorfer and Bockstael (1986) analysis via the use of dummy variables reflective of various database groups.[3]

In summary, this paper attempts to address part of the information necessary for a cost-benefit analysis,[4] namely the impact of bag limits on annual recreation benefits. Given the database deficiencies (see database section), the specific purpose of this paper reduces to estimation of the impact of possible reef fish bag limits on the average Panama City/Destin charterboat user's annual visitation and value (consumer surplus per year[5]).

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3 Dummy variables were used to test for possible differences between subgroups within the database. Dummy variables were used to model potential differences between the following groups: fixed vs flexible work schedules, half vs full day trips, high vs low/medium income, and varying trip purposes - business, extended stays, charterboating.

4 Cost benefit analysis involves comparing a proposal's cost and benefits over time. For each project alternative under consideration, discounted benefits are compared to discounted costs. The alternative whose discounted benefits exceed its costs by the largest amount would be the preferred alternative.

5 Consumer surplus is a legally acceptable method for estimation of value. It is based upon one's willingness-to-pay in excess of price.

RECREATIONAL ECONOMIC THEORY

Traditional demand theory analyzes product choice decisions within a context of constrained optimization. The objective is to maximize utility (satisfaction) by selecting the optimal bundle of goods and services subject to a given set of constraints. In our case, the utility function is simplified to represent charterboat trips to Panama City/Destin along with all other goods, subject to an income constraint.

For Example: Max U (C; Z)

ST: $Y = P_c * C + P_z * Z$ (budget constraint)

U = Utility
C = Charterboat Trips to Destin/Panama City
Z = vector of all other Goods
Y = Income
P_c = Price of Charterboat Trip to Destin/Panama City
P_z = vector of price of all other goods

The result of this constrained maximization problem provides the optimal selection of charterboat trips (C) and all other goods (Z) given one's inability to spend beyond one's income level (ignores use of accumulated wealth). Simplistic demand curves can then be derived where the number of annual charterboat trips are a function of the cost or price of the trip ($C = f(P_c)$). The annual number of recreational trips generally declines as price increases ($\partial C / \partial P_c < 0$). Additionally, the annual number of trips often increases as income increases ($\partial C / \partial Y > 0$ - that is, recreation is a normal good).

Simple demand curve analysis is somewhat limited in that the only explanatory variable for charterboat demand is trip price. We need to expand the analysis toward the development of demand curves where charterboat trips are a function of non-price as well as price variables. As is apparent from the constrained utility function, the demand for charterboat trips is also a function of income and the level of purchases of other goods and services. Since the demand for other goods and services are a function of their prices, we can represent the demand for charterboat trips by trip price, alternative goods and services (substitutes and complements), and income.

A complementary relationship implies that the goods support each other, e.g. fishing poles and fishing trips ($\partial C / \partial P_z < 0$ since C and Z are complements). Conversely, a substitutional relationship implies a more competitive situation where mutually exclusive choices between options are made, e.g. the choice between fishing at Panama City/Destin or Key West ($\partial C / \partial P_z > 0$ since C and Z are substitutes).

When considering how to incorporate substitute and complementary goods and services, recreational researchers apply the concept of a weakly separable demand function (Loomis, Sorg, Donnelly 1986). This assumes that goods and services can be grouped or separated in terms their basic purpose for determination of applicable substitutes and complements. Researchers often use exclusively recreation goods and services as the choice set, all other goods and services are excluded from their models. Normally, researchers go one step further and define the choice set within the same recreational activity (weakly separable by fishing activity).[6]

Product demand is also influenced by quality. While price is certainly quite influential, in many cases quality is the overriding factor in the purchase decision. Quality may or may not be as important as price in recreation, nevertheless it should be included into our demand models. To incorporate quality within the constrained optimization problem, we link quality with the quantity of charterboat trips. The objective function now becomes U (C{Q}; R). Differentiating this with respect to quality (Q) provides $\partial C/\partial Q * \partial U/\partial C$, therefore the demand for charterboat trips becomes a function of quality as well as price, income, substitutes and complements. The quality variable is often constructed as a positive relationship to trips consumed ($\partial C/\partial Q > 0$).

Another factor of major importance within the constrained optimization model is time. When time plays a role in the consumption decision, economic theory suggests the incorporation of another constraint into our optimization model representing time. Essentially, what economists are trying to model is the idea that time is a scarce resource and therefore should be somehow valued and considered in the demand equation.

$$\text{Max } U(C\{Q\}; R)$$

subject to:

$$Y = P_c * C + P_r * R \quad \text{(budget constraint)}$$
$$T = t_c * C + t_r * R + Tw \quad \text{(time constraint)}$$

U = Utility
C = Charterboat Trips to Destin/Panama City
R = vector of fishing related substitute and complementary goods and services (other sites)
Y = Income
P_c = Price of Charterboat Trip to Destin/Panama City
P_r = vector of prices for fishing related substitutes and complements (other sites)
T = Total time available
t_c = time required to pursue the charterboat trip
t_r = " " other fishing related activities
Tw = time at work

In this configuration, total time (T), work time (Tw), and the time required to pursue various fishing activities (t_c and t_r) would all enter into the demand curve. Leisure time

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6 Technically, when using a weakly separable demand function, one would need to define income in terms of a recreational budget as opposed to full income.

($T_L = T - T_W$) could be substituted for T and Tw. The number of charterboat trips would be expected to rise as one's leisure time rises all else held constant ($\partial C/\partial T_L > 0$). The time cost ($t_c$) in terms of the hours to pursue a charterboat trip would be expected to be negatively related to trip frequency ($\partial C/\partial t_c < 0$). The longer the trip length, the greater the time costs (results in fewer annual trips). The time required to purse other fishing related activities (t_r) represents a time cost and as such should follow the substitute/complementary relationships as P_Z above).

People with flexible work schedules (eg. self-employed), have the opportunity to substitute recreation time for money and vice versa. This allows modelers to convert recreational trip time to dollars. These monetary conversions represent potential lost wages resulting from the recreational trip (an opportunity cost).[7] Lost wages represent trip costs in the same fashion as transportation or any other out-of-pocket costs (creates a reduction in wealth). This conversion characteristic allows modelers to encompass both income and time constraints within one overall income constraint (for proof see appendix A).

$$\text{Max } U(C\{Q\}; R)$$

subject to: $wT = C(P_c + w^*t_c) + R(P_r + w^*t_r)$

where
wT = total possible income (w = wages, T = total time)
wt_c = opportunity cost of C in terms of lost wages
wt_r = " "R" "

For the flexible group, time is converted to an opportunity cost and summed into the price term ($P_c + wt_c$). Total available time is converted to total possible income (as a function of one's wage rate) and included in the demand function.

To summarize, the following variables are appropriate for modeling each group:

1) Fixed Work Schedule: $C = f(P_c, t_c, Q_c, R\{P_r, t_r, Q_r\}, Y, T_L)$
2) Flexible Work Schedule: $C = f(P_c + OPCOST_c, Q_c, R\{P_r + OPCOST_r, Q_r\}, wT)$

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7 This does not imply that individuals with fixed work schedules have zero opportunity costs. For these individuals, modelers can represent time costs in terms of physical units (hours, days etc.) or some other measure - including dollars. The conversion of this individual's time into dollars is less straightforward than for the fleible group (see price variable discussion under the general recreational model section.

C = number of annual charterboat trips to Panama City/Destin
P_c = price of charterboat trip
t_c = time cost of trip in hours/days
Q_c = quality of the charterboat trip
R = substitute & complementary sites as a function of their prices (P_r), time costs (t_r), and qualities (Q_r)
Y = income
T_L = leisure time (total time minus work time)
$OPCOST_c$ = opportunity cost of time in terms of lost wages for trip to Panama City/Destin
$QPCOST_r$ = opportunity cost of time in terms of lost wages for trips to other sites
wT = total possible income (w = wage, T = total annual time)

MODELING LOGIC

In the past few years, Travel Cost Method (TCM) demand studies have been attempting to model the individual recreator's decision making process. Two general categories of TCM models have surfaced: single site and regional models.

Single Site Models are site specific. Depending on the type of sample collected, the determination of the site's annual visitation varies. Separate approaches must be used depending upon whether the sample was taken on-site (users only) or from the general population (users and nonusers[8]).

> Annual Visitation via an On-site sample: Estimate the average individual's probability of participation at the study site times average individual's frequency of participation at the study site (see terms I and II below). This process converts visitation per user to visitation per capita for subsequent application to the appropriate general population (Brown et.al, 1983). A different way of approaching the same result is to multiply the probability of participation by the relevant population to provide an estimate of the number of users within the population. Applying the visitation per user times the number of users also estimates the annual visitation at the site.
>
> Unfortunately, the individual's probability of participation cannot be estimated from the information in a sample of site users. Information from the general population must be gathered (implies an additional sample of the general population). Given the sample utilized in this study consisted of users only, we are limited to studying only the visitation behavior of current anglers.
>
> Annual Visitation via a Population Sample: Estimate the average individual's frequency of participation times the relevant population. Given that the sample includes both users and nonusers, the frequency of participation represents visitation per capita as opposed to visitation per user. Multiplying visitation per capita times the relevant general population provides estimates of the annual visitation at the site. This general population approach combines the two pronged sampling scheme of the on-site approach into one survey.

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8 Users represent current participants (anglers), nonusers represent current nonparticipants.

One problem associated with both approaches is the need to sample the relevant general population (potential user population). The problem becomes one of determination of the relevant population. Geographically, this boils down to the population within a given radius of the site. As an approximation, the radius could be based upon the largest distance travelled by anyone using the site. This definition can become unwieldy as the distance travelled becomes large. Researchers often use a geographic cutoff based upon a preselected percentage of visitation (U. S. Water Resources Council (1983) guidelines suggest using 90 - 95% user radius).

Regional Models are much broader than single site models. They attempt to measure recreational benefits across a series of similar sites (ones providing similar recreational opportunities) within a defined geographic region (Loomis et. al., 1986). As such, these models require sampling across the entire region. Given our survey relates exclusively to the Panama City/Destin area of northwest Florida, we cannot employ regional modelling techniques.

TERM 1: Probability of Participation

This term, which is utilized by both single site and regional models, allows one to estimate the probability of an individual being a saltwater fisherman (or user). For the site model, the probability of participation relates to the probability of using only the focus site regardless of the level of usage of other sites. Given that the dependent variable represents whether or not the individual is a user of the site, the choice options are either yes or no (1,0) responses.

Econometric techniques for developing probabilities of participation often involve use of Dichotomous Choice Logit or Probit formats. Logit and Probit techniques utilize maximum likelihood functions where the objective is to select coefficient estimators for the explanatory variables which maximize the probability of achieving the sample distribution. Given that the dependent variable represents either a zero or one response, the output of these techniques provide site specific probabilities of participation for an individual with a given set of characteristics (explanatory variable values).

Given that the information for estimation of this model was unavailable (requires a sample of users and nonusers), this study focuses exclusively on frequency of participation per user. This is unfortunate because aggregate impacts of regulatory actions become impossible to determine. Even if we had an estimate of the current number of users of the site, the aggregation[9] could be questioned due to the inability to estimate the impact of regulatory actions upon the number of participants.

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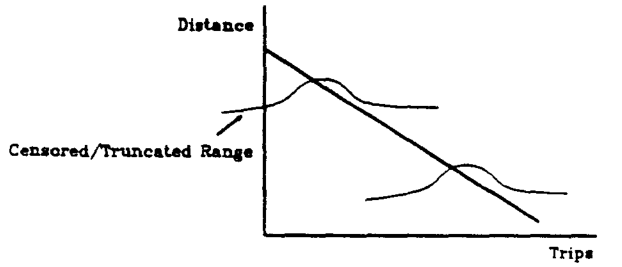
9 Current number of users times the visitation per user provides an estimate of total visitation at the site.

TERM 2: Frequency of Participation

In the site model, the frequency of participation term estimates the average individual's annual number of trips to the study site.

The frequency of participation model requires special econometric attention due to the nature of the sample. From the perspective of the total population, visitation cannot be negative (trips ≥ 0). When estimating visitation for a sample of users only (as we are in this study), the constraint expands to trips ≥ 1. Regardless of the perspective taken, the observable range of the dependent variable (visitation) would be constrained - negative (or zero) visitation is impossible. The constrained observable range of the dependent variable (referred to as a limited dependent variable), affects the error term about the regression line. By cutting off the left tail of the error term's distribution, we can no longer assume a normally distributed error distribution (see figure 1). With the error term assumptions violated, use of ordinary least squares estimation becomes inappropriate.

Figure 1: Censoring/Truncation Effects



These sample based constrained data ranges can be categorized as either censored or truncated. A censored sample implies the recording of data across the entire observable range. In the case of recreation, a censored sample includes observations from both users and nonusers (trips ≥ 0). A characteristic of a censored sample is that it involves data for each independent variable regardless of the value of the dependent variable (ie. if the dependent variable is zero, we still record data on the independent variables - this allows one to estimate a probability of participation term). A truncated data set implies missing values in the observable data range. Like the censored sample, the truncated sample has an unobservable range, but in addition, the sample is incomplete in that not all the observable range is present. In recreation, truncated samples are associated with on-site surveys. The complete observable range is missing due to the exclusion of nonusers.

The data set used in this study could be considered truncated because it included only charterboat users (trips ≥ 1), nonusers (trips ≥ 0) were not surveyed.

To handle this censoring/truncation characteristic, modelers have used limited dependent variable models (otherwise called sample selection models) - perhpas the most popular being the tobit model.[13] The tobit model can be used with either censored or truncated samples. The traditional censored tobit model with zero lower bound can be modified to provide for any lower bound[14] desired. In our case, the lower bound was adjusted upward to one (trips 1) to reflect our truncated sample (truncated tobit).

Given that our sample was dominated by individuals taking but one trip a year, the tobit model may suffer from problems due to lack of price responsiveness (distorts the consumer surplus estimates). In an attempt to address this problem, a potentially more appropriate estimation procedure (entitled "truncation") was run using our LIMDEP[15] package, unfortunately problems with lack of convergence resulted. The truncated tobit models are therefore presented in the results section.

The tobit model takes into account the restricted range of possible sample responses (censoring/truncation effects) by amplifying the probability of any obsrvation within the realistic range by the cumulative probability representing the additive inverse of the truncated (excluded) portion of the normal range. Using this technique adjusts the probabilities insuring they fall into the realistic range of responses.

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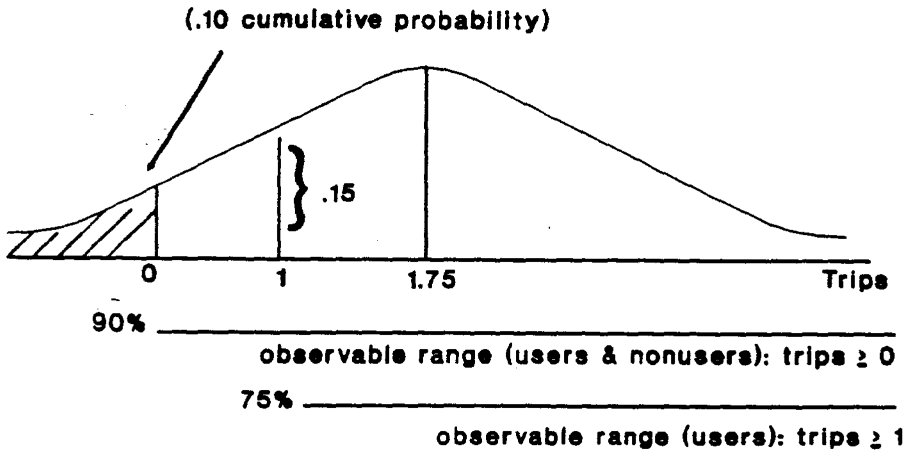
13 According to Arsanjani, et. al. (1987) and Haines, Guilkey, and Popkin (1988), if the probability of participation term requires a different set of independent variables than the frequency of participation term, the Tobit model should not be used (requires use of other limited dependent variable models: e.g. truncated, Heckman). Given our inability to address the probability of participation question, it was felt the Tobit model was adequate.

14 Used with censored samples of the general population (includes both users and nonusers, trips ≥ 0).

15 LIMDEP is an econometrics package designed by William H. Greene of New York University (1985).

Figure 2: Probability Density Function



Noting Figure 2, if the individual's probability of taking one trip[13] is equal to 15%, the tobit model adjusts this probability upward reflecting the limited range of the distribution (if the observation represents 15% of the full range from negative infinity to positive infinity, then it should represent a larger percentage of the more limited range from 0 to positive infinity). The adjustment in this case (based upon a 10% range exclusion: cumulative probability) is .15/(1 - .1) = .167. This censoring/ truncation is more of a problem for samples whose mean number of trips lie close to the vertical axis so the tails of the distribution cross into the negative (see Figure 1).

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13 Individual probabilities are measured by the height of the curve, whereas cumulative probabilities are measured by the area under the curve.

DATABASE

A database derived from a survey of charterboat anglers visiting the harbors of Destin and Panama City,[14] Florida during the late summer and autumn of 1985 was used for model estimation. Despite Arndorfer and Bockstael's (1986) focus on King mackerel regulatory impacts, the database is comprehensive enough (covers multiple species) for application to reef fish.

The majority of our sample took only one trip per year with an average grouper catch rate of 2 to 3 per angler per trip (Table 1).

Inherent Limitations of the Database: The following deficiencies from the perspective of regional fishery management can be noted in this database. These problems were unavoidable given the intent of the study as well as the time and funding limitations (no reflection upon the effort of the original researchers).

1) charterboat angler - A comprehensive analysis should include all parties impacted by the regulation: charter and party boaters, private boaters, shoreline anglers, etc.

2) study area - The database relates exclusively to the Panama City/Destin ports of northwest Florida - to be thorough, the analysis should include all affected sites. For a Gulf of Mexico regulation, this includes all sites along the Gulf plus any sites outside the region but still impacted by a Gulf site (in terms of potential substitution).

Given that this is a site specific study, any attempt to generalize the results to other regions or to the entire Gulf would be ill advised.

3) aggregation - Given that the database reflects data exclusively for site users, it is impossible to determine the aggregate value of a site without an estimate of the number of users (anglers). As noted above under the probability of participation term, without a survey of both users and nonusers, estimates of the user population cannot be made from this data (stems from inability to estimate the probability of participation term in

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14 The sample was conducted at both sites and 75% of the surveys were taken at Destin with the remainder at Panama City.

the overall individual decision making model). This lack of aggregation capability is an important problem associated with the database.

4) weather factors - During the survey period, two hurricanes hit the study region. These adverse weather conditions will likely bias the catch data and results of any models developed from the data.

It is impossible to predict with certainty the direction of the vias due to the conflicting nature of a hurricane on fishing. During the storm, use of the fishery drops to zero but after the storm fishing (catch) improves. Grouper catch improved dramatically after both hurricanes as the fish were pushed inshore. As a result, charterboat bookings increased. However, the hurricanes themselves closed the ports for approximately five weeks, including the normally busy Labor Day weekend.

5) species definition - The species emphasis, for sake of convenience and identification, was based upon a generic classification and not the individual species. For example, one can only consider the impact of

Table 1: STATISTICAL BREAKDOWNS: ANNUAL CHARTERBOAT TRIPS & AVERAGE GROUPER CATCH

Distribution of Annual Charterboat trips

Number	Frequency	Percentage	Cumulative Percentage
1	271	62.4	62.4
2	95	21.9	84.3
3	37	8.5	92.9
4	17	3.9	96.8
5	5	1.2	97.9
6	4	0.9	98.8
7	1	0.2	99.1
10	1	0.2	99.3
11	1	0.2	99.5
20	2	0.5	100.0
	434	100	

Avg. number of annual trips per angler = 1.75 Median = 1.85
Avg. & median number of trips per grouper angler (caught at least one grouper during interviewed trip) = 1.

Distribution of Average Grouper Catch (fishing party)

Range	Frequency	Percentage	Cumulative Percentage
0	139	32.0	32.0
0 - .99	75	17.3	49.3
1 - 1.99	55	12.7	62.0
2 - 2.99	50	11.5	73.5
3 - 3.99	27	6.2	79.7
4 - 4.99	23	5.3	85.0
5 - 5.99	23	5.3	90.3
6 - 6.99	9	2.1	92.4
7 - 7.99	11	2.5	94.9
8 - 8.99	6	1.4	96.3
9 - 9.99	6	1.4	97.7
10 - 10.99	3	0.7	98.4
11 - 11.99	0	0.0	98.4
12 - 12.99	1	0.2	98.6
13 - 13.99	1	0.2	98.8
14 - 14.99	0	0.0	98.8
15 - 15.99	3	0.7	99.5
25	1	0.2	99.8
35	1	0.2	100.0
	434	100	

Average number of grouper caught per angler on the sampled trip (total catch divided by party size) = 2.16 Median = 1

Average number of grouper caught per angler on the sampled trip when fishing party caught at least one grouper = 3.2 Median = 2

GENERAL RECREATION MODEL: VARIABLE DISCUSSION

As illustrated in the Recreational Economic Theory section, the variables normally utilized in recreational demand functions fall into five general categories: price, time, quality, substitutes, and socioeconomics.

The variables included in the demand function depend on whether or not one has flexibility over one's work schedule (see Arndorfer and Bockstael, 1986).

1) Fixed Work Schedule: $C = f(P_c, t_c, Q_c, R\{P_r, t_r, Q_r\}, Y, T_L)$
2) Flexible Work Schedule: $C = f(P_c + OPCOST_c, Q_c, R\{P_r + OPCOST_r, Q_r\}, wT)$

C = number of annual charterboat trips to Panama City/Destin
P_c = price of charterboat trip
t_c = time cost of trip in hours/days
Q_c = quality of the charterboat trip
R = substitute & complementary sites as a function of their prices (P_r), time costs (t_r), and qualities (Q_r)
Y = income
T_L = leisure time (total time minus work time)
$OPCOST_c$ = opportunity cost of time in terms of lost wages for trip to Panama City/Destin
$QPCOST_r$ = opportunity cost of time in terms of lost wages for trips to other sites
wT = total possible income (w = wage, T = total annual time)

Dependent Variable: **Trips:** The travel cost method requires uniformity in the measurement of the dependent variable. Unfortunately, one individual's trip is not identical to all others. The main problem has to do with length. A half day trip is drastically different from a week long trip. This problem can be addressed by distinguishing between trips of varying length through modelling with dummy variables. In our application, only single day trips were studied with a distinction made between half and full day trips.

According to McConnell (1985), an alternative approach to handling this question is to develop a separate function to estimate average trip length. Utilizing this approach would convert the overall focus from trips to some measure of recreation time (e.g. days or hours).

Independent Variables: **Price:** Given that recreational trips are not normally exchanged within a developed market system, a proxy for recreational price must be developed. Even where a market situation does exist (e.g. charterboat fishing industry), the full costs of obtaining the recreational experience are not adequately reflected in the price. In either case, a price term must be constructed.

A number of factors have been included in the formation of a price variable - direct transportation costs; lodging and incremental food expenditures; entrance fees; equipment rental and professional services; opportunity cost of time; travel time costs (disutility); and fixed costs (permits and licenses, etc.).

Direct transportation costs represent the costs required by your mode of transportation in accessing the site (fuel, maintenance & repairs for automotive travel, ticket costs for airline, train, bus, etc.).

Lodging and incremental food costs (in excess of everyday costs) are self-explanatory, however one needs to distinguish between in route and on-site costs (onsite costs are often excluded, see the problem of overnight stay below).

Entrance fees represent access costs for the recreational activity. While entrance fees may or may not vary between individuals on a given day, entrance fees are still often included in the price term. Entrance fees alone normally drastically understate the total costs of the recreation trip, however when the trip involves only minor travel, the entrance fee could be the major price element.

Equipment rental and professional services are incurred on an hourly or daily basis and are therefore should be included since they are directly related to the length of the recreational experience.

The opportunity cost of time relates to the value of the travel and on-site recreational time in its next best alternative[15]. Because individuals do not have an infinite supply of time, time is considered a scarce resource, and therefore has value. How economists value time is a subject of debate. Time could be valued in terms of dollars, alternative activities, or physical units of time. When trip time is converted to dollars, researchers normally combine trip costs into the price term.

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15 Time spent in the area of the recreational site while not recreating is often not converted to opportunity cost. If a trip involves an overnight stay, the entire trip length could be converted to opportunity cost if it was for the exclusive purpose of recreating. This idea is still subject to considerable debate however.

Time Definitions:
Travel - time spent traveling to and from the site.
Onsite - time spent recreating onsite.
Stay - time spent in the area of the recreation site not recreating.

Disutility time costs have also been measured in terms of the possible disutility or dissatisfaction associated with traveling to and from the site. Previous studies have used a disutility value as anywhere between 1/4 and 1/2 of the individual's wage rate (based on studies of commuting time).

Fixed costs (permits, licenses, etc.) are relevant costs for deciding whether or not to begin or continue participation in an activity (Walsh 1986). These costs are not relevant for decisions regarding additional trips to a site.

PROBLEMS: A number of problems arise when one attempts to develop a price term. First and foremost, which of the price factors should be included, and how should they be defined. Theoretically, the marginal cost of obtaining the recreational experience should represent trip price. However, as noted below, determining this marginal cost is no easy task.

An important problem which recreational researchers have yet to resolve is that of the **multiple purpose trip**. Frequently, trips involve multiple objectives - recreation, business, visiting friends, etc. In these cases, the entire cost of the trip cannot be attributed to the recreational purpose. The costs associated with accessing the site (transportation, lodging & meals in route, opportunity costs of travel time, disutility of travel time) should be apportioned among the trips objectives. If these costs cannot be realistically distributed between objectives, use of the travel cost method may be questioned. An often utilized approach is to determine whether recreation was the primary purpose of the trip. If so, an assumption is made that the trip costs are reflective of the recreational objective.

Another problem surfaces when the trip involves **overnight stays** on-site. Should the costs of lodging, meals, and time associated with the stay be included in the price of the recreational trip? Disagreement exists over this question with stay costs frequently left out of the equation. One reason for exclusion is that stay costs vary significantly across individuals with identical lengths of stay - a significant proportion of stay costs are at the discretion of the individual and may be more a function of one's income level as opposed to anything related to the recreational experience (Arndorfer & Bockstael, 1986). The bottom line is that those researchers who decide to leave stay costs out of the function believe that its variation has little to do with the variation in recreational demand.

An **extended stay** in the region creates even more problems for recreational researchers. When an individual vacations in the area for a period of weeks or even months (e.g. "snowbirds"), the problem of excluding stay costs amplifies. For those with extended stays, the stay costs may substantially outweigh the costs of accessing the region, ignoring these costs could severely understate trip costs. Of course, the longer the stay, the more likely a trip would involve multiple purposes and therefore require some sort of cost allocation between objectives. Another irritation involved with extended stay trips is how should one handle transportation and lodging costs incurred in traveling to the site. Obviously one doesn't incur these costs for each trip made to the site during the extended stay, the marginal travel costs reflect only the distance from one's place of lodging in the region to the site - yet the fact remains that without incurring the travel costs to the region, the recreational trips would be impossible. These two areas of multiple purpose trips and extended stay trips cause major problems for researchers, problems which require additional attention from the research community.

The problem of how to handle **time** has received a great deal of effort in the past but has yet to be resolved. To this researcher, the ideas of opportunity cost and disutility cost are separate and distinct concepts, not to be considered as mutually exclusive. It is quite possible that an individual could incur opportunity cost while simultaneously experience travel disutility.

Two methods for valuing time were attempted in this study. The first method (as previously alluded to) involved separating the database into two groups (fixed and flexible) and handling time costs differently for each. The second method made no such distinction, all individuals were valued according to the same overall concept.

> 1) Flexible/Fixed Group Approach - The approach, as applied in this study, separates the database into two groups: a flexible work schedule group and a fixed work schedule group.
>
> The flexible group has complete control over their work time both in terms of the number of hours and working schedule (eg. self-employed). As a result, time spent recreating could conceivably be spent working; therefore the individual is foregoing the option of earning income each time he recreates. This allows researchers to convert recreation time into dollars based upon the individual's average hourly wage rate. Obviously, the opportunity costs derived from this approach assume work is the next best alternative to the charterboat trip (may or may not be true).
>
> Conversely, the inflexible (or fixed) work schedule group does not have such control over their work schedule. These individuals have a set work pattern and must schedule their recreation during non-working hours. In addition, recreational trips are often taken utilizing paid vacation time. As a result, foregone income is not at issue here.
>
> Noting that the fixed group's time costs (opportunity costs) cannot be measured in terms of lost potential income, another measure of time is necessary. This doesn't mean that opportunity costs for this group equals zero, but that these individuals do not incur lost wages. Instead of valuing opportunity costs by working time, we could assign an opportunity cost based upon one's value of leisure time (Walsh 1986).

Determining a value for leisure time is difficult. In practice, researchers have used values ranging from zero to the individual's hourly wage rate. If a value cannot be approximated, a separate time variable based upon the trip time in hours/days may be considered.

2) Across-the-board Valuation Method - Trip time for all individuals is based upon some proportion of the individual hourly wage rate. It is up to the researcher to justify the value selected. An opportunity cost based on the minimum wage rate could be applied to trip time (on-site, travel, and stay time).

Disutility of travel time, as it is normally measured (1/4 to 1/2 of one's hourly wage rate[16] times trip length in hours), may be inappropriate for travel time due to the simple fact that the individual is not commuting. Depending upon how many times the individual has visited the site, the disutility associated with the travel may be less than that of commuting. A study by Morrison and Winston (1985), estimated disutility at six percent of the hourly wage rate. Another problem in estimating disutility is that the disutility cost may not be a constant per hour rate, in a study by Sanders (1985) willingness-to-pay for travel (benefits) decreases with trip time. It is likely that travel disutility costs may conversely increase with travel time. A possible approach to these problems may be to actually ask the individuals their willingness-to-pay to avoid the unpleasant travel time and use that as our disutility measure. Finally, it is possible that a significant proportion of travelers may actually be experiencing pleasure in terms of sightseeing benefits for at least portions of their travel time.[17] Table 2 summarizes the opportunity cost and disutility cost discussion for those with fixed/flexible work schedules.

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16 Based upon a study of work commutes by Cesario (1976).

17 For those experiencing sightseeing benefits, it may be appropriate to determine the benefit value (via a willingness-to-pay question) and balance it off against the disutility costs. Conceivably, one could have utility as opposed to disutility associated with the travel time if sightseeing values exceed disutility costs.

Table 2: **Time Cost Procedures**

Flexible Work Group	Travel Time	On-Site Time	Stay Time
Opportunity Costs (lost wages)	yes	yes	?
Disutility Costs	yes	n/a	n/a
Sightseeing Benefits	yes	n/a	n/a
Inflexible Work Group			
Opportunity Costs (lost wages)	n/a*	n/a*	n/a*
Disutility Costs	yes	n/a	n/a
Sightseeing Benefits	yes	n/a	n/a

*Use a separate time cost variable based upon trip length as opposed to the lost wages concept (no dollar conversion therefore no combination with the price term).

Needless to say, there are a plethora of factors to consider in the determination of a useful price variable in recreational demand estimation. No consensus of opinion has been developed by the research community as to the appropriate construction of the price term.

Time: In addition to the time cost procedures discussed above (discussion represents the right hand side of the time constraints, ie. P_c + $OPCOST_c$ and t_c terms), one also needs to incorporate the total time concept (left hand side of the same constraints).

To reflect the finiteness of time and its impact on charterboat demand for the inflexible work group, one's quantity of leisure time may be included into the demand equation (separate variable). The related concept for the flexible work group is total possible income which converts total time into income.

The problem with the setup of the time constraint in inflexible work schedule equation is that it assumes leisure time is available on a continuum. Leisure time is available in spurts, what is critical is the amount of uninterrupted leisure time. The time constraint could be used to determine the number of potentially schedulable trips per year given the individual's distribution of leisure time (in hours per day, days and weeks) as well as the individual's average trip length (includes travel, onsite, and stay time). The number of potentially schedulable trips would represent an upper bound for actual visitation.

Quality:

SITE QUALITY: The quality of the recreational site often plays an important role in influencing recreational demand. As with any good or service, as quality increases (ceteris paribus), the demand for recreational trips would also be expected to increase (positive relationship).

The problem with the quality variable is that it is very difficult to define. Catch rates are normally used as a quality variable in recreational fisheries demand modelling. However, defining quality purely in terms of catch rates could be overly simplistic. Other catch oriented factors should also be considered, e.g. the size and weight of the fish caught as well as the preference for the species caught. The point here is that sheer numbers of fish caught may not be the most important factor in determining demand. Individuals may prefer one large fish to several small fish or one highly desirable fish to several less desirable ones.[18]

Another distinction which could be made in the development of quality variables is the difference between catch and keep. Pure catch rates may be more representative of the quality of the site given that they represent the total catch for the average individual across all species. Keep rates obviously only represent quantity kept and ignore any released fish. To the extent that catch exceeds keep, any analysis that focuses only upon keep will understate the total quality of the site (misses value derived via catch and release).

In terms of governmental regulatory action, keep rates are the relevant quality index, not catch rates (may still catch the same number of fish, simply allowed to keep less). One must recall that bag and size limits do not impact the catch and release mortality problem. From a modeling perspective, to reflect regulations as impacting catch rates would overstate their influence. A potentially useful approach would be to include both catch and keep rate quality variables in the demand model. Despite the reasonableness of this suggestion, the approach may be impractical should the difference between the two variables be slight (multicollinearity would result). In such a case, only one of the two measures should be utilized, the objective of the study should indicate which to use.

A final note on the development of catch and/or keep rate based quality variables pertains to the impact of time. Given the variability in length of trip between observations, catch rates not converted to a common time frame cannot be compared.[19] However, in order to analyze the impact of a regulation, researchers must focus in on the trip or perhaps the recreation day.[20] A logical time period for comparison could be keep rates per hour or per fixed length day, unfortunately bag limits are not set up

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18 Desirability between species could be based on a number of factors, e.g. taste and propensity for fighting.

19 Only comparable if the models are separated by length of trip.

20 Bag and size limits are on a per trip basis.

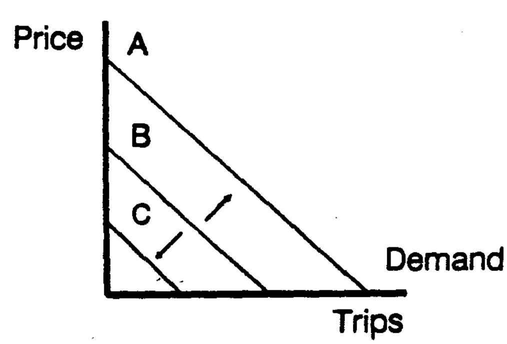
in this fashion. Should the data allow (enough divergence between catch and keep), catch variables could be developed based upon a common time frame whereas keep rates could be based on a per trip concept.

Other quality factors related to the recreational site may also affect recreational demand. Two possible areas for consideration include environmental quality and developmental quality. Environmental quality reflects the natural and man induced influences upon the environment. Such things as weather, visual beauty, pollution would fall into this element. Development quality reflects man-made improvements: number of boat slips, number of boat launches, piers/docks, channel dredging, etc.

TRIP QUALITY: A possible trip quality factor could be the degree of social interaction. The logic here is that as social interaction increases, trip satisfaction is likely to increase. Anything that contributes to trip satisfaction could contribute to increasing frequency of visitation. From a behavioral perspective, despite the fact that trip quality factors may have nothing to do with the recreational activity, they still contribute to the overall trip experience and by so doing, may impact demand.

Substitution: Substitution relates to the impact of choice options within the individual's selection process. The concept implies as the number of options increase, the tendency to distribute demand between them also tends to increase. In other words, when focusing on the demand for good A, an increase in the number and/or quality of substitutes is likely to attract some demand away from A. Conversely, as the price of a substitute rises, the demand for good A is also likely to rise (see Figure 3).

Figure 3: Substitution Shifts (Study Site)



A = Shift in Demand at Study Site due to an increase in substitute site price

B = Current Demand at Study Site

C = Shift in Demand at Study Site due to an increase in substitute site quality

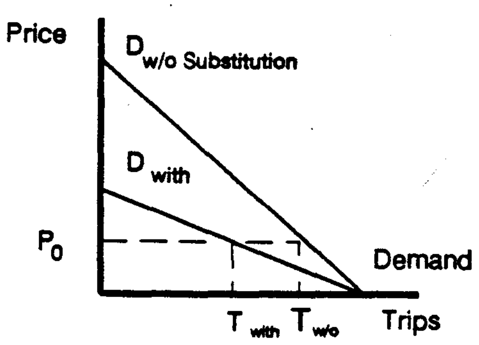
In recreational fisheries, substitution falls into four general areas: activity substitution, site substitution, species substitution, and mode substitution.

1) ACTIVITY SUBSTITUTION relates to the potential for substituting into or out of the fishing activity. The objective is to estimate how participation decisions (ie. number of users) may change as a result of management actions.

Activity substitution can be handled via the probability of participation term. This model indicates the probability that an individual will participate in the recreational activity given such factors as distance to nearest site, quality of site, the quantity and quality of substitute recreational activities, etc.

2) SITE SUBSTITUTION reflects the distribution of demand between sites normally as a result of price/quality relationships. When the study is site specific, the incorporation of substitute sites often results in reduced demand and consumer surplus at the study site. Conversely, excluding site substitutes would ignore this effect thereby overestimating site demand and consumer surplus (see Figure 4).

Figure 4: Modelling With & Without Substitution



Site substitution has been the focus of most attempts at modeling substitution. Within single site models, site substitution could be considered by the development of a single variable. The variable should be based upon the ratio of site quality to distance (e.g. catch rate per mile), summed across all influential sites. Two procedures have been used to select influential sites: all sites within a given radius of the study site or all competitive sites (any site with a quality/distance ratio that of the study site).

3) MODAL SUBSTITUTION involves movement between fishing modes: shoreline; man-made structures (bridges, piers); private boat; charterboat/partyboat. Since modal substitution involves shifts between modes on-site and regulations are site encompassing, it is unlikely that recreationally based regulatory actions would cause severe modal shifts. The only possibility for a modal shift due to a site wide regulation would be if a less expensive fishing mode becomes relatively more desirable because of convergence in keep rates with more expensive modes. For example, suppose the average keep rate for fish A was ten before the bag limit via the charterboat mode, and the keep rate for A was 2 via shoreline mode. If a bag limit is set at 4, people may switch to the shoreline mode given its lower cost and only slightly lower keep rate.

In a single site model, site substitution could be represented by separate variables and modal substitution by separate models (one for each mode). Little has been done by way of estimating modal shifts within the context of a single-site model, perhaps variables could be developed representing the catch rates of alternative modes (similar to site substitution variables reflecting catch rates of different sites). Alternatively, discrete choice models could also be designed for a single site.

4) SPECIES SUBSTITUTION implies changing the target species at the same site. Depending on how we define the trip in our model (single or multiple species), the expected sign on our species substitution variable could be either positive or negative.

Species substitution has not received a lot of attention in the recreational literature. However, it does appear that the quality variable may simultaneously be reflecting species substitutional effects.

Table 3: Substitution Variables

Single Site Multiple Species Trips	Study Site Demand Relationship
Quality Variables:	
Catch on All Species	+
Keep Rate on Regulated Species	+
Species Substitution Variable:	
Keep Rate on All Nonregulated Species*	+
Site Substitution Variable:	
Catch Rate on All Species at Other Sites	-
Single Site Single Species Trips	
Quality Variables:	
Catch Rate on Target Species	+
Keep Rate on Target Species	+
Species Substitution Variables:	
Keep Rate on All Nontarget Species*	-
Site Substitution Variable:	
Catch Rate of Target at Other Sites	-

* Technically, this variable could be construed as both a species substitution and site quality variable.

If the dependent variable is designed to represent multiple species trips, the species substitution variable is likely to have a positive relationship with visitation in the long run. For example, if a bag limit was imposed on grouper, this would be expected to create a decrease in fishing demand. However, if a number of close species substitutes exist on-site, individuals may switch to other species instead of changing sites, the decrease in demand due to the constraint on grouper may be negligible (species substitution counteracts the impact of the bag limit).

If the dependent variable was designed only to represent trips targeting a specific species on-site (e.g. grouper), the effect of species substitutes would be much different. Any trips taken to the site which do not target grouper would be ignored in this analysis. The presents of species substitutes would actually amplify the detrimental affects of any bag limit regulation as compared to the previous case where species substitution softened the blow. The amplification is due to the relative increase in catch rates of the nonregulated species due to the bag limit. With a bag limit on grouper, the catch of other reef fish becomes more desirable on a relative basis leading to the targeting of other species.

Socioeconomics: Socioeconomics is a catchall category for all those characteristics specific to the individual. Such facors as age, sex, ethnic background, education, occupation, income, years of experience, etc. may play a role in influencing demand. These factors are incorporated within a demand function to try and model tastes and preferences of various social groups.

RECREATION MODEL FOR REEF FISH STUDY: VARIABLE DISCUSSION

I. VARIABLE CONSTRUCTION: Initial (Theoretical) Model
The following discussion presents the initial models attempted based on the variables presented in the theoretical discussion section entitled "Recreational Economic Theory". Initially, the database was separated according to individuals with fixed and flexible work schedules and separate models were run.

A. Fixed (Inflexible) Work Schedule Group: This group consists of those individuals unable to convert recreation time into lost wages due to their inflexible work schedules. In the database, this group represents 308 of 434 observations or 71 percent.

Recalling the theoretical section, the demand for charterboat trips (C) for this group can be represented as follows:

$$C = f(P_c, t_c, T_L, Q_c, R\{P_r, t_r, Q_r\}, Y)$$

C = Annual Number of Charterboat Trips to Panama City/Destin
P_c = Price of Charterboat Trip
t_c = Time Cost of Charterboat Trip in Hours/Days (not dollars)
T_L = Annual Leisure Time (Total Time - Work Time)
Q_c = Quality of the Charterboat Trip
R = Annual Number of Charterboat Trips to Other Sites
P_r = Price of Charterboat Trip to Other Sites
t_r = Time Cost of Charterboat Trips to Other Sites in Hours/Days
Q_r = Quality of Charterboat Trip to Other Sites
Y = Annual Income

Utilizing the charterboat database, the above variables were specifically constructed according to the following concepts.

Dependent Variable (CTYTRP) = Annual number of Charterboat Trips to Panama City/Destin.[22]

Independent Variables: Price of Charterboat Trip (ADPRICE5[23]) = Round-trip travel cost + charterboat fee + stay costs. Round-trip travel cost was derived by doubling the one-way travel cost figure obtained in the survey. Charterboat fees were

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22 Semi and Double log functional forms were tried without success.

23 Variable name in the demand equation.

derived by multiplying $50 (standard rate per hour at the time according to Arndorfer and Bockstael 1986) times the on-site time (in hours). Stay costs were obtained directly from a survey question - represents food, lodging, etc.

Time Cost of Charterboat Trip in Hours/Days (TRIPTIM2) = Round-trip travel time + stay time. Stay time reflects time in the region both recreating and not recreating. This variable represents the time cost (opportunity cost) concept, time not converted into dollars.

Leisure Time (FREETIME) = Used leisure time per week (total hours per week minus working hours) as a proxy for total leisure time per year. No way of estimating schedulable number of trips from the database.

Quality of Charterboat Trip (LCATPR, LKGPR, LKSPR, LREEFPR, LOTHERPR, SOCIALQ) - These six variables reflect catch rates, keep rates, and social quality.

> **LCATPR** = Log of preference rate adjusted catch rate summed across all species caught on the trip by that individual.[24] Log is used to represent the diminishing marginal utility associated with each additional fish caught on the trip. A preference rate was developed based on a study by Johnson and Griffith (1985) and was used to reflect a possible measure of the utility represented by different species.
>
> Johnson & Griffith (1985) developed multiple scaling diagrams (four quadrant diagram) where various species of fish were listed according to edibility and fight. A continuum from high to low edibility and fight was developed based upon samples of fishermen in the southeast. These diagrams were used to develop and overall edibility/fight ranking.
>
> **LKGPR** - Log of preference rate adjusted keep rate on the grouper species.
>
> **LKSPR** - Log of preference rate adjusted keep rate on the snapper species.
>
> **LREEFPR** - Log of preference rate adjusted keep rate on reef fish surveyed other than grouper and snapper (includes amberjack, triggerfish, and barracuda).

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24 Technically, this is based on the average individual in the party since the catch of the party was divided by the number of angling members.

LOTHERPR - Log of preference rate adjusted keep rate on all nonreef fish surveyed (includes king mackerel, shark, drum, tuna & marlin, seatrout & seabass, billfish, bonito, croaker, bluefish, cobia, dolphinfish, flounder, catfish, spanish mackerel, wahoo).

SOCIALQ - Based on the response to the trip party question (traveling with friends, family, business associates, acquaintances, or alone), a social interaction variable was tested. The trip party responses were ranked 0 for alone, 1 for acquaintances, 2 for business associates, and 3 for family and friends. A variable was developed by multiplying party size by social rank.

Substitution: Activity: No information was available for estimation of the probability of participation model.

Site: Annual Number of Charterboat Trips to Other Sites = N/A. No information was available within the database as to the usage of alternative sites. As a result, no site substitution effects could be modelled.

Species: Species substitution is incorporated into the catch quality variables.

Modal: No data available.

Socioeconomics: Annual Income (INC) = A survey question was asked whereby annual income was provided in terms of ranges. INC variable was constructed as the midpoint of the indicated income range (or the lower bound for the highest boundless income range).

Experience: This variable (EXPERF) reflects the number of years the individual has been using charterboats. The idea is that experience may relate to the degree of interest or avidity in charterboat fishing. In addition, there may be some relationship between the level of experience and the individual's catch or keep rates (the correlation between these variables was slight).

Estimation Results: Fixed Work Schedule Group Dependent Variable: CTYTRP

Independent Variables:	Coefficient	T-ratio	Significance Level
CONSTANT	2.24	2.81	.005
ADPRICE5	-.00006	-.527	.60
TRIPTIM2	.00046	.317	.75
FREETIME	-.60	-1.23	.22
LCATPR	.0081	.1	.92
LKGPR	.0336	.803	.42
LKSPR	-.015	-.331	.74
LREEFPR	.0098	.237	.81
LOTHERPR	-.0047	-.105	.92
SOCIALQ	-.006	-.684	.49
INC	.00001	.195	.85
EXPERF	.034	3.390	.001

Chi Squared Log-Likelihood Ratio: 15.26
Significance: .17
Pseudo R^2 = .047[25]

Estimation Approach: Tobit

B. **Flexible Work Schedule Group:** This group consists of those individuals able to convert recreation time into money given their flexible work schedules. This group represents 126 of 434 observations or 29 percent.

Recalling the theoretical section, the demand for charterboat trips (C) for this group can be represented as follows:

$C = f(P_c + OPCOST_c, Q_c, R\{P_r + OPCOST_r, Q_r\}, wT)$
C = Annual Number of Charterboat Trips to Panama City/Destin
P_c = Price of Charterboat Trip
$OPCOST_c$ = Opportunity Cost of Trip Time to Panama City/Destin in terms of Lost Wages, trip time reflects travel plus stay time
Q_c = Quality of the Charterboat Trip
R = Annual Number of Charterboat Trips to Other Sites
P_r = Price of Charterboat Trip to Other Sites
$OPCOST_r$ = Opportunity Cost of Trip Time to Other Sites in terms of Lost Wages, trip time reflects travel plus stay time
Q_r = Quality of Charterboat Trip to Other Sites
wT = Total Possible Annual Income

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25 See end of Table 5 for explanation of the formula.

Utilizing the charterboat database, the above variables were specifically constructed according to the following concepts.

Dependent Variable (CTYTRP) = Annual number of Charterboat Trips to Panama City/Destin.

Independent Variables:

Price of Charterboat Trip + $OPCOST_c$ (PRICE9) = Round-trip travel cost + stay cost + charterboat fee + opportunity cost in dollars. Same as ADPRICE5 with the addition of opportunity cost. Opportunity cost is simply trip time (round-trip travel time plus stay time) multiplied by one's flexible hourly wage rate. These components are summed into one variable.

Quality of the Charterboat Trip (LCATPR, LKGPR, LKSPR, LREEFPR, LOTHERPR, SOCIALQ) - same as fixed equation.

Substitution: Same as fixed equation.

Socioeconomics: Total Possible Annual Income (TOTINC) = Total hours per year (8760) times flexible wage rate. This term combines into one variable both the time and income constraints.

Estimation Results: Flexible Work Schedule Group

Dependent Variable: CTYTRP

Independent Variables:	Coefficient	T-ratio	Significance Level
CONSTANT	2.69	3.049	.002
PRICE9	.00035	1.46	.144
LCATPR	-.0774	-.401	.69
LKGPR	.193	1.702	.089
LKSPR	-.126	-1.148	.25
LREEFPR	.161	1.665	.096
LOTHERPR	.122	1.182	.237
SOCIALQ	.025	1.098	.272
TOTINC	-.000001	-1.094	.274
EXPERF	.0382	1.781	.075

Chi Squared Log-Likelihood Ratio: 12.26
Significance: .20
Pseudo R^2 = .088

Estimation Approach: Tobit

As is apparent from these results, neither the fixed or flexible work schedule initial models proved useful in terms of variable significance or overall significance. As a result, alternative variable definitions were attempted with the final model presented in the next section.

II. VARIABLE CONSTRUCTION: Final Model

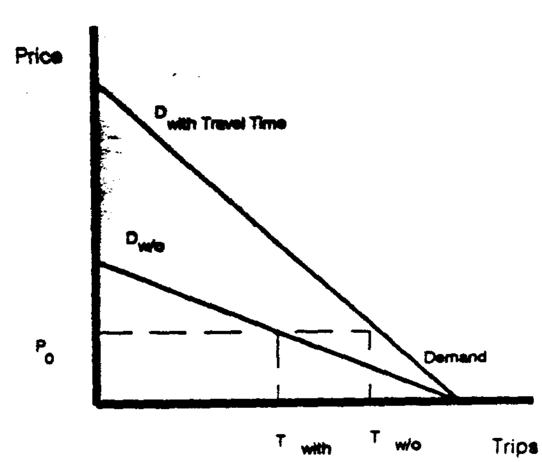
This section discusses the variables used in the final models, for a discussion of the options attempted prior to selection of the final models, see appendix E.

Price: Development of the price variable (MILEADJ) proved difficult. Numerous options were pursued with the final choice based upon variable significance. The simplistic MILEADJ variable was calculated from round-trip travel miles converted to dollars at $0.20 a mile. These distance costs were tested at two extremes: first, where costs were assumed incurred by one individual and second, where costs were divided equally among party members. In each case, the single individual allocation approach proved to be of greater significance and was therefore used throughout.

Time: Time costs were considered for both flexible and inflexible work schedule groups. An opportunity cost concept for those able to work during the charterboat trip (FLEX = 1) was calculated but proved insignificant. The time cost variable (TRIP-TIM1) was developed for those with fixed work schedules (since they couldn't convert time to opportunity costs), the variable represents the round-trip travel time plus charterboat trip length.

The TRIPTIM1 variable proved significant for the fixed group in most models but the wages based opportunity cost for the flexible group did not. Given the time costs concept worked for only one of the groups, it was decided to drop time costs from the final model. The effect of dropping time costs is to make the demand curve more elastic (less steep), thereby reducing demand and consumer surplus estimates (the demand curve pivot works in the opposite direction of the pivot created by exclusion of site substitution - see Figure 5).

Figure 5: Modelling with and without Time Costs



Quality: Keep rates were considered for each reef fish species contained in the database: grouper, snapper, amberjack, triggerfish, and barracuda. An additional keep rate index was included for all other fish in the database (king mackerel, shark, drum, tuna & marlin, seatrout & seabass, billfish, bonito, croaker, bluefish, cobia, dolphin-fish, flounder, catfish, spanish mackerel, wahoo). In the final model, amberjack, triggerfish, and barracuda were grouped into one variable due to the dominance of groupers and snappers in the reef fishery.

Substitution: Data was unavailable for developing variables for site substitution (needed are the relative quality and access costs of alternative sites).

Arndorfer/Bockstael (1986) note that the dominant harbor used by those surveyed were Panama City and Destin. No Atlantic coast sites appeared as major substitutes. Orange Beach, AL and Key West, FL were the next most likely harbors to be used. This is an expected result due to the generally low annual charterboat usage. To imply that Panama City and Destin have no site substitutes is premature because the sample doesn't involve anyone who didn't visit these sites.

Species substitution is incorporated by including keep rate information on species other than the focal species (grouper). That is, when considering grouper, the catch for other reef and nonreef species was also used in the model.

Activity and modal substitution weren't considered due to lack of information.

Socioeconomics: Three socioeconomic variables were tested in this study: age, income, and experience. Only experience showed significant impact upon visitation.

MODELING RESULTS FOR REEF FISH STUDY

As noted in previous discussion, differences between groups of individuals within the database may be expected. Four areas of possible differentiation were considered in this study: work schedules, charterboat trip length, income, and main trip purpose. To try an identify possible variations among individuals, use was made of dummy variables. Each of these areas have at least two possible scenarios:

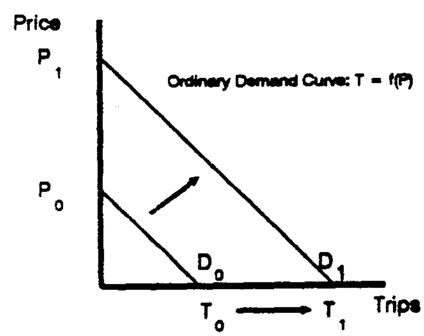
	Scenarios (possible groups)
work schedules	flexible or inflexible
trip length	half day or full day
income	low/middle or high
purpose	charterboat, extended stay, business

EXPLANATION DUMMY VARIABLE MODELS: Incorporation of dummy variables utilizes the full data set (as opposed to a sorted data subset) and involves including binary dummy variables to represent the effect of different subgroups (comparisons are made between the focal group and the nonfocal group(s)[26]). In addition to modeling each dummy variable concept separately, a model was run to reflect the impact of all dummies simultaneously. Should any of the dummy variables prove significant, this indicates that there is indeed a difference between the behavior of that subgroup compared to the nonfocal group.

Graphically, dummy variables attempt to determine if a specific subgroup creates a shift and/or pivot of the demand curve. Parallel shifts in the demand curve are illustrated by an intercept dummy variable which indicates movement of the intercept without a change in slope (see Figure 6). These intercept dummies are developed simply by converting the focal scenario into a binary variable (1 if the situation is present, 0 if not) and including it in the model.

Figure 6:

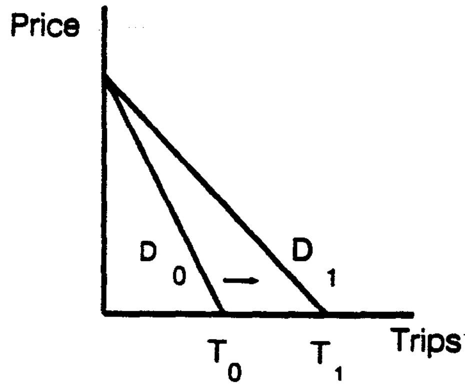
Demand Curve Shift via Intercept Dummy Variable



26 For example: Designing a dummy to represent the extended stay scenario compares the behavior of individuals with extended stays (focus group) to individuals without extended stays (nonfocus group).

Figure 7: Pivoting Demand Curve via Slope Dummy Variables

Slope dummies conversely represent a change in the slope of the demand curve without changing the intercept. To reflect this situation, a multiplicative dummy is required. The above dummy variable is multiplied by the slope variable. In ordinary demand curve analysis (used in this study) Quantity of Trips = f(price), therefore the dummy variable is multiplied by price resulting in a pivoting effect on the vertical axis (see figure 7).



(Ordinary Demand Curve)

Figure 8: Combined Dummy Shift and Pivot Effects

In the current study, both shift (intercept) and pivot (slope) dummy variables were used simultaneously on an ordinary demand curve to allow for both effects (see figure 8). This approach is somewhat simplistic in that the slope dummy could also be set up for each variable in the model (not only the price term). Of course, that would considerably increase the number of independent variables in our models.

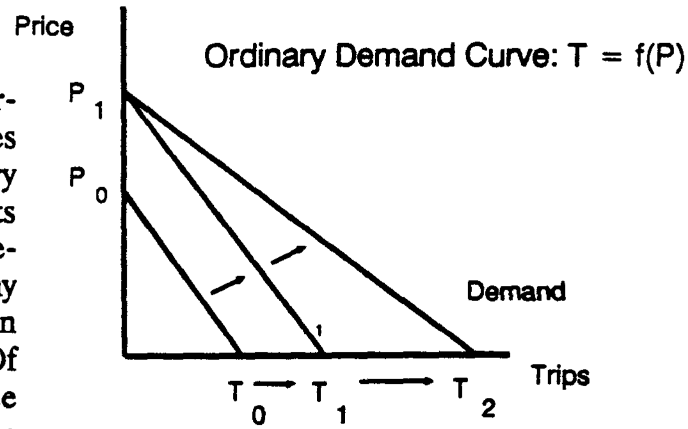


Table 4: Dummy Variable Scenarios

Area	Scenarios	Intercept Dummy	Dummy Representation
Work Schedules	Flexible, Inflexible	FLEX	Flexible schedule
Trip Length	Half Day Trip Full Day Trip	DUMTRP	1/2 Day, ≤ 6 hrs.
Income	High Low/Middle	DUMINC	Income ≤ 50K (Household)
Purpose	Business Extended Stay Charterboat	DUMBUS DUMEXT	Business Trips Extended Trips

Note: slope dummy = price times the binary dummy (variable names: PFLEX, PDUMTRP, PDUMINC, PDUMBUS, and PDUMEXT).

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TABLE 5: DEMAND MODELS (Dependent Variable = Number of Charterboat Trips per Year to site)

MODEL	CONST	MILEADJ	EXPERF	KEEPG	KEEPS	REEF	OTHER	INT. DUMMY	SLOPE DUMMY	Likelihood Ratio (Chi Squared)	Pseudo R^2
	|—— EXPLANATORY VARIABLES ——										
1) FULL	1.66	-0.0022	0.032	0.077	-0.012	-0.007	0.015				
(T-STAT)	(9.16)	(-2.735)	(3.30)	(3.145)	(-.653)	(-.333)	(.334)			31.40	.07
(SIGNIF)	(.000)	(.006)	(.001)	(.002)	(.51)	(.74)	(.74)			(.00)	
								FLEX	PFLEX		
2) FULLDUM	1.64	-0.0025	0.031	0.073	-0.013	-0.004	0.026	0.712	-0.002		
(T-STAT)	(5.08)	(-1.372)	(3.20)	(2.90)	(-.646)	(-.212)	(.569)	(2.11)	(-.884)		
(SIGNIF)	(.000)	(.17)	(.001)	(0.004)	(0.52)	(.83)	(.60)	(.035)	(.38)		
FULLDUM Continued --->		DUMTRP	PDUMTRP	DUMINC	PDUMINC	DUMBUS	PDUMBUS	DUMEXT	PDUMEXT		
		-0.653	.0028	.016	-.0009	.39	-.0003	.066	-.00002		
(T-STAT)		(-2.056)	(1.61)	(.054)	(-.52)	(.610)	(-.056)	(.150)	(-.010)	45.14	.09
(SIGNIF)		(.04)	(.11)	(.96)	(.60)	(.54)	(.96)	(.88)	(.99)	(.00)	
	CONST	MILEADJ	EXPERF	KEEPG	KEEPS	REEF	OTHER	FLEX	PFLEX		
3) FLEXDUM	1.46	-0.0016	0.0303	0.079	-0.014	-0.005	0.0126	0.719	-0.002		
(T-STAT)	(7.41)	(-1.847)	(3.175)	(3.193)	(-.749)	(-.257)	(.285)	(2.23)	(-1.03)	38.68	.08
(SIGNIF)	(.00)	(.065)	(.002)	(.001)	(.45)	(.80)	(.78)	(.026)	(.30)	(.00)	
								DUMTRP	PDUMTRP		
4) TRPDUM	1.88	-0.0037	0.032	0.077	-0.012	-0.005	0.025	-0.576	0.003		
(T-STAT)	(8.90)	(-3.11)	(3.39)	(3.12)	(-.632)	(-.245)	(.560)	(-1.90)	(1.84)	35.3	.08
(SIGNIF)	(.00)	(.002)	(.001)	(.002)	(.53)	(.81)	(.58)	(.06)	(.07)	(.00)	
								DUMINC	PDUMINC		
5) INCDUM	1.69	-.0018	.031	.076	-.013	-.005	.015	-.021	-.0007		
(T-STAT)	(6.52)	(-1.46)	(3.19)	(3.09)	(-.659)	(-.255)	(.345)	(-.074)	(-.459)	37.2	.07
(SIGNIF)	(.00)	(.14)	(.001)	(.002)	0.51	(.80)	(.73)	(.94)	(.65)	(.00)	
								DUMBUS	PDUMBUS		
6) PURPDUM	1.67	-.002	.032	.076	-.012	-.008	.017	.477	-.001		
(T-STAT)	(8.43)	(-2.47)	(3.35)	(3.08)	(-.604)	(-.398)	(.392)	(.741)	(-.258)		
(SIGNIF)	(.00)	(.014)	(.001)	(.002)	(.55)	(.69)	(.70)	(.46)	(.80)		
								DUMEXT	PDUMEXT		
								-.279	.001		
(T-STAT)								(-.668)	(.709)	33.36	.07
(SIGNIF)								(.50)	(.48)	(.00)	

Note: 1) Chi Squared: In maximum likelihood estimation, the log likelihood statistic (χ^2) tests the overall goodness-of-fit of the model, analogous to the F-statistic in OLS estimation.

2) Pseudo R Squared: Based on the ratio: c/c + N (where c = chi squared statistic and N = number of observations) as presented in Aldrich and Nelson (1984).

MODELING RESULTS: (Table 5)

Model 1.FULL

The FULL database model (1) utilized all 434 observations (as opposed to initial sorted models) and provided fairly useful results. Three of the six explanatory variables (price, experience, and grouper keep rate[27]) proved significant at the 1% level or better.

Comparisons were made between the FULL model and the dummy variable models (FULLDUM, FLEXDUM,TRPDUM,MINCDUM, and PURPDUM) to determine if the dummy combinations improved the overall model. None of the dummy variable models proved significantly different from the FULL model in terms of each model's overall significance (compared likelihood values via a log-likelihood ratio). Based upon these results, it was decided to use the FULL model for subsequent visitation and consumer surplus estimation.

Model 2:FULLDUM

The FULLDUM model expands upon the FULL model via the incorporation of dummy variables. The model not only utilizes dummies, it utilizes all of the dummies simultaneously. The objective was to incorporate possible interactive effects between the dummy variables.

The results of the model proved mixed. When compared to the FULL model, the price (MILEADJ) variable unfortunately became insignificant. However, two of the dummies (FLEX and DUMTRP) proved significant at the 10% level. This indicates there is a significant difference between the fixed and flexible work schedule groups as well as between the half and full day trip groups. In both cases, the difference shows up in the intercept term indicating shifting as opposed to pivoting demand curves.

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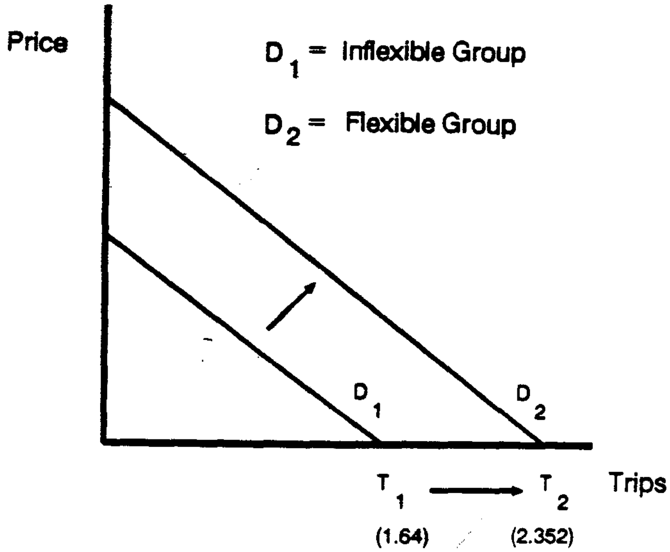
27 The relatively poor performance of the catch/keep rate variables (other than Keepg) throughout the models to some extent may be the result of the type of survey. Intercept surveys were conducted on-site - they reflect but one trip. Should the individual take multiple trips per year (not a major problem in this database), it is possible the catch/keep rates associated with the interview trip may not be reflective (i.e. catch/keep rates may vary across trips).

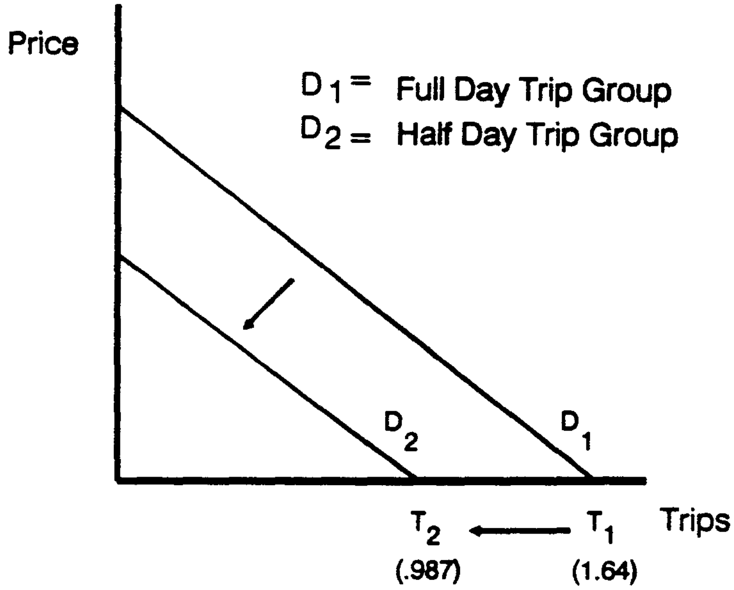
Figure 9: Demand Curve Shift (Flexible Group)



Specifically, for those with flexible schedules (FLEX = 1), we would expect the intercept (and therefore demand) to be .712 higher than the inflexible group (see Figure 9).

Figure 10: Demand Curve Shift (Half Day Trip Group)

Conversely, for those taking half day trips (DUMTRP = 1), we would expect the intercept (and therefore demand) to be .653 lower than for the full day trip group (see Figure 10).



Model 3: FLEXDUM

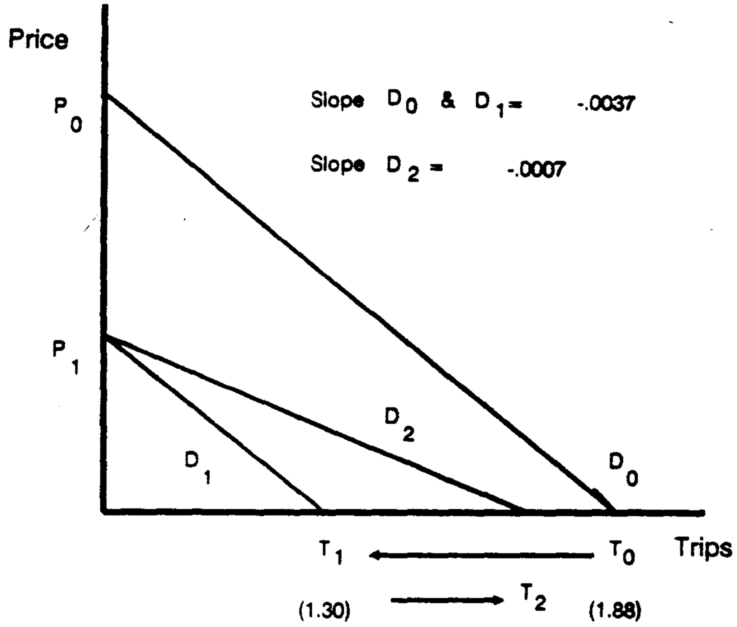
In addition to running the FULLDUM model to allow for interaction between the dummy variables, separate models were also run with each dummy variable combination to see if the lack of interaction had an effect.

The results of the dummied work schedule model (FLEXDUM) were interesting. Four of eight explanatory variables proved significant at the 10% level (Mileadj, Experf, Keepg, and Flex). The FLEX dummy indicates with 97% confidence that there is a difference between the flexible and inflexible groups. This difference is reflected through the intercept term which indicates those with flexible work schedules take on average .719 more trips per year compared to those with inflexible work schedules (horizontal intercept increased from 1.46 to 2.18).

Figure 11: Demand Curve Movement in Trip Length Dummy Model

Model 4: TRPDUM

The trip length dummy model (TRPDUM) was the only dummy variable model where both intercept and slope dummies were significant at the 10% level or better. The dummy variable reflects the effect of half day trips. The negative sign on the intercept dummy indicates that the average half day trip individual takes .576 trips less per year than the full day angler. The slope dummy creates an opposite impact by pivoting the demand curve upward (negative effect of price term reduces by .003, see figure 11).



A possible problem with this analysis is that it assumes the individual always takes the same sort of trip across all trips taken during the year. This is also a problem with the trip purpose concept, if the individual varies his/her trip length or trip purpose, this analysis looses its value.[28] Conversely, the work schedule and income areas are less variable than the trip length and purpose areas, it is unlikely these characteristics are likely to change drastically in the short-term (ie. between trips).

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28 This problem of varying trip characteristics is more of a problem when visitation is high (greater probability of variation simply due to the sheer number of trips involved). Given that charterboat visitation is infrequent (average of 1.75 trips annually per angler - see Table 1), variation problem may not be critical.

Model 5: INCDUM

The income dummy model (MINCDUM) was of little use in terms of the significance of the dummy variables.

Model 6: PURPDUM

The purpose dummy model (PURDUM) showed no significant variation between tested purposes (business & extended stay trips) and the charterboat objective.

In terms of fishery management implications, the grouper variable does appear significant in all models. On the other hand, the snapper variable was quite disappointing since it never came close to significance despite the fact that recent studies (Ditton, et. al. 1989) have indicated snapper to be a mainstay of the charterboat industry. Nevertheless, the negative coefficient on the snapper keep variable should not be used in fishery management analysis. For these reasons, evaluation of bag limits was restricted to grouper impacts.

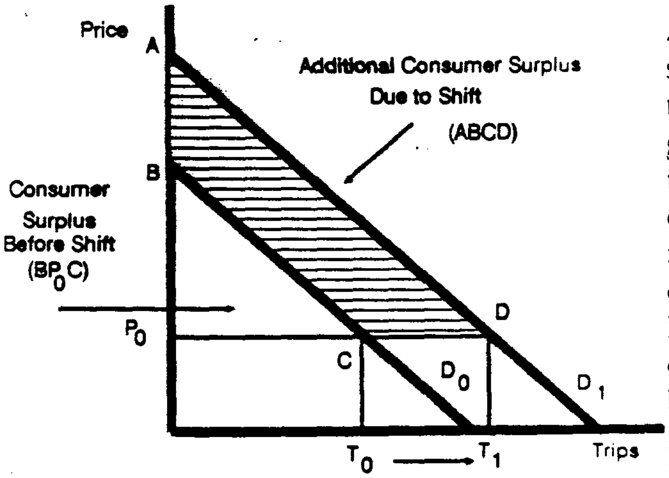
COST-BENEFIT ANALYSIS

An often utilized economic methodology for approaching the problem of whether or not to impose a regulation involves development of a cost benefit analysis (CBA). A comprehensive cost benefit analysis requires estimation of costs and benefits accruing to all relevant parties over the entire life of the project for each and every alternative under consideration. If a project's aggregated discounted benefits exceed its aggregated discounted costs, from an economic perspective it could be accepted. The chosen alternative would be that option whose benefits exceed its costs by the greatest amount. Although the logic seems sound, cost-benefit analyses must be viewed with caution. The cost and especially benefit estimates are often imprecise, they are normally fraught with substantial degrees of error.

This paper deals with the analysis of benefits associated with the imposition of hypothetical bag limits on the charterboat grouper fishery in northwest Florida. The demand curves discussed above, can be used for the development of benefit estimates. The area under the average individual's demand curve represents the maximum willingness-to-pay (WTP) rather than give up the activity (a measure of total benefits). Subtracting trip costs from maximum willingness-to-pay provides an estimate of annual net benefits (otherwise known as consumer surplus). Consumer surplus has been extensively used to indicate the average individual's net value. Aggregating consumer surplus across all individuals (anglers using the site) provides an estimate of the total net benefits of the site. Given we have no information as to the number of anglers at this site, aggregate value estimates cannot be made.

To achieve the goal of estimating the benefit impacts of regulations, we need to construct with and without regulation demand curves. Differences between consumer surplus estimates with and without the regulation indicates the incremental benefits (losses) associated the action (see Figure 12).

Figure 12: Consumer Surplus Estimation: Individual Demand Curve



Another limitation of this study is its short-run nature. Without data as to the likely re-population of the grouper fishery as a result of imposition of a bag limit as well as the likely decline in grouper population without regulatory action (specifically the increases and decreases in catch rates), long-run benefits of the regulation cannot be determined. The decline in benefits presented in tables 6 & 7 (see next section) reflect only the short-run impact of the regulation.

VISITATION/VALUATION ESTIMATES IN THE REEF FISH STUDY:

The objectives of studies of this type are to estimate angler demand and changes in demand due to possible regulatory actions. As noted above, demand estimation further allows for calculation of consumer surplus, a measure of angler benefits.

Demand estimates were derived for each individual by plugging appropriate responses from the 434 database observations into the demand function. Estimates of annual consumer surplus by individual for charterboat fishing in the Panama City/Destin area were derived from the following formula (Zellner and Park (1979)[29]):

$$\text{Consumer Surplus} = \frac{x^2}{-2B} \text{ X } \frac{1}{1+t^2}$$

where: x = annual number of charterboat trips
B = coefficient on the price term
t = t-statistic on the price term.

To estimate the impact of bag limits, this study assumes federal regulations are adopted by the states. This allows for estimation of the impacts upon overall charterboat demand in the area, no distinction must be made between trips into state versus federal waters. The bag limit regulations are assumed to be possession oriented and not additive (ie. given a grouper bag limit of 5, an angler cannot keep 5 fish in federal waters and 5 fish in state waters, only allowed to hold 5 at a time in total). Although there are exceptions, states often adhere to federal regulations.

Tables 6 and 7 provide the results of demand (trips) and valuation (consumer surplus) estimates using the "FULL" model discussed above. Table 6 utilizes the entire database and therefore reflects the average charterboat angler. Table 7 is more specific, it utilizes only those observations where the individual or party caught at least one grouper (293 of 434 observations, 68%). It is intended to reflect the impact on charterboat grouper anglers (this definition ignores the possibility of non-target bycatch and unsuccessful targeting).

The idea behind developing the two tables was to determine if the impact on grouper anglers was more severe than the "average" angler. Reviewing the tables indicates that the differences in the two tables was not great, therefore all references to demand and consumer surplus made in this paper refer to the average charterboat angler (table 6). Comparisons to the grouper subsample can easily be made should the reader so desire.

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29 Appropriate for linear demand functions.

Eight estimates of visitation and consumer surplus were run from the "Full" model in each table:

1) Actual - actual visitation & predicted consumer surplus (consumer surplus based on observed visitation)

2) Actual - actual visitation & predicted consumer surplus (consumer surplus based on observed visitation without four outliers - 4 observations excluded due to extremely high visitation levels as compared to the rest of the sample)

3) Predicted - predicted visitation & consumer surplus (consumer surplus based on predicted visitation without catch restrictions)

4) BAG5 - predicted visitation & consumer surplus (consumer surplus based on predicted visitation constrained by a grouper bag limit of 5)

5) BAG2 - predicted visitation & consumer surplus (consumer surplus based on predicted visitation constrained by a grouper bag limit of 2)

6) BAG0 - predicted visitation & consumer surplus (consumer surplus based on predicted visitation constrained by a closure of the grouper fishery)

7) KEEPG+1 - predicted visitation & consumer surplus (consumer surplus based on predicted visitation after an across the board increase of one grouper per individual per trip)

8) KEEPG-1 - predicted visitation & consumer surplus (consumer surplus based on predicted visitation after a decrease of one grouper per individual per trip - lower bound of grouper catch truncated to zero).

BASELINE: The first three estimation scenarios represent annual angler demand and value for charterboat fishing as of 1985. The wide divergences between both mean and median estimates are reflective of the range of visitation characteristic of the actual and predicted scenarios.

The actual scenarios use observed annual trips in calculating consumer surplus. The observed sample has a few extreme responses (4 observations with number of trips in excess of 10, see table 1) which can greatly affect the estimates of consumer surplus. Note how the average consumer surplus declines dramatically when the 4 outlying observations are excluded (scenario 1 to scenario 2: mean consumer surplus drops from $167 to $103). The outlier adjusted consumer surplus estimates begins to approach that of our predicted model ($90).

TABLE 6: Visitation & Consumer Surplus Estimation (Average Individual)

Scenarios	Annual Trips Average	Annual Trips Median	Annual Consumer Surplus ($) Average	Annual Consumer Surplus ($) Median
ACTUAL	1.756	1	167	28
STD DEV	1.717		786	
95% Confidence Interval	0 -- 5.19		0 -- 1739	
ACTUAL	1.63	1	103	28
STD DEV	1.028		160	
95% Confidence Interval (w/o 4 outlyers)	0 -- 3.69		0 -- 423	
PREDICTED	1.756	1.69 *	90	78
STD DEV	0.453		49	
95% Confidence Interval	.85 -- 2.66		0 -- 188	
BAG5	1.72	1.69	85	77
STD DEV	0.39		37	
95% Confidence Interval	.94 -- 2.5		0 -- 159	
BAG2	1.67	1.63	80	72
STD DEV	0.37		34	
95% Confidence Interval	.93 -- 2.41		12 -- 148	
BAG0	1.59	1.55	73	66
STD DEV	0.36		32	
95% Confidence Interval	.87 -- 2.31		9 -- 137	
KEEPG+1	1.833	1.74	100	83
STD DEV	0.55		65	
95% Confidence Interval	.73 -- 2.93		0 -- 230	
KEEPG-1	1.71	1.61	87	71
STD DEV	0.53		60	
95% Confidence Interval	.65 -- 2.77		0 -- 207	

* Model calculates fractional trips because it represents the average individual's visitation.

TABLE: 7 Visitation & Consumer Surplus Estimation (Average Grouper Angler)

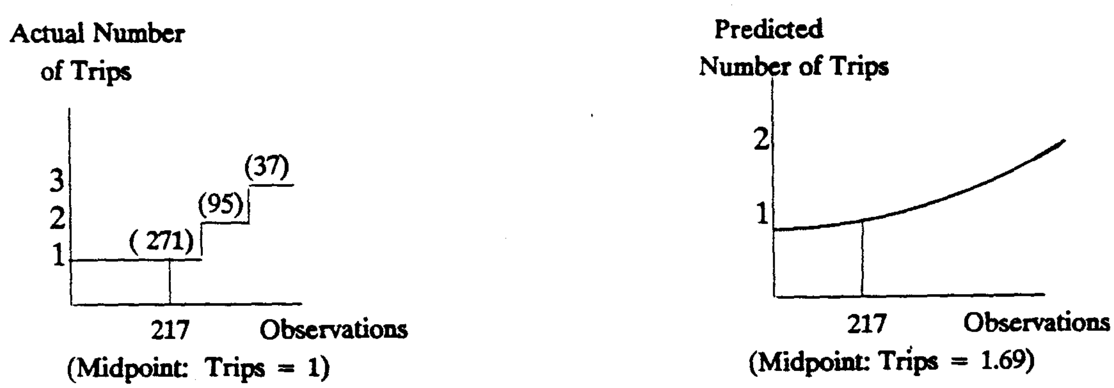
Scenarios	Annual Trips Average	Annual Trips Median	Annual Consumer Surplus ($) Average	Annual Consumer Surplus ($) Median
ACTUAL	1.85	1	197	28
STD DEV	1.91		935	
95% Confidence Interval	0 -- 5.67		0 -- 2067	
ACTUAL	1.7	1	111	28
STD DEV	1.06		163	
95% Confidence Interval (w/o 4 outlyers)	0 -- 3.82		0 -- 437	
PREDICTED	1.84	1.75 *	98	83
STD DEV	0.45		53	
95% Confidence Interval	.94 -- 2.74		0 -- 204	
BAG5	1.79	1.73	91	82
STD DEV	0.37		38	
95% Confidence Interval	1.05 -- 2.53		15 -- 167	
BAG2	1.71	1.66	83	75
STD DEV	0.35		35	
95% Confidence Interval	1.01 -- 2.41		13 -- 153	
BAG0	1.6	1.53	73	64
STD DEV	0.34		32	
95% Confidence Interval	.92 -- 2.28		9 -- 137	
KEEPG + 1	1.92	1.82	106	91
STD DEV	0.45		55	
95% Confidence Interval	1.02 -- 2.82		0 -- 216	
KEEPG-1	1.78	1.67	92	76
STD DEV	0.45		51	
95% Confidence Interval	1.02 -- 2.67		0 -- 194	

* Model calculates fractional trips because it represents the average

Since mean estimates are sensitive to extreme values, median measures of central tendency are often applied. However, a discrepancy between actual and predicted median demand and consumer surplus estimates are also apparent. This is due to the differences between actual and predicted number of annual trips. Unlike actual visitation, the predicted scenario allows for fractional trips. It was decided that fractional estimates were legitimate given that each observation represents the average individual in the fishing party and not a "true" individual's visitation (note: only 4 of 434 observations indicated a party size of 1).

Estimation of fractional trips from the predicted model results in a continuous demand function as opposed to a stepwise function representative of the actual model (see Figure 13). The continuous distribution creates a median trip estimate of 1.69 as opposed to the median estimate of 1 for the stepwise function from the actual data. This divergence in trips accounts for the variation in median consumer surplus estimates from $28 to $78 per year.

Figure 13: Trip Functions



Hypothetical Adjustments to Grouper Keep Rates: Scenarios 4 - 6 present the impacts of varying bag limits from 5, to 2, to zero (closure of the grouper fishery). Using predicted estimates (scenario 3) as the baseline, it appears as if a bag limit of 5 would not be overly constraining.

Recall that our catch rates are not for the individual, but for the average individual in the party. This design would be inappropriate for individual based bag limits - fortunately, charterboat bag limits are imposed differently. Regulations are imposed on charterboats on a per boat basis and not a per individual basis. A boat bag limit of 5 would allow 5 fish per individual per boat, the relevant threshold becomes the individual bag limit times the number of anglers per boat. With this enforcement scheme, the average catch rate concept is a legitimate way of constructing the catch variable for use in analysis of regulations.

With a bag limit set at 2, we begin to see a decline in consumer surplus and visitation. From the scenario 3 baseline, we see a reduction in median trips and consumer surplus (4 and 8% respectively).

Looking at the extreme case of closure of the grouper fishery, we notice a somewhat more perceptible decline in median demand and consumer surplus (8 and 15% respectively).

The final two scenarios (7 & 8) relate to the impacts of a marginal increase and decrease of one grouper per trip. The marginal increase of one fish per trip was experienced by the entire sample but due to the low coefficient value on the catch variable, a one fish increase per trip had little impact. Median trips increased by 3% and median consumer surplus by 6%.

The marginal decrease of one grouper per trip was only experienced by those whose average catch was greater than one. Nevertheless, its impact was slightly more than that of the marginal increase with a 5% negative impact on visitation and a 9% impact on consumer surplus.This scenario proved to be similar to that of the bag limit set at 2.

These results manifest themselves in a low point elasticity of demand for grouper. An elasticity of 0.095 was calculated for the 0 bag limit case (fishery closure). This highly inelastic effect indicates that the keep rate variable has little impact on charterboat demand. This could be the result of a number of factors including: 1) the possibility of species substitution when bag limits are imposed, 2) the importance of other nonkeep rate factors in the demand decision, 3) a poor model in terms of omitted variables. All three of these effects are likely to be occurring simultaneously.

The large and highly significant constant terms in all models dominate the demand estimates (1.81 for the full database model). These models will predict visitation even when keep rate = 0 due to the impact of the constant and other nonkeep variables. Taking the evaluation to the unlikely case of closure of all fisheries, this model would predict individuals would still take an average of 1.6 trips per year without ever keeping a fish. Fishing without the possibility of keeping any fish is illogical;[30] therefore, this model underestimates the impact of zero keep. A better estimate of the loss associated with the fishery closure is the current value of the fishery. This is not to say that the

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30 Illogical yet possible due to the option of pursuing catch and release trips. Note that closing is much different from converting a fishery to catch and release. Closing implies zero visitation and zero recreational fishing mortality. Catch and release implies positive visitation and fishing mortality (mortality often occurs as a result of catch and release activities, often a substantial percentage of quantity caught).

impacts of limited restriction are also understated. Given catch is possible, other noncatch factors will consistently influence demand.

CONCLUSION

Based upon the results of this study, it appears as if imposition of grouper[31] bag limits are unlikely to create major short run negative impacts upon charterboaters in northwestern Florida - either in terms of user demand (trips) or benefits (consumer surplus). Having said this, one must realize that the statement is not made with a great deal of confidence.

Substantial difficulties were experienced in model construction, numerous variables were tested and discarded due to insignificance (high probability of omitted variable bias). A more appropriate truncated estimation procedure was attempted but unfortunately lead to convergence problems - as a result, an adjusted "censored" tobit estimation procedure was utilized. On the other hand, the price and grouper catch rate variables proved highly significant in all models. In addition, the chi squared log likelihood ratio indicated that the all models were also highly significant.

Finally, the database proved problematic in a number of areas. These problem areas are characteristic of many databases - to provide a more complete database would require a great deal of time and funding.

1. **Site Specific**
   - No useful information on other sites, cannot model site substitution.
   - Results of single site models cannot be applied to other sites in the southeast due to area differences.
2. **Charterboat Anglers only**
   - Results can only represent charterboat anglers, they cannot be applied to other fishing modes.
   - Focus on charterboat anglers understates bag limit impacts by ignoring the potential impact upon number of users (need information on users and nonusers)
   - Lack of information on nonusers also creates a aggregation problem, cannot determine visitation or benefits per capita.

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31 Recall variables for other reef fish (snapper, amberjack, triggerfish, barracuda) were constructed but proved insignificant.

3. Weather

- Two hurricanes hit the region during the time period of the study, closing charterboat ports, but also improving fishing afterwards. It is not clear as to the direction of any bias this may create.

4. Generic Species Definition

- Catch rates were defined in terms of generic classification definitions (e.g. snappers and groupers). Fishery management requires consideration of regulations on an individual species basis.

To remedy some of these problems, fishery management studies should be focusing more on regional (multi-site) models. Regional models require data across the entire study area (eg. Gulf and S. Atlantic). The databases must be comprehensive in terms of season, mode and species. The database should also cover both anglers and non-anglers for estimation of probability of participation models (study the impacts of regulations on the number of anglers). Within NMFS, the Marine Recreational Fishery Statistics Survey (MRFSS) provides a likely forum for achieving this end. Any economic improvements to this survey should prove quite useful.

One final point worthy of further discussion is the long term concept. Given the lack of catch data over time, this study necessarily had a short term orientation. Comparisons were made as to the demand impact of current catch rates versus hypothetical bag limit constrained catch rates. A more appropriate long term analysis would consider these comparisons over time. To conduct a long-term analysis, one must compare demand estimates derived from the introduction of the bag limit (with scenario) to demand estimates derived from the status quo or do nothing scenario (baseline or without scenario).

The status quo scenario is based upon catch rates without regulatory action. Catch rates are unlikely to remain constant over time and therefore should be estimated - we require a time path of catch rates. However, this is very difficult to estimate, for as catch rates decline, visitation (effort) may also decline, thereby slowing the decline in catch rates as compared to a constant effort scenario.

Given catch rate time paths, with and without bag limit demand and benefit estimates can be made over time. With and without bag limit demand and benefit estimates can then be compared by year to provide an estimate of yearly incremental impacts. Incremental benefit estimates can then be discounted to the present and compared to discounted costs to determine an accept/reject decision.

This accept/reject decision should be presented along with all its assumptions. The implication of various assumptions (e.g. discount rate) could be reviewed via sensitivity analysis. Sensitivity analysis allows one to alter the assumptions and determine the overall impact upon the accept/reject decision. Fishery managers can then understand how sensitive the decision is to each assumption and react accordingly.

Appendix A

Theoretical Justification for Single Budget/Time Constraint:

Economic utility maximizing theory is used to justify the inclusion of variables within the recreational model. Individuals attempt to maximize utility or satisfaction based on choices between a finite set of alternative goods and services subject to budgetary constraints. Bockstael claims a reasonable approach for handling time is to incorporate another constraint (in addition to the income constraint) representing time.

$$\text{Max } U(C\{Q\}; Z)$$

subject to:

$$Y = P_c * C + P_z * Z$$
$$T = t_c * C + t_z * Z + T_w$$

U = Utility or satisfaction
C = Number of recreational charterboat trips to Panama City/Destin in a year
Q = Measure of the quality of the charterboat trip
Z = Vector of all other goods
Y = Income
P_c = Price of recreation trip to Panama City/Destin
P_z = Vector of prices for all other goods
T = Total time available
t_c = time required to pursue the recreational trip
t_z = " " other activities
T_w = time at work

For those individuals with fixed work schedules, a separate constraint is needed for budget and time. For those with flexible work schedules, the two constraint collapse into one.

$$\text{Max } U(C\{Q\}; Z)$$

subject to:

$$wT = C(P_c + w^* t_c) + Z(P_z + w^* t_z)$$

where wT = total possible income
wt_c = opportunity cost of C in terms of lost wages
wt_z = " "Z" "

Proof of One Constraint: Two constraints collapse into one.

Given:

1) $Y = Tw * w$ (Income)
2) $Y = P_c * C + P_z * Z$ (Income Allocated)
3) $T = t_c * C + t_z * Z + Tw$ (Time Allocated)

4) From 3: $Tw = T - t_c * C - t_z * Z$
5) Substituting step 4 into #1: $Y = (T - t_c * C - t_z * Z) * w$
6) Substituting step 5 into #2: $P_c * C + P_z * Z = (T - t_c * C - t_z * Z) * w$
7) Multiplying right hand side out: $P_c * C + P_z * Z = wT - w*t_c*C - w*t_z*Z$
8) Rearranging terms: $wT = P_c * C + w*t_c*C + P_z * Z + w*t_z*Z$
9) Rearranging terms again: $wT = C(P_c + w*t_c) + Z(P_z + w*t_z)$

Appendix B

Variable Development Arndorfer/Bockstael (1986):

Price: The price term used in the Arndorfer/Bockstael (1986) model is based on the round-trip travel cost to the port city plus the trip's charterboat fee. The travel cost component represents both transportation costs (automobile fuel costs, airline tickets, etc.) and lodging plus meal costs while in route. The charterboat fee was based on a rate of $50 per hour times the length of the charterboat trip.

These costs were gathered in aggregate for the entire party visiting the city or site, therefore in order for one to estimate a price per individual, these costs must be allocated among party members. The disaggregation is not as simple as dividing total costs by party size because of the composition of the party. If the party consists of a family (husband, wife, children), the costs could be incurred by the head of the household exclusively. Conversely, if the party consisted of friends, relatives from separate households, etc. these costs would be divided between the party members.

A survey question was asked to determine the relationship among party members - did they travel alone, with family, with friends, with acquaintances, or with business associates. This question was used to determine the level of disaggregation, the only problem with this is that these categories are not mutually exclusive - an individual could travel with both family and friends. This situation was witnessed by the range of responses, the range exceed that of the survey question indicating that individuals must have summed multiple responses.

Costs were allocated in the following manner - if the party was composed of a single individual or a family, the total cost was allocated to the individual. If the party was composed of friends, acquaintances, or business associates, the costs were divided up equally between party members.

For the charterboat fee estimation, party size also affects the number of boats needed. If the party size is greater than six (charterboat carrying capacity), more than one charterboat would be necessary to house the party. If the party size is not evenly divisible by six, meaning the party doesn't fully utilize the capacity of all boats employed, the likelihood of a multiple party situation occurring on the boat would be high. Multiple parties split fees in the same fashion as a single party. The manner in which Arndorfer/Bockstael (1986) handled parties not utilizing the charterboat's full capacity wasn't clearly stated although I gathered they assumed the boats to be used at capacity (therefore a party of two would incur two sixths of the charterboat fee).

Finally a note on stay costs. Arndorfer/Bockstael (1986) recognized the controversy over the inclusion of stay costs so they tested the contribution of this price element and found it to be insignificant. They mentioned that higher stay costs will be associated with a higher quality overall trip, but felt it had little to do with the charterboat trip and therefore excluded these costs from the model.

Despite the fact that stay costs were excluded from the model, Arndorfer/Bockstael (1986) did acknowledge that stay costs may be a significant factor for those involved in extended stay periods at the site. To account for this possibility, they included a variable reflecting the length of the stay (in days) at the site.

Time: The Arndorfer/Bockstael (1986) model focuses on the opportunity cost of time in terms of its potential for lost wages, no disutility of travel time is estimated. A survey question was asked to determine if the individual could have worked during the recreation trip. If so, the individual's travel and on-site recreation time is converted to opportunity cost at the individual's wage rate. If not, the individual would incur zero opportunity costs. For these individuals, a separate time variable again reflecting both travel and on-site recreation time was entered in the model (separate models were run for each group). Note that time spent in the port city while not recreating was not converted in an opportunity cost.

Site Quality: The primary focus of the Arndorfer/Bockstael (1986) model was to estimate the impact upon charterboat demand of the possible introduction or adjustment of regulatory bag limits on King Mackerel. To accomplish this, catch rates (or better yet, keep rates) on King Mackerel must be included as a quality variable.

Arndorfer/Bockstael (1986) defined three catch rate indices to represent quality. The first, developed solely for King Mackerel, utilized angler's expected catch. The idea here is that expected catch is more likely to influence visitational behavior than actual catch.

The two other indices represented a group of different species - one for bottom fish, and the other for fish caught while trolling. The bottom fish group was composed of grouper, snapper, drum, croaker, and triggerfish while the troll group was based on shark, tuna, marlin, jacks, bonito, dolphin, spanish mackerel, and wahoo. Due to poor expectation information, actual catch rates were used for these indices.

An individual catch rate was developed by taking the log of the catch across all relevant species divided party size or boat capacity (assumed at six), whichever was lower. By taking the log of these indices, diminishing marginal benefit for each additional fish can be modelled.

In terms of the time problem, Arndorfer/Bockstael (1986) developed catch indices based upon the trip and not over a common time frame.

Substitution Variables: Arndorfer/Bockstael (1986) posed a question in her mail survey regarding harbors used in the region. She noted a dominance of the Panama City/Destin harbors and therefore concluded that site substitution wasn't a major factor for her study.

As a result, Arndorfer/Bockstael (1986) included no substitutional variables in their model with the possible exception of the quality/species substitution variable.

Socioeconomics: Arndorfer/Bockstael (1986) included income as an explanatory variable in her demand model.

Appendix C

Results of Arndorfer/Bockstael (1986): (Tables C1 & C2)

Based on the variable constructions discussed above, Arndorfer/ Bockstael ran a series of truncated maximum likelihood regression models. Five general models were presented, each reflecting a variant combination of trip length and purpose. Database sorts for the following combination were regressed:

1) trip length	≤10	hours with business trips	omitted
2) "	12	"	"
3) "	18	"	"
4) "	10	"	included
5) "	18	"	"

The logic behind studying trips of varying length is to determine if they represent significantly different experiences. Arndorfer/Bockstael (1986) note as the sampled trip length increases over 12 hours, the results of the regressions diminish. This indicates those variables useful for modelling a single day trip may not be reflective of a multiple day trip (as noted above, perhaps stay costs become of increasing importance).

Sorts were also based upon the inclusion or exclusion of business trips. When the main purpose of the trip was for business reasons, a number of considerations change. Since the charterboat trip is not the primary trip objective, construction of the price term becomes difficult. Firstly, the cost of a business trip may not be incurred by the individual - lodging, transportation, meals, etc. are normally covered by the business. The individual experiences little to no out-of-pocket trip costs. This situation confounds demand curve estimation because the quantity of recreational trips taken under a business trip setting is not significantly affected by price. The number of business trips to the region may be a more important determinant of recreational demand for these individuals.

Even if the individual takes a charterboat trip on his own time during the business trip, the full cost of the recreational trip will be understated. Only the charterboat fees would require coverage, an obvious understatement of the full trip costs. The individual would incur costs as if a local resident, yet he hasn't the continual site access of a local. Business trips, while not normally a major portion of the overall sample, cause analytical problems and are therefore often excluded.

The results of the five model regressions are listed in table C1 (taken directly from Arndorfer/Bockstael (1986)).

Review of Results: In reviewing the regression results, all variables are of the expected sign in each of the regressions.

The price variable proved to be significant at the 90% confidence level for all models except model III (trip length < 18 hours). This is an expected result since the longer the trip, the greater the possible impact of stay costs, a variable which was excluded from the model. In addition the time cost variable for those with fixed work hours proved significant in each model.

The income variable, used to represent financial constraints and tastes and preferences, proved significant in all models. The positive sign for this variable indicates that recreation is a normal good as opposed to inferior (inferior goods are associated with negative signs on the income variable - as income rises, demand for the good decreases).

The length of stay variable proved to be positive and significant in each of the models. The positive relationship indicates the logical consequence of multiple trips associated with extended stays in the region.

The remaining variables represented the quality of the site based upon the catch rates indices. These variables varied in significance between the five models. The troll index proved significant for all models except model III (trip length < 18 hours). The bottom species index was less successful, proving significant only for model I. Model I reflects a trip length ≤ 10 hours (single day trip) excluding those trips with a main purpose of business. This model incorporates the majority of the sample, characteristic of 363 of 506 observations (72%). Finally, the King Mackerel index proved insignificantly different from zero at the 90% confidence level for all models. Arndorfer/ Bockstael notes that this insignificant King Mackerel result could illustrate either a lack of importance of King Mackerel (perhaps due to the prevalence of other valued species and their potential for species substitution) or a statistical problem due to the lack of observations indicating a catch or target of King Mackerel.

In addition to the five models indicated above, Bockstael also ran a couple of submodels for model I. Recalling the divergence in modelling approaches between those individuals with fixed and flexible work schedules, Arndorfer/Bockstael (1986) further sorted the database for model I by the fixed and flexible work week concept. Separate regressions were run for each database sort based upon the necessary variables. The results are presented in table C2.

In terms of the coefficient of determination (R^2), the fixed work week model (Model Ia) showed an improvement in explanatory power over the general model (model I) from 6.5% to 10.8%. Model Ib the flexible work schedule approach declined somewhat to a 5.8% R^2. While these coefficients of determination are low by traditional time series standards, Arndorfer/Bockstael (1986) state they are consistent with results from prior cross-sectional studies. Technically, these must be pseudo R^2 measures and not traditional R^2 measures.

In reviewing the impacts upon the variable significance for the fixed work week model, problems surfaced in the price elements. Both price and time costs became insignificant at the 90% level. In addition, the troll index also became insignificant.

However, the King Mackerel index proved significant in this model as opposed to the overall model.

The flexible work model proved interesting. The price term maintained its significance indicating the legitimacy of the time conversion approach. However, problems arose due to the insignificance of income and bottom species index (King Mackerel index remained insignificant as compared to the overall model).

TABLE C1
Estimated Demand Equations

	CONSTANT	PRICE (INCL. FLEX. TIME COSTS)	COEFFICIENTS INCOME ($000)	TIME COSTS (FIXED WORK)	LENGTH OF STAY INDEX	TROLL SPECIES INDEX	BOTTOM SPECIES INDEX	KING MACKEREL	R^2
Model I Trip Length <10 hr. Bus. Trips Omit.	.2358 (.938)*	-.000748 (-2.95)	.00762 (2.77)	-.2062 (-3.43)	.0618 (3.04)	.0611 (2.45)	.0524 (2.20)	.0335 (1.00)	.065
Model II Trip Length <12 hr. Bus. Trips Omit.	.2348 (1.00)	-.000502 (-2.30)	.00648 (2.53)	-.1793 (-3.27)	.0576 (2.94)	.0603 (2.62)	.0405 (1.80)	.02715 (.835)	.061
Model III Trip Length <18 Bus. Trips Omit.	.2534 (1.16)	-.000420 (-1.05)	.00515 (2.16)	-.1811 (-3.61)	.0478 (2.49)	.0399 (1.88)	.0283 (1.39)	.0216 (.718)	.046
Model IV Trip Length <10 hr. Bus. Trips Incl.	.0714 (.295)	-.000580 (-2.57)	.00827 (3.16)	-.1913 (-3.34)	.0620 (3.10)	.0608 (2.54)	.0392 (1.75)	.0322 (1.01)	.056
Model V Trip Length <18 hr. Bus. Trips Incl.	.1464 (.688)	-.000360 (-1.92)	.00554 (2.41)	-.1796 (-3.72)	.0514 (2.72)	.0407 (1.98)	.0193 (.989)	.0218 (.740)	.044

* Figures in parentheses indicate t-statistics.

TABLE C2

Revised Estimated Demand Equations

	CONSTANT	PRICE (INCL. FLEX. TIME COSTS)	COEFFICIENTS: INCOME ($000)	COEFFICIENTS: TIME COSTS (FIXED WORK)	LENGTH OF STAY INDEX	TROLL SPECIES INDEX	BOTTOM SPECIES INDEX	KING MACKEREL	R^2
Model I									
Trip Length <10 hr.	.2358	-.000748	.00762	-.2062	.0618	.0611	.0524	.0335	.0[illegible]
Bus. Trips Omit.	(.938)*	(-2.95)	(2.77)	(-3.43)	(3.04)	(2.45)	(2.20)	(1.00)	
Model Ia									
Trip Length <10 hr.	1.1026	-.001194	.00857	-.3518	.0576	0.512	.0802	.0885	.10[illegible]
Bus. Trips Omit.	(1.96)	(-1.71)	(2.30)	(-1.79)	(2.48)	(1.61)	(2.40)	(2.14)	
Individuals with									
Fix Work Time									
Model Ib									
Trip Length <10	-.2954	-.000703	.00693	------	.0837	.0806	.0385	-.0563	.05[illegible]
Bus. Trips Omit.	(-.79)	(-2.27)	(1.69)		(1.94)	(1.97)	(1.08)	(-.67)	
Individuals with									
Flexible Work Time									

* Figures in parentheses indicate t-statistics.

Appendix D

Value Estimation Arndorfer/Bockstael Model (1986): (Tables D1-D3)

Table D1 represents the total annual consumer surplus associated with the Panama City/Destin charterboat fishery. These values represent the maximum one would be willing-to-pay annually rather than forego the experience altogether.

Both median and mean consumer surplus values were estimated. Haneman (1980) indicates that median values are preferable to mean values due to the reduced impact of outliers (extreme responses).

The range of median estimates is substantial, from $300 to $1100 annually per individual. Given the diminishing results of the models reflecting business trips (IV & V) and extended trips (II & III), as well as the dominance of model I in terms of observations, Arndorfer/Bockstael (1986) concluded that model I would be the most representative consumer surplus estimate. Comparing the results of annual consumer surplus measures (models I and Ia), Arndorfer/Bockstael (1986) suggest the use of $300 as a lower bound for the representative individual's annual value of the fishery.

From this base fishery value, Bockstael went on to estimate the impact of various hypothetical bag limits. The results are listed under Table D2.

The average annual losses in consumer surplus due to one, two, and three fish bag limits range from $1.05 to $8.15. Note how the consumer surplus losses amplify as the bag limit is reduced, an expected result from the greater constraining factor. These relatively minor losses may be more reflective of the fact that the hypothetical bag limits were not binding as opposed to the overall lack of importance of King Mackerel. Since many (most) individuals are not impacted by the hypothetical bag limits (currently catching under the limit), the average consumer surplus loss across the sample should be slight. Despite the fact that the average decline in consumer surplus may be small, one should remember that in individual cases, the impact may be quite large (individual consumer surplus losses range from zero to $423 annually).

Finally, Arndorfer/Bockstael (1986) looked at the impact of improved catch rates. Given the objective of fishery management to achieve some sort of biologically sustainable annual yield, movement from an overfished state to a sustainable state (due to the enforcement of regulations) would likely increase catch rates by increasing species populations. Likewise, we would expect individuals to experience increases in annual consumer surplus from their increased catch. Table D3 in the appendix provides estimates of the marginal gains in annual consumer surplus from an increase in King Mackerel catch by one fish per trip.

The increases in consumer surplus from the additional King Mackerel are significantly higher than the losses from one less King Mackerel because everyone in affected. The losses are only felt by those who actually catch King Mackerel in excess of the hypothetical bag limit (a subset of the overall sample). Arndorfer/Bockstael (1986) state that for those who caught no King Mackerel, the value associated with that first fish can be quite large. As a result of diminishing marginal utility, the value associated of any additional fish declines with the level of catch.

TABLE D1

Estimated Annual Value of Charterboat Fishing Activity

Median Value of Consumer Surplus Over Sample*

	Median*	Mean
Model I Trip Length <10 hr. Bus. Trips Omit.	$ 599	$3155
Model Ia Trip Length <10 hr. Bus. Trips Omit. Fixed Work Time	$ 314	$2710
Model II Trip Length <12 hr. Bus. Trips Omit.	$ 837	$6943
Model III Trip Length <18 hr. Bus. Trips Omit.	$ 960	$5355
Model IV Trip Length <10 hr. Bus. Trips Incl.	$ 749	$4578
Model V Trip Length <18 hr. Bus. Trips Incl.	$1092	$6786

* Median values are considered perferable in problems of this sort as mean values are very much affected by extreme values which may reflect bad data or unusual (non-representative) circumstances.

TABLE D2

Estimated Annual Losses From Different Bag Limits

Average Values and Ranges for Samples

	LOSSES FROM 2 FISH BAG LIMIT	LOSSES FROM 3 FISH BAG LIMIT	LOSSES FROM 1 FISH BAG LIMIT
Model I			
Trip Length <10 hr.	$2.00	$1.30	$7.30
Bus. Trips Omit.	($215 - 0)*	($82 - 0)	($353 - 0)
Model Ia			
Trip Length <10 hr.			
Bus. Trips Omit.	$1.90	$1.30	$7.10
Fixed Work Time	($125 - 0)	($65 - 0)	($360 - 0)
Model II			
Trip Length <12 hr.	$2.05	$1.40	$7.80
Bus. Trips Omit.	($245 - 0)	($92 - 0)	($395 - 0)
Model III			
Trip Length <18 hr.	$1.66	$1.05	$6.55
Bus. Trips Omit.	($220 - 0)	($85 - 0)	($364 - 0)
Model IV			
Trip Length <10 hr.	$2.24	$1.50	$8.15
Bus. Trips Incl.	($257 - 0)	($98 - 0)	($423 - 0)
Model V			
Trip Length <18 hr.	$1.80	$1.20	$7.13
Bus. Trips Incl.	($255 - 0)	($95 - 0)	($420 - 0)

* Ranges over individuals in parentheses.

TABLE D3

Estimated Annual Gains From Hypothetical Improvements in King Mackerel Stocks

Median Value Over Sample

	Median	Mean
Model I Trip Length <10 hr. Bus. Trips Omit.	$200	$280
Model Ia Trip Length <10 hr. Bus. Trips Omit. Fixed Work Time	$309	$510
Model II Trip Length <12 hr. Bus. Trips Omit.	$223	$316
Model III Trip Length <18 hr. Bus. Trips Omit.	$200	$301
Model IV Trip Length <10 hr. Bus. Trips Incl.	$240	$346
Model V Trip Length <18 hr. Bus. Trips Incl.	$230	$352

Appendix E

Reef Model Unsuccessful Variable Considerations:

While dismissed variable options are not normally included in final reports, it was felt the logic behind their consideration was worthy of expression, therefore the following presents the intermediate model variables.

Price: These options were based on five price elements derivable from the database: distance cost, travel cost, opportunity cost of time, charterboat fees, and stay costs.

Distance Cost (DC) - transportation cost based from travel miles.

Travel Cost (TC) - full cost of traveling to the site (transportation, meals, lodging).

Opportunity Cost of Time (OC) - travel and recreation time converted to lost wages for those who could have worked.

Disutility Cost of Travel (DU) - travel time converted to disutility costs at one third of individual's hourly wage rate (only possible to calculate for those with flexible work schedules).

Charterboat Fees (CB) - charterboat trip length applied to a fixed rate of $50 an hour.

Stay Costs (SC) - costs of lodging and meals while at Destin/Panama City.

The options tested included many combinations of the above:

1) TC, OC, CB, SC
2) TC, OC, CB
3) TC, CB, SC
4) TC, OC
5) TC
6) TC, CB, SC, DU
7) DC, OC, CB
8) DC, OC
9) DC, etc.

These options were each attempted at the two extremes of price allocation (individual and equally among party members), as well as an abandoned best guess estimate. In excess of thirty price variable options were tested.

The best guess estimate was abandoned due to the lack of confidence in the trip party variable. This variable reflected the relationship between members of the fishing party (traveling with family, friends, business associates, acquaintances, or alone). The variable played an important role in allocating trip costs. Given the response options on this survey question were not mutually exclusive, multiple selections resulted. This problem required adjustment, unfortunately the information to do so was unavailable. Initially, problem responses were simply deleted, and the remaining observations were used to construct the best guess estimate. After greater consideration, it was determined that the problem responses could not be adequately identified, therefore the use of the trip party variable and any variables created from it (including Arndorfer/Bockstael (1986)'s price term) were eliminated.

Time: The time variable was also attempted using time in the port city (while not fishing) as another element along with travel and fishing time. This configuration proved insignificant.

Also, given that the opportunity cost concept (lost wages) proved insignificant for those with flexible work schedules, another time variable was tested based upon the travel and recreation time for all individuals (not just inflexible individuals). Flexible workers, while not constrained by a fixed work week, nonetheless are constrained by 24 hours in a day. This variable too proved insignificant.

Lastly, in a variable designed to try and reflect an individual's free time, a leisure time per week variable was constructed by subtracting work hours from the total hours in a week (168). This variable was intended to reflect a time constraint in the same way income represents a budget constraint, unfortunately this variable proved insignificant.

Socioeconomics:

Age: An age variable was tested but proved insignificant.

Income: Household income was included in each model to reflect the individual's budgetary constraint. Household income was based upon the midpoint of nine income categories represented on the survey instrument. Given the number of responses in the final category (income in excess of $75,000), and the designation for each as equal to 75,000, the average income of the sample was likely to be underestimated. Interestingly, income proved insignificant in each of the models.

Quality: The quality variables tested considered both catch and keep concepts. Catch rates were expected to better represent the overall quality of the site since some individuals release a portion of their catch. When focusing purely upon keep rates, all released catch is ignored, this obviously understates the overall quality of the site. Keep rates are important because they reflect the regulated extraction from the fishery. Bag limits are imposed on keep and not catch.

To further distinguish the two concepts, catch rates were converted to a common time frame. It is questionable whether catch or keep rates should be compared between trips of varying length. A catch rate of 2 fish on a one hour trip may be preferable to 4 fish on a three hour trip even though the later involves a greater overall catch. To try and account for this possibility, the catch rate variable was converted to an hourly basis thereby allowing for comparison between trips.

Catch rate variables on both an hourly and per trip basis were tested and both proved insignificant. A correlation analysis was conducted between catch and keep rates and high correlations resulted with the per trip variables. For these reasons, the catch rate index was dropped.

An attempt was also made at modelling a social quality variable. Based on the response to the trip party question (traveling with friends, family, business associates, acquaintances, or alone), a social interaction variable was tested. The trip party responses were ranked 0 for alone, 1 for acquaintances, 2 for business associates, and 3 for family and friends. A variable was developed by multiplying party size by social rank. Unfortunately, this variable also proved insignificant.

Substitution: In addition to species substitution based purely upon keep rate differentials, a species preference concept was also attempted. Using a study by Johnson & Griffith (1985), ranks of species preferences were constructed based upon desirability in terms of taste and fight. These preferences were combined with keep rates to allow for consideration of both effects simultaneously - however this variable also proved insignificant.

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