A Very Brief Description of the Cost and Earnings of the US Caribbean Fish Trap Fishery

Introduction

The trap fishery is one of the most valuable fisheries in the US Caribbean accounting for 20-25% of the region's dockside value. Fish traps are commonly found in coral reef and related habitats (e.g. algal plains), where they target a variety of species including spiny lobsters, deep-water snappers, shallow-water snappers, grunts, and groupers. In recent times, the impact of traps on coral reefs has been the focus of considerable debate. A number of organizations, including environmental groups, have expressed concern over the physical damage caused by the setting and hauling of traps (Sheridan et al, 2003). Early research indicated that 40% of the traps in St. Thomas, US Virgin Islands were on hard corals resulting in an estimated annual loss of 100 m2 of hard coral (Quandt, 1999). However, on-going research suggests that about 20% of the traps are on hard coral in the US Virgin Islands (Sheridan et al, 2003). In addition to habitat damage, the non-selective nature of fish traps is another source of concern. Fish traps catch a variety of overexploited reef fish species. Reef-fish species, particularly groupers, are vulnerable to harvesting because of their life history characteristics, which include slow growth, delayed reproduction, and sedentary behavior. Addressing the anthropogenic impacts of trap fishing not only requires biological and physical evaluations but also socio-economic assessments.

In anticipation of the need to evaluate the effects of proposed trap regulations on fishermen and their communities, we conducted a costs and earnings study. The primary objective of the study was to collect socio-economic information on the U.S. Caribbean fish trap fishery to support the management and conservation efforts of the Caribbean Fishery Management Council (CMFC). The draft Amendment to the Fishery Management Plans (FMPs) of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act is considering either reducing the number of existing fish traps and/or phasing out their use over a five to ten year horizon.

The paucity of socio-economic data is the main obstacle for developing regulations for reef fishes in the southeast. Most of the economic information is limited to dockside value. In Puerto Rico, price data is collected from voluntary trip ticket catch reports, whereas in US Virgin Islands, collects price information annually.[1] While Puerto Rico and US Virgin Islands catch statistics and fisher censuses routinely gather information on landings, fishing effort, and gear, detailed information on capital investments on vessels and equipment, variable and fixed costs are missing. The absence of this data hinders the socio-economic evaluation of regulatory proposals.

This paper provides a summary of the salient findings of the socio-economic characteristics of the US Caribbean fish trap fishery. The questionnaire inquired about household demographics, average landings, and revenue, variable and fixed costs, and capital investment in vessels and equipment. In addition to providing summary statistics, future research will use this data to develop models that evaluate the economic performance of various regulatory proposals such as a trap reduction program. For the purposes of this piece, US Caribbean encompasses the Commonwealth of Puerto Rico and Territory of the US Virgin Island (i.e., St. Thomas, St. John, and St. Croix). To protect respondents' confidentiality we only present group averages, frequency distributions, and other methods of summarization.

1 The new Puerto Rican regulations will make mandatory the reporting of landings.

Materials and methods

Survey Development and Administration

The Southeast Fisheries Science Center (SEFSC) commissioned the development fish trap cost and earnings study, on behalf of the CFMC. The study was to complement other federal, state, and local research efforts that examine gear and habitat interactions (see, Sheridan, Hill etc). On XXXX (ask Jim Waters), the SEFSC contracted Thomas J. Murray and Associates, Inc. (M&A) to develop and conduct the cost and earnings study.

The study commenced in September 2001, with a meeting between SEFSC and M&A social scientists. The meeting served to outline the logistics of the project and the content of the questionnaire. M&A. in collaboration with the SEFSC social scientists designed the survey instrument. A number steps were taken to develop the survey. Initially, M&A. organized two meetings to introduce the objectives of the study, identify main issues affecting the trap fishery, and solicit feedback on the initial set of proposed questions. Federal, commonwealth/territory, and local agencies representatives, academic experts, and commercial trap fishers attended the San Juan (Puerto Rico) and St. Thomas (US Virgin Islands) meetings. The comments received during these meeting where used to develop the initial questionnaire. Subsequently, questionnaire was tested with fishers who volunteered to assist with the study. The meetings and preliminary questionnaire testing took place in January-February 2002.

Following a number of exchanges, M&A. and SEFSC social scientists agreed on the revised questionnaire, and proceeded with the Paper Reduction Act (PRA) clearance process. The Office of Management and Budget (OMB) received the survey instrument and accompanying materials in July 2002. OMB approved the data collection in December 2002.

Due to the timing of the approval, M&A social scientists delayed testing of the questionnaire until April 2003. During this time, SEFSC social scientists developed sampling frame and research protocol. The protocol stated that enumerators were to contact each person in order from a randomized fishermen list, and that fishermen were only be removed from the list if they a) refused to participate participation; b) were not available due to illness or death, or; c) were contacted on eight separate occasions and could not be reached. In March 2003, US Virgin Island fishermen received a letter introducing the goals, objectives, and methodology of the study.

Between April and September of 2003, contractors conducted one hundred interviews in Puerto Rico and US Virgin Islands. In December 2003, the SEFSC received a database and an interim final report. The report described the development of the questionnaire, field training and questionnaire implementation, and the database structure design and transfer. SEFSC received the final report and database in March 2004.

Survey instrument

The survey instrument had nine sections. The first section asked for demographic information on the fisherman and it's household. It specifically elicited information on the age, number of dependents, years of formal education, years of commercial fishing experience, primary landing, or access site, percentage of income derived from commercial fishing, and participation and revenue generated from non-fishing activities. Section two inquired about dockside revenue by main species and gear types. The third section solicited information on fishing practices and trap usage. It elicited information on the number of traps fished last season, number of traps built last

season, average trap's life span, average number of trips taken per week, number of traps pulled per trip, duration of fishing trip, soak time, etc.

Section four collected variable cost information, including fuel, oil, ice, bait, supplies, and labor. The section five inquired about fishermen's annual distribution of effort and their participation on non-fishing activities. The sixth section collected capital investment on vessel and equipment. This section gathered information on the vessel size and age, hull type, engine horsepower, number and type of traps as well as the value of the vessel, traps, and other miscellaneous equipment. The seventh section requested information on fixed costs, which include docking fees, vessel mortgage payments, vessel insurance payments, and vessel and equipment maintenance and repair expenditures. The eight section sought information on fisherman's business motivations and reasons for certain fishing practices (e.g., factors that affect trap usage, reasons for not fishing ideal number of traps) as well as likely behavioral responses to trap plan (e.g., changes in soak time, gear switching, etc.). Lastly, we asked fishermen to describe the spatial distribution of their traps.

Sampling Design

Due to the absence of federal license requirements to operate in US Caribbean wasters, the USVI license registration and the 2002 Puerto Rico fisher census databases were used to establish a sampling frame.[2] The sampling frame identified 324 trap fishermen in Puerto Rico and 97 trap fishermen in US Virgin Islands (Table 1). The databases provided, among other things, fishers names and addresses, and number of fish traps owned. These were the most up to date datasets available.

We selected the 2002 PR fisher census over the PR license registration because Puerto Rico's Department of Natural and Environmental Resources (DNER) until recently did not require fishermen to obtain a license to operate in Commonwealth waters. While most fishermen had them because the Commonwealth government provides a number of incentives such as discounted boat registration fees, there was concern that the list contained a large (but unspecified) number of recreational fishermen seeking these incentives. In addition, because the 2002 Puerto Rico fisher census benefited from the extensive involvement local port samplers, it was felt that the census best identified genuine commercial fishermen.[3] Because PR license registration did not differentiate between commercial and recreational fishermen, it is difficult to assess whether the fisher census provides a representative sample of commercial fishermen. Last, only the 2002 Puerto Rico census database was available electronically. US Virgin Islands' Department of Planning and Natural Resources (DPNR) requires fishing licenses to operate in territorial waters. In 2001, USVI implemented a moratorium on the issuance of new commercial fishing permits. At the time of the study, DPNR was in the process of conducting the first USVI fisher census.

The sampling design required a stratified random sample of 100 fish trap fishermen. The sampling frame was stratified by scale of operation. The sampling designed called for a voluntary, in person interview of 60 fishermen in Puerto Rico, 20 fishermen in St. Thomas and St. John, and 20 fishermen in St. Croix. For each geographic area, the sampling plan divided fishermen into 2-3 scale of operation (i.e., trap allotment) strata, from which a simple random sample was drawn. The rationale for the stratification was to capture the fleet's heterogeneity

2 The only exception is the HMS permit, which is required for those vessels harvesting tunas, swordfish and sharks in the Atlantic Ocean, including Gulf of Mexico and Caribbean waters.

3 Matos-Carballo (2003) provides a summary of the latest 2002 Puerto Rican fisher census.

(i.e., small, medium, and large-scale operators) and to minimize the possibility of inadvertently marginalizing or excluding components of the fleet. Thus, the stratification disproportionately sampled large-scale operators while broadly mirroring the universe of the trap fishermen. In addition, the stratification made the survey more cost effective and convenient to administer. Scale of operation tiers were determined in consultation with local fisheries experts.

To meet the requirements of the sampling protocol, interviewers directed to contact selected fishermen from a randomized list. The fishermen list recorded fisherman name, address, and phone number. Surveyors were also instructed to select a replacement from the list if the fishermen a) refused to participate, b) were not available due to illness, death, or travel, and c) were contacted on eight separate occasions and could not be reached. To meet the target number of surveys per stratum replacements were continue to be drawn. When the low number of willing participants prevented meeting the stratum goal, interviewers could still meet the overall target by completing additional surveys in other strata. This situation occurred twice forcing interviewers to collect two (three) additional surveys in the Puerto Rican (St. Thomas and St. John) medium scale stratum (Table 1).

Table 1: Sample design and sampling outcome.

Area	Tier (number of fish traps)	Population (number of fishermen)	Target number of surveys	Number of completed surveys	Number of refusals
Puerto Rico	1-40	258	30	30	57
	41-100	53	20	22	31
	≥101	13	10	8	13
St. Thomas and St. John	1-50	19	8	5	19
	51-150	20	7	10	17
	≥151	13	5	5	9
St. Croix	1-19	31	13	13	30
	≥20	14	7	7	12

Notwithstanding considerable effort and resources devoted to this endeavor, there was an overall 53.2% response rate. Table 2 shows the distribution of non-response reasons. There 52 fishermen were unreachable and 18 fishermen that refused to participate, which accounted for 59.1% and 20.5% of the non-response rate, respectively. If we ignore the impact of unreachable and no longer qualified, the effective response rate increases to 80.6%.

Table 2: Non-response distribution.

	Puerto Rico	St. Thomas	St. Croix	Total

		and St. John		
Population	324	52	45	421
Planned sample	60	20	20	100
Number of contacts	101	45	42	188
Number of non-respondents	41	25	22	88
Reason for non-response				
Unreachable	25	13	14	52
No longer qualified	10	2	0	12
Refused	3	8	7	18
Other	3	2	1	6

Results

Demographics of respondents

Puerto Rico

The average age of the fish trap fishermen in Puerto Rico fluctuated between 50.3 and 54.8 years. Fishing experience was constant across the various tiers. It oscillated between 29.8 years in the lowest tier, to 31.3 years in the highest tier. Similarly, formal education was did not vary significantly across the tiers ranging from 8.8 in the highest tier to 9.7 in the lowest tier (Table 1). The number of dependents was steady across tiers, varying between 2.9 and 3.3.

Table 1: Puerto Rico demographic summary.

Variable	Puerto Rico Tier 1 (1-40 traps)	Puerto Rico Tier 2 (41-100 traps)	Puerto Rico Tier 3 (101+ traps)
Age (years)	50.3 (2.8)	52.4 (2.2)	54.8 (1.6)
Fishing experience (years)	29.8 (2.8)	30.5 (2.3)	31.3 (2.5)
Formal Schooling (years)	9.7 (0.7)	9.5 (0.5)	8.8 (1.0)
Number of dependents	3.3 (0.3)	3.3 (0.3)	2.9 (0.4)

St. Thomas and St. John

The average age of the fish trap fishermen in the islands of St. Thomas and St. John varied between 43.2 years and 50.4 years. Fishing experience varied significantly across the various tiers. The lower tier group had an average 20 years, the middle tier had an average of 29 years, and highest tier had an average of 25.8 years. Like in the Puerto Rican case, formal education was did not vary significantly across the tiers, ranging from 9.3 years in the lowest tier to 10.8 years in the highest tier (Table 2). The number of dependents was constant across tiers, varying between 2.6 and 3.2.

Table 2: St. Thomas and St. John demographic summary.

Variable	St. Thomas and St. John Tier 1 (1-50 traps)	St. Thomas and St. John Tier 2 (51-150 traps)	St. Thomas and St. John Tier 3 (151+ traps)
Age (years)	50.4 (0.9)	49.2 (1.9)	43.2 (3.4)
Fishing experience (years)	20.0 (4.1)	29.0 (2.0)	25.8 (4.0)
Formal Schooling (years)	9.3 (1.4)	10.6 (0.5)	10.8 (0.9)
Number of dependents	2.8 (0.6)	2.6 (0.3)	3.2 (0.4)

St. Croix

The average age of Cruzan trap fishers varied between 55.1 years and 62.6 years. Fishing experience was highest in the higher tier were it averaged 38.3 years compared to 24.6 years in the lowest tier. Like in the Puerto Rican and St. Thomas and St. John cases, formal education was did not vary significantly across the tiers, ranging from 8.1 years in the lowest tier to 10.7 years in the highest tier (Table 3). The number of dependents oscillated between 3.1 and 3.5.

Table 3: St. Croix demographic summary.

Variable	St. Croix Tier 1 (1-20 traps)	St. Croix Tier 2 (21+ traps)
Age (years)	55.1 (3.5)	62.6. (2.5)
Fishing experience (years)	24.6 (3.6)	38.3 (1.5)
Formal Schooling (years)	8.1 (0.7)	10.7 (1.1)
Number of dependents	3.5 (0.3)	3.1 (0.6)

Indices of fishing dependence

Puerto Rico

Household income derived commercial fishing was found to be significant for all tiers. Tiers 1, 2, ad 3 derived 64%, 88.9%, and 78.1 % of their income from commercial fishing, respectively. Trap derived income as a proportion of the total fishing income monotonically increased from the lower tier (56.1%) to the higher tier (84.4%). If we multiply the latter variables, we can observe that trap fishing contribution to overall income is 36% for tier 1, 62.5% for tier 2 and 65% for tier 3. Family use of the catch varied between 2.8% and 4.7% (Table 4).

Table 4: Indexes of fishing dependence for Puerto Rican trap fishers.

Variable	Puerto Rico Tier 1 (1-40 traps)	Puerto Rico Tier 2 (41-100 traps)	Puerto Rico Tier 3 (101+ traps)
Household income from commercial fishing (%)	64.0 (5.7)	88.9 (3.4)	78.1 (5.5)
Fishing income from fish trap fishing (%)	56.1 (5.5)	69.3 (4.2)	84.4 (5.5)
Family use of the catch (%)	2.8 (0.8)	2.9 (0.5)	4.7 (1.6)

St. Thomas and St. John

Household income derived from commercial fishing varied across the different tiers, oscillating between 49% and 93%. The contribution of trap fishing income to the overall commercial fishing income was equally significant fluctuating between 50.8% in the lowest to tier to 73 % in the highest tier. Fish traps contribution to overall income from the lowest to highest tier was 24.8%, 52.1%, and 67.9%, respectively. Home consumption of the catch was found to be highest in tier 1 (7.6%) and lowest (1.0%) in tier 3 (Table 5).

Table 5: Indexes of fishing dependence for St. Thomas and St. John trap fishers.

Variable	St. Thomas and St. John Tier 1 (1-50 traps)	St. Thomas and St. John Tier 2 (51-150 traps)	St. Thomas and St. John Tier 3 (151+ traps)
Household income from commercial fishing (%)	49.0 (18.0)	85.5 (4.7)	93.0 (4.5)
Fishing income from fish trap fishing (%)	50.8 (16.5)	61.0 (7.0)	73.0 (9.9)
Family use of the catch (%)	7.6 (3.0)	1.6 (0.4)	1.0 (0.3)

St. Croix

Household income derived from commercial fishing was relatively constant across tiers oscillated between 84.2% and 81.4%. The contribution of trap fishing income to the overall commercial fishing income was significantly different across the tiers, fluctuating between 61.8% in the lowest to tier to 99.3 % in the highest tier. Fish traps contribution to overall income was 52% for tier 1 and 80.8% for tier 2. Home consumption of the catch was 2.2% in tier 1 and 3.1% in tier 2 (Table 6).

Table 6: Indexes of fishing dependence for St. Croix trap fishers.

Variable	St. Croix Tier 1 (1-20 traps)	St. Croix Tier 2 (21+ traps)
Household income from commercial fishing (%)	84.2 (5.6)	81.4 (7.7)
Fishing income from fish trap fishing (%)	61.8 (8.8)	99.3 (0.5)
Family use of the catch (%)	2.2 (0.5)	3.1 (0.6)

Income

Puerto Rico

Table 9: Puerto Rican fish trap income.

Variable	Puerto Rico Tier 1 (1-40 traps)	Puerto Rico Tier 2 (41-100 traps)	Puerto Rico Tier 3 (101+ traps)
Revenue ($/year)	11,718 (1,914.6)	28,607 (2,431.1)	54,940 (6,810.3)
Catch (lbs/year)	3,677.7 (460.4)	9,377.3 (830.4)	15,371 (1,553.0)

In Puerto Rico, fish traps generated about 3,677.7 lbs of seafood valued at $11,718 for tier 1 fishermen, 9,377.3 lbs of seafood valued at $28,607 for tier 2 fishermen, and 15,371 lbs of seafood valued at $ 54,940 for tier 3 fishermen (Table 9).

St. Thomas and St. John

In St. Thomas and St. John, fish traps generated about 7,432 lbs of seafood valued at $27,640for tier 1 fishermen, 10,469 lbs of seafood valued at $43,224for tier 2 fishermen, and 12,150 lbs of seafood valued at $ 49,467 for tier 3 fishermen (Table 10).

Table 10: St. Thomas and St. John fish trap income.

Variable	St. Thomas and St. John Tier 1 (1-50 traps)	St. Thomas and St. John Tier 2 (51-150 traps)	St. Thomas and St. John Tier 3 (151+ traps)
Revenue ($/year)	27,640 (5,242.5)	43,224 (9,535)	49,467 (11,823)
Catch (lbs/year)	7,432 (1,478.9)	10,469 (2,428.8)	12,150 (2,577.8)

St. Croix

In St. Croix, fish traps generated about 6,320.9 lbs of seafood valued at $24,340 for tier 1 fishermen, and 12,221 lbs of seafood valued at $ 50,136 for tier 2 fishermen (Table 11).

Table 11: St. Croix fish trap income.

Variable	St. Croix Tier 1 (1-20traps)	St. Croix Tier 2 (21+ traps)
Revenue ($/year)	24,340 (6,130.3)	50,136 (12,466)
Catch (lbs/year)	6,320.9 (1,328.7)	12,221 (3,045)

Capital investment and cost structure

Puerto Rico

On average, tier 1, tier 2, and tier 3 trap fishermen have 24.7, 63.6, and 212.2 fish traps, respectively. Fuel and bait costs account for the largest share of the variable costs. Fuel costs vary between $11.1, in the lowest tier, to $16.1 in the highest tier. Similarly, bait costs oscillate between $2.5, in the lowest tier, to the $10.0 in the highest tier. Oil and ice cost do not show significances across the tiers (Table 12).

Table 12: Variable cost information for Puerto Rican fish trap fishermen.

Variable	Puerto Rico Tier 1 (1-40 traps)	Puerto Rico Tier 2 (41-100 traps)	Puerto Rico Tier 3 (101+ traps)
Fuel ($/trip)	11.11 (2.2)	13.02 (2.2)	16.1 (3.4)
Oil ($/trip)	2.5 (0.3)	2.3 (0.4)	1.8 (0.3)
Bait ($/trip)	2.5 (1.1)	6.1 (2.3)	10.0 (6.2)

Ice ($/trip)	1.8 (2.5)	1.3 (0.4)	2.8 (0.8)
Number of fish traps	24.7 (2.4)	63.6 (5.0)	212.3 (21.7)

St. Thomas and St. John

On average, tier 1, tier 2, and tier 3 trap fishermen have 33, 107.3, and 161 fish traps, respectively. Fuel and bait costs account for the largest share of the variable costs. Fuel costs vary between $49.8, in the highest tier, to $61 in the lowest tier. This counter-intuitive result arises because the highest tier tends to use out-board diesel engines, whereas the lowest tier tends to use outboard gasoline engines. Bait costs oscillate between $15.4, in the lowest tier, to the $36.7 in the highest tier. Oil and ice cost do not show significances across the tiers (Table 13).

Table 13: Variable cost information for St. Thomas and St. John fish trap fishermen.

Variable	**St. Thomas and St. John Tier 1 (1-50 traps)**	**St. Thomas and St. John Tier 2 (51-150 traps)**	**St. Thomas and St. John Tier 3 (151+ traps)**
Fuel ($/trip)	61.0 (7.4)	56.8 (4.2)	49.8 (7.0)
Oil ($/trip)	4.0 (1.1)	4.2 (0.7)	3.8 (0.6)
Bait ($/trip)	15.4 (5.2)	16.7 (4.8)	36.7 (10.8)
Ice ($/trip)	6.6 (3.2)	8.1 (2.1)	6.6 (2.4)
Number of fish traps	33.0 (6.3)	107.3 (8.1)	161.0 (5.0)

St. Croix

On average, tier 1, tier 2, and tier 3 trap fishermen have 15.4, and 31.9 fish traps, respectively. Fuel and bait costs account for the largest share of the variable costs. Fuel costs vary between $15.4, in the lowest tier, to $31.9 in the highest tier. Bait costs oscillate between $3.7, in the lowest tier, to the $24.3 in the highest tier. Ice cost did not vary significantly across the tiers (Table 14).

Table 14: Variable cost information for St. Croix fish trap fishermen.

Variable	**St. Croix Tier 1 (1-20traps)**	**St. Croix Tier 2 (21+ traps)**
Fuel ($/trip)	15.4 (1.8)	31.9 (8.7)
Oil ($/trip)	2.5 (0.4)	5.6 (1.5)
Bait ($/trip)	3.7 (1.2)	24.3 (9.2)
Ice ($/trip)	3.8 (0.7)	3.4 (1.1)
Number of fish traps	20.2	42.1

	(3.6)	(8.2)

Conclusions

This article details the main results of the US Caribbean fish trap cost and earnings study. The present study contributes to our understanding on the fleet by highlighting a high degree of heterogeneity among fishery participants in the different islands.

The study showed that middle-aged individuals made up a significant part of the fleet. St. Croix tended to be the oldest trap fishers, followed by the Puerto Rican. Similarly, fishing experience tended higher in St. Croix and Puerto Rico. On average, trap fishers had between 8 to 10 years of formal education and had about three dependents. Another interesting result of the study is the high level of dependence on trap fishing. For those individual with high capital investment (measured in terms of trap ownership), trap fishing accounted between 65-80% of their household income.

Last, fuel and bait were the most important variable costs of the fishing operation. In Puerto Rico, fuel costs were relatively low oscillating between $12 and $20; and, in St. Croix, they oscillated between $15 and $32. St. Thomas and St. John operations spend the most on fuel. On average, they spent between $50 and $61. Bait costs oscillated between $2.5 and $10 in Puerto Rico, between $16 and $37 in St. Thomas and St. John and between $3 and $25 in St. Croix.

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