

**NETFISHING OVERVIEW – ST. CROIX, U.S. VIRGIN ISLANDS:  
MANAGEMENT IMPLICATIONS FOR RESTRICTIONS ON THE USE OF  
GILL AND TRAMMEL NETS**

General Fishery Description

**Shallow Water Reef Fish Fishery**

The shallow water coral reef fishery is the most important fishery in the U.S. Caribbean, comprised of some 350 species of reef fish, 180 of these are landed in quantity throughout the region as part of the commercial fishery (Caribbean Fishery Management Council, 1985). The fisheries in the U.S. Virgin Islands, as well as in Puerto Rico, are multi-species, multi-gear and artisanal in nature. There are approximately 380 registered commercial fishers in the U.S. Virgin Islands (Tobias et al., 2000). The commercial fishing fleet on St. Croix consists primarily of small-sized, open, wood or fiberglass fishing boats, which average 20-26 feet in length and are powered by outboard engines. Because of limited sheltered waters, relatively flat land and good road system on St. Croix, these vessels represent a mobile fishing fleet, trailered to access sites around the island, depending on sea conditions and target species. Larger vessels are used for trap-based fisheries, due to space requirements for traps and machinery (Caribbean Fishery Management Council, 2003) and are typically maintained in the water. Gear types used in the fishery include traps, line fishing, nets and diving. Many fishers use multiple gear types and more than one gear type may be used on a fishing trip.

**Recorded Landings**

A shallow water reef fish stock assessment of the U.S. Caribbean was conducted in 1991, focusing on comparing data from the fishing years 1985 and 1990 (Appeldoorn et al., 1992). Data poor conditions were noted for the U.S. Virgin Islands, especially for historical data sets. Projected reef fish landings appeared reasonably stable between 1975 and 1989 in the U.S. Virgin Islands (1.3 million pounds), averaging 0.9 million pounds for St. Thomas/St. John and 0.4 million pounds for St. Croix. Fish traps accounted for approximately 70% of the landings by weight. However, the capture size of numerous species caught in traps had decreased over time (parrotfish, grunts, surgeonfish, trunkfish and queen triggerfish). Large grouper species were absent from the fishery. Only two smaller grouper species were common, red hind and coney. Recorded landings for the Virgin Islands from 1990 to 2001 also averaged 1.3 million pounds with a range of 1.0-1.6 million pounds. However, the reported landings from St. Croix during this period increased from .4 to .8 million pounds (38-53% of total landings).

Gill and Trammel Net Fishery

**Origin**

Within the 10-year period from 1989 to 1999, numerous hurricanes have impacted the territory and adversely affected the fisheries, most notably Hurricanes Hugo (1989), Luis and Marilyn (1995), Bertha and Hortense (1996), Georges (1998) and Lenny (1999). Unfortunately, St. Croix was in the direct path of all of these systems. Commercial

fishers lost significant amounts of fish traps, the most popular fishing gear in the territory, during the hurricanes. Unable to obtain loans or federal grants to replace this gear and reluctant to sustain additional gear losses, many fishers abandoned traditional trap and handline gear for the higher catch rates and economic returns afforded by net fishing. Once the net fishing techniques were learned, fishers harvested more fish with gill and trammel nets in a shorter period of time and did not have to leave the gear in the water to be subject to storm events. The net gear returned home with the fisher after several hours of fishing.

The increase in gill and trammel nets in St. Croix also coincided with a net ban that was passed in Florida state waters in 1994. Sales representatives from Atlantic and Gulf Fishing Supply Company, a major commercial fishing gear supplier in south Florida, visited the Virgin Islands to promote entanglement net gear that they were no longer able to market in Florida.

### **Net Definitions**

Article X, Section 16 of the Florida State Constitution defines ***gill net*** as “one or more walls of netting which capture saltwater finfish by ensnaring or entangling them in the meshes of the net by the gills” (Andersen, 2002). Gill nets consist of a wall of virtually invisible monofilament netting, equipped with weights at the bottom and floats at the top. The fish swim into the netting and become entangled when their gill covers are caught in the mesh. Gill nets may be fixed to the bottom or set midwater or near the surface for pelagic species (Barnette, 2001). An entangling net is defined as “a drift net, trammel net, stab net or any other net which captures saltwater finfish, shellfish or other marine animals by causing all or part of the head, fins, legs or other body parts to become entangled or ensnared in the meshes of the net” (Andersen, 2002). A trammel net is made up of two or more panels suspended from a float line and attached to a single lead line. The outer panels are of a larger mesh size than the inner panel. Fish swim through the outer panel and hit the inner panel, which carries it through the other outer panel, creating a bag and trapping the fish. Smaller and larger fish become wedged, gilled or tangled (Barnette, 2001).

### **Net Fishing Methods**

Several net fishing methods are used to harvest reef fish species. Some fishers prefer gill nets; while others prefer multi-mesh trammel nets. Nets may be set by fishers from a boat and fished indiscriminately or set with the aid of scuba divers for target fish species, with the divers working the fish into the net. Fishers may scout an area for large aggregations of adult fish and then use their nets to either surround the whole school or have scuba divers drive fish into the set nets. Other fishers set nets in areas that are predictably used by fish during their evening migration between diurnal foraging grounds and nocturnal reef slope or deep reef resting grounds. The migration routes or “fish highways” are along spur and groove zones or sand channels through hard bottom communities. Once the fish migration behavior and “highways” are known, the fish are particularly vulnerable to harvest by net fishing techniques. The nets are set to form a wall blocking the migration route of the schooling fishes. This net fishing method is very effective in capturing large numbers of schooling fishes.

Observations of this net fishing method made by Division staff indicate that as many as five 300-ft sections of trammel net (1,500 ft in total length), eight feet in height, may be linked together. Divers deploy the nets from mesh bags underwater and secure the lead line of the net to the bottom by placing it around or under coral, gorgonids, sponges or other features on the bottom. Care is taken by the divers to firmly secure the net to the bottom. If the net is lifted off the bottom by ensnared fish, the remainder of the fish will escape under the net. Sections of net are stitched together underwater. The terminal sections of the net (approximately 100 ft in length) are folded back “hairpin-style” to form pockets on either end. The nets were set parallel to the depth contour (30-45 ft depth) across several shallow groove areas (“fish highways”) on the seafloor, with the pockets formed on the landward side of the net. The net was fished from 2:00 P.M. until 6:30 P.M. with divers clearing the net of turtles and sharks every hour. Divers were observed to “rush” the net near the end of the set, chasing a school of confused redbill parrotfish into the pocket of the net. Most of the target fish, schooling parrotfishes, were caught during the last 1.5 hours of daylight. Because parrotfishes are social and gregarious spawners, a disproportionate number of breeding adults are removed by net fishing, as compared to other fishing methods.

The nets containing the gilled or entangled fish are removed from the water by fishers in the boat hauling the net in combination with divers freeing the net from bottom obstructions. The same amount of care in placing the net around coral, gorgonids, sponges, etc., during the set is not taken during the net haulback procedure, which results in environmental damage to the benthic community. Once the net has been hauled into the boat, the fishers return to shore and pick fish from the net at home, where the catch can be sorted, placed in coolers and iced for sale the next day.

Studies conducted in Puerto Rico indicate that gill nets and trammel nets are size-selective and capture fish of larger size than other gears (Acosta, 1988; Matos Caraballo, 1991; Valdes Pizzini et al., 1992). The use of fishing gear in coral reef areas is limited to the nature of the substrate. Typically, the only convenient methods are passive gears, such as fish traps, hook and line, gill nets and trammel nets (Acosta, 1994). None of the authors of net fishing studies conducted in Puerto Rico indicated that scuba gear was used in trammel net fishing. Scuba gear is not commonly used to set trammel nets in Puerto Rico due to the additional cost of the gear (D. Matos, Puerto Rico Department of Natural Resources, personal communication). Gobert (1992) reported that trammel nets are more species selective than fish traps in Martinique and that trammel nets are not fished with scuba gear. St. Croix fishers have apparently found a more effective way of net fishing by using divers equipped with scuba gear to actively set and work nets in areas where they would not be fishable if deployed from a vessel, due to the presence of coral reefs. The ability to fish in deeper, offshore, shelf edge coral reef/hard bottom habitat with nets and the knowledge of the daily migratory behavioral patterns and “highways” used by schooling parrotfishes has enabled gill and trammel net fishers to capture entire breeding schools of parrotfishes in one set.

A summary of St. Croix gill and trammel net data obtained directly from personal contact interviews with commercial fishers during a Caribbean Fishery Management Council

fisher census survey in 2003 is shown in Table 1. A total of 43 gill and trammel net fishers were identified, 34 gill net and 9 trammel net fishers. Gill net fishers owned 78 nets, 69 of which were fished. The nets were made of both monofilament and nylon. Gill nets were described as 90-1000 ft in length (mean=397 ft) and 3-12 ft in height (mean=6 ft). Mesh size (square) ranged from 1.3–3.5 in. The gill nets soaked a mean of 3.79 hours and the fishers made a mean of 3.09 trips/week. Trammel net fishers owned 27 nets, 23 of which were fished. The trammel nets were identified as made mostly of monofilament. Trammel nets ranged from 200-1000 ft in length (mean=4.83 ft) and 4-8 ft in height (mean=6). Mesh size (square) ranged from 1.0-3.0 in. The trammel nets soaked a mean of 4.13 hours and the fishers made a mean of 3.33 trips/week

### **Target Species**

The Division collects biostatistical data, individual fish lengths and weights, from complete catches from cooperative fishers through two Department of Commerce, National Marine Fisheries Service grants, the State/Federal Cooperative Statistics Program and the Inter-jurisdictional Fisheries Program. This information is entered into a Trip Interview Program (TIP) database and forwarded to the National Marine Fisheries Service. Based on the analysis of sixteen personal contact interviews with commercial net fishers by Division port sampling agents from 1998 to 2002, a total of 4,589 fish were measured weighing 4,890 pounds (Table 2). The average total number of fish per sample was 287 and the average total weight of the catch was 306 pounds. On the average, there were 233 parrotfish, weighing 269 pounds per catch. Parrotfish represented 83% of the catch by weight and 77% of the catch by number.

Species composition of the net fisher biostatistical catches is shown in Table 3. Six parrotfish species represented 81% of the catch by number (26.4% stoplight, 24.6% redbtail, 13.8% redfin, 11.3% redband, 3.0% queen and 2.0% princess parrotfish). The same six parrotfish species represented a total of 88% of the total catch by weight (30.5% stoplight, 26.9% redbtail, 17.9% redfin, 6.1% redband, 4.8% queen and 1.9% princess parrotfish). All other species combined accounted for 8.4% by number and 6.9% by weight of the total catch.

### **By-catch**

Observations made during the trammel net fishing trip indicate that non-target species or by-catch can be significant. Federally endangered and threatened sea turtles (one hawksbill and three green turtles) were caught in the net (The presence and abundance of sea turtles may be a function of the fishing location.). Coastal shark species were also caught. Because the nets are picked at home and not at sea immediately when hauled, it is not possible to release unwanted species alive. Additional by-catch species included butterflyfish (four-eye, banded and longsnout butterflyfish are protected in federal waters), filefish, porcupine pufferfish, scorpionfish, small surgeonfish, small grunts and an assortment of other species. By-catch also included benthic invertebrates such as stony corals, fire coral, gorgonids, sponges and algae. Munroe et al. (1987), Ohman et al. (1993), and Jennings and Polunin (1996) also reported damage to the benthic community (corals) during net haulback. Based on the fisher's method of sorting his catch, the observed trammel net trip resulted in approximately 400 pounds of marketable fish, 400

pounds of “give away” fish (to the crew or friends) and 50 pounds of “throw-away” fish. All consumable fish would presumably be recorded on commercial catch record forms. “Throw-away” fish represent by-catch that would not reported on commercial catch record forms.

### **Fish Spoilage and Wanton Waste**

In warm tropical waters, the spoilage of the catch can be great if the trammel nets are left to fish too long. Gobert (1992) and Acosta (1994) reported greater than 30% spoilage of fish caught in trammel nets fished for 20 hours. The inability to quickly remove the fish from the net and ice down and store the catch decreases the quality of the catch and increases the possibility of fish spoilage. Division personnel have received unconfirmed reports of large quantities of preferred food fish species (redtail and stoplight parrotfish) discarded at the public landfill. This wanton waste is believed to be the result of over-harvesting of the resource by net fishers and their inability to process and market the resource before spoiling. The “wanton waste” of fish is prohibited in the Virgin Islands under Title 12, Virgin Islands Code, Sections 302, 304(b) and 321(b).

### **Fish Dumping**

Division staff has responded to a number of incidents involving quantities of fish, coral and gorgonids and one endangered sea turtle carcass apparently discarded as by-catch from the net fishery. These incidents include 120 fish (19 species), one poached hawksbill sea turtle and benthic invertebrates on 10 January 2002 from Estate Castle Burke, 102 fish (12 species) and benthic invertebrates on 18 July 2002 from the West Airport Road, 82 fish (12 species) from Half Penny Bay beach on 28 June 2003 and 240 fish (13 species) again from Half Penny Bay beach on 18 December 2003. Twenty-eight species of fish, representing 17 families, and one poached hawksbill sea turtle were recorded as by-catch from these four incidents (Table 4).

### **Derelict Nets**

Gill nets or trammel nets set carelessly by fishers in areas of coral reef or left unattended may become entangled on the bottom. If the fisher is unable to retrieve the net, the whole net or the section of net entangled in the coral is abandoned. The cost of the gear usually does not warrant the expenditure of time and effort on the part of the fisher to retrieve it. This is particularly true if the fisher is not a good swimmer and does not own dive equipment. Division staff encountered an abandoned monofilament gill net, 94 feet in length and 10 feet in height (1.5”sq mesh/3.0” stretch mesh), entangled in coral in 20 feet of water north of Frederiksted on 8 March 2002. The net had been cut and abandoned for an unknown period of time; however, the net continued to catch fish. One coney, two scorpionfish, one white grunt, one blue runner, a small coral head, one gorgonian and eight branching sponges were removed from the net. Monofilament net material is invisible in the water and does not deteriorate. The discarded, algal-overgrown gill net continued to catch fish, “ghost fish”, long after it was abandoned.

## Commercial Landings

### **Catch Records**

Commercial fishers are required by law to submit catch reports on an annual basis to the Division of Fish and Wildlife, prior to fishing license renewal. The reported reef fish landings from traps and nets, as recorded from catch reports submitted by commercial fishers from 1989 to 2003 for St. Croix, are shown in Figure 1. Gaps in the data set exist at the present time due to on-going data validity checks. In the fishing year 1990-1991, a total of 297,009 pounds of reef fish were landed, 88.7% (263,527 pounds) of this total was from traps and 11.3% (33,482 pounds) from nets. Over the next twelve-year period (1991-2003), the total landings have increased to 346,638 pounds, 42.8% from traps (148,229 pounds) and 57.2% (198,409 pounds) from nets (Figure 2). Reef fish landings by fishers using nets have gradually increased since 1990 and currently exceed fish trap landings. The reported St. Croix reef fish landings for 2002-2003 by species group are shown in Table 5. Two major species groups, parrotfish and surgeonfish, represented 56.2% (198,586 pounds) and 12.9% (45,759 pounds), respectively, of the total landings by weight. A total of 75.9% of all parrotfish landed were caught by nets, 23.6% by traps and 0.6% by other methods. Biostatistical reef fish samples from net fishers catch have identified six species of parrotfish (by priority of number and weight), stoplight, redbtail, redbfin, redband, queen and princess parrotfish. Surgeonfish represented the second most abundant species group harvested by net (36.5%).

### **Predicted vs. Recorded Catch Estimates**

The accuracy of reported landings on catch report forms is questionable at best. Fishers reported 198,409 pounds of net fish in 2002/2003. Biostatistical samples (N=16) from net fishers from 1998-2002 indicate that the average trammel net fishing trip yields 285 fish weighing 306 pounds (maximum 567 pounds). About 80% of the catch is predominantly stoplight and redbtail parrotfish by number, frequency and weight.

A commercial fisher census survey conducted in 2003 identified 43 registered net fishers, 34 reported using gill nets and 9 reported using trammel nets. We can estimate the annual net landings by the following:

$$43 \text{ fishers} \times 300 \text{ lbs/fisher/trip} \times 2 \text{ trips/week} \times 52 \text{ weeks/yr} = 1,341,600 \text{ lbs/yr.}$$

The annual landings for net fishing may be in excess of 1.3 million pounds, with a value of 4 million dollars. Parrotfish would comprise about 1 million pounds annually. This represents a seven-fold increase over the reported landings from the commercial catch records. Although errors incorporated in estimating landings may be substantial, it is believed that commercial fishers may be significantly under-reporting landings on catch reports.

No data is presently available on the amount of by-catch from the net fishery. Estimates obtained from the commercial fisher during the one trammel net observer trip indicated that the harvest was 400 pounds of “marketable” fish, 400 pounds of “give-away” fish and 50 pounds of “trash” fish. By-catch is considered as non-marketable catch, “trash” fish. The amount of by-catch can depend on mesh size of the net, the area fished and the

net fishing method employed. If we assumed 50 pounds of by-catch per trip and apply the same calculations used to determine estimated annual landings, 223,600 pounds of by-catch would be generated annually from the net fishery. By-catch potentially represents 63% of the total reported reef fish landings and 111% of the total reported net landings for St. Croix (Table 5). More by-catch may result from the net fishery than the present total reported landings from the net fishery. Impacts to benthic invertebrates and habitat have been identified but have not been quantified at the present time.

#### User Group Opinion Surveys and Comments

The Division of Fish and Wildlife conducted three public opinion surveys to obtain information that would be beneficial in the development of a strategic plan for fisheries. Opinion surveys were conducted with commercial fishers on the impacts of the expansion of new national monument areas (Uwate et al., 2001). Opinion surveys were also conducted with commercial fishers and the marine recreational industry (Gordon and Uwate, 2002) and with members of the Virgin Islands recreational fishing clubs (Messineo and Uwate, 2003). In each of these surveys, the major issue and problem with fishing in St. Croix was identified as the excessive catch by fishers with nets (gill and trammel nets) and the need to regulate their use. The Division also participated in a commercial fisher census survey for the Caribbean Fishery Management Council in 2004 (in preparation). Of the 215 fishers interviewed on St. Croix, 67.8% of the fishers responded that fishing was worse now than 10 years ago. The major reasons for the decline in the St. Croix fishery were given as net fishers taking too many fish (38.9%), too many fishers (32.9%) and less fish (25.9%).

Fisheries Advisory Committees were established under Title 11, Chapter 27, Section 1404 of the Virgin Islands Code with the responsibility of making management recommendations for fisheries resources to the Commissioners of Commissioners of Planning and Natural Resources and Agriculture. Members on this committee include representatives from the Departments of Agriculture, Planning and Natural Resources and Law, a marine scientist, a representative from a recreational sport fishing club, the dive industry and commercial and recreational fishers. On 15 October 2002, the St. Croix Fisheries Advisory Committee recommended to ban the use of gill and trammel nets in St. Croix, due to the over-harvesting of parrotfishes and indiscriminate take of by-catch species.

The St. Croix Fishery Advisory Committee also received a letter from the St. Croix Charter Dive Operators in support of a ban on gill and trammel nets.

#### Coral Reef Impacts

##### **Implications on Over-harvesting of Herbivorous Fishes**

The St. Croix net fishery selectively targets large herbivorous reef fish, primarily parrotfishes and surgeonfishes, and their removal may ultimately have a substantial impact upon the health of our coral reefs. Herbivores play an important ecological role in maintaining coral reefs. By directly feeding upon algae and plants, these fish enable hard

corals to recruit and grow in areas where they otherwise might be out-competed by faster growing algal species. When herbivores are absent, due to removal or disease, reefs deteriorate. A 90% reduction in live coral was reported for reefs near Discovery Bay, Jamaica. Following the 1983 Pan-Caribbean die-off of *Diadema* sea urchins, the major invertebrate grazer on coral reefs, and removal of herbivorous fish, the major vertebrate grazer, reefs were unable to recover from storm disturbance. Algae replaced live coral. The heavy harvesting of all herbivores is incompatible with vigorous coral growth (Pennings, 1996).

#### Management Alternatives

Net fishers have proposed several alternatives to reduce the gill and trammel net harvest. These measures include seasonal closures for net fishing, area closures and temporal closures (i.e., net fishing only two days per week). The proposed alternatives would be inadequate because they would not sufficiently reduce the fishing effort required for rebuilding of the fish stocks and they would also be difficult or impractical to enforce.

A complete ban on gill and trammel nets would be the most effective and enforceable management alternative. However, gill nets are used in different fisheries. Surface gill nets are also used to harvest baitfish, such as ballyhoo and flyingfish. Bottom gill and trammel nets are used to harvest parrotfishes and other reef fish. An accurate description of the gear would be required to permit specific net fisheries to exist.

#### Fishery Transition Mitigation

##### **Multi-Gear/ Multi-Methods**

Data collected during the Caribbean Fishery Management Council commercial fishers census survey in 2003 indicate that the majority of net fishers also use other methods of fishing. A summary of gear types used by net fishers is shown in Table 6. Handline fishing + diving and trap + handline + diving are the most popular methods used by gill and trammel net fishers. Only two out of thirty-four gill net fishers reported that gill nets were the only gear fished. No trammel net fishers reported using only trammel nets. Restrictions on the use of nets will result in a shift of fishers from one fishing gear to another to maintain their income. That shift will most likely be to a combination of line fishing, diving and traps.

##### **Net Buy-Back**

The Division has received a \$75,000 grant from the Department of Commerce, National Marine Fisheries Service, for the buy-back of gill and trammel nets. Based on the information received during the commercial fisher survey (Table 1), 43 fishers own a total of 105 nets; 78 gill nets and 27 trammel nets. The buy-back will be at 80% value of the net (net + floats + weights), based on current retail price plus shipping (\$.80/ft for gill nets and \$1.34/ft for trammel nets). The buy-back of incomplete nets will be for 50% of the retail value of the net plus shipping. The buy-back of any additional nets not accounted for in the commercial fisher census survey will be at 50% of the retail value of the net plus shipping on a funds available basis. If there are funds remaining in the buy-



back program following the cutoff date, the participating net fishers will receive an additional payment increasing the buy-back value of their reported nets above 80%. The net buy-back can commence in July, during the registration period for commercial fishers, with a cut-off date of August 31, 2004.

### **FADs**

The Government of the Virgin Islands receives funding from the Department of Interior, U.S. Fish and Wildlife Service, Sport Fish Restoration Program, for the deployment of fish aggregating devices (FADs) in offshore waters. The FADs are surface or underwater buoys, which attract seasonally abundant pelagic fish species (tuna, dolphin and wahoo) for harvest. The FADs concentrate pelagic fish species, reduce the travel time and fishing trip costs and increase fishing trip productivity. The FAD program has been extremely successful and highly regarded in the fishing community. Additional FADs have been placed around the Virgin Islands to accommodate increased effort on offshore species and more are planned.

### **Increased Enforcement Presence**

One of the reasons fishers switched from traps to nets was the reduced cost of not having to leave gear at sea for long periods of time. While left at sea, traps may be damaged by storms, traps may be stolen or hauled by other fishers and trap lines may be cut by passing vessels, resulting in lost traps. Nets are set and hauled daily and the net returns home with the fisher. With the removal of nets from the fishery, it is anticipated that the numbers of fish traps in territorial and federal waters will increase. It would be a relief to fishers who have switched from nets to traps if the at-sea presence of enforcement officers was increased to ensure that tampering of gear does not occur. This may require the establishment of routine patrols to monitor compliance with fish trap regulations. These patrols may be combined with at sea vessel safety inspections.

### **Fishermen Loan Programs**

To support fishers in the transfer from one gear type to another, additional funds will be required above what is provided through the net-buyback. The Small Business Development Agency should be encouraged to promote a series of workshops on the availability of low-interest loans to the fishers. The seminars should include information on Micro-Loans (unsecured loans to \$10,000 at 5% interest), Farmers and Fisherman's Loans (loans to \$17,000 at 4% interest) and Direct Loans (loans to \$25,000+ at 9.5%).

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