

RECONSTRUCTION OF TOTAL MARINE FISHERIES CATCHES FOR THE BRITISH VIRGIN ISLANDS (1950 – 2010)¹

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ABSTRACT

The problem of underreporting catches in fisheries is global. This report presents the reconstruction of total marine fisheries catches for the British Virgin Islands for the period 1950-2010, which includes estimates of misreported near-shore catches, reported offshore catches and un-reported recreational catches. The reconstructed total catches for the British Virgin Islands for the period 1950-2010 were estimated to be approximately 72,000 t, which is 2.3 times the reported catch of 30,271 t as presented by the FAO on behalf of the British Virgin Islands. This amount better reflects the importance of small-scale fisheries in providing seafood to consumers, livelihoods to fishers and recreation to visitors.

INTRODUCTION

The British Virgin Islands (BVI) consist of 60 islands, islets and cays situated in the Eastern Caribbean, located around 18° 30' N and 64° 30' W (Figure 1). The BVI have an Exclusive Economic Zone of approximately 81,000 km² (www.seaaroundus.org) with an estimated total population of around 22,000 persons (Anon. 2003). Sixteen of the islands are inhabited, but only four (Tortola, Jost Van Dyke, Virgin Gorda and Anegada) have major settlements.

Originally settled by Arawaks, (aboriginals originating from South America), the islands were rediscovered by Christopher Columbus in 1493, who claimed them for Spain. From about 1615 to 1640, the Dutch privateer Joost Van Dyk commanded a Dutch settlement on Tortola, farming cotton and tobacco. In 1640, Spain attacked Tortola and killed the Dutch. Subsequently, the British Virgin Islands came under British control in 1672 and have remained so ever since.

From 1925 to about 1950, the economic activities in the BVI involved small-scale agriculture, fishing, charcoal production and livestock rearing. From 1950 to 1960, tourism developed on the neighbouring US Virgin Islands (USVI). However, the development of tourism in BVI did not take place until about 1967, with the advent of constitutional reform and establishment of a ministerial government in BVI.² Eventually, with resorts and hotels being built to accommodate visitors, many immigrants from surrounding islands arrived to work in BVI in the construction and service sectors. Today, tourism and international financial services are the leading economic activities and *per capita* Gross Domestic Product (GDP) is approximately \$20,000 US. The rapid population growth, particularly in the last ten years in which the population grew by 47%, has had a marked impact on the development of BVI.³ For instance, the growth of total acreage of developed land on both Tortola and Virgin Gorda is 5 times greater today than in the mid 1970s.

The fisheries of the BVI are small-scale, multi-gear and multi-species (Alimoso and Overing 1996). The fisheries can be divided into three sectors: a near-shore fishery, the offshore pelagic longline fishery and the recreational fishery (Anon. 2003). However, fishers derive subsistence benefits too, as some portion of catches are retained by fishers for



Figure 1. Map showing the British Virgin Islands with line demarcating EEZ.

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² <http://www.dpu.gov.vg/> [accessed September 10th, 2012]

³ <http://www.dpu.gov.vg/> [accessed August 10th, 2012]

their families. Traps are the predominant gear used to catch lobster, as well as other shallow water reef species, e.g., doctor fish (*Acanthurus chirurgus*) and yellow-tail snapper (*Ocyurus chrysurus*). Haul seines, handlines and diving are also employed by the near-shore fishery. The offshore pelagic fishery targets tuna (Scombridae), dolphin fish (Coryphaenidae) and wahoo (*Acanthocybium solandri*) by longlining. Like the USVI recreational fishery, fishers in the BVI use rod and reel, handline, spearfishing, free diving, scuba diving and cast netting (Jennings 1992; Mateo 1999) to exploit a variety of species. However all billfishes are strictly catch and release in the BVI.

In the past, approximately half of the annual catch from the near-shore artisanal fleet was exported directly to USVI due to better pricing and marketing arrangements (CDB 1980). For example, in the late 1970s fishers from Anegada would sell processed fish to USVI vendors, who would collect the products in an airplane twice weekly (CDB 1980). Even though an export market existed, the locally retained catches were not sufficient to satisfy local and tourist demand in BVI, therefore, seafood products were also imported to supply the local market. There are no trade data in the FAO database for BVI or USVI; however, other sources reveal the level of seafood imports into the islands. For instance, according to an appraisal of the fisheries sector in the BVI in the mid 1970s, approximately 60 t-year⁻¹ of seafood products were imported between 1974-1976 (CDB 1980).

Formal fisheries management in the BVI is less than twenty five years old and routine catch data collection at the Government Fishing Complex in Road Town in Tortola started in November 2001 (Mills *et al.* 2005). However only 25% of all fishers market their catches at this site, while the remaining 75% of fishers market their catch in the countryside (Alimoso and Overing 1996). Thus, fisheries data collection does not encompass all landing sites in Tortola, nor those of Jost van Dyke, Virgin Gorda and Anegada. Presently, data are collected by log-books, which are distributed to every licensed fisher on the main islands. Fishers record catches by species and return books to the fisheries office in Tortola once a month (A. Pickering, pers. comm., Conservation and Fisheries Department, September, 12th 2012).

The catches submitted by the Department of Conservation and Fisheries to the FAO reportedly consist solely of catches made by the offshore pelagic longline fishery, while data from the near-shore trap fisheries is not submitted to the FAO (A. Pickering, pers. comm., Conservation and Fisheries Department, September, 12th, 2012). Furthermore, FAO landings data for the BVI consist of both reported and estimated catches. Catch estimates are provided by the FAO when countries do not report any fisheries statistics for a given year (Garibaldi 2012). For the years 1976-1982 and 2005-2010, landings were estimated by the FAO. Despite the deficiency in data collection and reporting, implementation of regulations, monitoring and enforcement seem exceptional in the BVI. Spearfishing using SCUBA is not permitted in the BVI, charters must obtain licenses for recreational fishing and fines for illegal fishing can be up to US\$15,000, and compliance seems high. In 2003, there were several cases of the USVI fishing illegally in the BVI. Penalties included detainment of a commercial fishing vessel, a fine of US\$11,000 and jail time.⁴ Unfortunately, historically catch data from this illegal foreign fishery were not available (Walters 1984) and the situation has not changed in present time.

Like many other Caribbean islands, the economy of the BVI is very dependent on the marine and coastal environment and its resources, and the tourism sector in particular. Lack of comprehensive fisheries catch data is hampering fisheries management in the BVI, as without reliable time series catch or effort data, it is difficult to make an informed analysis of the state of the fisheries resources. The fisheries of the BVI have been reported on by Peacock (1975), Klausning (1978), CDB (1980), Alimoso and Overing (1996), Pomeroy (1999) and Franklin (2007). Through review of all available fisheries literature (published and unpublished), we establish the level of fishing in the BVI for the period 1950-2010 in order to create a more accurate picture of the total catches in these islands.

METHODS

Using information on the number of fishers from various sources (see below), together with catch per unit effort information from Klausning (1978), we reconstruct the total small-scale catches from the artisanal near-shore fishery from 1950-2010 in the BVI. No estimates of hand-line catches or haul seine catches were available; thus we conservatively assumed our reconstruction based on trap catch, effort and total number of fishers accounted for all near-shore catches. Since catches from the offshore pelagic longline fishery are captured by the current data collection system, we extracted these catches from the FAO dataset and assumed no unreported catches from this sector. Further, in 2003, reported landings were 2,771 t, which is double of that reported in the year before and after. Since we found no information to explain this sudden rise in catches, we did not accept the FAO reported value and instead used our own reconstructed total which was lower and assumed no unreported catches in this year. Finally we applied a minimal recreational catch per tourist to estimate catches made by the recreational sector. It should be noted that the FAO baseline was adjusted for one year, 2003, as detailed in the results section below.

Table 1. Data sources used to estimate number of fishers in the BVI.

Year	No. active fishers	Source
1950	98	Assumption based ^a
1978	151	Klausning (1978)
1991	280	Alimoso and Overing (1996)
1999	374	Pomeroy (1999)
2010	410	Assumption based ^b

^a Based on a proportion of fishers to total population of 0.014 in 1978.

^b Based on the proportion of fishers to total population of 0.022 in 1999.

⁴ www.stthomassource.com [Accessed 2 October, 2012]

Small-scale fisheries

Details on the number of fishers were obtained from various sources for the years 1978, 1991 and 1999 (Table 1). Taking the proportion of fishers within the population as a ratio, and using direct linear interpolation between anchor points in 1978, 1991 and 1999, we estimated the population of fishers operating on the islands from 1950-2010 (Figure 2). For the period 1950-1978, we used the ratio of fishers to total population in 1978 (0.014) as a constant. Similarly, for the period 1999-2010, we used the ratio of fishers to total population in 1999 (0.022) as a constant.

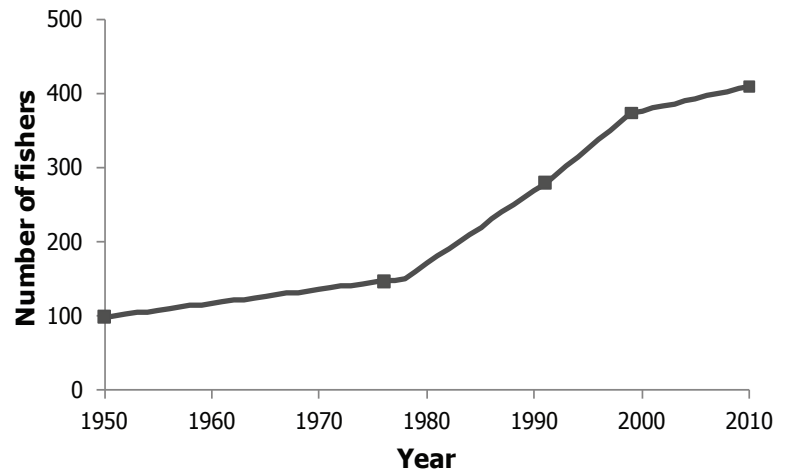


Figure 2. Time-series of the number of fishers in the British Virgin Islands during the period 1950-2010 (anchor points represented by solid points on graph).

Near-shore fishery

Klausing (1978) conducted a feasibility study for medium-scale fisheries in the BVI in 1975, as part of a United Nations funded project. He described the current effort of the near-shore trap fishery as 50 fishing weeks per year, 3 fishing days per week, 15 trap hauls per day and 5 lbs of catch per trap, giving a rate of 5.11 t·fisher⁻¹·year⁻¹. Assuming this rate remained constant, we combined this rate with the number of fishers, and estimated the catches from BVI's near-shore fishery as:

$$\text{Catch} = \# \text{ fishers} \times 5.11 \text{ t} \cdot \text{fisher}^{-1} \cdot \text{year}^{-1}$$

Since it is known that fishers take home a portion of their catch (Anon. 2003), we assumed some proportion of our reconstructed catches to be part of subsistence catches. To assign small-scale catches to artisanal and subsistence sectors, it was assumed that in 1950, 70% of near-shore catches were from the subsistence sector and 30% were from the artisanal sector. In 2010, it was assumed that 30% of catches were attributed to the subsistence sector and 70% to the artisanal sector. A linear interpolation was done between these two years to derive an assignment by sector for the entire 1950-2010 time-period.

Offshore longline fishery

The offshore pelagic longline fishery is limited to a few active boats (Franklin 2007). Catches from this sector are reported to the FAO under the present data collection system (A. Pickering, pers. comm., Conservation and Fisheries Department, September, 12th, 2012). As such, we relied on the FAO data to represent catches for this sector. We assumed no unreported catch component for this sector. Kelleher (2005) describes discards from small-scale longline fisheries in the range of 7.5%–15%, thus taking 10% of the total offshore catches we reconstructed the discards associated with this sector.

Recreational fishery

During the 1975 assessment of BVI fisheries, Klausing (1978) conservatively assumed catches from the recreational sector were 23 t for that year. Assuming the recreational sector is comprised mainly of tourists, we divided this catch of 23 t by the number of stop-over tourists in the BVI⁵ in 1975 to get an average *per capita* recreational catch rate of 0.001 t·tourist⁻¹·year⁻¹. Assuming conservatively that this rate remained constant, we combined this with the number of annual stop-over tourists (Figure 3), to estimate catches from BVI's recreational sector for the period 1950-2010.

Table 2. Derived taxonomic breakdown for the near-shore fisheries of British Virgin Islands.

Family	Percentage composition	
	1950	2010
Balistidae	2.00	2.30
Carangidae	1.20	2.30
Carcharhinidae	0.04	0.02
Centropomidae	0.90	0.50
Clupeidae	0.60	2.30
Exocotidae	0.40	0.50
Gereidae	0.40	4.60
Haemulidae	18.50	4.60
Holocentridae	0.50	2.30
Labridae	1.00	2.30
Lobster	8.30	7.30
Lutjanidae	1.20	7.30
<i>Lutjanus analis</i>	1.50	2.30
<i>Lutjanus synagris</i>	2.90	2.30
<i>Lutjanus vivanus</i>	12.70	6.90
<i>Ocyurus chrysurus</i>	3.90	23.90
Miscellaneous marine fishes	4.80	4.60
Mullidae	7.10	6.90
Octopus	0.90	2.30
Ostraciidae	0.60	3.70
Scaridae	8.30	4.60
Scombridae (Mackerels)	3.30	0.05
Serranidae	11.30	0.50
Shellfish, whelks	0.80	4.60
Sparidae	0.90	0.50
Sphyraenidae	1.00	0.50
Strombidae	4.90	0.30

⁵ Caribbean Tourism Organisation website: <http://www.onecaribbean.org/> [Accessed September 11th, 2012]

Taxonomic composition of catches

Island specific quantitative catch composition data for the near-shore were unavailable in the BVI fisheries literature accessed for this study. FAO data for BVI consists of 15 taxonomic groups from 13 families. A detailed breakdown of catches from Puerto Rico in the year 1975 was presented in the appraisal report on the fisheries of the BVI (CDB 1980). We applied the Puerto Rico catch breakdown to the year 1950 and took the average FAO breakdown for 2001-2010 and applied it to the year 2010. Given that the FAO breakdown only consisted of 13 families, whereas the Puerto Rico breakdown included 26 families, we further disaggregated the FAO breakdown based on our knowledge of changes in herbivores on Caribbean coral reefs and popularity of certain reef fishes in diets. The assumed and derived taxonomic breakdown of the catch can be seen in Table 2.

RESULTS

Reconstructed catches from the near-shore fishery totalled just under 69,000 t for the BVI during the period 1950-2010. Catches from the offshore fishery totalled 400 t from its start in 1994 to 2010. The discards from this sector were estimated at approximately 40 t for the same period. Reconstructed catches from the recreational sector in BVI amounted to slightly over 1,800 t for the full time period (Figure 4a).

The increase in reported landings in 2001 coincides with the year in which systematic data collection began (Figure 4a). Except for the year 2003, reported landings for BVI fluctuated between 100 and 1,200 t·year⁻¹, with annual reported landings averaging 507 t·year⁻¹. In 2003, reported landings were 2,058 t, which is double of that reported in the year before and after. Since we found no information to explain this sudden and short-lived spike in reported landings, we did not accept the FAO record for 2003. Thus there were no obvious unreported catches in this year. Total unreported catches for the period 1950-2010 were estimated at slightly over 40,900 t, with average annual unreported catches of approximately 670 t·year⁻¹ (Figure 4).

Catches from the subsistence sector were estimated at 17,800 t from 1950-2010, while those from the artisanal sector were estimated at 51,600 t for the same period (Figure 4a). Total reconstructed catches for the BVI for the period 1950-2010 were estimated to be just over 71,000 t, which is 2.3 times the reported landings of 30,272 t as presented by the FAO on behalf of BVI.

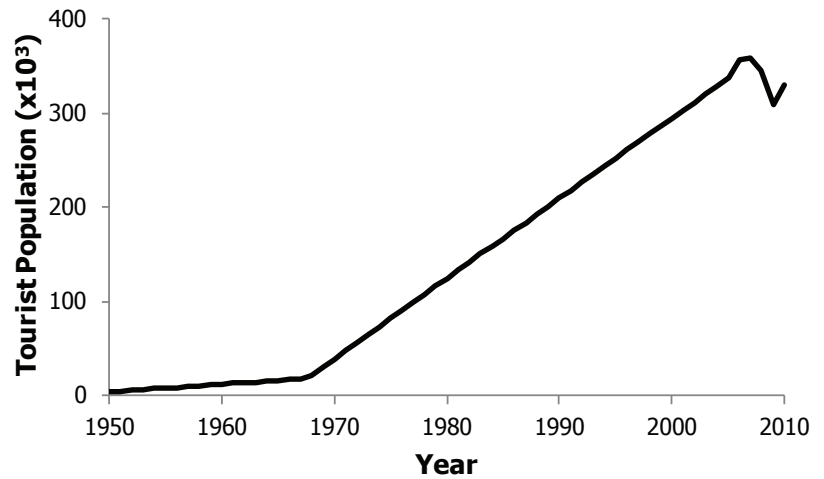


Figure 3. Stop-over tourist population for the British Virgin Islands during the period 1950-2010.

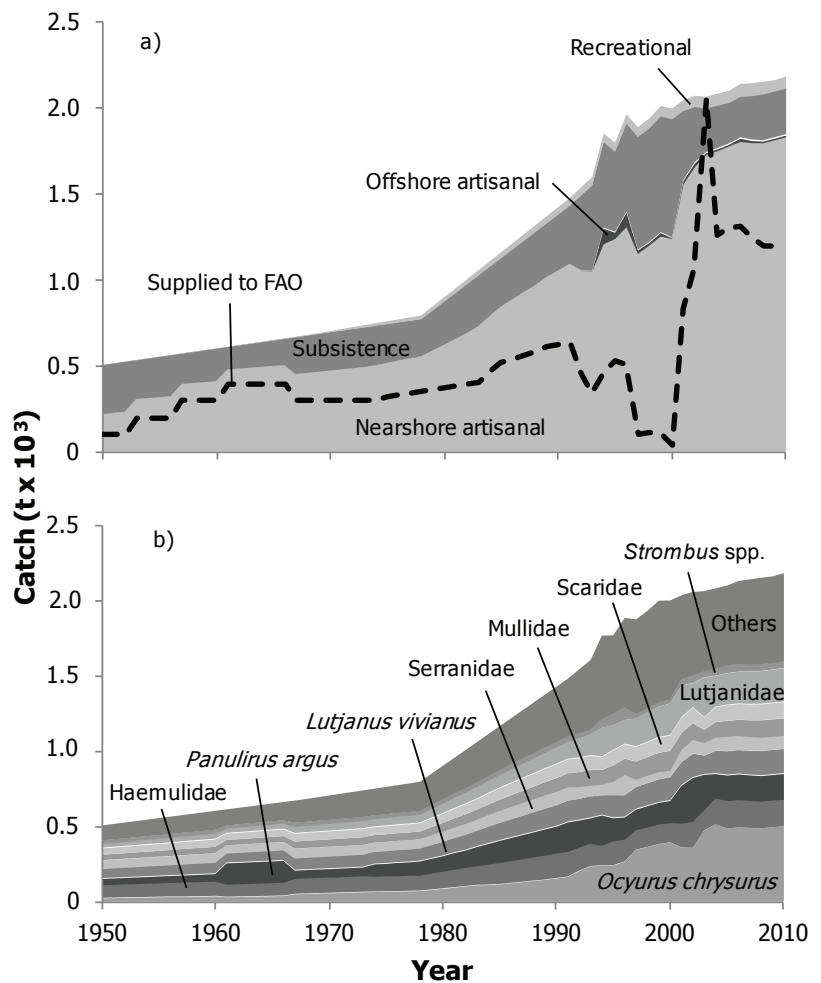


Figure 4. Reconstructed total catches for the British Virgin Islands; a) by sector with FAO reported landings shown as an overlaid line graph; and b) by taxa, with ‘Others’ consisting of 20 additional taxonomic groups.

Catches were dominated by reef species such *Ocyurus chrysurus* (yellowtail snapper 14%) and *Lutjanus vivanus* (silk snapper 9%), with 'other lutjanids' comprising 4% of total catches. Grunts (Haemulidae 11%) and groupers (Serranidae 6%) were also important in catches, as were goatfish (Mullidae 6%) and parrotfish (Scaridae 6%). Catches of marine invertebrates such as *Panulirus argus* (10%) and *Strombus gigas* (3%) were common. The 30% 'Others' category was comprised of 10 demersal families, 8 pelagic families, miscellaneous marine fishes, and miscellaneous marine invertebrates (Figure 4b).

DISCUSSION

A report by the Development Planning Unit of the Ministry of Finance stated that fishing contributed 2.5% to the GDP of the BVI in 1988. However, this report failed to indicate that fish provided a valuable protein source to the local population (Anon. 2003) and was likely based on reported landings only. Despite the economic and cultural significance of marine fisheries to these islands, fisheries administration is lagging, with less than 25 years of formal fisheries management in the BVI (Mills *et al.* 2005). On the other hand, there have been major improvements since routine data collection began in 2001 (Mills *et al.* 2005). This is illustrated by the steep increase in FAO reported landings in the later period. Furthermore, surveillance and enforcement of fisheries legislation is routinely conducted in the BVI. All fishers must have valid licenses to fish, and monitoring and enforcement is routine, while illegal fishing is being combated with fines up to US\$15,000 (A. Pickering, pers. comm., Conservation and Fisheries Department, September, 12th 2012).

Despite increased vigilance in monitoring and enforcement, our reconstructed catches were 2.3 times higher than those reported to the FAO over the 1950-2010 time period, and for the most recent decade the discrepancy was still 940 t·year⁻¹ (or 65%). Our study of total reconstructed catches for the BVI contains under-reported catches from the near-shore fishery, which is the major fishing sector in the islands (CDB 1980; Alimoso and Overing 1996), as well as unreported catches from a popular recreational sector. To what extent mis- or under-reporting occurs also in the offshore pelagic sector could not be determined in the present study, but it is likely. Furthermore the discards from this sector should not be overlooked.

There seems to be some distrust by the Conservation and Fisheries Department, which collects near-shore catch data but treats it as confidential, and does not report it to the FAO. Such withholding of data on a public resource is surprising and should be rectified by the responsible authorities. In addition, catches from the recreational sector are not being captured by the present data collection system. Reconstructed recreational catches amounted to approximately 1,800 t for the period 1950-2010. Thus, the impact of tourists is being underestimated. This should be of particular concern for islands such as the BVI, where tourist populations are an order of magnitude greater than local resident populations, and where tourist experience is a major economic factor.

Data reported by the FAO on behalf of the BVI were presented in 13 taxonomic categories. Reconstructed catches were disaggregated into 26 families, which is a major improvement over the reported data. Given that no quantitative catch composition data were available, our reconstruction is the best representation of likely total catches made in the BVI at present. With greater transparency from and some targeted investigations by the Conservation and Fisheries Office, these estimates could be improved upon.

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Appendix Table A1. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector for the British Virgin Islands, 1950-2010.

Year	FAO landings	Reconstructed total catch	Nearshore artisanal	Offshore artisanal	Subsistence	Recreational
1950	100	505	221	-	283	1
1951	100	515	227	-	287	1
1952	100	525	233	-	291	1
1953	200	534	307	-	226	1
1954	200	544	312	-	231	2
1955	200	554	317	-	235	2
1956	200	564	323	-	239	2
1957	300	573	394	-	177	2
1958	300	583	399	-	181	2
1959	300	593	405	-	186	2
1960	300	602	410	-	190	3
1961	400	612	478	-	131	3
1962	400	622	483	-	136	3
1963	400	632	488	-	140	3
1964	400	641	494	-	145	3
1965	400	651	499	-	149	3
1966	400	661	505	-	153	4
1967	300	671	452	-	215	4
1968	300	681	458	-	218	5
1969	300	693	465	-	221	7
1970	300	704	472	-	224	8
1971	300	715	478	-	227	10
1972	300	727	485	-	229	12
1973	300	738	492	-	232	14
1974	306	750	503	-	231	16
1975	318	761	517	-	227	18
1976	330	772	530	-	223	19
1977	340	784	543	-	220	21
1978	350	795	555	-	217	23
1979	360	848	588	-	235	25
1980	370	900	622	-	252	27
1981	380	953	656	-	269	28
1982	390	1,005	690	-	285	30
1983	407	1,058	729	-	297	32
1984	470	1,111	789	-	287	34
1985	520	1,163	844	-	283	36
1986	543	1,216	886	-	292	38
1987	565	1,268	928	-	301	39
1988	582	1,321	968	-	312	41
1989	615	1,373	1,016	-	315	43
1990	624	1,426	1,053	-	328	45
1991	634	1,479	1,091	-	340	47
1992	453	1,540	1,056	-	436	49
1993	343	1,602	1,052	-	500	50
1994	470	1,764	1,211	91	501	52
1995	532	1,766	1,242	36	470	54
1996	506	1,882	1,310	85	516	56
1997	105	1,872	1,154	20	660	58
1998	116	1,928	1,203	15	666	59
1999	115	1,996	1,256	20	679	61
2000	45	1,997	1,241	4	693	63
2001	837	2,032	1,561	19	406	65
2002	1,062	2,054	1,661	22	326	67
2003	2,058	2,059	1,732	10	258	69
2004	1,262	2,078	1,754	10	253	70
2005	1,300	2,095	1,783	9	241	72
2006	1,309	2,127	1,809	18	242	76
2007	1,250	2,137	1,801	12	259	77
2008	1,200	2,148	1,800	9	273	74
2009	1,200	2,157	1,818	9	273	66
2010	1,200	2,178	1,836	9	272	71

Appendix Table A2. Reconstructed total catch (in tonnes) by major taxa for British Virgin Islands, 1950-2010. 'Others' contain 26 additional taxonomic categories.

Year	<i>Ocyurus chrysurus</i>	Haemulidae	<i>Panulirus argus</i>	<i>Lutjanus vivanus</i>	Serranidae	Mullidae	Scaridae	Lutjanidae	<i>Strombus</i> spp.	Others
1950	19	93	42	64	57	36	42	29	25	99
1951	21	94	42	65	57	36	42	30	25	102
1952	23	95	43	66	58	37	43	31	25	105
1953	24	96	44	67	58	38	44	31	26	107
1954	25	97	45	68	59	38	44	32	26	110
1955	27	98	45	68	59	39	45	33	26	113
1956	29	99	46	69	60	40	45	34	26	116
1957	28	101	47	71	61	40	46	34	27	117
1958	30	102	48	72	62	41	47	35	27	120
1959	31	103	49	72	62	42	47	36	27	123
1960	33	104	49	73	62	42	48	37	27	126
1961	27	89	142	62	53	36	41	31	23	107
1962	29	90	142	63	54	37	41	32	24	110
1963	30	91	143	64	54	37	42	33	24	112
1964	32	92	144	65	55	38	43	34	24	115
1965	34	93	145	66	55	39	43	35	24	118
1966	35	94	145	67	56	39	44	36	24	121
1967	47	109	54	79	64	47	51	44	28	147
1968	49	109	55	79	64	48	52	45	28	151
1969	51	110	56	80	64	48	52	47	28	156
1970	53	110	56	81	64	49	53	48	28	161
1971	56	111	57	81	64	50	53	49	28	166
1972	58	111	58	82	64	50	54	50	28	172
1973	60	111	59	82	64	51	54	51	28	177
1974	62	107	82	80	62	50	52	51	27	177
1975	63	108	83	81	62	51	53	52	27	181
1976	65	108	88	81	62	51	53	52	27	185
1977	66	109	89	82	62	52	54	53	27	189
1978	68	109	94	82	62	52	54	54	27	193
1979	75	115	98	87	65	55	57	59	28	208
1980	83	120	102	92	68	59	60	63	30	224
1981	90	125	111	96	69	62	63	68	31	239
1982	99	130	114	101	72	66	66	73	32	255
1983	106	133	127	104	74	69	68	77	32	268
1984	108	141	137	110	78	72	72	79	34	279
1985	112	148	147	115	82	75	75	83	36	291
1986	119	153	153	119	85	78	78	87	37	306
1987	127	158	160	124	87	81	81	91	38	321
1988	135	162	166	128	89	85	84	96	39	337
1989	142	168	174	132	92	88	87	100	40	351
1990	151	171	178	136	93	92	90	106	41	368
1991	161	172	196	139	93	94	91	110	41	382
1992	201	162	179	139	82	100	91	126	36	425
1993	231	157	168	140	76	105	92	139	34	460
1994	236	138	201	128	73	99	85	190	60	553
1995	237	167	153	147	93	109	97	164	79	519
1996	262	152	148	142	138	110	93	158	85	593
1997	340	137	137	144	53	121	95	184	32	628
1998	359	137	141	146	54	124	97	194	32	644
1999	378	137	144	150	53	129	99	201	31	674
2000	389	136	147	152	47	133	101	208	27	658
2001	356	167	250	150	87	113	99	208	46	555
2002	352	181	291	154	98	110	101	160	51	555
2003	469	141	236	121	89	88	80	262	42	532
2004	509	179	162	148	95	103	97	204	50	531
2005	481	190	170	155	101	107	102	208	53	530
2006	488	189	171	155	100	108	102	211	53	550
2007	485	187	169	157	97	111	103	213	50	564
2008	482	187	168	160	95	115	105	216	47	574
2009	489	185	169	160	94	116	105	219	46	573
2010	496	184	170	160	92	117	105	222	46	586