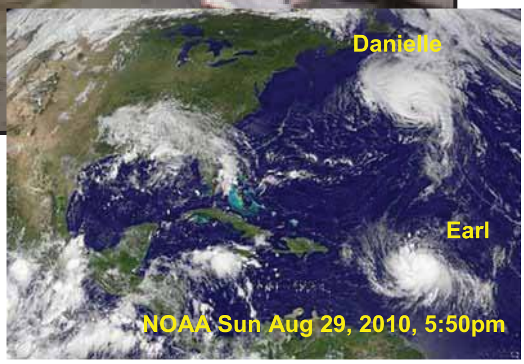
HURRICANE EARL – FINAL DAMAGE ASSESSMENT REPORT FOR ANTIGUA AND BARBUDA'S FISHERIES SECTOR



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Hurricane Earl – Final Damage Assessment Report for Antigua and Barbuda's Fisheries Sector by Ian Horsford, October 2010

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Purpose and Scope

The purpose of this document is to provide an assessment of the damage done to the fisheries sector of Antigua and Barbuda following the passage of Hurricane Earl, a category-two hurricane on the Saffir-Simpson Wind Scale, on Monday, 30 August 2010. Hurricane Earl was the third hurricane of the 2010 Atlantic hurricane season and it packed maximum sustained winds of 100 miles per hour (161 km / hour) when it passed the islands. According to the Antigua and Barbuda Meteorological Services, about 7 inches (178 mm) of rain fell across both islands, resulting in widespread flooding.

Methodology

Following the passage of Hurricane Earl, a damage assessment was conducted from 31 August to 2 September 2010, and a preliminary report published. Surveyors were fisheries personnel that were directly responsible for inspecting and licensing fishing vessels, and managers of fisheries complexes. A total of 29 landing sites were visited in Antigua and Barbuda and the damage done to fishing vessels, equipment and fisheries infrastructure was recorded. The estimated cost of the damage was determined using various methods:

- Direct assessment by surveyors of the cost of repair materials and labour;
- Interview of vessel owners; and
- Interview of individuals contracted or responsible for repairs (e.g., shipwright, marine engineer, public works engineer).

In the case where a vessel was completely destroyed or lost at sea, the value of the vessel was based on the depreciated value. The following depreciation rates were applied annually provided no major refurbishing took place:

- hull at 10%;
- outboard engine at 20%;
- inboard engine at 10%; and
- fishing / navigation equipment at 10%.

Damage assessment of fishing gear was based on the replacement cost of the gear. In the case of fish pots or traps, replacement cost included cost of construction materials (hexagonal wire, tie wire, wattle or steel, buoy, rope, etc) plus the cost of labour. The list of surveyors and the form used for the assessment of fishing vessels, equipment and gear is included in Appendix I. Final assessment of the damage done to the sector was completed on Friday, 8 October, 2010. This was due to the fact that marine advisories related to Tropical Storm Fiona, Tropical Storm Gaston and Hurricane Igor, delayed many fishers from checking the status of their gear. The passage of Hurricane Igor, September 13 to 15, 2010, generated large swells particularly on the western and northern coast of Antigua (Figure 1). Antigua and Barbuda's fisheries sector is primarily based on targeting the demersal resources (e.g., Caribbean spiny lobster, reef and slope fishes), hence lost gear are mainly fish pots or traps.

Estimate of the number of fish pots (traps) in operation prior to Hurricane Earl was based on the following:

- the number of active trap fishing units per size class; and
- the mean number of reported traps per size class.

In order to validate the fore mentioned estimate, the maximum number of fish pots that could be in operation prior to Hurricane Earl, was calculated based on:

- the number of units of fish pot wire (hexagonal wire) imported into Antigua and Barbuda;
- the mean number of pots (traps) per unit of hexagonal wire; and
- the anecdotal information that fishers reserve about 10% of their pots for unforeseen events (e.g., theft, ground swell).

Data on the importation of hexagonal wire was obtained from the Fisheries Division's records regarding duty-free concessions. The mean life span of fish pots ranged from 9 to 12 months; hence only data from the period 20 August 2009 to 20 August 2010 was used in the calculations. Reports of loss pots (traps) and total number of pots in operation were checked for consistency with the records pertaining to catch and effort, vessel registration and annual vessel licence.

In order to guide future mitigation strategies as well as improve the resilience of the sector to tropical storms / hurricanes, risk assessment was conducted with respect to fishing vessels and fishing gear. The *odds ratio* or the *cross-product ratio* (ψ) was used as a measure of risk. The odds ratio is defined as:

$$\psi = \frac{P[B \mid A] / P[B^c \mid A]}{P[B \mid A^c] / P[B^c \mid A^c]}$$

The numerator is the odds of event B happening relative to event A, while the denominator is the odds of event B happening relative to the complement of A. The *sample odds ratio*, r_o, can then be defined by replacing the conditional probabilities by the respective relative frequencies:

$$r_o = \frac{[a / (a + c)] / [c / (a + c)]}{[b / (b + d)] / [d / (b + d)]}$$

$$r_o = ad / bc$$

Hence the odds ratio is the ratio of the odds of an event happening in one group to the odds of it happening in another group. The 95% confidence limits for the odds ratio were used to determine if the odds were significantly different. The approximate 95% confidence limits were defined as follows:

$$\text{Lower limit} = e^{R - (1.96) * [(1 / a) + (1 / b) + (1 / c) + (1 / d)]^{1/2}}$$

$$\text{Upper limit} = e^{R + (1.96) * [(1 / a) + (1 / b) + (1 / c) + (1 / d)]^{1/2}}$$

where R equals $\log_e [r_o]$.

Figure 1. Swells generated in Parham by the passage of Hurricane Igor, September 13, 2010.

Results & Discussion

Damage Assessment for Fishing Vessels and Equipment

St. John's Harbour, the chief port of the island of Antigua, continues to be the main "hot spot" when it comes to damage caused to fishing vessels (and infrastructure) by storms or hurricanes. As far back as August 27, 1995, six fishing vessels in St. John's Harbour were the only reported damage attributed to Tropical Storm Iris. Seven of the fourteen fishing vessels (or 50% of the vessels) damaged by Hurricane Earl in Antigua were located at landing sites in St. John's Harbour (e.g., Keeling Point, Point Wharf, Bryson Wharf) (Table 1). In Barbuda, only four fishing vessels were reportedly damaged; they were all located at Codrington Wharf.

Total estimate of the damage done to fishing vessels and equipment was valued at EC$80,090 (Table 1). This value did not include salvage cost which in certain cases exceeded the repair cost. Photographs of damaged fishing vessels are included in Appendix II.

Table 1. Summary of damage done to fishing vessels and equipment in Antigua-Barbuda by Hurricane Earl, August 2010. Estimated cost only included repair cost; salvage cost in the case of grounded or sunk vessels were not included.

	Landing Site	Status of Vessel	Number of Vessels	Estimated Cost (EC$)
	English Harbour	Damaged Lost at sea Destroyed	1 0 0	$13,560
	Jolly Harbour	Damaged Lost at sea Destroyed	1 0 0	$2,600
	Parham	Damaged Lost at sea Destroyed	1 0 0	$6,000
	Point Wharf and Bryson Wharf	Damaged Lost at sea Destroyed	6 0 0	$29,250
	Keeling Point	Damaged Lost at sea Destroyed	1 0 0	$1,000
	Emerald Cove, Willikies	Damaged Lost at sea Destroyed	4 0 0	$21,030
ANTIGUA		**Damaged** **Lost at sea** **Destroyed**	**14** **0** **0**	**$73,440**
BARBUDA	Codrington Wharf	**Damaged** **Lost at sea** **Destroyed**	**4** **0** **0**	**$6,650**
TOTAL		**Damaged** **Lost at sea** **Destroyed**	**18** **0** **0**	**$80,090**

Risk Assessment for Fishing Vessels

In terms of risk of damage to fishing vessels by hurricanes, pooled data from Hurricane Luis, Hurricane Georges and Hurricane Earl, indicated that vessels located in St. John's Harbour were three times more at risk for damage than vessels located at other landing sites in Antigua; the sample odds ratio (r_o) was 3.149 (Table 2). This risk was statistically significant since the 95% confidence interval for the odds ratio did not include the value 1 (Table 2); it ranged from at least 2.106 to at most 4.710. Therefore the risk of vessel damage by hurricanes in St. John's Harbour is significantly greater than other fish landing sites in Antigua, and with 95% confidence the risk is at least two times more and at most five times as much.

Due to the unavailability of comprehensive data at the landing site level for Barbuda, similar risk assessment could not be conducted. The absence of comprehensive data at the landing site level for other tropical storms / hurricanes also prevented further risk assessment of other possible factors (e.g., hurricane strength, hurricane path, method of securing vessel).

Table 2. Summary of risk analysis for vessel damage, by location, for Antigua using pooled data from Hurricane Luis (1995), Hurricane Georges (1998) and Hurricane Earl (2010).

	Risk factor for fishing vessels: Location during hurricane		
	St. John's Harbour	**Other Fish Landing Sites**	**Total**
Condition:			
Vessel damage	65	44	**109**
No vessel damage	364	776	**1140**
Total	**429**	**820**	**1249**
	Sample odds ratio (r_o)		**3.149**
	Lower 95% confidence limit for the odds ratio parameter (ψ)		**2.106**
	Upper 95% confidence limit for the odds ratio parameter (ψ)		**4.710**

Damage Assessment for Fishing Gear

A total of 1,104 fish pots (traps) were reportedly lost following the passage of Hurricane Earl; some of these trap losses may be attributed to Hurricane Igor (Table 3). As mentioned previously, marine advisories related to Tropical Storm Fiona, Tropical Storm Gaston and Hurricane Igor, delayed many fishers from checking the status of their traps. Replacement cost of lost gear (fish pots) was valued at EC$251,054 and accounted for 14.8% of the estimated number of fish pots in operation prior to the passage of Hurricane Earl (Table 3). A total of 43 fishers / investors were directly affected or 6.0% of the active workforce. With 3.2 financial dependants per fisher, this translates to an additional 138 individuals indirectly affected. Reports of lost traps were limited to fishers from Antigua despite the centre of Hurricane Earl passing 35 miles (56 km) north of Barbuda. This was probably due to the fact that SCUBA diving is fast becoming the preferred method for targeting the Caribbean spiny lobster in Barbuda. The spiny lobster is the principal species of commercial interest in Barbuda.

Estimate of the number of fish pots (traps) in operation prior to Hurricane Earl and validation of estimate are included in Appendix III.

Table 3. Summary of fishing gear (trap) losses due to Hurricane Earl (August 2010) for Antigua-Barbuda. Note some of the reported trap losses may be attributed to Hurricane Igor.

Number of Traps in Operation Prior to Hurricane Earl	Number of Traps Reported Lost	Percentage Trap Loss (%)	Estimated Value of Lost Traps (EC$)
7,483	1,104	14.8%	$251,054

Risk Assessment for Fishing Gear (Traps)

Since Hurricane Luis in 1995 when 12,064 traps (fish pots) were reportedly lost, trap fishers have employed various strategies during the hurricane season to mitigate their risk. These include:

1) Reducing the number of traps in operation.
2) Shifting to fishing gears that involve less risk (e.g., hand line, gill net, SCUBA).
3) Shifting to fishing methods that involve less risk (e.g., hauling and setting, a limited number of baited snapper traps, multiple times in a trip, thereby allowing the fishers to bring their traps back to shore and at the same time maintain revenues).
4) Setting traps in deeper waters outside the assumed boundary of the active wave energy (for traps set without surface buoys).

The latter strategy is assumed to reduce the drag on fish traps during a hurricane and was employed by certain fishers following the passage of a winter swell in March 2008. This was seen as an alternative to bring traps to shore.

Table 4 attempts to quantify the risk with respect to method of trap deployment during a hurricane using data from Hurricane Earl. Of the fishers reporting lost gear, 49% of the traps deployed with buoys were lost as opposed to 46% of the traps deployed without buoys. In terms of measure of risk, the odds of gear loss for traps set with buoys was 1.13 times that for those set without buoys. Given that the 95% confidence interval estimate covers the value 1 (Table 4), the odds of gear loss occurring during a hurricane is not significantly different for the two methods of trap deployment. Further risk assessment will have to be done to confirm this initial findings since data was only available for one event (hurricane) and other risk factors (e.g., depth of deployment, location of gear) may influence the outcome. Lack of comprehensive data with respect to gear depth and gear location hindered further analysis; most fishers would only provide a depth range and a general location.

In regards to choice of gear deployment, 72% of the vessels reporting trap loss do not utilise surface buoys when fishing for the shallow reef fishes and the Caribbean spiny lobster. Setting without buoys, using a Global Positioning System (GPS) receiver, has become a mitigation strategy to address gear loss associated with theft and cut-away. Over the past ten years, this method of deployment has increased in popularity due to improvements in the affordability, "user-friendliness" and precision of the GPS technology.

Table 4. Summary of risk analysis for trap (pot) loss, by method of deployment, for Antigua using data from Hurricane Earl (August 2010).

	Risk factor for traps: Method of deployment during hurricane		
	Set with Buoys	**Set without Buoys**	**Total**
Condition:			
Gear loss	143	885	**1028**
No gear loss	147	1031	**1178**
Total	**290**	**1916**	**2206**
	Sample odds ratio (r_o)		**1.133**
	Lower 95% confidence limit for the odds ratio parameter (ψ)		**0.885**
	Upper 95% confidence limit for the odds ratio parameter (ψ)		**1.451**

Damage Assessment for Fisheries Infrastructure

There are currently four fisheries complexes in Antigua: Point Wharf; Market Wharf; Urlings and Parham. A fifth complex is currently under construction at Codrington Wharf in Barbuda. In terms of damage to infrastructure, only the docks at the Point Wharf Fisheries Complex were damaged (See Appendix IV). Inspection of the structure indicated that the wooden planks were dislodged from the supporting beams and estimate of the damage was valued at EC$21,586 (Table 5).

At River Wharf in Barbuda, deposition of sand and other debris in the channel have made access to the landing site difficult from the sea; the channel will have to be dredged to improve access for fishing vessels and other users (e.g., ferry, sand barge).

Table 5. Summary of damage done by Hurricane Earl (August 2010) to fisheries infrastructure in Antigua-Barbuda and estimated cost of repairs.

Fisheries Infrastructure	Area of Damage	Estimated Cost of Repair Materials (EC$)	Estimated Cost of Labour (75% of materials) (EC$)	Total Cost of Repairs (EC$)
Point Wharf Fisheries Complex, Antigua	Docks	$12,335	$9,251	$21,586

Conclusion

Based on the damage done to fishing vessels (EC$80,090) and fisheries infrastructure (EC$21,586), and the replacement cost of lost gear (EC$251,054), total damage done by Hurricane Earl to the fisheries sector of Antigua and Barbuda was valued at EC$352,730. While this value is no where in the magnitude of previous hurricanes, the loss of 14.8% of the total number of traps in operation is expected to impact fisheries' gross domestic product for 2010. Couple this with a decline in demand for fishery products (both from the tourism and domestic export sector), the economic outlook for the latter quarter of 2010 looks bleak. This is best highlighted by the decrease in demand for the Caribbean spiny lobster, a luxury food item, despite above average landings per trap (associated with the passage of Hurricane Earl and Hurricane Igor), and a reduction in price; the decrease in demand was attributed to the contraction of the national economy as a result of the economic downturn experienced with respect to the key driver of the economy, tourism.

As mentioned previously, the collection of comprehensive damage assessment data is critical towards risk assessment. The risk assessment done with respect to vessel location and fishing gear is a step in the right direction. The Fisheries Division hopes to incorporate other formal risk assessment methods (e.g., attributable risk, Monte Carlo simulation) into future damage assessments to:

- guide mitigation strategies with respect to hurricanes and other disasters; and
- ultimately improve the resilience of the sector.

Appendix I: List of Surveyors & Damage Assessment Form

List of Surveyors: Mark Archibald; Taryn Edwards; John Webber; Hilroy Simon; Ian Horsford; Orlando Morris; Cheryl Appleton; and Elton Ryan

FISHERIES DIVISION ANTIGUA & BARBUDA

Modified by: Taryn Edwards

24/09/2010

DAMAGE ASSESSMENT FORM FOR FISHERIES

Name of Fisher………………………………………………Tel. contact #…………………………………

Owner ☐ Captain ☐ Crew ☐ Investor ☐

Other ☐ Specify……………………………………………………………………………………

Name of Boat……………………………………………………………………Reg. #……………………

DAMAGE ASSESSMENT FOR FISHING BOATS AND EQUIPMENT

Type of Boat……………………………………Size…………………………Engine……………………

Landing Point…………………………………Insured with………………………………………………

Destroyed ☐ Loss ☐ Damaged ☐ Cost (EC$)……………………

Specify Damage………………………………………………………………………………………………

……

DAMAGE ASSESSMENT FOR FISH POTS

No. of Pots on Buoys………… Depth (specify feet or fathom)……… No. Loss ……. Area…………

No. of Pots without Buoys…… Depth (specify feet or fathom)……… No. Loss ……. Area…………

Cost (EC$) ……………………………………………………

DAMGE ASSESSMENT FOR OTHER FISHING GEAR

Type of Gear……………………………………………………………Cost (EC$)………………………

Comments……………………………………………………………………………………………………

……

Assessor's Signature…………………………………………………Date……………………………

Appendix II: Photographs of Damaged Fishing Vessels

English Harbour: vessel hull severely damaged

Mosquito Cove, Jolly Harbour: vessel with damaged prop, shaft and rudder

Keeling Point, St. John's Harbour: vessel with damaged hull

Point Wharf, St. John's Harbour

Point Wharf, St. John's Harbour: vessel with bent prop, broken keel and major damage to stern and hull

Point Wharf, St. John's Harbour: vessel with damaged bow

Bryson Wharf, St. John's Harbour

Bryson Wharf, St. John's Harbour: vessel with hull and bow severely damaged

Bryson Wharf, St. John's Harbour

Bryson Wharf, St. John's Harbour: vessel with hull severely damaged

Point Wharf, St. John's Harbour: vessel with damaged gunwale

Point Wharf, St. John's Harbour: vessel with minor damaged to gunwale

Emerald Cove, Willikies: vessel flooded and loss equipment

Emerald Cove, Willikies: vessel with flooded two-stoke outboard engine

Appendix III: Estimate of the Number of Traps in Operation Prior to Hurricane Earl & Validation of Estimate

Size Class	Active Trap fishing Vessels in Antigua-Barbuda	Mean Number of Traps	Estimated Number of Traps Prior to Hurricane Earl
<21 ft.	31	17.5	543
21-30 ft.	52	86.1	4,479
31-40 ft.	23	63.1	1,451
41-50 ft.	7	63.1	442
> 50ft.	4	142.5	570
Total	**117**		**7,483**

Validation of the Estimated Number of Traps in Operation Prior to Hurricane Earl Based on the Number of Units of Imported Fish Pot Wire.

Number of Rolls of Fish Pot Wire Imported into Antigua-Barbuda (20 Aug 2009 - 20 Aug 2010)	Mean Number of Traps per Roll	Maximum Number of Traps that Could have been Constructed Prior to Hurricane Earl	Maximum Number of Traps that Could have been in Operation Prior to Hurricane Earl (assuming 10% of the gear is reserved for unforeseen events and ignoring prior gear loss)
1,205	8.44	10,170	9,153

Appendix IV: Photographs of Damaged Fisheries Infrastructure


Photo: Mark Archibald

Damage to the eastern section of the docks at Point Wharf Fisheries Complex, St. John's Harbour, Antigua

Photo: John Webber

Damage to the western section of the docks at Point Wharf Fisheries Complex, St. John's Harbour, Antigua