A Collaborative Assessment of the Virgin Islands Spiny Lobster Fishery

Una Evaluación Colaborativa de la Pesquería de Langosta de Islas Vírgenes

Une Évaluation Concertée de la Pêche des Langoustes D'îles Vierges

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ABSTRACT

Virgin Islands spiny lobster resources were evaluated through a cooperative research project between the Caribbean Fishery Management Council (CFMC) and Virgin Islands Fishermen. Virgin Islands fishermen tagged over 5,000 spiny lobsters, carried out observers who measured entire catches and recaptured nearly 10% of the lobsters tagged. Additionally, historic data on landings and port sampling were assembled and analyzed for status of resources. The results were used to provide resource management recommendations to the CFMC.

KEY WORDS: Spiny lobster, Virgin Islands, fishermen, collaboration

INTRODUCTION

Studies of the Virgin Islands lobster resources began in the 1960s with the work of Jack Randall (Idyll and Randall, 1959) and with the underwater studies that were part of the Tektite undersea habitat project (http://www.islands.org/Tektite/). In addition, a summary report (Dammann 1969) provides useful information about the fishery.

The Tektite underwater studies centered mainly on behavior with some tagging. A tag and recapture project was carried out following the removal of the Tektite habitat. In these studies (Olsen et al. 1975, Olsen and Koblick 1975) early estimates of growth and mortality were developed.

Since these early days the Virgin Islands spiny lobster fishery has expanded from less than 10,000 lbs in the early 1970s. Current combined landings for St. Thomas/St. John and St. Croix have approached nearly 300,000 lbs in recent years (Figure 1).

Lobster is not a traditional element of the Virgin Islands diet and before the development of the islands' tourism industry; lobsters were frequently broken up in the traps and used as bait. However, as hotels developed and a substantial tourism industry expanded, fishermen found an increasing market for their product. Currently lobster is selling on St. Thomas for $10 per pound and on St. Croix for $8 per pound.

ISLAND DIFFERENCES

There is a pronounced difference between the St. Thomas/St. and St. Croix island groups in the manner in which the fishery is carried out. In St. Thomas[1], 98% of the landings come from the trap fishery while in St. Croix 92% of the landings are taken by diving methods. Some of this difference has come about following Hurricane Hugo in 1989 which did considerable damage to the trap fishery in St. Croix and resulted in a fishery-wide shift from traps to diving methods.

This difference has resulted in a fishery in which St. Thomas fishermen fish from larger (25 - 42 ft.) boats and have a substantial investment in boats and traps relative to the St. Croix lobster fishery. Currently twelve St. Thomas fishermen land 90% of the annual lobster landings. St. Thomas fishermen in recent years have averaged around 1,600 fishing trips per year, during which they haul between 100 and 140 fish and lobster traps per day (Figure 2) and land between 80 and 300 lbs. of lobster per day.

In St. Croix, most fishermen trailer their boats and make day trips during which they may use as many as six SCUBA tanks. St. Croix fishermen make many more trips and have averaged over 3,500 fishing trips annually in recent years and land around 40 - 50 lbs. on an average day. The fishery has a much broader economic impact on St. Croix as over twice as many fishermen (26) are involved in landing 90% of the catch.

There are additional differences in the history of management between the two island groups. Over the years the staff of the Division of Fish and Wildlife in St. Thomas developed a cooperative relationship with local fishermen while in St. Croix they took a more top-down regulatory approach. This has resulted is an environment of suspicion and non-cooperation on St. Croix while St. Thomas has taken on more of a co-management approach. This difference will be discussed subsequently.

[1]St. Thomas is being used to refer to the St. Thomas/St. John Island group which is separated by 36 miles from St. Croix. These are also separated as two separate reporting areas by the Territorial Division of Fish and Wildlife

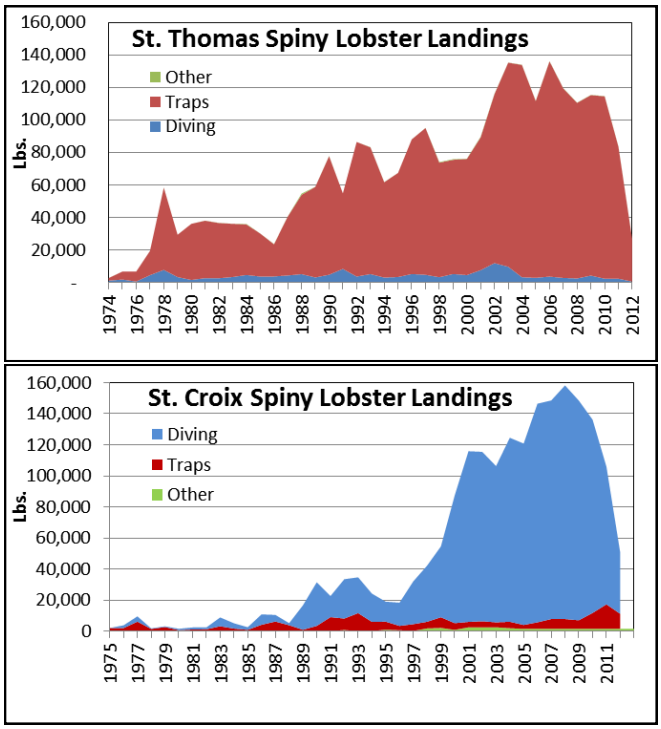


Figure 1. Lobster landings by fishing method for St. Thomas/St. John and St. Croix from 1974 through 2012. Landings for 2012 are incomplete.

Figure 2. St. Thomas lobster fishermen prepare a plastic lobster trap for deployment.

MANAGEMENT HISTORY

Prior to passage of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) in 1976, Virgin Islands fisheries were regulated under Virgin Islands Act 3330 (VIC 12(9A)) which set regulations for the industry and penalties for non-compliance. Following passage of the MSFCMA, the Department of Conservation and Cultural Affairs (now Department of Planning and Natural Resources) Division of Fish and Wildlife has worked closely with the Caribbean Fishery Management Council (CFMC) to develop management proposals for the industry in both Federal and Territorial waters. In 1984, the minimum size limit for spiny lobsters was established at 3.5 inches and in 2008 a Federal prohibition on the import of lobsters smaller than this size to the Territory was approved.

In its 2007 amendment, the MSFCMA required the establishment of allowable catch limits for all managed stocks. Prior to the current study, it was believed that this region's larger size limit (Florida has a 3 inch minimum carapace requirement) was sufficient to protect the resource. Thus, local fishermen tended to disagree that additional management actions were required.

Despite this, the CFMC set overfishing limits (OFL) for both the St. Croix and St. Thomas/St. John Districts based upon recent average landings. These OFLs were followed by allowable catch limits (ACL) which were set 10% below the OFL levels. The OFL and ACL values are shown in Table 1.

One aspect of the current study was to evaluate the fishermen's view that the minimum carapace length required in the Virgin Islands (and Puerto Rico) was sufficient for management requirements or if the additional restrictions on landings resulting from the 2007 MSFCMA were necessary, and if these landings limits are appropriate to the fisheries found there.

Table 1. Overfishing Limits (OFL) and Allowable Catch Limits (ACL) in pounds for Virgin Islands spiny lobster resources set by the Caribbean Fishery Management Council in 2011.

Island	Overfishing Limit	Allowable Catch Limit
St. Thomas/St. John	115,776	104,199
St. Croix	119,230	107,307

Methods

The study consists of six activities:

i) *A tag and recapture study* — fishermen on both islands were paid to tag short and berried (with eggs) lobster that would normally be discarded (Figure 3).

- The CFMC also provided funds for "purchase" of market lobster for tagging in order to insure that larger lobsters would be represented in the tagging population. A total of 1079 lobsters weighing 2598 lbs were tagged in addition to the shorts and berried lobsters.
- Fishermen measured lobster carapace length, tagged at the joint between the carapace and the tail, and released the lobsters. Location was recorded with GPS whenever possible. When fishermen did not have GPS (sometimes the case on St. Croix) VI Division of Fish and Wildlife reporting zones were recorded.

Figure 3. Tagging spiny lobsters with Floy spaghetti tags. Measuring carapace length, tagging, checking tag.

ii) *"Observer" trips* — Project staff accompanied fishermen and measured the entire catch in order to obtain a complete size-frequency distribution of the lobsters being caught.

iii) *Recapture data* — Posters in English and Spanish were distributed on both islands at dive shops and other public gathering sites. The tags had the principal investigator's phone number on them. Data were collected from project fishermen, non-project fishermen, and sport divers. One record was collected when a server at a restaurant noticed the tag as she was serving the dinner.

iv) *Growth from recapture data*.

v) *Lobster movement* — All of the St. Thomas tagged lobsters were recorded with GPS coordinates and most of the recaptures provided either GPS data or location sufficient to indicate location caught. These data were analyzed by GIS to provide information on distances moved. The majority of St. Croix movements were only approximate because the mark and/or recovery location of nearly all tagged lobsters was recorded by fishermen who did not have GPS.

vi) *Tag loss* — was measured by placing 45 tagged lobsters in the Coral World aquarium facility (www.coralworldvi.com/) and recording whether or not tags were lost when the lobsters molted. Small lobsters were used in this study (37 to 87 mm CL) because it was expected that these would have a higher rate of molting than larger lobsters. The lobsters were observed daily and fed three times a week.

vii) *Population estimation* — The population of lobsters on St. Thomas was estimated by comparing the tagging results to predicted lobster landings based upon 2011 monthly results.

- As can be seen from Figure 4, the St. Thomas lobster fishery has a strong seasonality which corresponds directly with the annual cycle of the tourism industry, the primary market for lobsters in St. Thomas.
- Landings for 2011 were chosen as the base year for comparison because that is the most recent year for which complete data are available.

The population estimate was developed on a monthly basis by multiplying the cumulative number tagged by the percent of tagged lobsters that were in the estimated landings. Population abundance (P) was estimated each month by equation (1). Note that the analysis was only carried out for St. Thomas because fishermen from St. Croix ceased to be involved in the study after January 2013.

$$P=(F)/(R/T)$$

Where:

T = number of tagged lobster released into the population at that point, adjusted to account for estimated mortality and retention by fishermen.

F = the total number of lobster caught up to that point.

R = the total number of recaptured lobster up to that point.

The formula comes from the fairly straightforward assumption that the proportion of tagged lobster in the monthly catch (R/F) is equal to the proportion of tagged lobsters in the population as a whole (T/P)

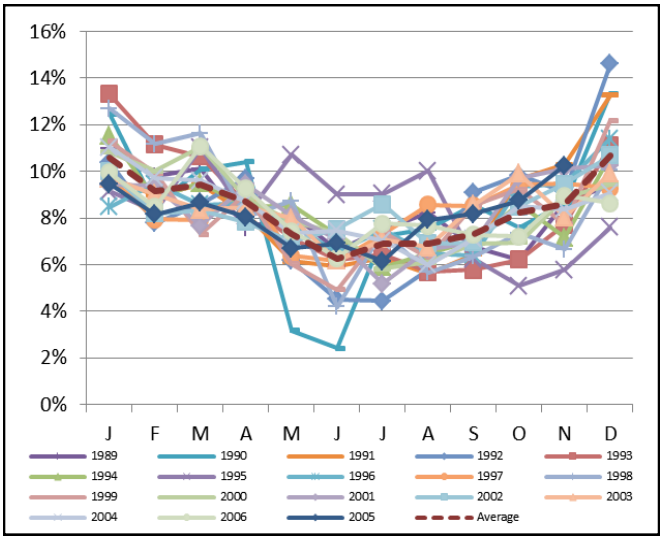


Figure 4. Monthly landings for spiny lobsters in St. Thomas.

viii) *Mortality* — Total mortality rate (Z) was calculated from size frequency distributions from the current study and size frequency distributions from Division of Fish and Wildlife (DFW) port sampling data obtained from the Southeast Fisheries Science Center (SEFSC). Total mortality rate (Z) from equation (2) was calculated by the following methodology.

$$N_t = N_{(t-1)}e^{-Zt}$$

Where:

N_t is the number of fish at time (t) a

Z is the rate of total mortality.

An age specific instantaneous Z was calculated by solving the Von Bertalanffy growth equations for t (median age of the size class in the frequency distribution). Growth parameters using in the analysis came from de León et al. (2005).

$$l_{(t)} = L_\infty(1 - e^{-k(t-t_0)})$$

Where:

l_t is the length (in mm) at age (t).

$L\infty$ is the asymptotic length at which growth is zero.

t_0 is included to adjust the equation for the initial size of the organism and is defined as age at which the organisms would have had zero size.

Solving equation for t (age) allows for calculation of the age (in years) of each lobster based on their size.

$$t = t_0 - \frac{(\ln(L_\infty - l_t)}{k} + \frac{\ln(L_\infty)}{k}$$

The VonBertalanffy growth parameters used were from an extensive Cuban study (deLeon et al. 2005). They found that $L\infty$ was equal to 195mm, k was equal to 0.24 and t_0 was equal t_o -.46 yrs. An earlier study in the Virgin Islands (Olsen and Koblick 1975) found 152 mm for $L\infty$, k = 0.432 and t_0 = -0.11 years. The Cuban study was used because many of the lobsters tagged in the earlier Virgin Islands study were juveniles which may have contributed to the high growth rate and low value for $L\infty$.

Historic data from Division of Fish and Wildlife catch reports and port sampling was analyzed using a model that relied on catches, abundance indices, and length distributions of catches. Rather than using a pre-existing stock assessment model, we programmed our own in Excel, using log-residuals for catches and indices, and multinomial residuals for length compositions (adapted from Williams and Shertzer 2005). In this model, we did not impose any recruitment restrictions. Instead, we allowed the model to estimate what recruitment strength would lead to the best fit of the model to the data. Other fitting parameters included the age structure of the initial population, fishing mortality rates (including selectivity function parameters). For the trap and dive fisheries, catchability coefficients for these two fisheries, and a coefficient of variation for converting lengths to ages were also calculated. We also input several fixed parameters, shown in Table 1. We ran one version of the model for St. Thomas and another for St. Croix. Since we did not impose any recruitment relationship, we have the ability to examine possible relationships treating the islands independently or interactively. By modeling the two islands separately, we did assume that, once recruited to the fishery, lobsters did not move between island shelves.

RESULTS

Seasonality

The market for the St. Thomas lobster fishery is primarily in the tourist hotels and restaurants. Lobster is seldom available for the local street market except for the period between August and October when many of the restaurants close and air arrivals are at their lowest level (Figure 5) (http://www.usviber.org/A11.pdf).

Despite this clear seasonality in the market for lobsters, fishermen generally make the same number of trips per month (Figure 6) with the exception of February which is a period of high winds which limit fishing activities to a degree.

Catch per unit effort (lbs/trap haul) during the study peaked during the months of December to May. The low CPUE values in September and October of 2012 were most likely associated with project start up.

Tag-Recapture Study

Tagging and recapture data are summarized in Table 2 and locations are shown in figures 7(a and b) and 8. Dur-

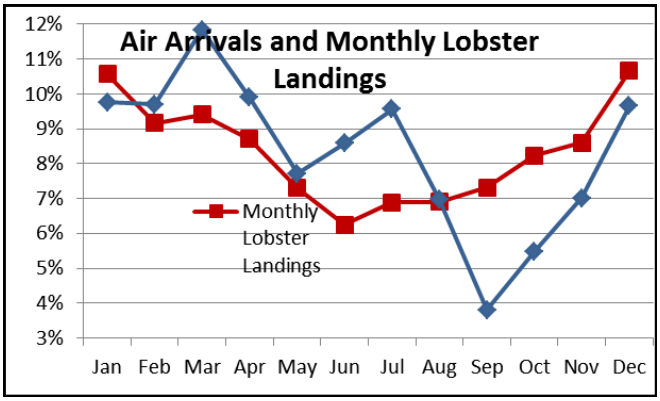


Figure 5. Correlation between monthly lobster landings and air arrivals.

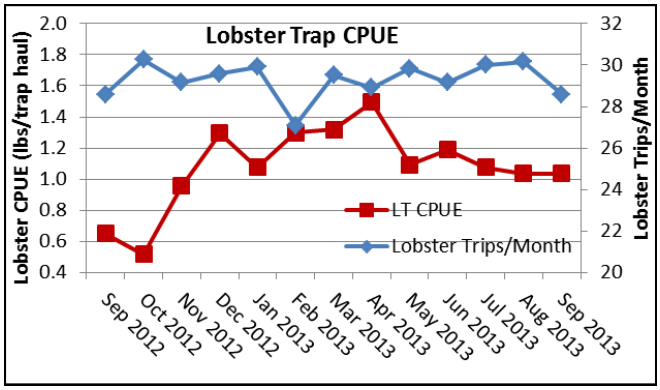


Figure 6. Monthly catch per unit effort during the study and fishing effort (trips/month).

ing the study, project fishermen landings constituted as high as 55% of the monthly (2011) monthly landings for St. Thomas. In general, STFA fishermen land between 85 and 97% of the lobster landings for the island. This constitutes a fairly high participation in sampling of the population which, coupled with the relatively high contribution for recaptures from non-project fishermen and sport divers, provides some confidence that the population is being adequately sampled. The tagging project is supposed to continue until the end of 2013 so results presented here are preliminary.

Observer Trips

Eight trips were completed on St. Croix and 21 on St. Thomas. St. Croix observers measured 385 lobster and St. Thomas observers 1,483.

Size frequency distributions were developed for each island (Figure 7). They reveal a substantial difference between the two islands in terms of the average size of landed lobsters. While the two islands employ different fishing methods, when the average size for trap caught and diver caught lobsters in port sampled catches was compared by ANOVA, the difference (0.3 mm) was not significant, suggesting that the difference does not result from differences in fishing methods but rather represents a population difference.

Growth from Recapture Data

Preliminary growth patterns were analyzed from the 216 recaptures recorded as of 3 October 2013, when lobster were at liberty for at least 30 days. When analyzed without constraint, the best fit for von Bertalanffy growth parameters were a k near zero and an extremely large L_∞. These parameters essentially suggest linear indeterminate growth, but may have been heavily influenced by the fairly limited range of sizes observed. For example, 90% percent of lobsters fell within a size range of 65 to 117.5 mm carapace length at first capture, corresponding to an age range of approximately 1.35 to 2.45 years. If we constrained L_∞ to the value observed in the Cuba study, which seemed reasonable given our observations here, k was estimated at 0.48.

Movement

A total of 317 lobsters were recaptured with GPS data for both tag and recapture locations. Recaptures ocurred between 7 and 340 days after tagging with the bulk of them

Table 2. Summary of St. Thomas tag-recapture results.

Month	Cumulative # Tagged	Adjusted for Mortality	Project Recaptures	Non-Project Recaptures	# Kept
September-12	494	494	6	1	2
October-12	1268	1256	15	1	1
November-12	1587	1546	16	2	4
December-12	1885	1815	29	2	12
January-13	2152	2043	26	2	9
February-13	2450	2295	20	3	8
March-13	2705	2494	24	1	4
April-13	3299	3029	32	4	7
May-13	3637	3317	28	3	27
June-13	3820	3423	26	3	10
July-13	3995	3527	16	11	9
August-13	4097	3530	24	1	9
September-13	4279	3656	9	3	19
October-13	4288	3569	6	0	1
Total	4279	3656	249	37 (12%)	119

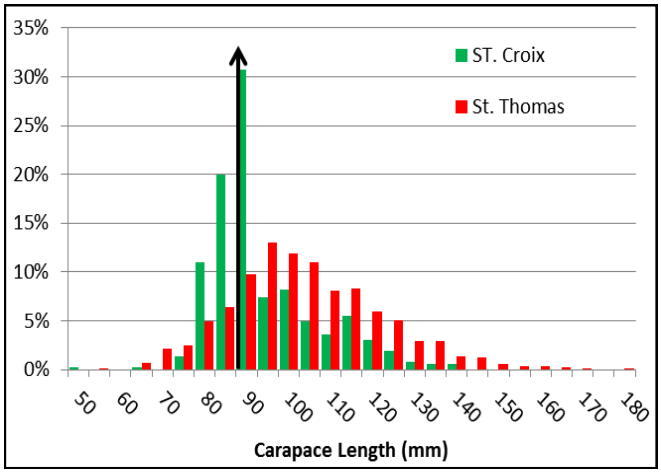


Figure 7. Carapace length-frequency distributions from "Observer" trips from St. Thomas and St. Croix where all lobsters were measured. The arrow designates the minimum legal carapace length (89 mm).

less than 60 days. Distances between tagging and recapture sites are shown in Figure 9.

Tag Loss Study

Forty-five tagged lobsters were held at Coral World. As of 17 October, 2013, there have been seven cases where lobsters molted, with no tag loss among the larger lobsters. Only one of the smallest lobsters (less than 45 mm CL) retained its tag during six molts. The smallest lobster tagged during the field study was 55 mm CL and all of the lobsters in Coral World that were larger than this size retained their tags when molting. We interpret this as to indicate that tag loss for the larger lobsters was not significant.

Population Estimation

Monthly estimates of the total population of lobster that St. Thomas/St. John fishermen exploit were calculated after equation (1) on a monthly basis. The results are shown in Figure 10 and indicate that the probable population is slightly over 400,000 lobsters and that annual landings (estimated at 37,000 lobsters in 2011) constitute less than 10% of that amount.

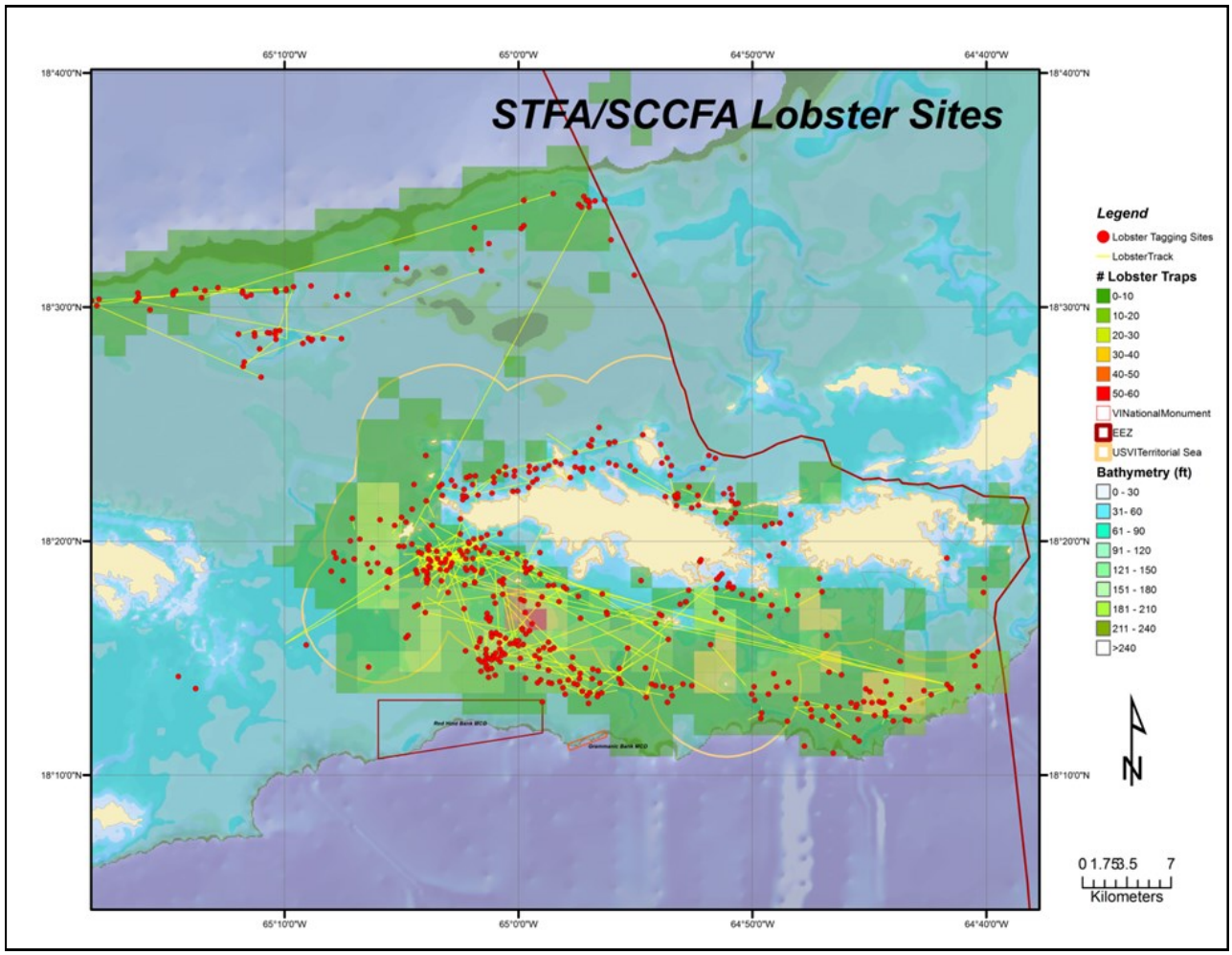


Figure 8a. Sites where spiny lobsters were tagged on the St. Thomas/ St. John shelf.

PRELIMINARY STOCK ASSESSMENT

St. Thomas/St. John

Upon initial evaluation of the St. Thomas/St. John catch report data, it became apparent that the number of traps hauled daily was inconsistently confused with the total number of traps in the water (Figure 14). In order to resolve this confusion, a census of the affected fishermen was carried out and substituted into the data base for the period from 1996 - 2007.

This confusion led to overestimates of trap fishing effort by as many as 250,000 hauls.

Data confidentiality issues have prevented access to individual fishermen's records from late 2007 onwards. In order to calculate an estimate of daily trap hauls from 2007 to 2012 we carried out a regression of all available trap haul information. These included the "adjusted" figures, data from port sampling, prior reports and STFA studies. This estimate was carried out in order to provide a more accurate estimate of daily trap fishing effort (Figure 15).

On St. Thomas/St. John, landings have seen a general increase since the 1970s, particularly in the trap. Indices of abundance were generally flat with the exception of higher CPUE for trap fisheries in the first year for which we have data, 1997. The assessment model was able to fit early landings data well and recent landings with some difficulty (Figure 16).

It was possible to provide a good fit for all but the first year of the trap index and the general pattern of the diver index. The size structure did not fit as well, although note that the scale on the figure gives the impression that the deviations are larger than they really were. In total, this model was not a perfect fit but might be sufficient for making management decisions.

The St. Thomas/St. John model results suggest that fishing mortality is focused on individuals of age 3+, who experience fishing mortality rates near 1. These rates appear to have been stable in the most recent years included

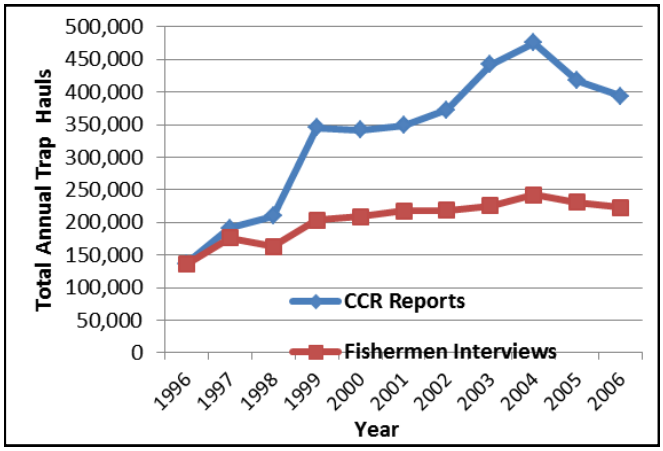


Figure 14. Comparison of average reported daily trap hauls from catch reports and "adjusted" values provided by fishermen.

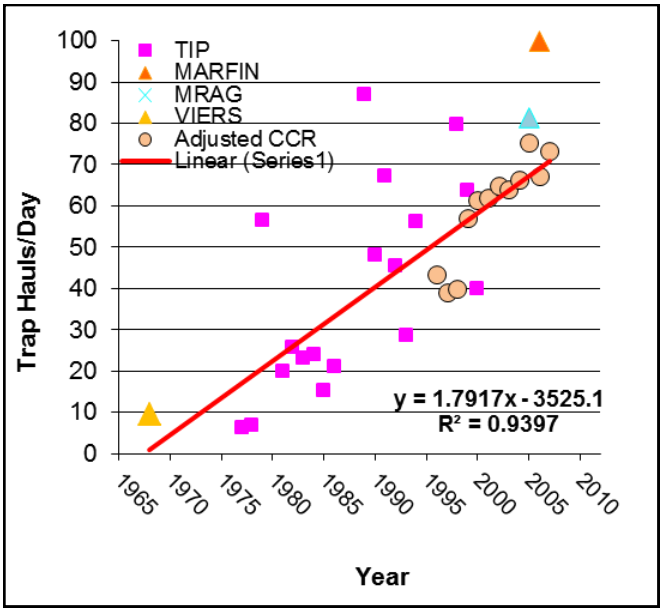
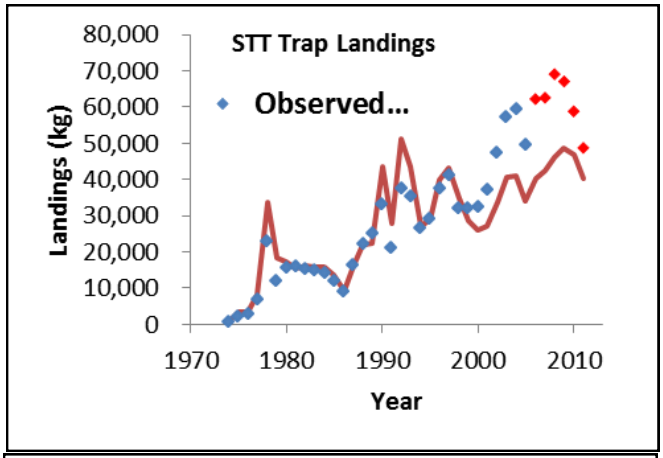
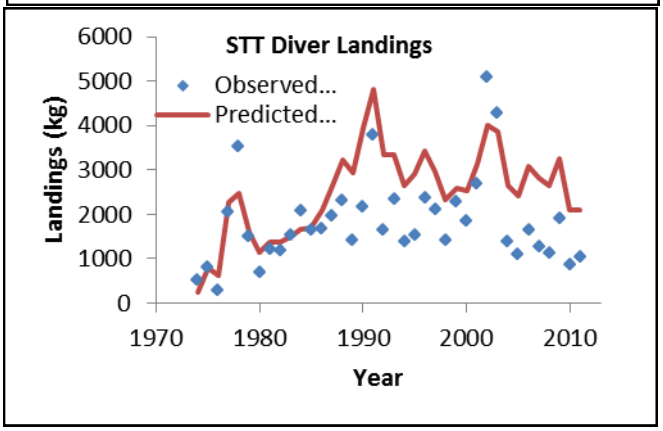


Figure 15. Estimated St. Thomas trap fishing effort as determined from historical reports, port sampling and catch reports adjusted by fishermen interviews.





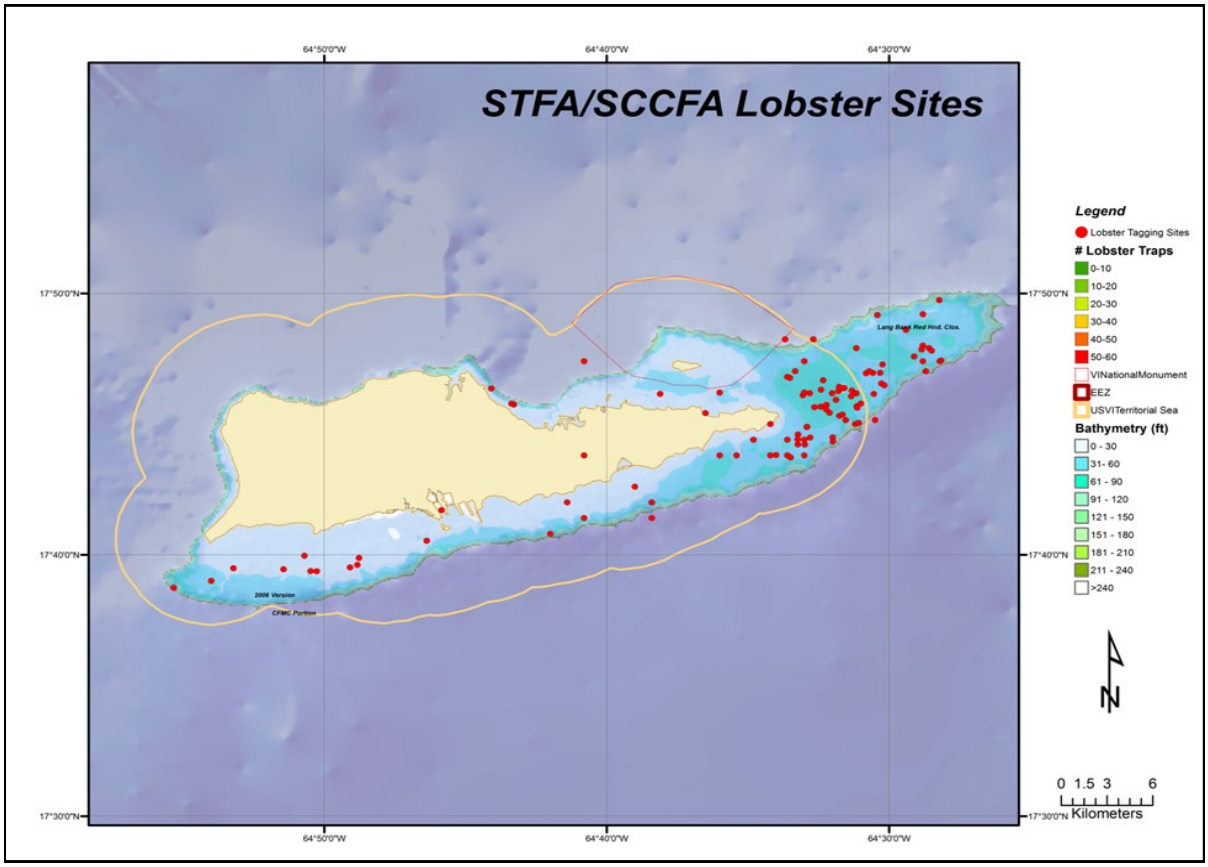


Figure 8b. Sites where lobsters were tagged on the St. Croix shelf.

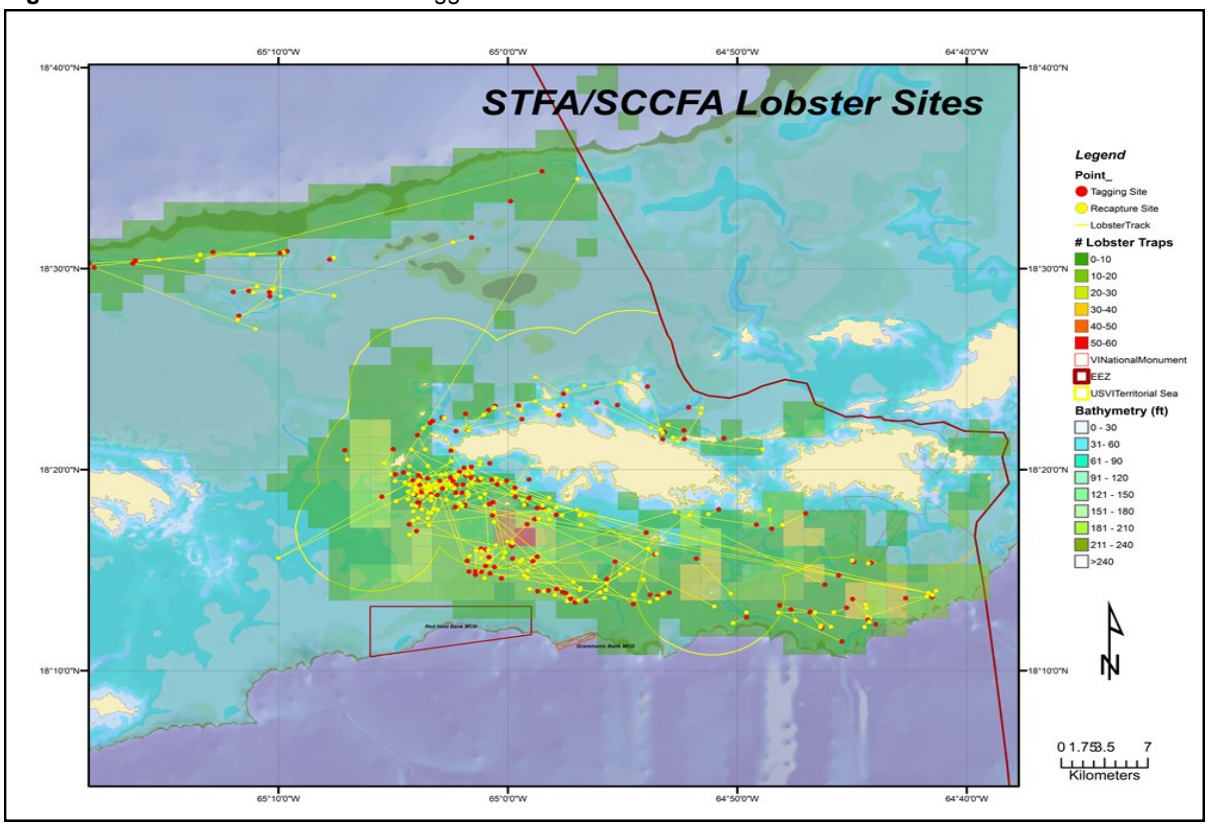


Figure 9. Movements of St Thomas/St. John lobsters following tagging.

Mortality Calculations

Total mortality (Z) was calculated after the methodology outlined in equations (2) through (4) from size frequency distributions collected during "observer" trips and from data collected during DFW port sampling between 1980 and 2012. In addition, data from 1971 were available from the 1971 Olsen and Koblick (1975) study. The results indicate currently there is a much higher total mortality rate for St. Croix (Z = 1.369) than for St. Thomas (Z = 0.484). When the long term trend for total mortality (Figure 11) are shown, both islands lobster resources exhibited similar mortality rates until about 2005 when the St. Croix rate remained relatively constant around Z = 1.4 while the St. Thomas/St. John rate declined to its current level of less than 1.

A similar pattern can be seen when the average sizes are plotted over time (Figure 12). The average size lobsters were very similar for each island until about 2007 when St. Croix lobster size began to decrease while on St. Thomas it appeared to be increasing. These contrasting changes were unexpected because they followed periods of high landings on both islands.

Both port sampling and project "complete" trips provide nearly identical results for 2012 and document a > 1 cm decrease in the average size of lobster in St. Croix.

Yield per Recruit

Yield per recruit relationships were calculated for Virgin Islands lobsters after the method of Beverton and Holt (Ricker 1975). The results, shown in Figure 13, indicate that St. Thomas lobster landings are much closer to the maximum YPR value than are St. Croix landings.

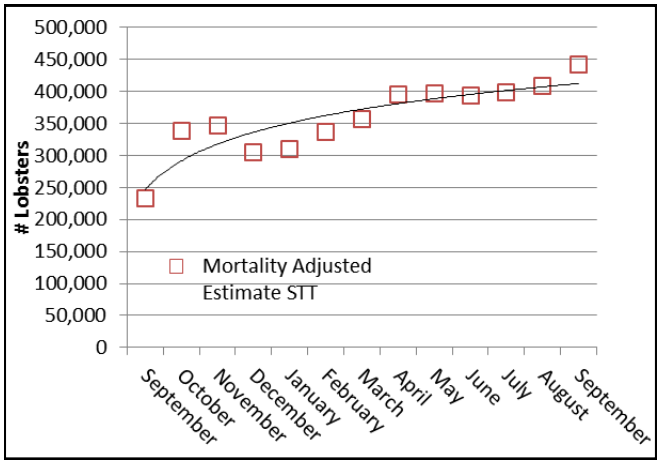


Figure 10. Estimated population of lobsters in St. Thomas/St. John and % of tagged lobsters recaptured.

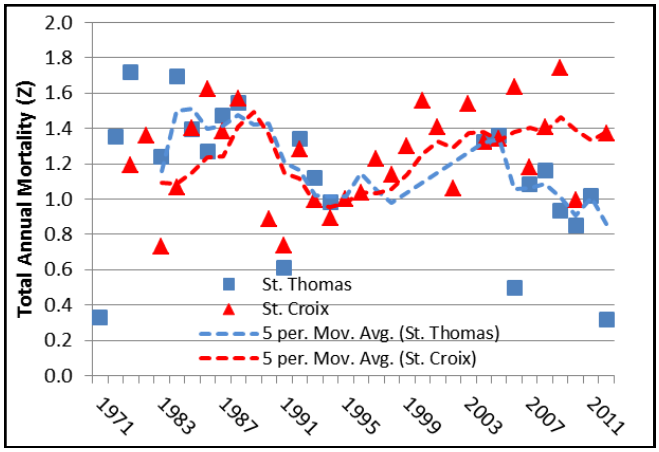


Figure 11. Total mortality rate (Z) for St. Thomas/St. John and St. Croix from 1980 to 2012 as determined from historic port sampling data.

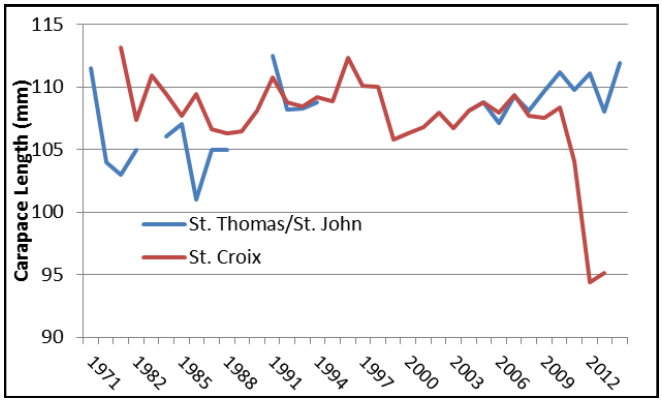


Figure 12. Average carapace of port sampled lobsters from 1971 to 2013 including lobsters from project "complete" trips.

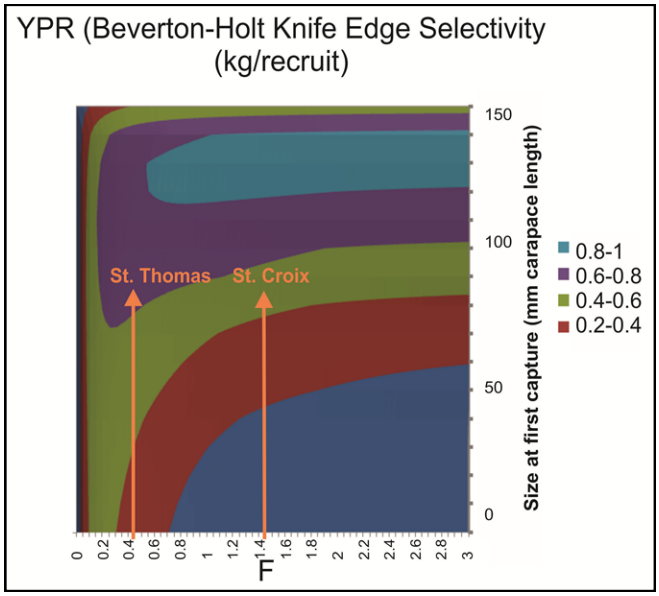


Figure 13. Yield per recruit calculations for Virgin Islands spiny lobsters.

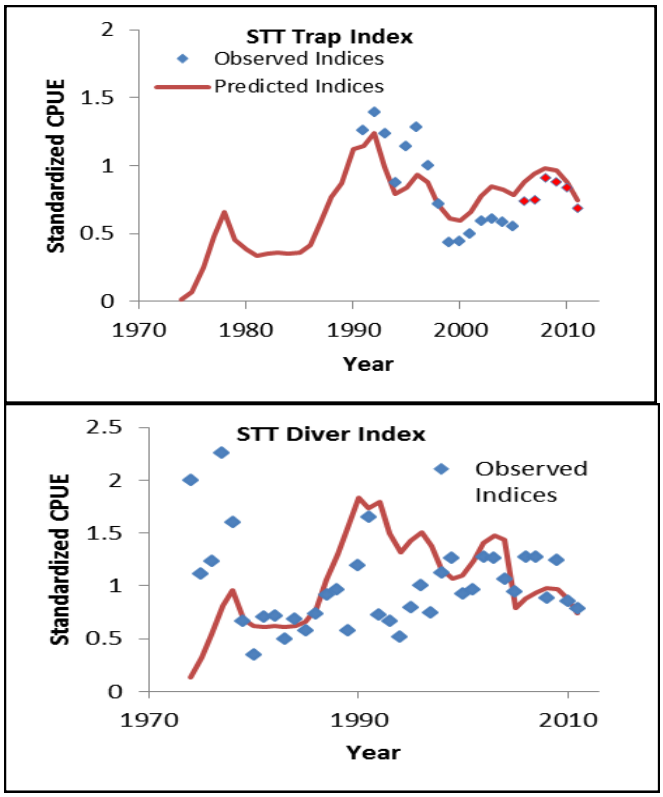


Figure 16. Stock evaluation results for St. Thomas/St. John trap and lobster fisheries. The red markers are years that were calculated from the regression shown in Figure 10.

in the model. The model estimated that the lobster population has also been mostly stable with evidence of recent increases. Over the last 10 years, the population size estimates ranged from 100,000 to 300,000 age 1+ lobsters, with an average of 168,000.

On St. Croix, indices of abundance were generally flat with the exception of higher CPUE for trap fisheries in the first year for which we have data, 1995. The assessment model was able to fit landings data quite well (Figure 17). It was able to provide a good fit for all but the first year of the trap index but did not fit the diver index well at all. The size structure did fit well, even at a magnified scale. Like the St. Thomas/St. John results, this model was not a perfect fit but might be sufficient for basing management action.

The St. Croix model results suggest that fishing mortality is focused on individuals of age 1+, with rates starting at over 1.5 for age 1 individuals and peaking at 3 for age 4+ individuals. These rates appear to have increased in the most recent years included in the model. The model estimated that the lobster population has also been mostly increasing with evidence of very recent declines. Over the last 10 years modeled, the population size estimates ranged from 175,000 to 900,000 age + lobsters, with an average of 550,000.

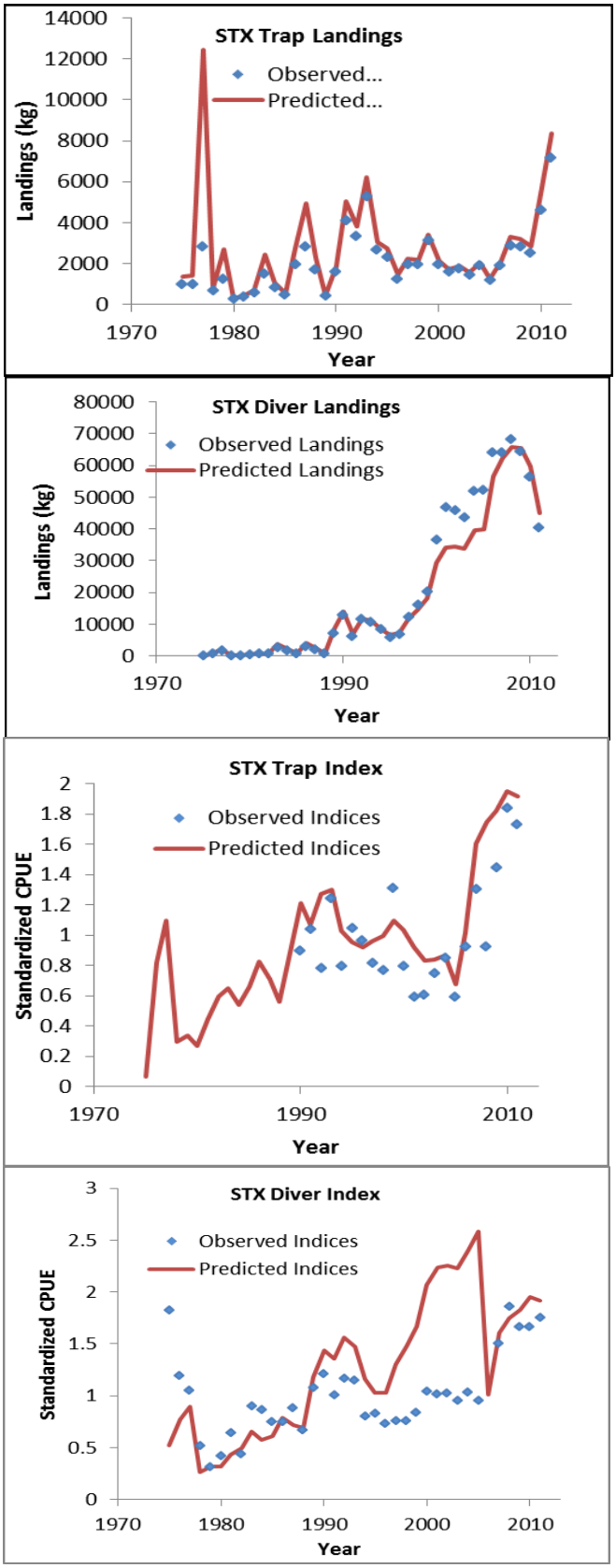


Figure 17. Stock evaluation results for St. Croix trap and lobster fisheries.

DISCUSSION

While our preliminary study results provide useful information for management of Virgin Island spiny lobster resources, they also highlight the differences between the two island districts. First of all, the deep-seated suspicion that St. Croix fishermen exhibit for management agencies in general, led to the withdrawal of St. Croix fishermen from the study as soon as results were presented that indicated the recent drop in the average size of lobsters being harvested there.

As a result, the project was more or less limited to analysis of historical data which was complete over the time period (1975 to present for landings data and 1980 to present for port sampling data). The limited recapture data were insufficient to evaluate population size and the fact the St. Croix fishermen generally do not use GPS restricted discussion of movements.

The study also documented that the St. Croix lobster resource is harvested by more than twice as many fishermen as in St. Thomas and that the diving fishery there leads to many more trips with smaller landings. Thus, one would expect that the economic impact from lobster harvest is greater in St. Croix than in St. Thomas.

In contrast, the STFA's history of successful studies proved to be a real asset for the current project as well as the somewhat unexpected response from non-project fishermen and sport divers.

In evaluating the "health" of the St. Thomas stock, we attempted to assess if the high landings which occurred between 2003 and 2006 posed issues for the resource itself. Following that period, landings have consistently declined and in 2011 they were nearly 50,000 lbs. less than the peak period. The results of this analysis are shown in Figure 18. In examining the results of our evaluation, there was no indication either in terms of catch per unit effort or declining average sizes that supported the idea that landings in excess of 130,000 lbs. had damaged the ability of the resource to replenish itself. Thus, it appears that the current overfishing limit of 115,776 lbs. estimated by the CFMC could be increased by nearly 15,000 lbs and would be consistent with the MSFCMA National Standard 1 requirement to "*prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry*". (http://www.nmfs.noaa.gov/sfa/magact/magact.html#s301)

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In St. Croix, on the other hand, we see a different result of our stock evaluation (Figure 19). Currently landings are around 114,000 lbs., above the Allowable Catch Limit (107,307 lbs.), and the CFMC is imposing a seasonal closure in December of 2013.

Catch per unit effort has risen considerable since 2005 and peaked during the period of high harvest. One problem in evaluating CPUE in St. Croix is the prevalence of diver landings. St. Croix divers do not focus on a single prey species but may pursue lobster and conch, and spear fish, on a single trip. Thus, CPUE is not generally helpful in evaluating the fishery. Increases from Trap CPUE can easily be explained by the entry of new, more efficient trap fishing operations following closure of a gillnet fishery in 2008.

What is apparent, however, is the decline in the average size of lobsters being landed in St. Croix in 2011 and 2012. This decline, documented by both DFW port sampling and our own project observer trips followed a period of nearly three decades where the average lobster size remained relatively constant despite a fourteen-fold increase in landings. The very high landings between 2006 and 2009 appear to have not only led to decreased harvest but also a decrease in the size of lobsters being landed. Cur-

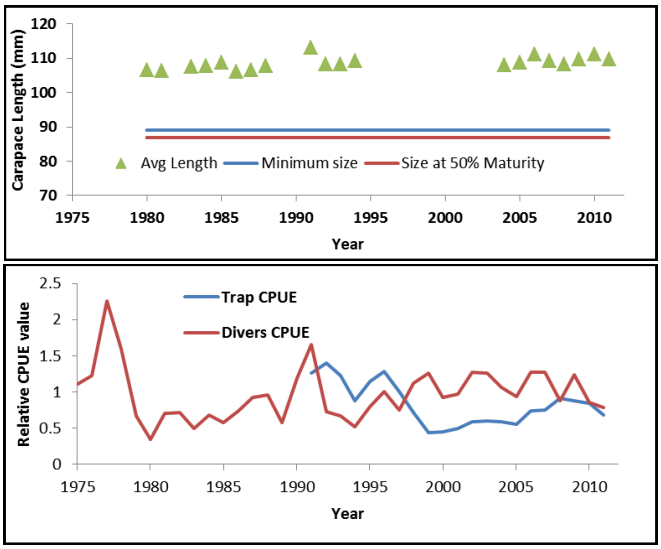

Figure 18. Stock "Health" evaluation for the St. Thomas/St. John spiny lobster fishery.

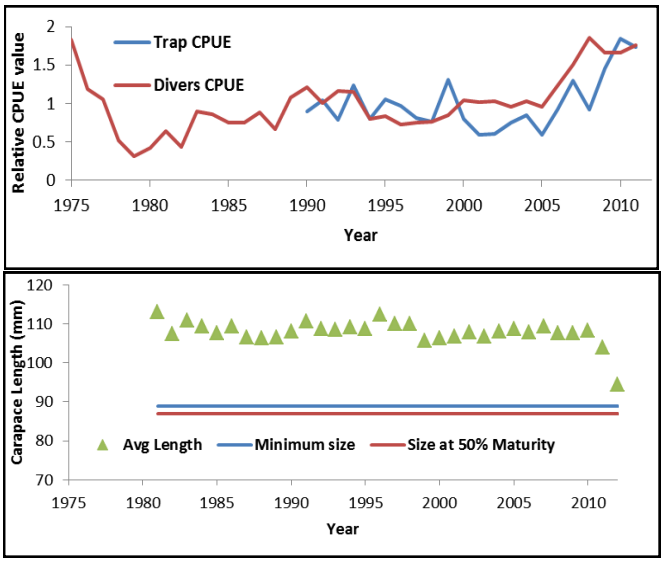

Figure 19. Stock "Health" evaluation for the St. Croix spiny lobster fishery.

rently over 30% of the lobsters harvested in St. Croix have just become legal (compared on 12% in St. Thomas) and there are few of the large individuals which are found in the northern islands. The average size is not only approaching the minimum legal size but also the size at which 50% of the population become reproductive.

Our assessment indicates that the current overfishing limit for St. Croix (119,230) may well be appropriate but that management needs to prevent over runs of the Allowable Catch Limit if the fishery is to recover from the high early harvest levels.

A final comment on the collaborative nature of the current study. In many ways this was simply another study carried out by the St. Thomas Fishermen's Association although, in fact the opportunity was entirely provided by the Caribbean Fishery Management Council and could not have been completed without the cooperation of the Southeast Fishery Science Center in providing historical data. At times, all three of the collaborators found this relationship frustrating but we hope that we (all) have learned the value added provided when fishermen and managers work together.

Finally, to our fishermen friends in St. Croix we wish to recognize that the failure of the Territorial Government to establish a collaborative relationship with the fishing community over the past three decades not only endangered collaboration between two fishermen's organizations but also endangers management of the St. Croix resource in the future. We hope that this can be resolved.

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