## 1.1 APPENDIX I - ECONOMIC AND SOCIAL TRENDS IN THE SEA SCALLOP FISHERY

### 1.1.1 Introduction

This section of the document describes the economic and social trends of the scallop fishery, including trends in landings, revenues, prices and foreign trade for the sea scallop fishery since 1994. In addition, it provides background information about the scallop fishery in various ports and coastal communities in the Northeast.

### 1.1.2 Trends in Landings, prices and revenues

In the last nine fishing years since 2003, the landings from the northeast sea scallop fishery stayed above 50 million pounds, surpassing the levels observed historically (Figure 1). The recovery of the scallop resource and consequent increase in landings and revenues was striking given that average scallop landings per year were below 16 million pounds during the 1994-1998 fishing years, less than one-third of the present level of landings. The increase in the abundance of scallops coupled with higher scallop prices increased the profitability of fishing for scallops by the general category vessels. As a result, general category landings increased from less than 0.4 million pounds during the 1994-1998 fishing years to more than 4 million pounds during the fishing years 2005-2009, peaking at 7 million pounds in 2005 or 13.5% of the total scallop landings (Table 20). The landings by the general category vessels declined after 2009 as a result of the Amendment 11 implementation that restricts TAC for the limited access general category fishery to 5.5% of the total ACL. However, the landings by limited access general category IFQ fishery increased in 2011 from its levels in 2010 due to a higher projected catch and a higher ACT for all permit categories.

Figure 2 shows that total fleet revenues more than quadrupled in 2011 ($582 million) fishing year from its level in 1994 ($123 million, in inflation adjusted 2011 dollars). Scallop ex-vessel prices increased after 2001 as the composition of landings changed to larger scallops that in general command a higher price than smaller scallops. However, the rise in prices was not the only factor that led to the increase in revenue in the recent years compared to 1994-1998. In fact, inflation adjusted ex-vessel prices in 2008-2009 were lower than prices in 1994 (Figure 3). The increase in total fleet revenue was mainly due to the increase in scallop landings and the increase in the number of active limited access vessels during the same period. The ex-vessel prices increased significantly to about $10 per pound of scallops in 2011 fishing year, however, as the decline in dollar attracted more imports of large scallops from the European countries resulting in record revenues from scallops reaching to $582 million for the first time in scallop fishing industry history (Figure 2 and Figure 3).

**Figure 1. Scallop landings by permit category and fishing year (in lb., dealer data)**

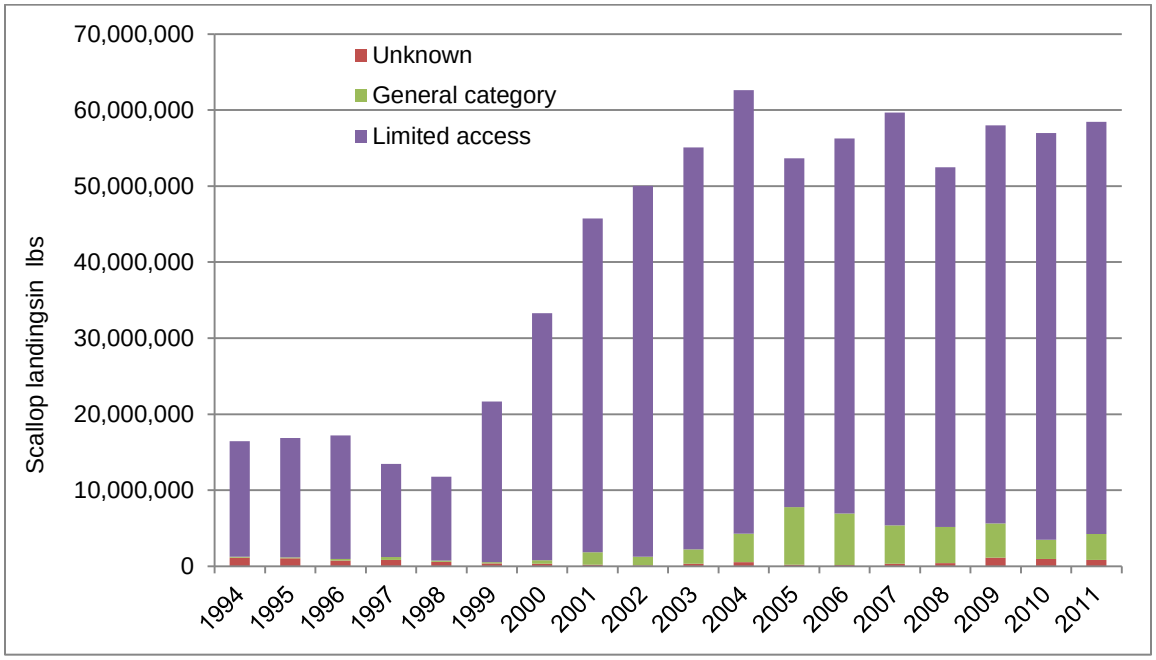



**Figure 2. Scallop revenue by fishing year in 2011 inflation adjusted prices (dealer data)**

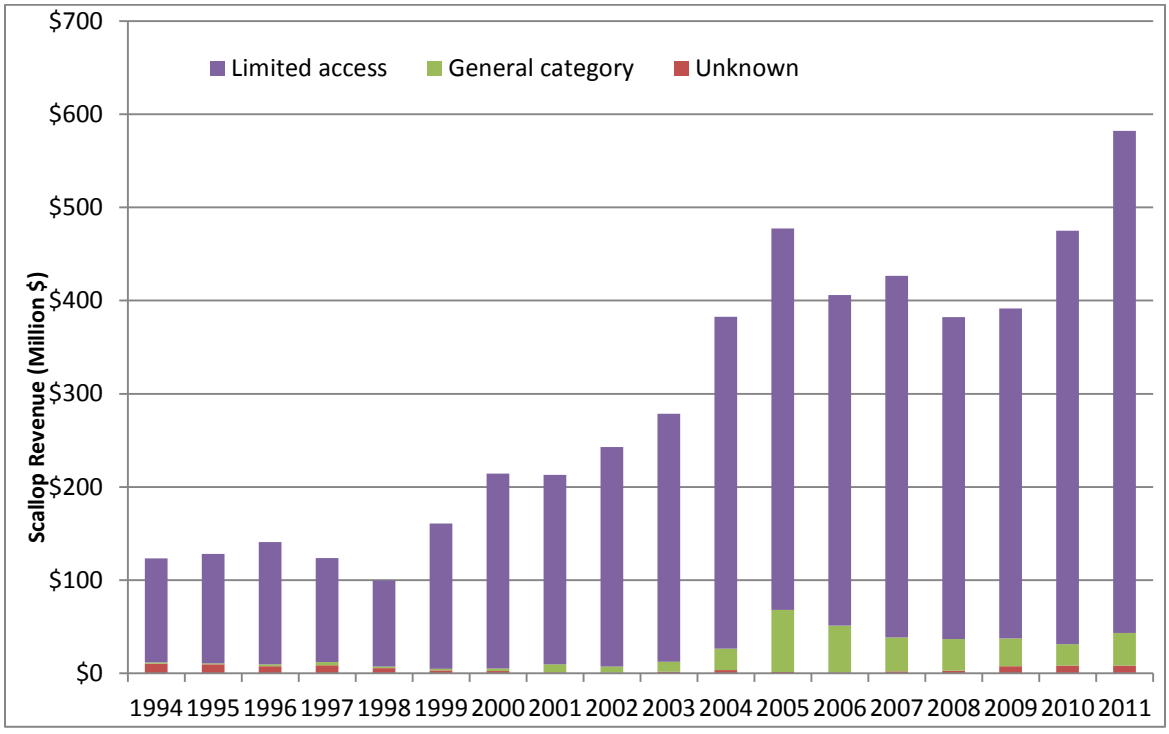
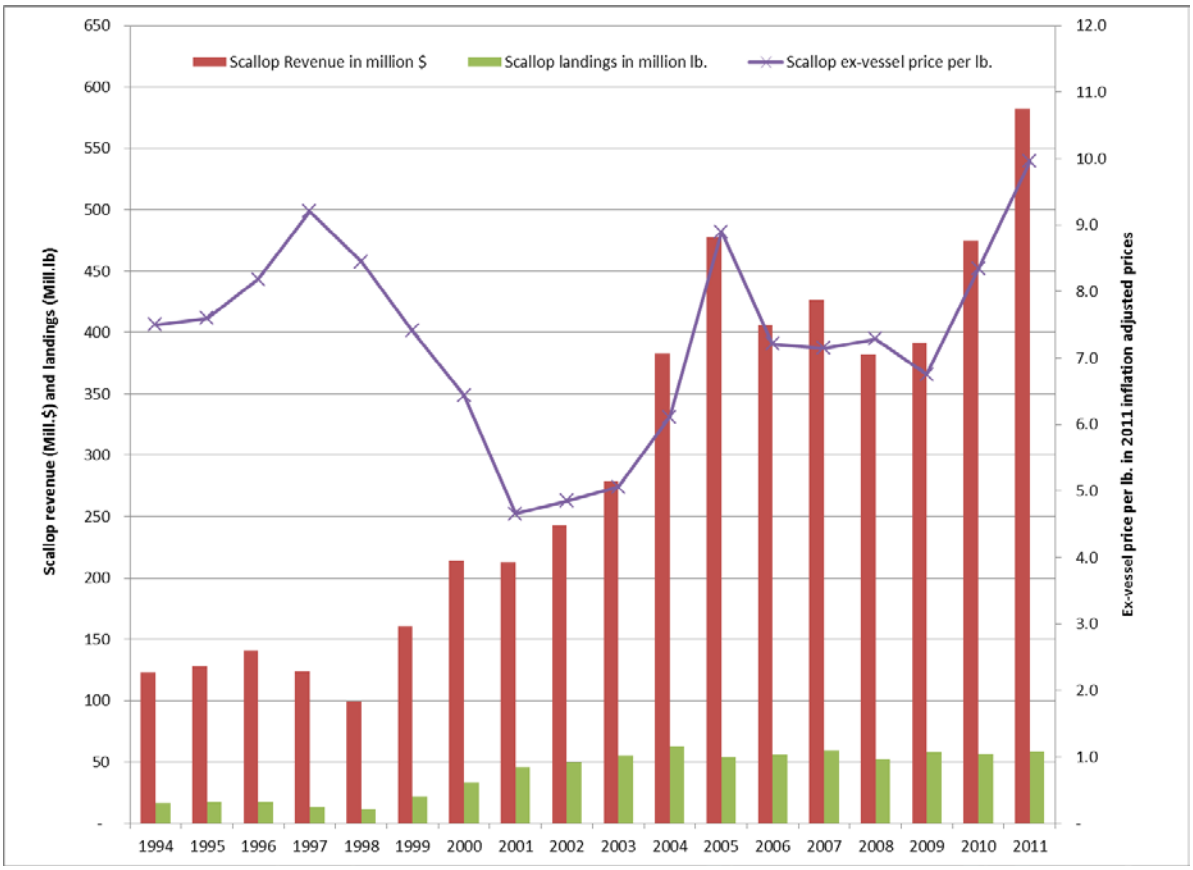


**Figure 3. Trends in total scallop landings, revenue and ex-vessel price by fishing year (including limited access and general category fisheries, revenues and prices are expressed in 2011 constant prices)**




The trends in revenue per full-time vessel were similar to the trends for the fleet as a whole. Figure 4 shows that average scallop revenue per limited access vessel (includes all categories) almost quadrupled from about $430,000 in 1994 to over $1,5480,000 in 2011 as a result of higher landings combined with an increase in ex-vessel price to about $10.00 per pound of scallops. For full-time dredge vessels, average revenue per vessel increased from $518,000 in 1994 to over $1,728,000 in 2011 (Figure 6).

**Figure 4. Trends in average scallop revenue per vessel by permit plan (in 2011 inflation adjusted prices)**

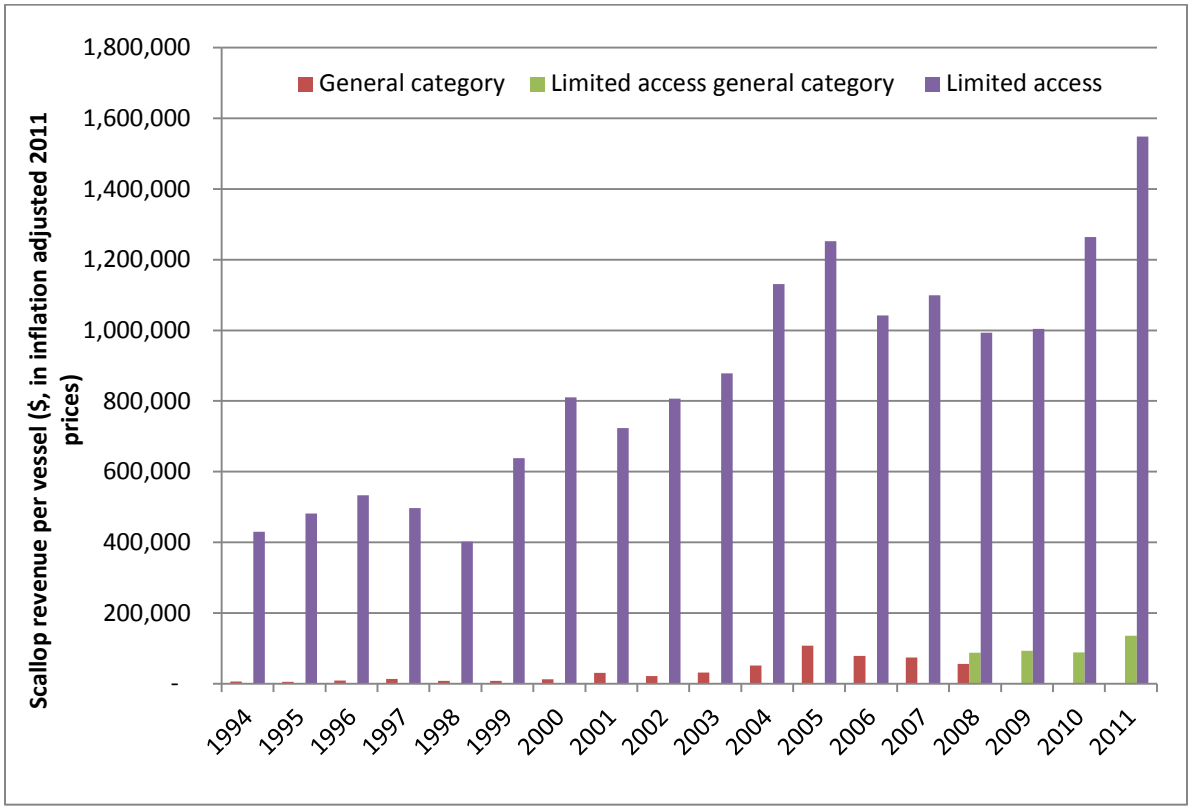


**Figure 5. Trends in average scallop landings per full time vessel by category (Dealer data)**

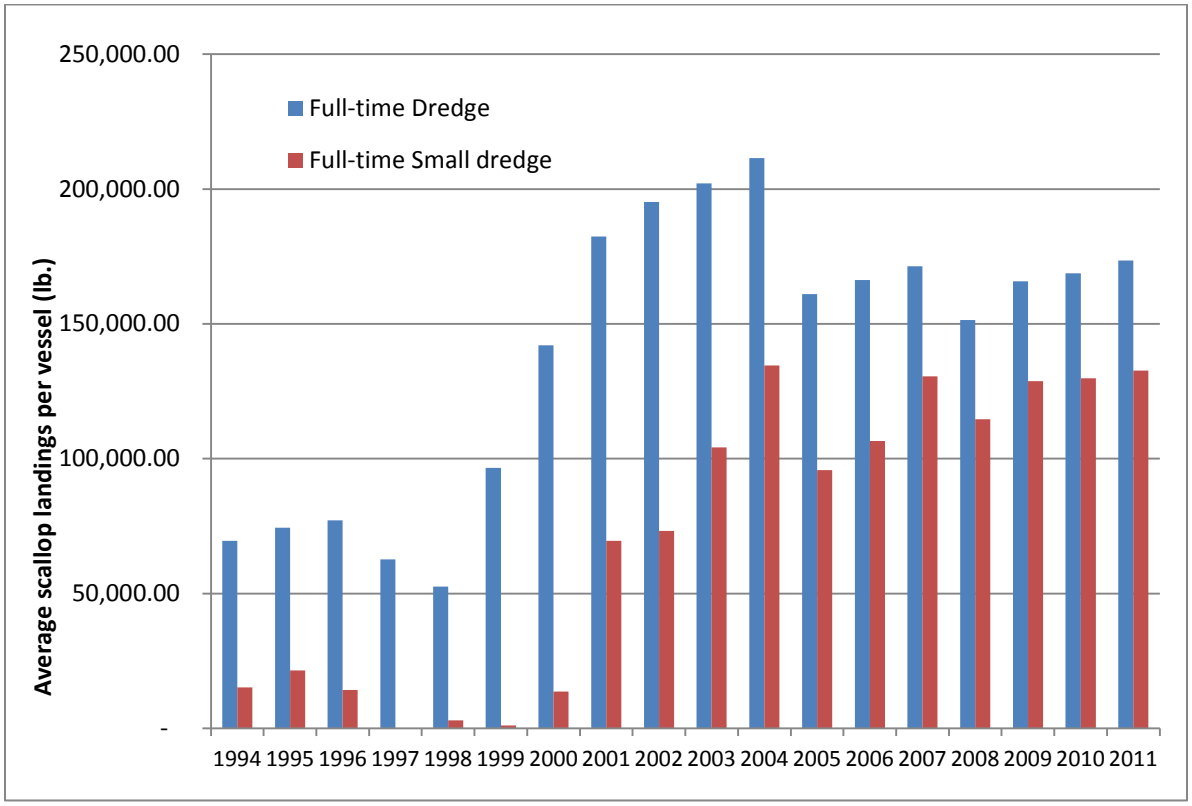
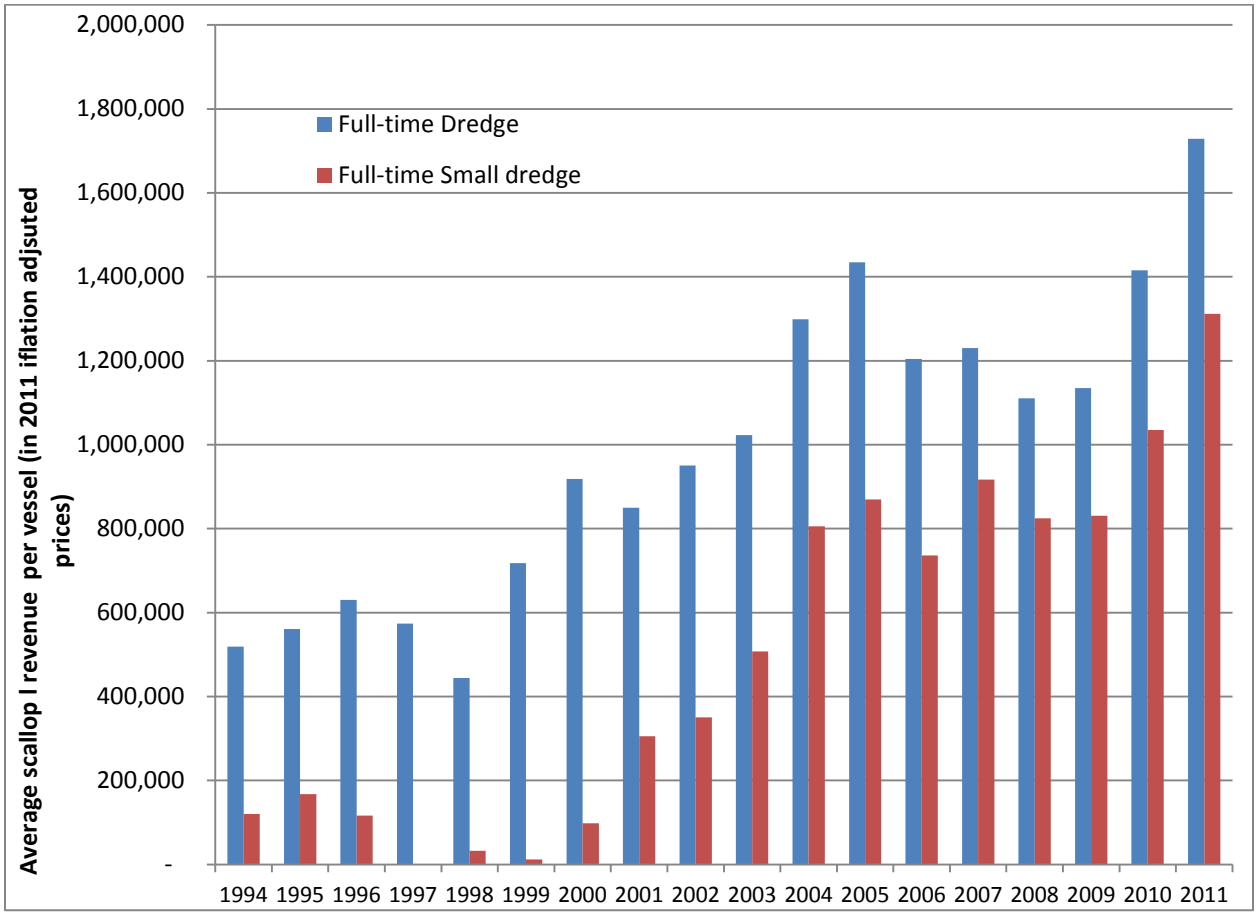


**Figure 6. Trends in average scallop revenue per full-time vessel by category (Dealer data)**




Although general category landings declined after 2009, the revenue per active limited access general category vessel increased in 2011 as the quota is consolidated on or fished by using fewer vessels. It should be noted that these are estimated numbers from dealer data based on some assumptions in separating the LAGC landings from LA landings. It was assumed that if an LA vessel also had an LAGC permit, those trip landings which are less than 600 lb. in 2011 and less than 400 lb. in 2010 and 2009 were LAGC landings and any among above these were LA landings.

**Table 1. Estimated Average annual revenue per limited access general category vessel (Dealer and Permit Data)**

| Data | Fishyear | IFQ | INCI | NGOM | |
|---|---|---|---|---|---|
| Number of vessels | 2009 | 231 | 74 | 12 | 317 |
| | 2010 | 179 | 68 | 12 | 259 |
| | 2011 | 169 | 76 | 14 | 259 |
| Average scallop lb. per vessel | 2009 | 18,650 | 2,650 | 2,038 | 14,286 |
| | 2010 | 13,319 | 2,238 | 595 | 9,820 |
| | 2011 | 19,717 | 796 | 789 | 13,142 |
| Average scallop revenue per vessel | 2009 | 121,884 | 16,768 | 13,551 | 93,245 |
| | 2010 | 120,782 | 18,583 | 4,883 | 88,580 |
| | 2011 | 203,814 | 7,735 | 7,164 | 135,647 |

### 1.1.3 Trends in effort and LPUE

There has been a steady decline in the total DAS used by the limited access scallop vessels from 1994 to 2011 fishing years as a result of the effort-reduction measures of Amendment 4 (1994). DAS allocations during were reduced almost by half from 204 DAS in 1994 to 120 DAS in 2003 fishing year for the full-time vessels and in the same proportions for the part-time and occasional vessels from their base levels in 1994 (Table 2). As a result, estimated DAS-used (VTR data) reached the lowest levels of about 24,000 days in the 1999 from over 30,000 days in 1995-1996 (Figure 7).

**Table 2. DAS and trip allocations per full-time vessel**

| Year | Allocations based on the Management Action | Total DAS Allocation (1) | Estimated Open area DAS allocations (2) | Access area trip allocations (3) | DAS charge per access area trip (4) | DAS allocation estimate for access areas (5) |
|---|---|---|---|---|---|---|
| **1994** | Amendment 4 | 204 | None | None | | None |
| **1995** | Amendment 4 | 182 | None | None | | None |
| **1996** | Amendment 4 | 182 | None | None | | None |
| **1997** | Amendment 4 | 164 | None | None | | None |
| **1998** | Amendment 4 | 142 | None | None | | None |
| **1999** | Amendment 7 Framework 11 | 120 | 90 to 120 | 3 | 10 | 0 to 30 |
| **2000** | Framework 13 | 120 | 60 to 120 | 6 | 10 | 0 to 60 |
| **2001** | Framework 14 | 120 | 90 to 120 | 3 | 10 | 0 to 30 |
| **2002** | Framework 14 | 120 | 90 to 120 | 3 | 10 | 0 to 30 |
| **2003** | Framework 15 | 120 | 90 to 120 | 3 | 10 | 0 to 30 |
| **2004** | Framework 16 | 126 | 42 (MAX.62) | 7 | 12 | 84 |
| **2005** | Framework 16 | 100 | 40 (MAX.117) | 5 | 12 | 60 |
| **2006** | Framework 18 | 112 | 52 | 5 | 12 | 60 |
| **2007** | Framework 18 | 111 | 51 | 5 | 12 | 60 |
| **2008** | Framework 19 | 95 | 35 | 5 | 12 | 60 |
| **2009** | Framework 19 | 97 | 37 | 5 | 12 | 60 |
| **2010** | Framework 21 | 86 | 38 | 4 | 12 | 48 |
| **2011** | Framework 22 | 80 | 32 | 4 | 12 | 48 |
| **2012** | Framework 22 | 82 | 34 | 4 | 12 | 48 |

*Total DAS allocation per full-time vessel represents a rough estimate for years 2004-12 since DAS is allocated for open areas only. DAS allocation for access areas is estimated by assuming an equivalent 12 days-at-sea charge for each access area trip with a possession limit of 18,000 pounds.*

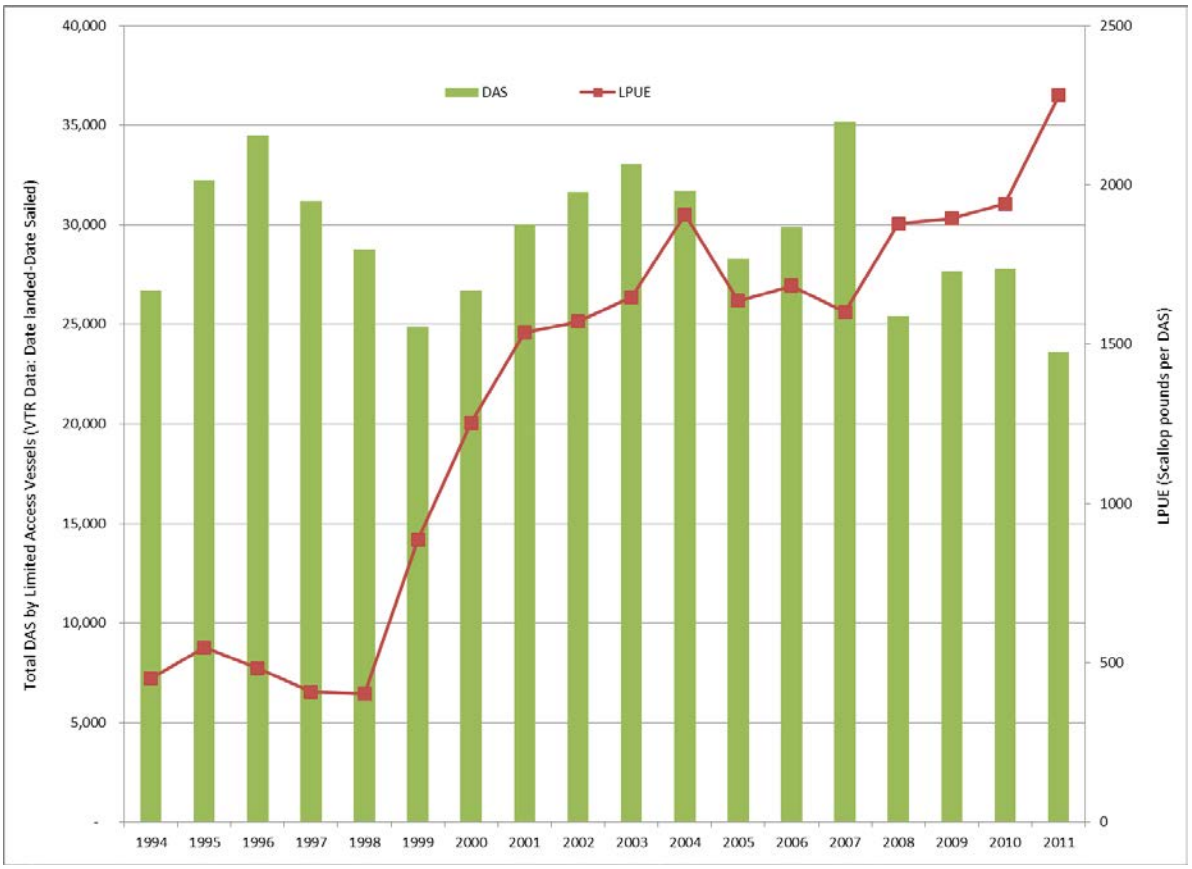
After fishing year 1999, fishing effort started to increase as more limited access vessels participated in the sea scallop fishery. The increase in total effort was mostly due to the increase in the number of vessels because total DAS allocations (mostly less than 120 days) were lower than the DAS allocations in the mid-1990s (over 142 days, Table 2). The recovery of the scallop resource and the dramatic increase in fishable abundance after 1999 increased the profits in the scallop fishery, thus leading to an increase in participation by limited access vessels that had been inactive during the previous years. Georges Bank closed areas were opened to scallop fishing starting in 1999 by Framework 11 (CAII) and later by Framework 13 (CAII, CAI, NLS), encouraging many vessel owners to take the opportunity to fish in those lucrative areas. Frameworks 14 and 15 provided controlled access to Hudson Canyon and VA/NC areas. As a result, the number of active limited access permits in the sea scallop fishery increased from 258 in 2000 to 303 in 20003. The total fishing effort by the fleet increased to about 33,000 days in 2003 from about 26,700 days in 2000 (**Table 15** and Figure 7 ). Total fishing effort (DAS used) declined after 2003 even though the number of active vessels increased to 340 vessels in 2006 from 303 vessels in 2003.

The column 1 in of Table 3 shows total DAS allocations (not DAS-used or days fished) including both open and access areas. Until the implementation of Amendment 10, each access area trip were assigned a 10 DAS trade-off such that any vessel that choose not to fish in access areas could instead fish for scallops in the open areas for 10 DAS. Thus, total DAS allocation for the access areas is calculated as the number of trips multiplied by 10 DAS (even though it

might have taken less than 10 DAS to land the possession limit in those areas). Following this method, Column 1 shows that total DAS allocations for open and access areas per full-time vessel declined from 204 DAS in 1994 to 120 DAS in 2003. With the implementation of Amendment 10 (2004) the limited access vessels were allocated DAS for open areas and area specific access area trips with no open area trade-offs. Although the vessels could no longer use their access area allocations in the open areas, Amendment 10 and Frameworks 16 to 18 continued to include an automatic DAS charge of 12 DAS for each access area trip until it was eliminated by NMFS. For the purposes showing the trend in the DAS allocations, the shaded area in Column 1 of Table 2 provides an estimate of total DAS allocation if the same system of DAS charge for the access areas ( i.e., 12 DAS charge for each access area trip) continued. Under this scenario, the total DAS allocations would have been reduced to below 90 DAS after 2009 (compared to 204 DAS in 1994) -- again reflecting the dramatic increase in the productivity of the scallop fishery. The open area allocations were reduced to its lowest level, 32 DAS, in 2011 whereas full-time vessels were allocated 4 access area trips in the same year (NEFSC, Framework 21).

Even though total DAS allocations remained around the same levels during 2005-2007 (at about 110 DAS, Table 2), the fishing effort, i.e., fleet DAS used increased in the 2007 fishing year as many vessels took their unused 2005 HCA trips in that year. If not for those HCA trips, the total effort in the scallop fishery would probably have stayed constant during 2005-2007 with almost all qualified limited access vessels participating in the fishery. Total DAS-used declined further in 2008 to about 25,400 days as the open area DAS allocations are reduced by 30% from 51 days to 35 days per full-time vessel, but increased to 26,300 in 2009 as the limited access vessels received access area trips (5 trips per vessel). Total DAS-used by the limited access vessels were higher in 2010 despite lower number of access area trips (4 trips per vessel). Open area DAS allocations were slightly higher in 2010 (38 DAS versus 37 DAS in 2009) and vessels spend more time fishing in the access areas. Total DAS-used further declined in 2011, however, despite the increase in the open area DAS allocations. This because DAS-used in the access areas declined due higher LPUEs in these areas compared to 2010 fishing year (Table 6).

**Figure 7. Total DAS-used (Date landed – Date sailed from VTR data) by all limited access vessels and LPUE**




The impact of the decline in effort below 30,000 days since 2005 (with the exception of 2007) on scallop revenue per vessel was small, however, due to the increase in LPUE from about 1600 pounds per day-at-sea in 2007 to over 2200 pounds per day-at-sea in 2011 in all areas (As estimated from Date landed – Date sailed from VTR data (Figure 7). Figure 8 shows that LPUE for the full-time dredge vessels was higher (about 2475 lb. in 2011fishing year) than the LPUE of small dredge vessels (about 1776 lb. in 2011 fishing year, Figure 9).

**Figure 8. Total DAS-used (Date landed – Date sailed from VTR data) by Full-time dredge vessels and LPUE**

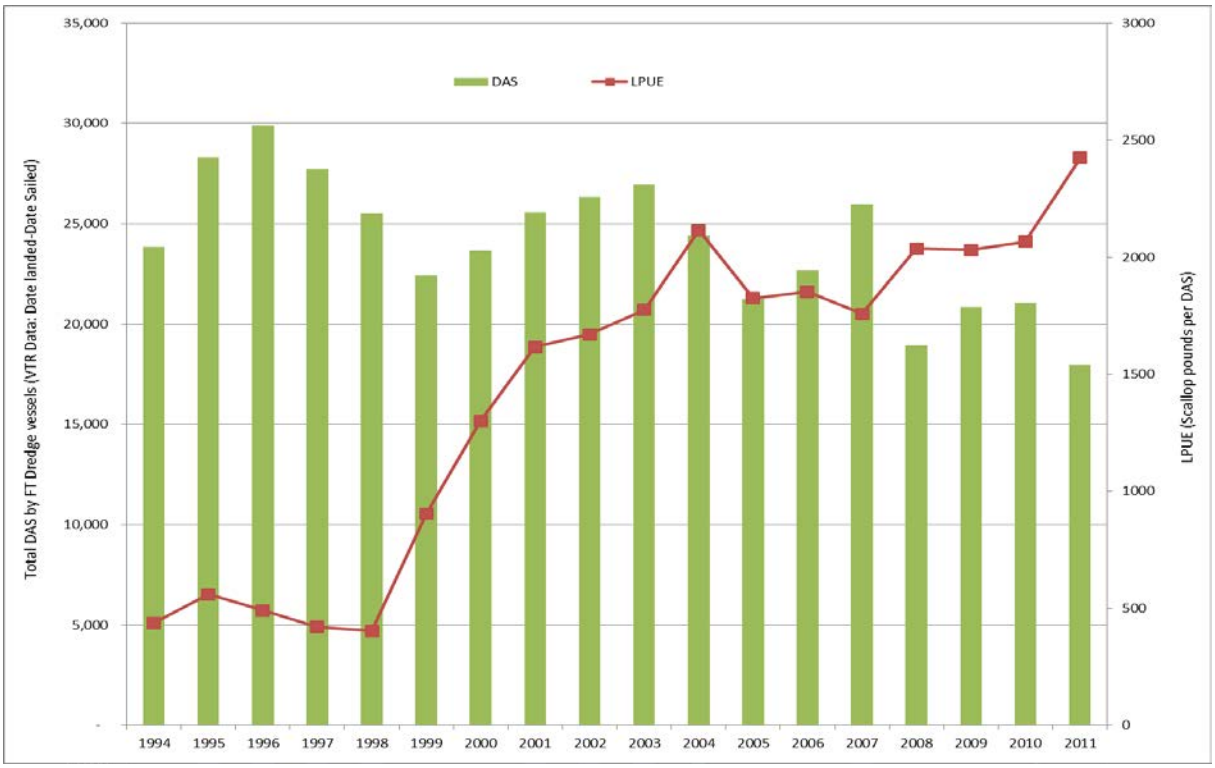
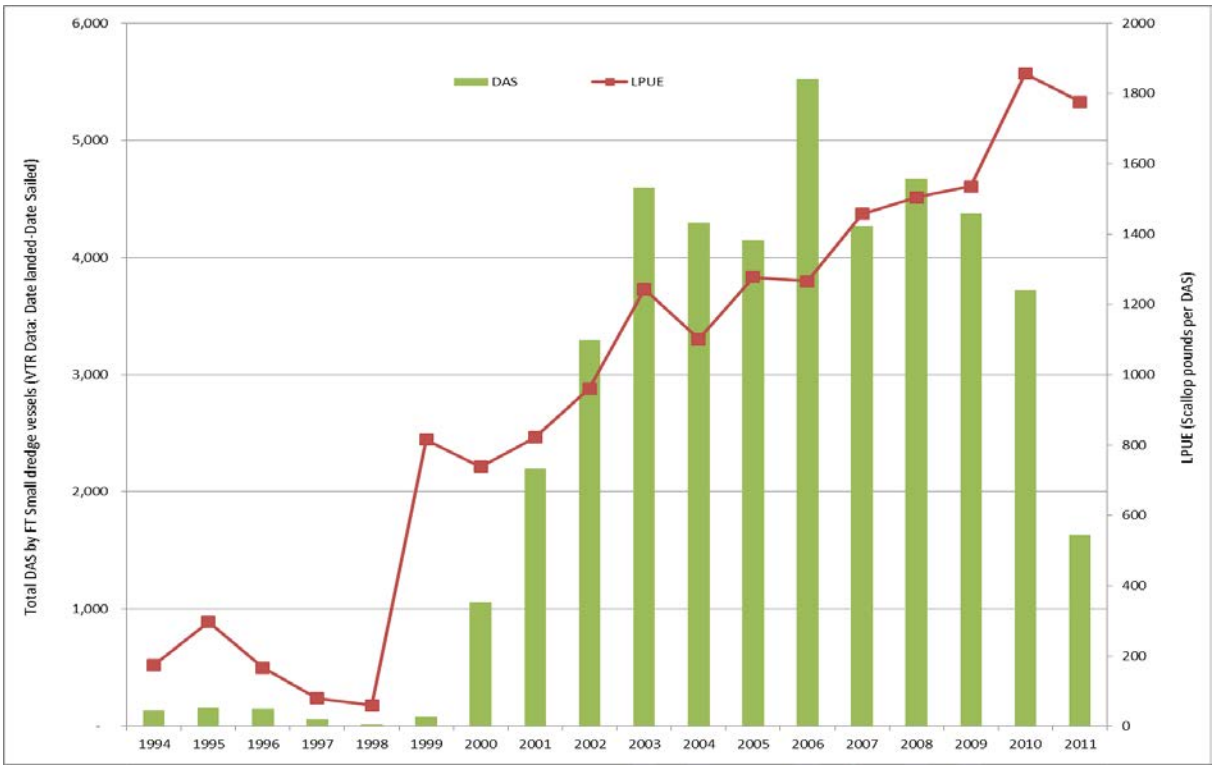
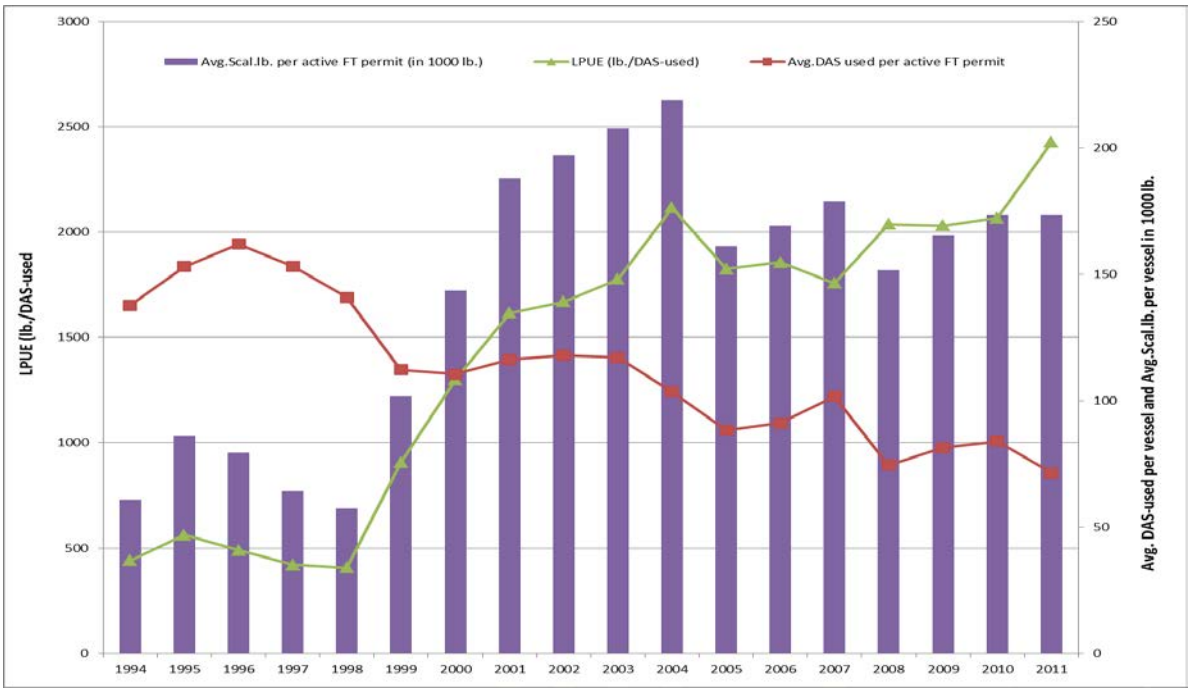



**Figure 9. Total DAS-used (Date landed – Date sailed from VTR data) by Full-time small dredge vessels and LPUE**



It must be cautioned that these LPUE numbers are lower than the estimates used in the PDT analyses used to estimate open area DAS allocations. The numbers in Figure 7 through Figure 10 are obtained from the VTR database and include the steam time as calculated the days spent at sea starting with the sail date and ending with the landing date. In addition, those numbers include both open and access areas. In contrast, total "DAS used" in the fishery is the value incorporated in the LPUE models by the PDT to calculate future DAS allocations in the open areas for the full-time vessels. In these models, the value for DAS used comes from the field "DAS charged" from the DAS database. DAS charged is based on the time a vessel crossed the VMS demarcation line going out on a trip, and the time it crossed again coming back from a trip, so it wouldn't include the time from (to) the port to (from) the demarcation line at the start (end) of the trip. Therefore, the DAS-used (LPUE) calculated from the VTR data would be greater (lower) than the DAS-used (LPUE) calculated from the demarcation line in the DAS database. Because VTR data is available for a longer period, however, it is useful in analyzing the historical trends in LPUE (from port to port) since 1994. As a result of this increasing trend in LPUE from about 450 pounds per DAS in 1994 to over 2000 pounds per DAS in 2011, scallop revenue per vessel quadrupled in recent years compared to the levels in mid 1990s. The LPUE numbers estimated from the VTR database are also different from the LPUE numbers calculated from the data that combined Dealer database with the VMS as presented in Table 5 and Table 6 below. Following figure show the trends in LPUE, average annual scallop pounds and average DAS-used per active vessel with FT dredge permit that fished more than 30 DAS annually and landed more than 10,000 lb. of scallops.

**Figure 10. LPUE and average DAS-used (VTR data, includes steam time) and scallop landings per FT Dredge vessel**



### 1.1.3.1 Landings and LPUE by area

Table 3 describes the fraction of total landings by area for all limited access vessels from 2004-2009 by calendar year. The open area catch has declined from about 62% to 64% of total catch in 2004-2005 to about 44% in 2007 and 2008. However, recently the share of open area catch increased again to 61% in 2010 and to almost 58% in 2011 as LPUE increase over 2,600 lb. per DAS in 2010 and over 3000 lb. per DAS (for the first time in 2011) in the open areas (Table 6). It must be pointed out that the LPUE numbers reported in Table 5 and Table 6 are obtained by combining VMS (DAS activity) data with the dealer data and as such they wouldn't include the time from (to) the port to (from) the demarcation line at the start (end) of the trip. Because VTR data includes the time from port to (from) the demarcation line at the start (end) of the trip, LPUE's that are derived from VTR database (as in Figure 10) are lower than the LPUE's shown in Table 5 and Table 6.

**Table 3 – Percent of total limited access scallop catch by area and calendar year (Dealer and VMS data)**

| Access Area | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Closed Area 1 | 0.00% | 11.92% | 0.00% | 9.85% | 0.00% | 0.00% |
| Closed Area 2 | 5.52% | 9.90% | 23.52% | 0.00% | 0.00% | 5.02% |
| Delmarva | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.21% |
| Elephant Trunk | 0.00% | 0.00% | 0.00% | 27.40% | 46.99% | 28.64% |
| Hudson Canyon | 29.12% | 14.13% | 0.71% | 9.12% | 0.12% | 0.00% |
| Nantucket Lightship | 3.44% | 0.00% | 15.89% | 10.02% | 8.58% | 0.00% |
| OPEN | 61.92% | 64.04% | 59.89% | 43.60% | 44.31% | 57.13% |

**Table 4 – Percent of total limited access scallop catch by area and fish year (Dealer and VMS data)**

| Access Area | 2010 | 2011 |
|---|---|---|
| Closed Area 1 | 0.00% | 15.35% |
| Closed Area 2 | 0.00% | 4.90% |
| Delmarva | 11.17% | 10.28% |
| Elephant Trunk | 16.75% | 1.68% |
| Hudson Canyon | 0.16% | 10.10% |
| Nantucket Lightship | 10.81% | 0.00% |
| OPEN | 61.10% | 57.68% |

**Table 5 – LPUE by area and calendar year (Limited access vessels, dealer and VMS data)**

| Access Area | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| Closed Area 1 | | 2,355 | | 2,804 | | |
| Closed Area 2 | 2,312 | 2,192 | 2,287 | | | 2,370 |
| Delmarva | | | | | | 1,931 |
| Elephant Trunk | | | | 2,563 | 2,422 | 1,940 |
| Hudson Canyon | 1,886 | 1,130 | 629 | 1,034 | 1,053 | |
| Nantucket Lightship | 2,399 | | 3,085 | 3,575 | 3,324 | |
| OPEN | 2,326 | 2,300 | 1,791 | 1,481 | 1,612 | 2,110 |

**Table 6 – LPUE by area and fish year (Limited access vessels, dealer and VMS data)**

| Access Area | 2010 | 2011 |
|---|---|---|
| Closed Area 1 | | 2,511 |
| Closed Area 2 | | 2,102 |
| Delmarva | 2,038 | 1,733 |
| Elephant Trunk | 1,362 | 779 |
| Hudson Canyon | 1,897 | 2,415 |
| Nantucket Lightship | 2,406 | |
| OPEN | 2,632 | 3,112 |

### 1.1.4 Trends in the meat count and size composition of scallops

Average scallop meat count has declined continuously since 1999 as a result of effort-reduction measures, area closures, and an increase in ring sizes implemented by the Sea Scallop FMP. The share of larger scallops increased with the share of U10 scallops rising to over 20% during 2006-2008, and to 15% in 2009 on compared to less than 10% in 2000-2004. The share of 11-20 count scallops increased from 12% in 1999 to 77% in 2011. On the other hand, the share of 30 or more count scallops declined from 30% in 1999 to 1% or less since 2008 (Table 8). Larger scallops priced higher than the smaller scallops contributed to the increase in average scallop prices in recent years despite larger landings (Table 10 and Figure 3). The price of smaller scallops, especially the 21 to 30 count scallops, increased however in 2011 fishing year as their supply declined to 6% of total scallop landings. The scarcity of smaller scallops reduced the differences in price of large and small scallops especially in 2011 fishing year.

**Table 7. Scallop landings by market category**

| FISHYEAR | U10 | 11 to 20 | 21 to 30 | >30 | UNK | Grand Total |
|---|---|---|---|---|---|---|
| 1999 | 3,690,533 | 2,613,754 | 6,195,369 | 7,365,692 | 2,705,775 | 22,571,123 |
| 2000 | 2,393,703 | 6,771,024 | 14,364,895 | 7,282,469 | 3,482,834 | 34,294,925 |
| 2001 | 1,520,424 | 10,783,931 | 24,596,256 | 4,587,499 | 5,872,646 | 47,360,756 |
| 2002 | 2,484,107 | 7,436,720 | 34,083,568 | 2,133,778 | 5,599,078 | 51,737,251 |
| 2003 | 3,639,749 | 12,211,950 | 31,844,817 | 1,755,259 | 7,711,197 | 57,162,972 |
| 2004 | 5,110,209 | 28,937,348 | 24,986,628 | 588,931 | 4,994,479 | 64,617,595 |
| 2005 | 6,905,448 | 31,605,992 | 11,482,597 | 1,126,285 | 4,008,939 | 55,129,261 |
| 2006 | 13,274,082 | 28,804,491 | 10,772,955 | 705,158 | 3,698,803 | 57,255,489 |
| 2007 | 14,894,752 | 32,021,763 | 7,518,148 | 2,227,602 | 4,478,999 | 61,141,264 |
| 2008 | 12,303,050 | 27,664,117 | 10,229,476 | 366,744 | 2,222,662 | 52,786,049 |
| 2009 | 8,420,979 | 35,701,483 | 12,142,881 | 172,383 | 1,458,359 | 57,896,085 |
| 2010 | 8,737,293 | 35,928,883 | 10,935,017 | 66,311 | 1,154,560 | 56,822,064 |
| 2011 | 8,554,959 | 45,263,289 | 3,247,515 | 309,435 | 1,122,944 | 58,498,142 |
| 2012 | 2,317,822 | 17,110,035 | 1,053,931 | 1,892 | 253,955 | 20,737,635 |

*2012 is for months 3 to 5

**Table 8. Size composition of scallops**

| FISHYEAR | U10 | 11 to 20 | 21 to 30 | >30 | UNK | Grand Total |
|---|---|---|---|---|---|---|
| 1999 | 16% | 12% | 27% | 33% | 12% | 100% |
| 2000 | 7% | 20% | 42% | 21% | 10% | 100% |
| 2001 | 3% | 23% | 52% | 10% | 12% | 100% |
| 2002 | 5% | 14% | 66% | 4% | 11% | 100% |
| 2003 | 6% | 21% | 56% | 3% | 13% | 100% |
| 2004 | 8% | 45% | 39% | 1% | 8% | 100% |
| 2005 | 13% | 57% | 21% | 2% | 7% | 100% |
| 2006 | 23% | 50% | 19% | 1% | 6% | 100% |
| 2007 | 24% | 52% | 12% | 4% | 7% | 100% |
| 2008 | 23% | 52% | 19% | 1% | 4% | 100% |
| 2009 | 15% | 62% | 21% | 0% | 3% | 100% |
| 2010 | 15% | 63% | 19% | 0% | 2% | 100% |
| 2011 | 15% | 77% | 6% | 1% | 2% | 100% |
| 2012 | 11% | 83% | 5% | 0% | 1% | 100% |

*2012 is for months 3 to 5

**Table 9. Size composition of scallops in 2012**

| MONTH | U10 | 11 to 20 | 21 to 30 | >30 | UNK | Grand Total |
|---|---|---|---|---|---|---|
| 1 | 6% | 60% | 27% | 1% | 6% | 100% |
| 2 | 3% | 65% | 27% | 1% | 4% | 100% |
| 3 | 6% | 87% | 6% | 0% | 2% | 100% |
| 4 | 11% | 82% | 5% | 0% | 2% | 100% |
| 5 | 15% | 80% | 5% | 0% | 1% | 100% |
| 6 | 24% | 70% | 3% | 0% | 2% | 100% |
| 7 | 34% | 61% | 2% | 0% | 2% | 100% |

**Table 10. Price of scallop by market category (in 2011 inflation adjusted prices)**

| FISHYEAR | U10 | 11 to 20 | 21 to 30 | >30 | UNK | All counts |
|---|---|---|---|---|---|---|
| 1999 | 8.04 | 8.18 | 7.54 | 6.62 | 7.65 | 7.41 |
| 2000 | 8.94 | 6.73 | 6.02 | 6.08 | 6.54 | 6.43 |
| 2001 | 7.47 | 4.75 | 4.45 | 4.54 | 4.65 | 4.65 |
| 2002 | 6.84 | 4.97 | 4.66 | 5.43 | 4.82 | 4.86 |
| 2003 | 5.95 | 4.98 | 4.99 | 5.55 | 4.94 | 5.06 |
| 2004 | 7.14 | 6.20 | 5.79 | 6.03 | 5.68 | 6.08 |
| 2005 | 9.09 | 8.94 | 8.80 | 8.69 | 8.64 | 8.90 |
| 2006 | 6.63 | 7.33 | 7.69 | 7.59 | 6.77 | 7.20 |
| 2007 | 7.44 | 7.14 | 6.88 | 6.34 | 6.78 | 7.13 |
| 2008 | 7.48 | 7.20 | 7.06 | 6.86 | 6.72 | 7.21 |
| 2009 | 8.39 | 6.48 | 6.38 | 6.05 | 6.10 | 6.72 |
| 2010 | 10.83 | 7.71 | 8.44 | 8.74 | 7.65 | 8.33 |
| 2011 | 10.18 | 9.87 | 10.31 | 9.77 | 9.89 | 9.94 |
| 2012 | 10.47 | 9.33 | 9.36 | 9.74 | 9.72 | 9.46 |

### 1.1.5 The trends permits by permit plan and categories

Table 11 shows the number of limited access vessels by permit category from 1999 to 2011. The fishery is primarily full-time, with a small number of part-time permits. There no occasional permits left in the fishery since 2009 because these were converted to part-time small dredge. The number of full-time vessels has been on the rise since 1999. Of these permits, the majority are dredge vessels, with a small amount of full-time small dredge and full-time trawl vessels. The permit numbers shown in Table 11 include duplicate entries because replacement vessels receive new permit numbers and when a vessel is sold, the new owner would get a new permit number. The unique vessels with right-id numbers are shown in Table 12 for 2008-2012. For example, only 347 out of 362 permits in 2008 belonged to unique vessels. If the number of permits in 1999 fishing year included only the number of unique vessels, this would mean an increase in the number of limited access vessels by 56 vessels (347-291), or by about 20% since 1999.

**Table 11. Number of limited access vessels by permit category and gear**

| Permit category | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Full-time | 220 | 224 | 234 | 238 | 242 | 248 | 255 | 256 | 254 | 259 | 252 | 253 |
| Full-time small dredge | 3 | 13 | 25 | 39 | 48 | 57 | 59 | 63 | 56 | 55 | 54 | 53 |
| Full-time net boat | 17 | 16 | 16 | 16 | 15 | 19 | 14 | 12 | 11 | 11 | 11 | 11 |
| **Total full-time** | 240 | 253 | 275 | 293 | 305 | 324 | 328 | 331 | 321 | 326 | 317 | 316 |
| Part-time | 16 | 14 | 14 | 10 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| Part-time small dredge | 4 | 6 | 8 | 19 | 26 | 30 | 34 | 35 | 32 | 34 | 34 | 32 |
| Part-time trawl | 20 | 18 | 10 | 8 | 3 | - | - | - | - | - | - | |
| **Total part-time** | 40 | 38 | 32 | 37 | 33 | 33 | 37 | 37 | 34 | 37 | 38 | 34 |
| Occasional | 4 | 5 | 4 | 3 | 3 | 1 | 2 | 1 | 1 | - | - | - |
| Occasional trawl | 16 | 19 | 15 | 8 | 5 | 5 | - | - | - | - | - | - |
| **Total occasional** | 20 | 24 | 19 | 11 | 8 | 6 | 2 | 1 | 1 | 0 | 0 | 0 |
| **Total Limited access** | 300 | 315 | 326 | 342 | 346 | 363 | 367 | 369 | 356 | 361 | 353 | 351 |

*Note: The permit numbers above include duplicate entries because replacement vessels receive new permit numbers and when a vessel is sold, the new owner would get a new permit number.*

**Table 12. Scallop Permits by unique right-id and category by application year**

| Permit category | 2008 | 2009-2011 |
|---|---|---|
| Full-time | 250 | 250 |
| Full-time small dredge | 52 | 52 |
| Full-time net boat | 11 | 11 |
| **Total full-time** | **313** | **313** |
| Part-time | 2 | 2 |
| Part-time small dredge | 31 | 32 |
| Part-time trawl | 0 | 0 |
| **Total part-time** | **33** | **34** |
| Occasional | 1 | 0 |
| **Total Limited access** | 347 | 347 |

Table 13 shows that the number of general category permits declined considerably after 2007 as a result of the Amendment 11 provisions. Although not all vessels with general category permits were active in the years preceding 2008, there is no question that the number of vessels (and owners) that hold a limited access general category permit under the Amendment 11 regulations are less than the number of general category vessels that were active prior to 2008 (Table 13). Table 14 shows the combinations of permits owned by LA and LAGC vessels. For example, 19 full-time limited access vessels also owned LAGC-IFQ permits, another 19 full-time vessels owned LAGC-NGOM permits and about 83 full-time vessels also owned LAGC-incidental permits in 2011.

**Table 13. General category permit before and after Amendment 11 implementation**

| AP_YEAR | General category permit (up to 2008) | Number of permits qualify under Amendment 11 program | | | Grand Total |
|---|---|---|---|---|---|
| | | Limited access general category (A) | Limited access NGOM permit (B) | Incidental catch permit (C) | |
| 2000 | 2263 | | | | 2263 |
| 2001 | 2378 | | | | 2378 |
| 2002 | 2512 | | | | 2512 |
| 2003 | 2574 | | | | 2574 |
| 2004 | 2827 | | | | 2827 |
| 2005 | 2950 | | | | 2950 |
| 2006 | 2712 | | | | 2712 |
| 2007 | 2493 | | | | 2493 |
| 2008 | | 342 | 99 | 277 | 718 |
| 2009 | | 344 | 127 | 301 | 772 |
| 2010 | | 333 | 122 | 285 | 740 |
| 2011 | | 288 | 103 | 279 | 670 |

**Table 14. Scallop Permits by unique permit combinations by application year**

| Permit category | 2009 | 2010 | 2011 | 2012* |
|---|---|---|---|---|
| FT | 131 | 133 | 132 | 132 |
| FT and IFQ | 18 | 18 | 19 | 18 |
| FT and NGOM | 19 | 19 | 19 | 19 |
| FT and INCIDENTAL | 84 | 82 | 83 | 84 |
| FTSD | 22 | 21 | 22 | 21 |
| FTSD and IFQ | 12 | 12 | 12 | 12 |
| FTSD and NGOM | 5 | 5 | 5 | 5 |
| FTSD and INCIDENTAL | 14 | 14 | 14 | 14 |
| FTTRW | 6 | 6 | 6 | 6 |
| FTTRW and IFQ | 1 | 1 | 1 | 1 |
| FTTRW and NGOM | 2 | 1 | 1 | 1 |
| FTTRW and INCIDENTAL | 3 | 3 | 3 | 3 |
| PT and IFQ | 2 | 2 | 2 | 2 |
| PT and NGOM | 2 | 3 | 2 | 2 |
| PTSD | 10 | 9 | 9 | 9 |
| PTSD and IFQ | 8 | 7 | 7 | 7 |
| PTSD and INCIDENTAL | 15 | 14 | 14 | 14 |
| LAGC IFQ | 303 | 293 | 247 | 215 |
| LAGC NGOM | 99 | 94 | 76 | 62 |
| LAGC INCIDENTAL | 185 | 172 | 165 | 151 |

*2012 Numbers are preliminary

The trends in the estimated number of active vessels are showing in Table 15 by permit plan. There has been an increase in participation by both LA and general category vessels after 1999 fishing year as the recovery of the scallop resource and yield fishing more profitable along with

the higher prices of scallops. Table 16 shows the number of active LAGC vessels by permit category excluding those LA vessels which have both LA and LAGC permits and indicates that there quota has been fished by fewer vessels in 2011 compared to 2009 and 2010. For example, there were about 288 vessels with LAGC-IFQ permits in 2011 and only 169 of these seem to have landed any scallops.

**Table 15. Active vessels by fishyear and permit category (Vessels that landed any amount of scallops--may include duplicate records for replaced vessels with different permit numbers)**

| Fishyear | General category | Limited Access General Category | Limited Access |
|---|---|---|---|
| 1994 | 186 | | 260 |
| 1995 | 188 | | 244 |
| 1996 | 222 | | 246 |
| 1997 | 244 | | 225 |
| 1998 | 209 | | 229 |
| 1999 | 194 | | 244 |
| 2000 | 208 | | 258 |
| 2001 | 280 | | 281 |
| 2002 | 299 | | 292 |
| 2003 | 337 | | 303 |
| 2004 | 446 | | 315 |
| 2005 | 618 | | 327 |
| 2006 | 639 | | 340 |
| 2007 | 485 | | 353 |
| 2008 | 151 | 288 | 348 |
| 2009 | | 317 | 353 |
| 2010 | | 267 | 351 |
| 2011 | | 259 | 348 |

**Table 16. Number of active vessels with LAGC permits by permit category**

| Fishyear | Permit type | IFQ | INCI | NGOM | Grand Total |
|---|---|---|---|---|---|
| 2009 | LA+LAGC | 27 | 8 | <4 | 36 |
| | LAGC only | 204 | 66 | >8 | 281 |
| 2009 Total | | 231 | 74 | 12 | 317 |
| 2010 | LA+LAGC | 31 | 15 | 4 | 50 |
| | LAGC only | 148 | 53 | 8 | 209 |
| 2010 Total | | 179 | 68 | 12 | 259 |
| 2011 | LA+LAGC | 28 | 21 | 7 | 56 |
| | LAGC only | 141 | 55 | 7 | 203 |
| 2011 Total | | 169 | 76 | 14 | 259 |

Source: Dealer and Permit Databases

### 1.1.6 Landings by permit categories and gear type

Table 17 through Table 18 describe scallop landings by limited access vessels by gear type and permit category. These tables were obtained by combining the dealer and permit databases.

Most limited access category effort is from vessels using scallop dredges, including small dredges. The number of full-time trawl permits has decreased continuously and has been at 11 full-time trawl permitted vessels since 2008 (Table 11). Furthermore, according to the 2009-2011 VTR data, the majority of these vessels (10 out of 11 in 2010) landed scallops using dredge gear even though they had a trawl permit. There has also been an increase in the numbers of full-time and part-time small dredge vessels after 2002.

Table 18 shows the percent of limited access landings by permit and year. In terms of gear, majority of the scallop landings by the limited access vessels were with dredge gear including the small dredges, with significant amounts also landed by full-time and part-time trawls until 2000. Table 18 shows that the percentage of landings by FT trawl permits declined after 1998 to about 3% of total limited access scallop landings in 2011. There were only 11 FT trawl permits in 2011. However, 2009-2011 VTR data also show that over 90% of the scallop pounds by the FT trawl permitted vessels are landed using dredge gear (10 vessels) since these vessels are allowed to use dredge gear even though they have a trawl permit. Similarly, all of the part-time trawl and occasional trawl permits are converted to small dredge vessels. Over 80% of the scallop pounds are landed by vessels with full-time dredge and close to 13% landed by vessels with full-time small dredge permits since the 2007 fishing year. Including the full-trawl vessels that use dredge gear, the percentage of scallop pounds landed by dredge gear amounted to over 99% of the total scallop landings in 2009-2011.

**Table 17. Scallop landings (lbs.) by limited access vessels by permit category and gear**

| FISHYEAR | FT Dredge | PT Dredge | FT SD | PT SD | FT TRW* | PT TRW | OC TRW |
|---|---|---|---|---|---|---|---|
| 1994 | 13,220,405 | 77,668 | 45,787 | 3,279 | 1,676,178 | 138,258 | NA |
| 1995 | 13,917,047 | 205,147 | 42,944 | 10,017 | 1,313,153 | 175,932 | 47,098 |
| 1996 | 14,268,680 | 259,791 | 28,644 | 13,336 | 1,199,765 | 376,874 | 93,375 |
| 1997 | 11,216,499 | 148,742 | | 19,093 | 634,815 | 242,396 | NA |
| 1998 | 9,727,603 | 84,929 | 2,956 | 339 | 870,409 | 315,627 | 4,176 |
| 1999 | 19,315,020 | 303,397 | 1,101 | 15,692 | 945,252 | 564,111 | 15,950 |
| 2000 | 29,841,612 | 599,186 | 13,692 | 80,741 | 1,251,164 | 710,032 | 14,284 |
| 2001 | 39,403,382 | 861,087 | 765,342 | 208,176 | 1,882,339 | 744,057 | 17,756 |
| 2002 | 43,131,627 | 918,534 | 1,757,695 | 269,284 | 2,168,295 | 504,441 | 34,108 |
| 2003 | 46,285,721 | 932,815 | 3,125,474 | 482,472 | 1,788,116 | 272,668 | NA |
| 2004 | 49,686,664 | 323,389 | 5,654,387 | 825,223 | 1,742,183 | 125,949 | 17,625 |
| 2005 | 38,490,448 | 236,757 | 4,788,085 | 1,379,360 | 978,171 | | 14,407 |
| 2006 | 41,384,039 | 173,455 | 5,223,125 | 1,304,877 | 1,238,844 | | |
| 2007 | 44,053,640 | 248,050 | 6,917,823 | 1,601,167 | 1,488,612 | | |
| 2008 | 38,322,912 | 189,037 | 6,191,944 | 1,221,951 | 1,396,536 | | |
| 2009 | 42,273,762 | 210,979 | 6,952,137 | 1,255,064 | 1,646,005 | | |
| 2010 | 43,034,572 | 413,837 | 6,749,909 | 1,651,572 | 1,614,694 | | |
| 2011 | 43,904,743 | 180,879 | 6,898,238 | 1,512,142 | 1,719,575 | | |

*Note: Although these vessels have trawl permits, majority of these vessels used dredge gear. As a result, over 90% of the scallop landings by the FT trawl permitted vessels are caught using dredge gear in 2009-2010 according to the VTR data.

**Table 18. Percentage of scallop landings (lbs.) by limited access vessels by permit category**

| FISHYEAR | FT Dredge | PT Dredge | FT SD | PT SD | FT TRW* | PT TRW | OC TRW |
|---|---|---|---|---|---|---|---|
| 1994 | 87.2% | 0.5% | 0.3% | 0.0% | 11.1% | 0.9% | 0.03% |
| 1995 | 88.6% | 1.3% | 0.3% | 0.1% | 8.4% | 1.1% | 0.30% |
| 1996 | 87.9% | 1.6% | 0.2% | 0.1% | 7.4% | 2.3% | 0.57% |
| 1997 | 91.5% | 1.2% | 0.0% | 0.2% | 5.2% | 2.0% | 0.00% |
| 1998 | 88.4% | 0.8% | 0.0% | 0.0% | 7.9% | 2.9% | 0.04% |
| 1999 | 91.3% | 1.4% | 0.0% | 0.1% | 4.5% | 2.7% | 0.08% |
| 2000 | 91.8% | 1.8% | 0.0% | 0.2% | 3.8% | 2.2% | 0.04% |
| 2001 | 89.8% | 2.0% | 1.7% | 0.5% | 4.3% | 1.7% | 0.04% |
| 2002 | 88.4% | 1.9% | 3.6% | 0.6% | 4.4% | 1.0% | 0.07% |
| 2003 | 87.5% | 1.8% | 5.9% | 0.9% | 3.4% | 0.5% | 0.00% |
| 2004 | 85.1% | 0.6% | 9.7% | 1.4% | 3.0% | 0.2% | 0.03% |
| 2005 | 83.9% | 0.5% | 10.4% | 3.0% | 2.1% | 0.0% | 0.03% |
| 2006 | 83.9% | 0.4% | 10.6% | 2.6% | 2.5% | 0.0% | 0.00% |
| 2007 | 81.1% | 0.5% | 12.7% | 2.9% | 2.7% | 0.0% | 0.00% |
| 2008 | 81.0% | 0.4% | 13.1% | 2.6% | 3.0% | 0.0% | 0.00% |
| 2009 | 80.8% | 0.4% | 13.3% | 2.4% | 3.1% | 0.0% | 0.00% |
| 2010 | 80.5% | 0.8% | 12.6% | 3.1% | 3.0% | 0.0% | 0.00% |
| 2011 | 81.0% | 0.3% | 12.7% | 2.8% | 3.2% | 0.0% | 0.00% |

*Note: Although these vessels have trawl permits, majority used dredge gear in 2009-2010 and over 90% of the scallop landings by the FT trawl permitted vessels are caught using dredge gear during the same years.

Since 2001, there has been considerable growth in fishing effort and landings by vessels with general category permits, primarily as a result of resource recovery and higher scallop prices. Amendment 11 implemented a limited entry program for the general category fishery allocating 5% of the total projected scallop catch to the general category vessels qualified for limited access. The main objective of the action was to control capacity and mortality in the general category scallop fishery. There is also a separate limited entry program for general category fishing in the Northern Gulf of Maine. In addition, a separate limited entry incidental catch permit was adopted that will permit vessels to land and sell up to 40 pounds of scallop meat per trip while fishing for other species.

During the transition period to the full-implementation of Amendment 11, the general category vessels were allocated 10% of the scallop TAC. Beginning with 2010 fishing year, limited access general category IFQ vessels were allocated 5% of the estimated scallop catch resulting a decline in landings by the general category vessels (Table 19 and Table 20). These tables were obtained from the dealer and permit databases. The trip information obtained from the dealer data shows the permit number but does not specify whether a particular trip was taken as a the limited access(LA) or general category (LAGC) trip. Because many vessels had and have both LA and general category permits, to separate the LA trips from LAGC trips for the same vessel requires some assumptions. If a vessel had both an LA and LAGC-IFQ permit, it was assumed that if scallop landings were equal or less than 400lb. (600lb.) for years up to 2010 (after 2010), that was an LAGC trip. If an LA vessel also had an LAGC-incidental permit, it was assumed that if scallop landings were equal or less than 100lb. , that was an LAGC-incidental trip. For the LAGC-NGOM fishery it was assumed that if the scallop landings were equal or less than 200lb., that trip was a LAGC trip, otherwise it was an LA trip. In addition to these issues, there were many trips that were not associated with any valid permit plan (perhaps due to mistakes in the

entry of permit number by dealers). Thus, it must be pointed out that the separation of landings by permit plan were estimated from the above assumptions and could differ slightly from actual landings. For example, Table 20 shows that in 2011 fishyear, the *estimated landings* by LAGC vessels including those by vessels with IFQ, NGOM and incidental catch permits and including the LAGC landings by the LA vessels that have both permits, amounted to 5.8% of total scallop landings in that fishyear.

**Table 19. *Estimated Landings* by permit plan before and after Amendment 11 implementation**

| FISHYEAR | General Category | Limited Access General category* | Limited Access | Unknown | Grand Total |
|---|---|---|---|---|---|
| 1994 | 133,065 | | 15,219,551 | 1,104,675 | 16,457,291 |
| 1995 | 129,500 | | 15,711,338 | 1,039,227 | 16,880,065 |
| 1996 | 212,571 | | 16,240,465 | 754,339 | 17,207,375 |
| 1997 | 370,207 | | 12,261,725 | 815,643 | 13,447,575 |
| 1998 | 176,571 | | 11,042,134 | 554,891 | 11,773,596 |
| 1999 | 167,447 | | 21,160,523 | 351,958 | 21,679,928 |
| 2000 | 451,540 | | 32,510,711 | 328,424 | 33,290,675 |
| 2001 | 1,649,916 | | 43,882,139 | 190,957 | 45,723,012 |
| 2002 | 1,126,203 | | 48,783,984 | 131,532 | 50,041,719 |
| 2003 | 1,902,253 | | 52,889,177 | 301,558 | 55,092,988 |
| 2004 | 3,735,008 | | 58,375,420 | 530,062 | 62,640,490 |
| 2005 | 7,586,819 | | 45,887,228 | 184,078 | 53,658,125 |
| 2006 | 6,790,919 | | 49,324,340 | 159,252 | 56,274,511 |
| 2007 | 5,058,517 | | 54,309,292 | 302,081 | 59,669,890 |
| 2008 | 1,223,058 | 3,538,740 | 47,322,380 | 391,125 | 52,475,303 |
| 2009 | | 4,528,767 | 52,337,947 | 1,106,772 | 57,973,486 |
| 2010 | | 2,543,506 | 53,464,584 | 952,897 | 56,960,987 |
| 2011 | | 3,403,692 | 54,215,577 | 830,408 | 58,449,677 |

**Table 20. *Estimated Landings* by permit plan before and after Amendment 11 implementation**

| FISHYEAR | General Category | Limited Access General category* | Limited Access | Unknown | Grand Total |
|---|---|---|---|---|---|
| 1994 | 0.8% | 0.0% | 92.5% | 6.7% | 100.0% |
| 1995 | 0.8% | 0.0% | 93.1% | 6.2% | 100.0% |
| 1996 | 1.2% | 0.0% | 94.4% | 4.4% | 100.0% |
| 1997 | 2.8% | 0.0% | 91.2% | 6.1% | 100.0% |
| 1998 | 1.5% | 0.0% | 93.8% | 4.7% | 100.0% |
| 1999 | 0.8% | 0.0% | 97.6% | 1.6% | 100.0% |
| 2000 | 1.4% | 0.0% | 97.7% | 1.0% | 100.0% |
| 2001 | 3.6% | 0.0% | 96.0% | 0.4% | 100.0% |
| 2002 | 2.3% | 0.0% | 97.5% | 0.3% | 100.0% |
| 2003 | 3.5% | 0.0% | 96.0% | 0.5% | 100.0% |
| 2004 | 6.0% | 0.0% | 93.2% | 0.8% | 100.0% |
| 2005 | 14.1% | 0.0% | 85.5% | 0.3% | 100.0% |
| 2006 | 12.1% | 0.0% | 87.6% | 0.3% | 100.0% |
| 2007 | 8.5% | 0.0% | 91.0% | 0.5% | 100.0% |
| 2008 | 2.3% | 6.7% | 90.2% | 0.7% | 100.0% |
| 2009 | 0.0% | 7.8% | 90.3% | 1.9% | 100.0% |
| 2010 | 0.0% | 4.5% | 93.9% | 1.7% | 100.0% |
| 2011 | 0.0% | 5.8% | 92.8% | 1.4% | 100.0% |

*Includes landings by LAGC IFQ, NGOM and incidental permits and LAGC landings by LA vessels.

**Table 21. *Estimated scallop landings* by LAGC vessels by permit category (Dealer and permit databases, including vessels that have both LA and LAGC permits)**

| Fishyear | Permit Type | IFQ | INCI | NGOM | Grand Total |
|---|---|---|---|---|---|
| 2009 | LA+LAGC | 322,945 | 1,865 | 130 | 324,940 |
| | LAGC only | 3,985,303 | 194,198 | 24,326 | 4,203,827 |
| 2009 Total | | 4,308,248 | 196,063 | 24,456 | 4,528,767 |
| 2010 | LA+LAGC | 206,627 | 3,811 | 1,255 | 211,693 |
| | LAGC only | 2,177,528 | 148,406 | 5,879 | 2,331,813 |
| 2010 Total | | 2,384,155 | 152,217 | 7,134 | 2,543,506 |
| 2011 | LA+LAGC | 264,388 | 11,533 | 5,047 | 280,968 |
| | LAGC only | 3,067,777 | 48,954 | 5,993 | 3,122,724 |
| 2011 Total | | 3,332,165 | 60,487 | 11,040 | 3,403,692 |

The general category scallop fishery has always been a comparatively small but diverse part of the overall scallop fishery. The number of vessels participating in the general category fishery has continued to rise until 2007 when the New England Fisheries Management Council proposed limiting access in response to concerns of redirected effort from other fisheries. When the limited access general category was implemented, in 2008, there was a corresponding decline in the total number of active vessels. Then again in 2010, there was a decline in the number of active general category vessels when the GC IFQ program began and a "hard" Total Allowable Catch of 5% of the total scallop catch limit was established. These declines are evident in Table 22 and Table 23 where the overall number of active vessels and scallop landings dropped, both in 2008 and in 2010.

Table 23 and Table 24 describe general category landings by gear type. These tables are generated by VTR data and since not all VTR records include gear information, the number of vessels in these tables will differ from other tables that summarize general category vessels and landings from dealer data. Primary gear is defined as the gear used to land more than 50% of scallop pounds. Most general category effort is and has been from vessels using scallop dredge and other trawl gear. The number of vessels using scallop trawl gear increased through 2006 but has declined in recent years. In terms of landings, most scallop landings under general category are with dredge gear, with significant amounts also landed by scallop trawls and other trawls. Table 23 shows the percent of general category landings by primary gear and year. The percentages of scallop landings with other trawl gear in 2008 and 2009 were the highest they have been since 2001, but still significantly less than dredge.

**Table 22. Number of general category vessels by primary gear and fishing year (excluding LAGC vessels with LA permits)**

| Year | DREDGE, OTHER | DREDGE, SCALLOP | MISC. | TRAWL, OTHER | TRAWL, SCALLOP |
|---|---|---|---|---|---|
| 1994 | * | 33 | 4 | 42 | * |
| 1995 | 4 | 91 | 5 | 48 | 4 |
| 1996 | 7 | 101 | 13 | 49 | * |
| 1997 | 6 | 118 | 9 | 55 | |
| 1998 | 10 | 100 | 8 | 52 | * |
| 1999 | 10 | 87 | 3 | 61 | 5 |
| 2000 | 7 | 78 | 9 | 91 | 3 |
| 2001 | 4 | 122 | 7 | 118 | 6 |
| 2002 | 3 | 147 | 3 | 104 | 9 |
| 2003 | 6 | 155 | * | 116 | 17 |
| 2004 | 8 | 218 | 10 | 173 | 34 |
| 2005 | 24 | 280 | * | 175 | 56 |
| 2006 | 28 | 369 | 5 | 151 | 58 |
| 2007 | 26 | 280 | 4 | 124 | 30 |
| 2008 | 9 | 130 | 5 | 62 | 21 |
| 2009 | 8 | 135 | * | 57 | 28 |
| 2010 | 11 | 102 | | 41 | 16 |
| 2011 | 9 | 93 | * | 42 | 15 |

** indicates 3 or less vessels*
*UNK - value unknown*

**Table 23. General category scallop landings by primary gear (pounds, excluding LAGC vessels with LA permits)**

| Year | DREDGE, OTHER | DREDGE, SCALLOP | MISC. | TRAWL, OTHER | TRAWL, SCALLOP |
|---|---|---|---|---|---|
| 1994 | * | 144,139 | * | 9,564 | * |
| 1995 | 4,812 | 501,910 | 1,146 | 43,585 | 11,797 |
| 1996 | 1,352 | 578,884 | 3,314 | 19,460 | * |
| 1997 | 3,253 | 682,270 | 3,465 | 30,227 | |
| 1998 | 6,049 | 334,930 | 2,443 | 19,677 | * |
| 1999 | 18,322 | 236,482 | 599 | 17,537 | 3,970 |
| 2000 | 6,446 | 303,168 | 1,411 | 173,827 | 8,179 |
| 2001 | 91,939 | 1,254,153 | 6,518 | 404,709 | 28,276 |
| 2002 | 21,888 | 1,266,144 | 919 | 74,686 | 41,977 |
| 2003 | 22,614 | 1,590,575 | * | 171,511 | 196,376 |
| 2004 | 36,260 | 2,499,393 | 2,359 | 422,426 | 340,921 |
| 2005 | 187,571 | 4,808,194 | * | 721,039 | 885,559 |
| 2006 | 189,786 | 5,583,477 | 5,431 | 399,909 | 549,745 |
| 2007 | 142,044 | 4,519,800 | 724 | 222,931 | 398,883 |
| 2008 | 88,761 | 2,596,790 | 1,502 | 525,675 | 290,179 |
| 2009 | 72,766 | 2,690,335 | * | 840,019 | 376,905 |
| 2010 | 63,795 | 1,601,073 | | 238,773 | 175,610 |
| 2011 | 75,223 | 2,428,386 | * | 329,148 | 189,703 |

** indicates 3 or less vessels*

**Table 24. Percentage of general category scallop landings by primary gear**

| Year | DREDGE, OTHER | DREDGE, SCALLOP | MISC. | TRAWL, OTHER | TRAWL, SCALLOP |
|---|---|---|---|---|---|
| 1994 | 0.07% | 92.00% | 0.17% | 6.10% | 1.66% |
| 1995 | 0.85% | 89.11% | 0.20% | 7.74% | 2.09% |
| 1996 | 0.22% | 95.74% | 0.55% | 3.22% | 0.27% |
| 1997 | 0.45% | 94.86% | 0.48% | 4.20% | 0.00% |
| 1998 | 1.65% | 91.30% | 0.67% | 5.36% | 1.02% |
| 1999 | 6.62% | 85.40% | 0.22% | 6.33% | 1.43% |
| 2000 | 1.31% | 61.49% | 0.29% | 35.26% | 1.66% |
| 2001 | 5.15% | 70.24% | 0.37% | 22.67% | 1.58% |
| 2002 | 1.56% | 90.08% | 0.07% | 5.31% | 2.99% |
| 2003 | 1.14% | 80.27% | 0.02% | 8.66% | 9.91% |
| 2004 | 1.10% | 75.71% | 0.07% | 12.80% | 10.33% |
| 2005 | 2.84% | 72.82% | 0.01% | 10.92% | 13.41% |
| 2006 | 2.82% | 82.98% | 0.08% | 5.94% | 8.17% |
| 2007 | 2.69% | 85.53% | 0.01% | 4.22% | 7.55% |
| 2008 | 2.53% | 74.13% | 0.04% | 15.01% | 8.28% |
| 2009 | 1.83% | 67.58% | 0.02% | 21.10% | 9.47% |
| 2010 | 3.07% | 77.00% | 0.00% | 11.48% | 8.45% |
| 2011 | 2.49% | 80.34% | 0.00% | 10.89% | 6.28% |

### 1.1.7 Landings by permit categories and home state

**Table 25. Full-time Scallop Dredge Permits by Home State**

| Year | Home State | Number of permits |
|---|---|---|
| 2011 | CT | 8 |
| | FL | 2 |
| | MA | 129 |
| | ME | 2 |
| | NC | 15 |
| | NJ | 54 |
| | PA | 2 |
| | RI | 2 |
| | VA | 36 |
| 2011 Total | | 250 |
| 2012 | CT | 8 |
| | FL | 2 |
| | MA | 129 |
| | ME | 2 |
| | NC | 15 |
| | NJ | 54 |
| | NY | 1 |
| | PA | 2 |
| | RI | 2 |
| | VA | 35 |
| 2012 Total | | 250 |

**Table 26. Full-time Scallop Small Dredge Permits by Home State**

| Year | Home State | Number of permits |
|---|---|---|
| 2011 | CT | 1 |
| | FL | 2 |
| | MA | 18 |
| | ME | 1 |
| | NC | 9 |
| | NJ | 16 |
| | NY | 2 |
| | VA | 3 |
| 2011 Total | | 52 |
| 2012 | CT | 1 |
| | FL | 2 |
| | MA | 17 |
| | ME | 1 |
| | NC | 9 |
| | NJ | 16 |
| | NY | 1 |
| | VA | 4 |
| 2012 Total | | 52 |

**Table 27. Number of LAGC-IFQ vessels by home state (2012 Application year, Permit data)**

| Home Port | Number of permits |
|---|---|
| CT | 3 |
| DE | 3 |
| MA | 84 |
| MD | 6 |
| ME | 8 |
| NC | 29 |
| NH | 6 |
| NJ | 82 |
| NY | 17 |
| PA | 3 |
| RI | 6 |
| TX | 1 |
| VA | 7 |
| **Grand Total** | **255** |

**Table 28. Number of LAGC-IFQ vessels and scallop landings by gear code and state of landings (2011, VTR data)**

| Gear | State | Number of vessels | Scallop landings (lb.) |
|---|---|---|---|
| DRS (SCALLOP DREDGE) | CT | NA | NA |
| | MA | 45 | 898,705 |
| | MD | 4 | 9,111 |
| | NC | NA | NA |
| | NH | NA | NA |
| | NJ | 47 | 1,187,586 |
| | NY | 6 | 55,156 |
| | RI | 16 | 119,421 |
| | VA | NA | NA |
| DRS Total | | 125 | 2,278,627 |
| OTF (Otter TRW) | MA | 13 | 9,369 |
| | MD | NA | NA |
| | NC | 7 | 2,613 |
| | NJ | 21 | 122,727 |
| | NY | 17 | 214,295 |
| | RI | NA | NA |
| | VA | 4 | 2,790 |
| OTF Total | | 65 | 355,274 |
| DRC (Q&CLAM DR.) | MD | NA | NA |
| | NJ | 9 | 49073 |
| DRC Total | | NA | NA |
| OTC (SCAL.TRW) | NC | 4 | 1,298 |
| | NJ | 7 | 60,539 |
| | NY | 9 | 117,812 |
| | VA | 6 | 9,923 |
| OTC Total | | 26 | 189,572 |

Note: The data for 3 or less vessels are not shown to protect confidentiality. The landings by vessels that have both LAGC and LA permits are excluded. Other gear included OTB (Bottom fish trawl) and OHS.

### 1.1.8 Trends in ownership patterns in the scallop fishery

#### 1.1.8.1 Limited access vessels

According to the ownership data for 2008, only 67 out of 322 vessels were owned by one person and/or cooperation (Table 29). The ownership structure 2010 was similar with 68 out of 343 vessels belonged to single boat owners. The data for 2011 shows a slight decline in the number of single boat owners to 63, however, that could be due to the data imperfections given that 4 vessels did not have corresponding ownership data in 2011 (Table 30).

The rest of the 78% to 80% of the scallop vessels with limited access permits were owned by several individuals and/or different corporations with ownership interest in more than one vessel. This factor makes it difficult assigning each vessel to a specific group of owners. The following tables were generated by selecting a primary owner for each group of vessels that are owned by

multiple individuals/entities based on the maximum number of vessels owned by one person/entity. For example, if Mr. A and Mrs. B were listed as the joint owners of the same 5 vessels, but Mrs. B was also listed as an owner of additional two vessels, Mrs. B has been assigned as the primary owner of these 7 vessels. Therefore, each owner group in Table 29 to Table 31 includes more than one person (usually several family members), who collectively own the corresponding number of vessels. For example, in the "10 and over" category, 5 different sets of owners owned 61 boats in 2008 with each of the 5 sets containing multiple individuals or entities.

**Table 29. Limited Access vessels (all categories, includes the LA vessels that have a LGC vessel) - Owner groups according to the number of vessels with ownership interest (2008)**

| Number of vessels owned | Number of owners | Number of vessels | Percent of total number of vessels | Percent of total scallop landings |
|---|---|---|---|---|
| 1 | 67 | 67 | 20.81% | 20.25% |
| 2 | 28 | 56 | 17.39% | 16.18% |
| 3 | 9 | 27 | 8.39% | 8.17% |
| 4 | 8 | 32 | 9.94% | 9.41% |
| 5 | 6 | 30 | 9.32% | 10.15% |
| 6 to 9 | 7 | 49 | 15.22% | 15.24% |
| 10 and over | 5 | 61 | 18.94% | 20.60% |
| Grand Total | 130 | 322 | 100.00% | 100.00% |

Because there were overlaps with owners for multiple vessels, such that two people has ownership interest in 5 boats, primary ownership was assigned to one person in 3 out of 5 boats, and the other person was assigned the 2 remaining boats. Another example includes common ownership of a vessel, with each individual also owning another vessel: Vessel A was owned by Mr. A, but Mr. A also owned another boat, Vessel B together with Mr. B, who owned 5 boats. As a result, vessel B was assigned to Mr. B because he is a 5 boat owner. As a result, Mr. A was classified as a multi-boat owner even though only one vessel's ownership (Vessel A) was assigned to him.

Table 30 shows that only 18% of the limited access vessels were owned by one entity or person in 2011, whereas 16% of the vessels are owned by 4 separate entities (group of individuals) each owned 10 or more vessels. As a result, the landings by single boat owners amounted to about 18% of the total fleet landings and the landings by owners of 10 and more boats amounted to 17% of fleet scallop landings in 2011. The landings include the limited access general category landings by vessels that also have a limited access permit.

The concentration of ownership could be even more than shown in Table 30 because not all family relationships could be taken into account according to the method applied above. It also must be pointed out that the dealer data included some vessels (about 7 permits) for which there was no corresponding ownership data. Given that the total number of unique vessels with limited access vessels were 347 since 2009, the ownership information about 3 vessels in 2011 is missing (Table 12). Still, it is evident from Table 30 that about half of the vessels in 2011 were owned by multi-boat owners having 5 or more boats and single boat owners constituted less than $1/5^{th}$ of the scallop fleet.

**Table 30. Number of vessels by owner groups (determined according to the total number of vessels with owned by each unique entity, i.e., multiple people with ownership interest on the same vessel, includes vessels that have both LA and LAGC permits)**

| Fishyear | Number of vessels owned | Number of owners | Number of vessels | Percent of total number of vessels | Percent of total scallop landings |
|---|---|---|---|---|---|
| 2010 | 1 | 68 | 68 | 20% | 19% |
| | 2 | 27 | 54 | 16% | 16% |
| | 3 | 11 | 33 | 10% | 9% |
| | 4 | 6 | 24 | 7% | 7% |
| | 5 | 4 | 20 | 6% | 6% |
| | 6 to 9 | 11 | 76 | 22% | 22% |
| | 10 and more | 5 | 68 | 20% | 21% |
| | 2010 Total | 132 | 343 | 100% | 100% |
| 2011 | 1 | 63 | 63 | 18% | 18% |
| | 2 | 32 | 64 | 19% | 17% |
| | 3 | 10 | 30 | 9% | 9% |
| | 4 | 5 | 20 | 6% | 6% |
| | 5 | 6 | 30 | 9% | 10% |
| | 6 to 9 | 11 | 81 | 24% | 24% |
| | 10 and more | 4 | 56 | 16% | 17% |
| 2011Total | | 131 | 344 | 100% | 100% |

### 1.1.8.2 Ownership by Limited Access General Category Vessels

According to the permit data, 293 vessels had LAGC-IFQ permits in 2010 and 247 vessels had LAGC-IFQ permits in 2011. These numbers do not include vessels with LA permits. There was a corresponding ownership data for only 230 vessels in 2010 and 222 vessels in 2011. It is possible that some of the numbers in permit data included the same vessels that are replaced or sold to another owner. However, the available data connecting unique owners to the vessels indicate that majority of the vessels (134 out of 222 vessels in 2011) with LAGC-IFQ permits were owned by a single entity (Table 31). The part of the Table showing the data for active IFQ vessels (i.e., vessels with a record of scallop landings) indicates that close to half of the vessels owned by a single entity did not land scallops in 2010 and 2011 fishing years. Again, it must be cautioned that Table 31 does not include all the IFQ vessels due to the lack of ownership data for some of these vessels at this time. For example, although there were 161 number of active vessels with LAGC-IFQ permits in 2011, only 107 of these vessels had some corresponding ownership data (See Table 16 for all active LAGC vessels).

Table 32 shows the ownership information for all vessels with LAGC permits including the IFQ, NGOM and Incidental permits but excluding those with LA permits. The results are similar to Table 31 showing that majority of the vessels, 242 out of 448 vessels with LAGC permits, were owned by one entity/person in 2011. Again, only half of these boats were active or landed scallops in 2011.

**Table 31. Unique number of owners according to the number of vessels owned (Vessels with LGC permits including A, B and C categories, excluding vessels that also have LA permits)**

| Fishyear | Number of vessels owned | All vessels with LGC permits | | Active vessels with LGC permits only | | | |
|---|---|---|---|---|---|---|---|
| | | Total number of owners | Total number of vessels | Total number of owners | Total number of vessels | Percent of vessels | Percent of scallop landings |
| 2010 | 1 | 147 | 147 | 66 | 66 | 56% | 75% |
| | 2 | 22 | 44 | 6 | 12 | 10% | 6% |
| | 3 or more | 8 | 39 | 8 | 39 | 33% | 19% |
| 2010 Total | | 177 | 230 | 80 | 117 | 100% | 100% |
| 2011 | 1 | 134 | 134 | 65 | 65 | 61% | 76% |
| | 2 | 28 | 56 | 16 | 32 | 30% | 14% |
| | 3 or more | 5 | 32 | 3 | 10 | 9% | 11% |
| 2011 Total | | 167 | 222 | 84 | 107 | 100% | 100% |

**Table 32. Unique number of owners according to the number of vessels owned (Vessels with LGC permits including A, B and C categories, excluding vessels that also have LA permits)**

| Fishyear | Number of vessels owned | All vessels with LGC permits | | Active vessels with LGC permits only | | | |
|---|---|---|---|---|---|---|---|
| | | Total number of owners | Total number of vessels | Total number of owners | Total number of vessels | Percent of vessels | Percent of scallop landings |
| 2010 | 1 | 269 | 269 | 122 | 122 | 49% | 65% |
| | 2 | 43 | 86 | 19 | 38 | 15% | 16% |
| | 3 | 13 | 39 | 6 | 18 | 7% | 7% |
| | 4 | 2 | 8 | 1 | 4 | 2% | 0% |
| | 5 | 2 | 10 | 2 | 10 | 4% | 2% |
| | 6 and over | 6 | 57 | 6 | 57 | 23% | 10% |
| 2010 Total | | 335 | 469 | 156 | 249 | 100% | 100% |
| 2011 | 1 | 242 | 242 | 118 | 118 | 46% | 54% |
| | 2 | 49 | 98 | 29 | 58 | 23% | 28% |
| | 3 | 12 | 36 | 4 | 12 | 5% | 4% |
| | 4 | 2 | 8 | 1 | 4 | 2% | 0% |
| | 5 | 2 | 10 | 2 | 10 | 4% | 2% |
| | 6 and over | 5 | 54 | 5 | 54 | 21% | 12% |
| 2011 Total | | 312 | 448 | 159 | 256 | 100% | 100% |

### 1.1.9 Trip Costs for the Limited Access Full-time vessels

Data for variable costs, i.e., trip expenses include food, fuel, oil, ice, water and supplies and obtained from observer cost data for 1994-2011. Because of the increase in fuel prices in 2011, the share of fuel costs increased to 80% of the total trip cost and average trip cost per DAS for the full-time dredge vessels amounted to over $1950 per day-at-sea (Table 34). Average trip costs for full-time small dredge vessels was about $1250 per day-at-sea in 2011 (Table 36).

**Table 33. Observer data information for the full-time dredge vessels**

| Year | Number of vessels | Scallop lb. per trip | DAS | LPUE | Number of crew | VHP | GTONS |
|---|---|---|---|---|---|---|---|
| 1994 | 12 | 5556 | 13.3 | 415 | 6.5 | 1116 | 171 |
| 1995 | 16 | 6425 | 12.2 | 491 | 6.8 | 986 | 174 |
| 1996 | 35 | 6221 | 12.0 | 480 | 6.1 | 1012 | 171 |
| 1997 | 27 | 5927 | 12.9 | 447 | 6.1 | 941 | 174 |
| 1998 | 12 | 2753 | 8.3 | 326 | 5.6 | 1006 | 180 |
| 1999 | 65 | 10964 | 8.0 | 1,448 | 6.5 | 964 | 172 |
| 2000 | 224 | 11056 | 7.1 | 1,711 | 6.5 | 913 | 171 |
| 2001 | 93 | 17133 | 9.2 | 1,920 | 6.9 | 914 | 165 |
| 2002 | 90 | 17981 | 10.2 | 1,757 | 7.0 | 892 | 171 |
| 2003 | 102 | 19130 | 10.6 | 1,767 | 7.0 | 878 | 166 |
| 2004 | 204 | 18684 | 8.6 | 2,197 | 6.9 | 887 | 162 |
| 2005 | 150 | 17698 | 9.1 | 2,018 | 6.9 | 901 | 163 |
| 2006 | 117 | 14967 | 7.9 | 2,035 | 7.0 | 871 | 157 |
| 2007 | 193 | 14988 | 7.6 | 2,062 | 6.8 | 889 | 158 |
| 2008 | 263 | 16671 | 8.1 | 2,144 | 6.7 | 868 | 156 |
| 2009 | 218 | 19887 | 9.2 | 2,124 | 7.0 | 848 | 156 |
| 2010 | 179 | 18115 | 8.6 | 2,077 | 6.9 | 872 | 155 |
| 2011 | 202 | 21542 | 8.3 | 2,553 | 7.1 | 853 | 154 |

**Table 34. Fuel and total trip costs (in 2011 inflation adjusted prices)**

| Year | Average fuel price | Average fuel costs per DAS | Average trip costs per DAS (Includes fuel costs) | Fuel costs as a % of total trip costs |
|---|---|---|---|---|
| 1994 | 1.17 | 700 | 952 | 73% |
| 1995 | 1.11 | 639 | 976 | 64% |
| 1996 | 1.20 | 716 | 985 | 71% |
| 1997 | 1.07 | 652 | 909 | 65% |
| 1998 | 0.88 | 559 | 905 | 56% |
| 1999 | 0.38 | 637 | 809 | 72% |
| 2000 | 1.56 | 834 | 1,184 | 61% |
| 2001 | 1.51 | 665 | 965 | 62% |
| 2002 | 1.44 | 743 | 1,126 | 61% |
| 2003 | 1.58 | 852 | 1,172 | 66% |
| 2004 | 1.90 | 1,003 | 1,387 | 69% |
| 2005 | 2.52 | 1,326 | 1,603 | 76% |
| 2006 | 2.71 | 1,454 | 1,730 | 75% |
| 2007 | 2.83 | 1,512 | 1,844 | 75% |
| 2008 | 3.79 | 1,934 | 2,111 | 82% |
| 2009 | 2.39 | 1,317 | 1,509 | 76% |
| 2010 | 2.82 | 1,541 | 1,790 | 78% |
| 2011 | 3.54 | 1,881 | 1,953 | 80% |

**Table 35. Observer data information for the full-time small dredge vessels**

| Year | Number of vessels | Scallop lb. per trip | DAS | LPUE | Number of crew | VHP | GTONS |
|---|---|---|---|---|---|---|---|
| 2004 | 18 | 10963 | 9.3 | 1,237 | 5.0 | 577 | 126 |
| 2005 | 16 | 10820 | 8.0 | 1,248 | 4.9 | 504 | 116 |
| 2006 | 17 | 14780 | 8.4 | 1,731 | 5.5 | 610 | 121 |
| 2007 | 30 | 10951 | 7.9 | 1,445 | 5.4 | 487 | 106 |
| 2008 | 72 | 12643 | 6.6 | 1,845 | 5.2 | 620 | 103 |
| 2009 | 55 | 12917 | 7.8 | 1,537 | 5.3 | 600 | 105 |
| 2010 | 35 | 12743 | 7.8 | 1,517 | 5.3 | 510 | 106 |
| 2011 | 42 | 14757 | 7.6 | 1,820 | 5.3 | 491 | 103 |

**Table 36. Fuel and total trip costs for full-time small dredge vessels (in 2011 inflation adjusted prices)**

| Year | Average fuel price | Average fuel costs per DAS | Average trip costs per DAS (Includes fuel costs) | Fuel costs as a % of total trip costs |
|---|---|---|---|---|
| 2004 | 1.89 | 575 | 879 | 62% |
| 2005 | 2.45 | 881 | 1,023 | 67% |
| 2006 | 2.77 | 1,978 | 1,984 | 77% |
| 2007 | 2.92 | 1,186 | 1,517 | 70% |
| 2008 | 3.78 | 1,270 | 1,513 | 79% |
| 2009 | 2.36 | 853 | 1,072 | 71% |
| 2010 | 2.85 | 960 | 1,024 | 73% |
| 2011 | 3.52 | 1,229 | 1,251 | 78% |

### 1.1.10 Trends in Foreign Trade

One of most significant change in the trend for foreign trade for scallops after 1999 was the striking increase in scallop exports. The increase in landings especially of larger scallops led to a tripling of U.S. exports of scallops from about 5 million pounds in 1999 to a record amount of 32 million pounds in 2011 (Figure 11).

Figure 11 shows scallop exports including fresh, frozen and processed scallops. Although exports include exports of bay, calico or weathervane scallops, it mainly consists of sea scallops. Canada, France and other European countries were the main importers of US scallops.

In contrast, imports of scallops declined to 42 million lb. in 2011 from about 60 million lb. in 2010, that is by almost 30% (Figure 12). Because of the increase in the value of scallop exports to over $214 million in 2011, the difference in the value of exported and imported scallops, that is scallop trade deficit reached to its lowest level, $42 million, since 1994 (Figure 13). Therefore, rebuilding of scallops as a result of the management of the scallop fishery benefited the nation by reducing the scallop trade deficit in addition to increasing the revenue for the scallop fishery as a whole.

**Figure 11 - Scallop exports in lb., export value and prices (by Fishyear)**

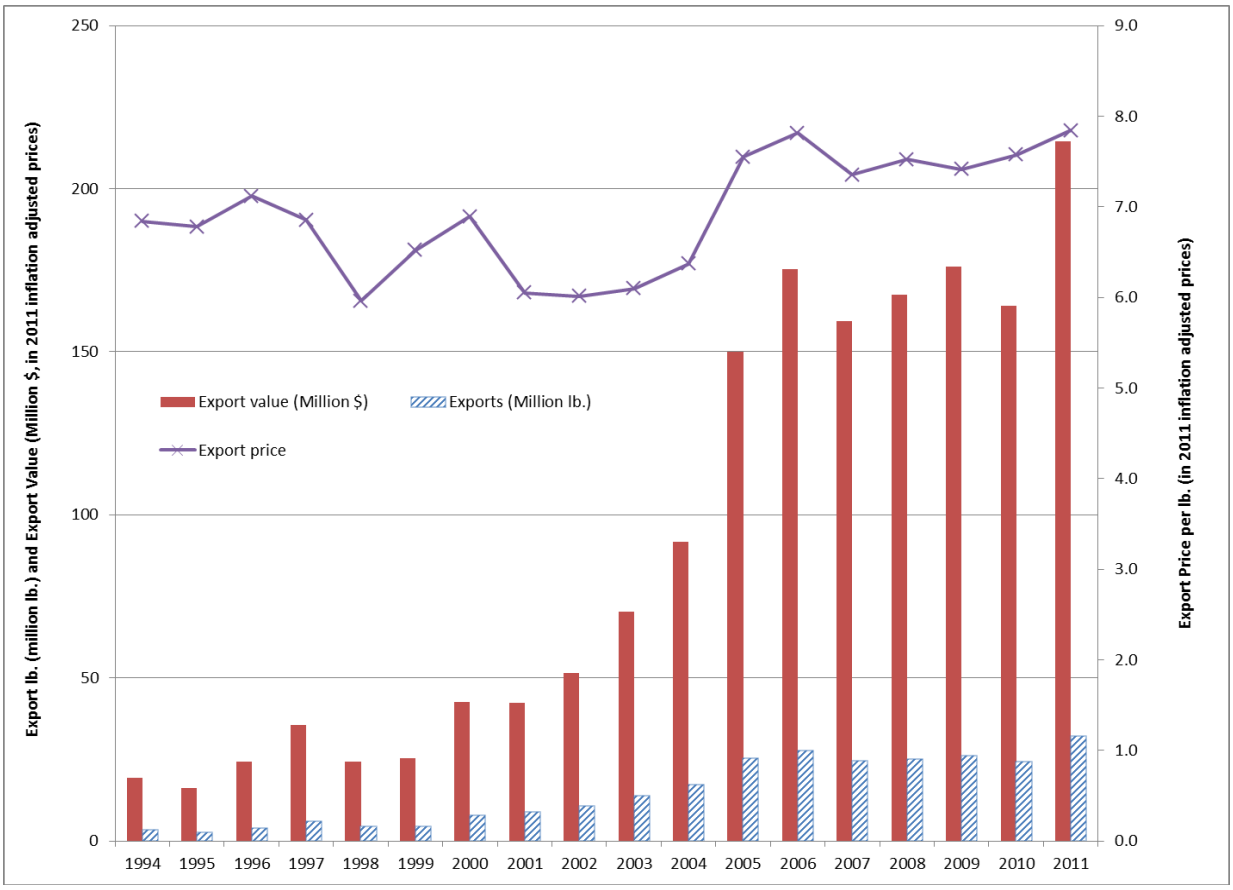


**Figure 12 - Scallop imports, value of imports and prices (by Fishyear)**

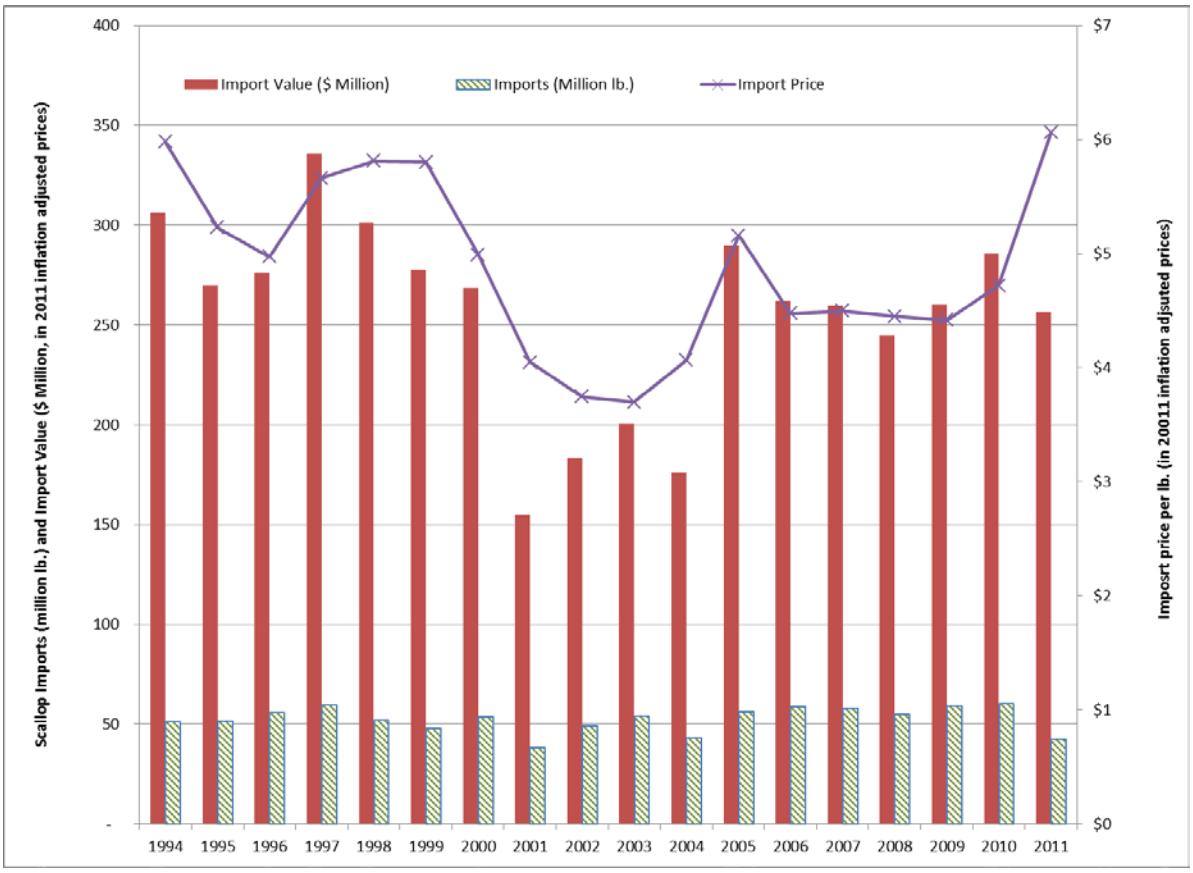
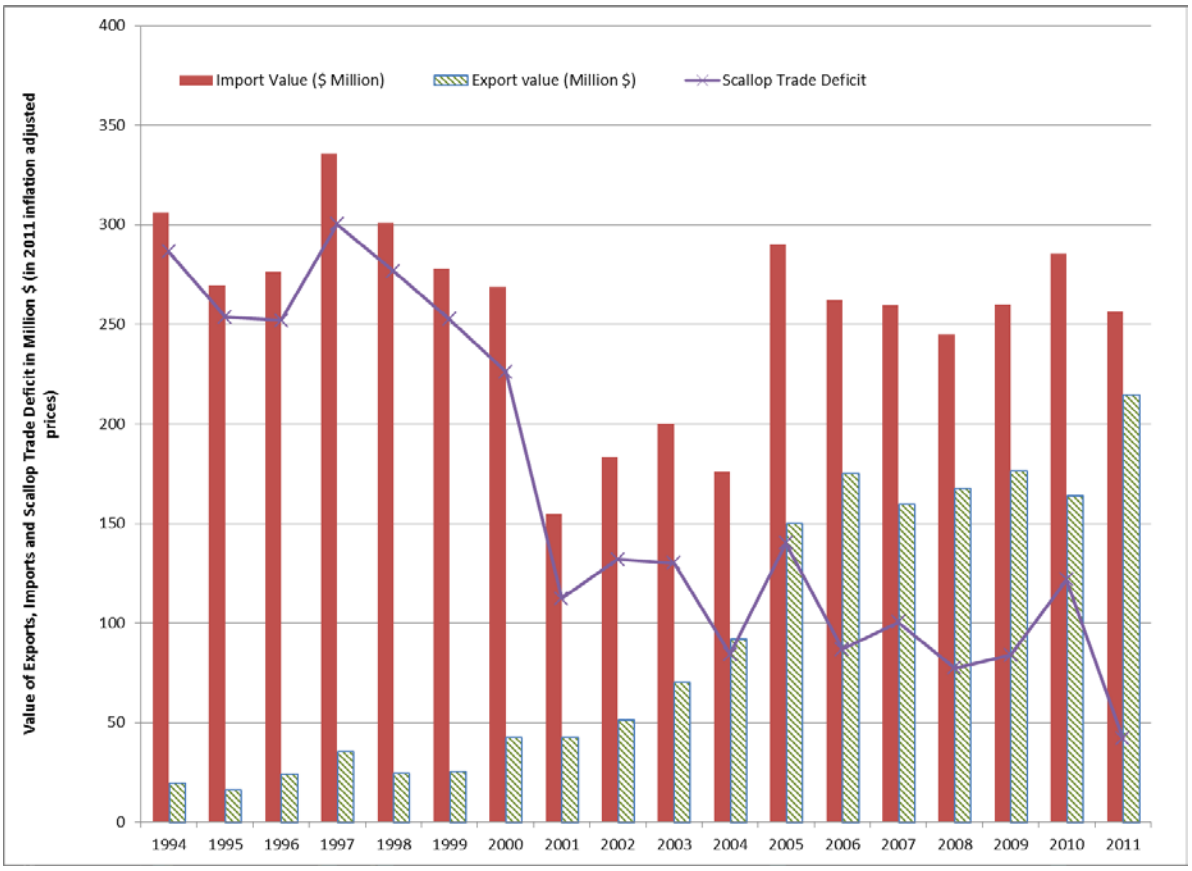


**Figure 13. Value of Scallop imports and exports (by calendar year)**




### 1.1.11 Dependence on the Scallop Fishery

The dependence of a fleet of vessels on a particular marine resource is estimated by examining what proportion of a fleet's overall revenue is derived from that resource. Both full-time and part-time limited access vessels had a high dependence on scallops as a source of their income. Full-time limited access vessels had a high dependence on scallops as a source of their income and the majority of the full-time vessels (94%) derived more than 90% of their revenue from the scallop fishery in 2011 (Table 37). Comparatively, part-time limited access vessels were less dependent on the scallop fishery in 2011, with only 37% of part-time vessels earning more than 90% of their revenue from scallops (Table 37).

Table 38 shows that general category permit holders (IFQ and NGOM) are less dependent on scallops compared to vessels with limited access permits. In 2011, less than half (43%) of IFQ permitted vessels earned greater than 50% of their revenue from scallops. Among active NGOM permitted vessels (that did not also have a limited access permit), 88% had no landings with scallops in 2011. Scallops still comprise the largest proportion of the revenue for IFQ general category vessels, accounting for 38.6% of these vessels revenue. Scallops still comprise the largest proportion of the revenue for IFQ general category vessels, accounting for 38.6% of these

vessels revenue (Table 39). For NGOM vessels (that did not also have a limited access permit) scallop landings accounted for less than 1% of revenue in 2011. The composition of revenue for both the IFQ and NGOM general category vessels are shown in Table 39.

The relative ease with which a vessel is able to switch between fisheries is an indicator of the dependence on any one fishery or species. Table 41 and Table 42 show the number and percentage of scallop vessels with permits from other fishery management plans, while Table 43 to Table 44 show the number scallop vessels that have actual landings of other species. Together, these Tables describe a limited access fishery where a large percentage of vessels have permits in other fisheries but relatively few vessels actually landing species other than scallops. Alternatively, Table 42 and Table 45 show a general category fishery where a large percentage of vessels have permits in other fisheries and landings of corresponding species.

**Table 37. Dependence of scallop revenue by limited access vessels**

| | | 2008 | | 2009 | | 2010 | | 2011 | |
|---|---|---|---|---|---|---|---|---|---|
| Permit Category | Scallop Revenue as % of total | Number of Vessels | % | Number of Vessels | % | Number of Vessels | % | Number of Vessels | % |
| FT Vessels | <75% | 6 | 2% | 3 | 1% | 8 | 3% | 9 | 3% |
| | 75% - 90% | 13 | 4% | 19 | 6% | 13 | 4% | 10 | 3% |
| | >=90% | 287 | 94% | 286 | 93% | 291 | 93% | 294 | 94% |
| Total | | 306 | 100% | 308 | 100% | 312 | 100% | 313 | 100% |
| PT Vessels | <75% | 7 | 23% | 13 | 38% | 9 | 26% | 13 | 37% |
| | 75% - 90% | 9 | 29% | 4 | 12% | 9 | 26% | 9 | 26% |
| | >=90% | 15 | 48% | 17 | 50% | 17 | 49% | 13 | 37% |
| Total | | 31 | 100% | 34 | 100% | 35 | 100% | 35 | 100% |

**Table 38. Dependence on scallop revenue among limited access general category vessels (excluding GC vessels with LA permits)**

| | | 2008 | | 2009 | | 2010 | | 2011 | |
|---|---|---|---|---|---|---|---|---|---|
| Permit Category | Scallop Revenue as % of total | Number of Vessels | % | Number of Vessels | % | Number of Vessels | % | Number of Vessels | % |
| IFQ | <10% | 92 | 39% | 81 | 32% | 103 | 48% | 82 | 43% |
| | 10% - 49% | 29 | 12% | 32 | 13% | 26 | 12% | 27 | 14% |
| | 50% - 74% | 29 | 12% | 37 | 15% | 16 | 7% | 16 | 8% |
| | 75% - 89% | 10 | 4% | 15 | 6% | 11 | 5% | 12 | 6% |
| | >=90% | 75 | 32% | 87 | 35% | 60 | 28% | 55 | 29% |
| | Total | 235 | 100% | 252 | 100% | 216 | 100% | 192 | 100% |
| NGOM | No scallops landed | 61 | 91% | 74 | 89% | 65 | 89% | 53 | 88% |
| | >0% | 6 | 9% | 9 | 11% | 8 | 11% | 7 | 12% |
| | Total | 67 | 100% | 85 | 100% | 73 | 100% | 60 | 100% |

**Table 39. Composition of Revenue for the Limited Access General Category Vessels (including those vessels with LA permits)**

| | | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| LAGC - IFQ | SCALLOP, SEA | 53882244 | 60745820 | 63662791 | 89295862 |
| | | 56.2% | 60.2% | 58.9% | 62.2% |
| | FLOUNDER, SUMMER | 3698635 | 4057324 | 5965707 | 8601902 |
| | | 3.9% | 4.0% | 5.5% | 6.0% |
| | COD | 4898076 | 4019584 | 3878797 | 6692224 |
| | | 5.1% | 4.0% | 3.6% | 4.7% |
| | HADDOCK | 4651156 | 5175295 | 7006451 | 5902674 |
| | | 4.9% | 5.1% | 6.5% | 4.1% |
| | FLOUNDER, WINTER | 4166806 | 3796259 | 3059348 | 4657612 |
| | | 4.3% | 3.8% | 2.8% | 3.2% |
| | ANGLER | 3735774 | 2356285 | 2523998 | 3535926 |
| | | 3.9% | 2.3% | 2.3% | 2.5% |
| | SQUID (LOLIGO) | 1340455 | 1168888 | 1706643 | 2647702 |
| | | 1.4% | 1.2% | 1.6% | 1.8% |
| | QUAHOG, OCEAN | 3791416 | 3353203 | 5489910 | 2508971 |
| | | 4.0% | 3.3% | 5.1% | 1.7% |
| | LOBSTER | 2786929 | 2166218 | 2205683 | 2292524 |
| | | 2.9% | 2.1% | 2.0% | 1.6% |
| | FLOUNDER, YELLOWTAIL | 1690610 | 1601151 | 1415039 | 2120194 |
| | | 1.8% | 1.6% | 1.3% | 1.5% |
| | Total Landings | 95790993 | 100902468 | 108034448 | 143470717 |
| LAGC - NGOM | SCALLOP, SEA | 22567094 | 28040044 | 38445080 | 47443489 |
| | | 59.6% | 59.4% | 65.8% | 69.7% |
| | COD | 3223210 | 3746617 | 4115123 | 3374241 |
| | | 8.5% | 7.9% | 7.0% | 5.0% |
| | HERRING, ATLANTIC | 2990716 | 2550621 | 2121472 | 3156026 |
| | | 7.9% | 5.4% | 3.6% | 4.6% |
| | ANGLER | 1777693 | 1775242 | 2050529 | 2198031 |
| | | 4.7% | 3.8% | 3.5% | 3.2% |
| | LOBSTER | 1931610 | 1709890 | 1640465 | 2152479 |
| | | 5.1% | 3.6% | 2.8% | 3.2% |
| | POLLOCK | 1178299 | 1673283 | 1272260 | 1480100 |
| | | 3.1% | 3.5% | 2.2% | 2.2% |
| | HAKE, WHITE | 695850 | 992009 | 1273557 | 1316034 |
| | | 1.8% | 2.1% | 2.2% | 1.9% |
| | SQUID (LOLIGO) | 162987 | 1233517 | 1204669 | 1279234 |
| | | 0.4% | 2.6% | 2.1% | 1.9% |
| | FLOUNDER, SUMMER | 84715 | 452240 | 597024 | 1091929 |
| | | 0.2% | 1.0% | 1.0% | 1.6% |

| | | | | | |
|---|---|---|---|---|---|
| | Total Landings | 37878720 | 47237827 | 58396286 | 68038894 |

**Table 40. Composition of Revenue for the Limited Access General Category Vessels (not including those vessels with LA permits)**

| | | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| LAGC - IFQ | SCALLOP, SEA | 21844640 | 24882995 | 19072784 | 32321259 |
| | | 35.2% | 39.1% | 31.2% | 38.6% |
| | FLOUNDER, SUMMER | 3049527 | 3525085 | 4983035 | 7330321 |
| | | 4.9% | 5.5% | 8.1% | 8.8% |
| | COD | 4897712 | 4017741 | 3878797 | 6692224 |
| | | 7.9% | 6.3% | 6.3% | 8.0% |
| | HADDOCK | 4651152 | 5175295 | 7006451 | 5902674 |
| | | 7.5% | 8.1% | 11.4% | 7.1% |
| | FLOUNDER, WINTER | 4165799 | 3795185 | 3059348 | 4656247 |
| | | 6.7% | 6.0% | 5.0% | 5.6% |
| | ANGLER | 3558964 | 2217851 | 2415365 | 3404805 |
| | | 5.7% | 3.5% | 3.9% | 4.1% |
| | SQUID (LOLIGO) | 1143579 | 1052227 | 1477045 | 2510885 |
| | | 1.8% | 1.7% | 2.4% | 3.0% |
| | QUAHOG, OCEAN | 3791416 | 3353203 | 5489910 | 2508971 |
| | | 6.1% | 5.3% | 9.0% | 3.0% |
| | LOBSTER | 2786253 | 2157673 | 2204780 | 2290224 |
| | | 4.5% | 3.4% | 3.6% | 2.7% |
| | FLOUNDER, YELLOWTAIL | 1690610 | 1600759 | 1414633 | 2116837 |
| | | 2.7% | 2.5% | 2.3% | 2.5% |
| | Total Landings | 62139710 | 63632899 | 61201103 | 83713450 |
| LAGC - NGOM | SCALLOP, SEA | 101898 | 109568 | 45577 | 56071 |
| | | 0.7% | 0.6% | 0.3% | 0.3% |
| | COD | 3223210 | 3746617 | 4103903 | 3324619 |
| | | 21.2% | 20.9% | 22.6% | 18.7% |
| | HERRING, ATLANTIC | 2990716 | 2550621 | 2121472 | 3156026 |
| | | 19.7% | 14.2% | 11.7% | 17.7% |
| | ANGLER | 1584378 | 1622777 | 1958468 | 1992570 |
| | | 10.4% | 9.1% | 10.8% | 11.2% |
| | LOBSTER | 1931610 | 1709890 | 1637785 | 2108245 |
| | | 12.7% | 9.6% | 9.0% | 11.8% |
| | POLLOCK | 1178299 | 1673283 | 1271664 | 1474862 |
| | | 7.7% | 9.3% | 7.0% | 8.3% |
| | HAKE, WHITE | 695850 | 991451 | 1273189 | 1299613 |
| | | 4.6% | 5.5% | 7.0% | 7.3% |
| | FLOUNDER, AM. PLAICE | 635104 | 1117767 | 1186356 | 845083 |

| | | | | |
|---|---|---|---|---|
| | 4.2% | 6.2% | 6.5% | 4.7% |
| SHRIMP (PANDALID) | 307429 | 1127253 | 1909525 | 679079 |
| | 2.0% | 6.3% | 10.5% | 3.8% |
| Total Landings | 15219581 | 17903392 | 18194579 | 17812223 |

**Table 41. Other fishery management plan permits held FY 2011, by vessels with limited access scallop permits**

| | | 2011 | |
|---|---|---|---|
| Plan | Description | Permit count | % LA vessels |
| BLU | Bluefish | 327 | 92% |
| BSB | Black Sea Bass | 148 | 42% |
| DOG | Dogfish | 342 | 97% |
| FLS | Summer Flounder | 303 | 86% |
| HRG | Herring | 298 | 84% |
| LO | Lobster | 232 | 66% |
| MNK | Monkfish | 349 | 99% |
| MUL | Multispecies | 343 | 97% |
| OQ | Ocean Quahog | 290 | 82% |
| RCB | Red Crab | 286 | 81% |
| SC | Scallop LA | 354 | 100% |
| LGC | Scallop LAGC | 185 | 52% |
| | LAGC - IFQ | 43 | 12% |
| | LAGC - NGOM | 28 | 8% |
| | LAGC - incidental | 114 | 32% |
| SCP | Scup | 140 | 40% |
| SF | Surf Clam | 289 | 82% |
| SKT | Skate | 321 | 91% |
| SMB | Squid/Mackerel/Butterfish | 336 | 95% |
| TLF | Tilefish | 312 | 88% |

**Table 42. Other fishery management plan permits held FY 2011 by vessels with general category permits**

| | | 2011 | | | | | |
|---|---|---|---|---|---|---|---|
| Plan | Description | LAGC - IFQ | % of IFQ vessels | LAGC - NGOM | % of NGOM vessels | LAGC - incidental | % of inc. vessels |
| BLU | Bluefish | 262 | 90% | 98 | 90% | 246 | 88% |
| BSB | Black Sea Bass | 105 | 36% | 26 | 24% | 142 | 51% |
| DOG | Dogfish | 265 | 91% | 100 | 92% | 264 | 95% |
| FLS | Summer Flounder | 168 | 58% | 43 | 39% | 209 | 75% |
| HRG | Herring | 235 | 81% | 101 | 93% | 238 | 85% |
| LO | Lobster | 172 | 59% | 86 | 79% | 199 | 71% |
| MNK | Monkfish | 278 | 96% | 102 | 94% | 266 | 95% |
| MUL | Multispecies | 242 | 83% | 102 | 94% | 254 | 91% |
| OQ | Ocean Quahog | 184 | 63% | 59 | 54% | 214 | 77% |
| RCB | Red Crab | 207 | 71% | 76 | 70% | 224 | 80% |
| SC | Scallop LA | 43 | 15% | 28 | 26% | 114 | 41% |
| LGC | Scallop LAGC | 290 | 100% | 109 | 100% | 279 | 100% |
| SCP | Scup | 115 | 40% | 29 | 27% | 149 | 53% |
| SF | Surf Clam | 181 | 62% | 63 | 58% | 215 | 77% |
| SKT | Skate | 264 | 91% | 95 | 87% | 252 | 90% |
| SMB | Squid/Mackerel/Butterfish | 251 | 87% | 96 | 88% | 253 | 91% |
| TLF | Tilefish | 233 | 80% | 85 | 78% | 249 | 89% |

**Table 43. Number of full-time vessels with landings of corresponding species (includes fisheries with 5 or more participating vessels in 2011)**

| | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| ANGLER | 276 | 243 | 232 | 217 |
| BLUEFISH | 21 | 18 | 23 | 27 |
| BUTTERFISH | 15 | 13 | 14 | 7 |
| COD | 8 | 7 | 8 | 10 |
| CUSK | 5 | 5 | 5 | 5 |
| FLOUNDER, AM. PLAICE | 6 | 8 | 7 | 8 |
| FLOUNDER, SUMMER | 66 | 68 | 86 | 74 |
| FLOUNDER, WINTER | 22 | 14 | 13 | 18 |
| FLOUNDER, WITCH | 11 | 15 | 9 | 14 |
| FLOUNDER, YELLOWTAIL | 10 | 17 | 53 | 58 |
| HADDOCK | 7 | 7 | 7 | 9 |
| HAKE, SILVER | 10 | 10 | 13 | 12 |
| HAKE, WHITE | 6 | 6 | 6 | 7 |
| HALIBUT, ATLANTIC | 4 | 5 | 6 | 6 |
| JOHN DORY | 6 | 4 | 14 | 13 |
| LOBSTER | 11 | 11 | 14 | 16 |
| POLLOCK | 6 | 6 | 6 | 7 |
| REDFISH | 5 | 7 | 6 | 6 |
| SCALLOP, SEA | 306 | 308 | 312 | 313 |
| SCUP | 20 | 16 | 34 | 25 |
| SEA BASS, BLACK | 26 | 24 | 34 | 37 |
| SKATES(RACK) | 7 | 6 | 9 | 11 |
| SQUID (ILLEX) | 4 | 2 | 4 | 10 |
| SQUID (LOLIGO) | 27 | 22 | 31 | 35 |
| TILEFISH, BLUELINE | 5 | 3 | 4 | 11 |
| TILEFISH, GOLDEN | 5 | 4 | 12 | 13 |
| WEAKFISH, SQUETEAGUE | 13 | 7 | 12 | 10 |
| WHITING, KING | 7 | 5 | 8 | 10 |

**Table 44. Number of part-time and occasional vessels with landings of corresponding species (includes fisheries with 5 or more participating vessels in 2011)**

| | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| ANGLER | 27 | 28 | 31 | 26 |
| BLUEFISH | 11 | 15 | 11 | 19 |
| BUTTERFISH | 8 | 6 | 7 | 9 |
| CROAKER, ATLANTIC | 5 | 6 | 3 | 6 |
| DOGFISH SPINY | 1 | 3 | 4 | 5 |
| FLOUNDER, SOUTHERN | | 6 | | 5 |
| FLOUNDER, SUMMER | 20 | 22 | 24 | 22 |
| HAKE, RED | 5 | 2 | 7 | 6 |
| HAKE, SILVER | 7 | 4 | 7 | 6 |
| JOHN DORY | 4 | 3 | 6 | 8 |
| MACKEREL, ATLANTIC | 5 | 6 | 8 | 5 |
| SCALLOP, SEA | 31 | 34 | 35 | 35 |
| SCUP | 8 | 13 | 18 | 17 |
| SEA BASS, BLACK | 17 | 15 | 20 | 18 |
| SHRIMP,BROWN | | 6 | | 7 |
| SQUID (LOLIGO) | 15 | 15 | 13 | 17 |
| TILEFISH, BLUELINE | 2 | 3 | 2 | 5 |
| TILEFISH, GOLDEN | 2 | 4 | 8 | 6 |
| WEAKFISH, SQUETEAGUE | 8 | 7 | 7 | 7 |
| WHITING, KING | 2 | 7 | 3 | 10 |

**Table 45. Number of LAGC - IFQ vessels with landings of corresponding species**

**(includes fisheries with 10 or more participating vessels in 2011, but not vessels that also possess LA scallop permits)**

| | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| ANGLER | 176 | 187 | 162 | 144 |
| BASS, STRIPED | 13 | 2 | 24 | 14 |
| BLUEFISH | 54 | 75 | 63 | 75 |
| BUTTERFISH | 34 | 55 | 42 | 46 |
| COD | 83 | 72 | 72 | 53 |
| CRAB, JONAH | 6 | 6 | 11 | 16 |
| CROAKER, ATLANTIC | 19 | 32 | 18 | 18 |
| CUSK | 34 | 33 | 30 | 20 |
| DOGFISH SMOOTH | 22 | 35 | 32 | 32 |
| DOGFISH SPINY | 32 | 57 | 44 | 46 |
| EEL, CONGER | 15 | 12 | 13 | 11 |
| FLOUNDER, AM. PLAICE | 70 | 65 | 52 | 43 |
| FLOUNDER, SUMMER | 100 | 104 | 102 | 94 |
| FLOUNDER, WINTER | 89 | 72 | 60 | 43 |
| FLOUNDER, WITCH | 78 | 64 | 62 | 43 |
| FLOUNDER, YELLOWTAIL | 80 | 74 | 66 | 53 |
| HADDOCK | 69 | 62 | 53 | 43 |
| HAKE, RED | 23 | 27 | 29 | 22 |
| HAKE, SILVER | 47 | 51 | 43 | 39 |
| HAKE, WHITE | 57 | 52 | 46 | 38 |
| HALIBUT, ATLANTIC | 41 | 38 | 24 | 22 |
| HERRING, ATLANTIC | 11 | 12 | 14 | 16 |
| JOHN DORY | 9 | 7 | 13 | 15 |
| LOBSTER | 85 | 78 | 75 | 50 |
| MACKEREL, ATLANTIC | 20 | 27 | 23 | 16 |
| POLLOCK | 62 | 55 | 50 | 41 |
| REDFISH | 39 | 43 | 36 | 31 |
| SCALLOP, SEA | 189 | 206 | 148 | 141 |
| SCUP | 35 | 41 | 51 | 52 |
| SEA BASS, BLACK | 47 | 47 | 52 | 49 |
| SEA ROBINS | 10 | 15 | 12 | 12 |
| SHRIMP,BROWN | 1 | 13 | | 11 |
| SKATE, WINTER(BIG) | 32 | 41 | 44 | 43 |
| SKATES(RACK) | 79 | 76 | 68 | 61 |
| SQUID (LOLIGO) | 46 | 58 | 54 | 55 |
| TILEFISH, BLUELINE | 4 | 6 | 8 | 10 |
| TILEFISH, GOLDEN | 9 | 8 | 20 | 16 |
| TUNA, BLUEFIN | 5 | 7 | 12 | 12 |
| WEAKFISH, SQUETEAGUE | 30 | 38 | 27 | 37 |

| | | | | |
|---|---|---|---|---|
| WHELK, CHANNELED | 11 | 14 | 15 | 10 |
| WHELK, KNOBBED | 6 | 8 | 10 | 13 |
| WHITING, KING | 13 | 23 | 13 | 24 |

**Table 46. Number of LAGC - NGOM vessels with landings of corresponding species**

**(includes fisheries with 10 or more participating vessels in 2011, but not vessels that also possess LA scallop permits)**

| | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| ANGLER | 52 | 62 | 51 | 40 |
| BLUEFISH | 14 | 24 | 19 | 13 |
| COD | 52 | 63 | 54 | 38 |
| CUSK | 34 | 36 | 27 | 20 |
| DOGFISH SPINY | 24 | 35 | 26 | 20 |
| FLOUNDER, AM. PLAICE | 46 | 57 | 49 | 35 |
| FLOUNDER, WINTER | 39 | 48 | 43 | 28 |
| FLOUNDER, WITCH | 48 | 55 | 45 | 35 |
| FLOUNDER, YELLOWTAIL | 37 | 47 | 44 | 30 |
| HADDOCK | 49 | 55 | 44 | 35 |
| HAKE, SILVER | 24 | 35 | 28 | 25 |
| HAKE, WHITE | 45 | 50 | 42 | 33 |
| HALIBUT, ATLANTIC | 19 | 25 | 21 | 18 |
| LOBSTER | 48 | 47 | 37 | 34 |
| MACKEREL, ATLANTIC | 11 | 18 | 8 | 12 |
| POLLOCK | 47 | 55 | 47 | 35 |
| REDFISH | 42 | 47 | 41 | 32 |
| SHRIMP (PANDALID) | 14 | 23 | 26 | 22 |
| SKATE, WINTER(BIG) | 6 | 6 | 9 | 10 |
| SKATES(RACK) | 23 | 32 | 30 | 22 |
| SQUID (LOLIGO) | 9 | 13 | 8 | 12 |

### 1.1.12 Trends in Employment in the Scallop Fishery

In the Northeast fishing industry, actual employment numbers are not tracked but information about crew size on a trip and the duration of a trip can be gained from the Vessel Trip Report. Although these data do not identify the actual number of individuals employed and a crew member will often work for more than one vessel owner, the data can be used to indicate the number of crew positions available and the length of time crew spend at sea. These general indicators can then be used to describe broad trends in employment in the fishery.

The number of crew positions, measured by summing the average crew size of all active limited access vessels on all trips that included scallops, has increased slightly from 2,172 positions in 2007 to 2,262 positions in 2011 (a 4% increase) (Table 47). Broken out by home port state, the number of crew positions has stayed relatively constant during the past five years. Limited

access vessels with a home port in Massachusetts and New Jersey experienced the largest percentage increase (5%: 969 to 1015 crew positions in MA and 15%: 490 to 564 crew positions in NJ). Most other home port states experienced moderate declines in the number of available crew positions. Recently the number of crew positions in the general category fishery has declined sharply, first in 2008 when the LAGC was implemented and then again in 2010 when the hard TAC was set at 5% of the total scallop catch limit. Between 2007 and 2008 the total number of crew positions on general category vessels landing scallops dropped 43%, from 1276 positions to 731 (Table 48). Then, the total number of general category crew positions dropped another 21% in 2010, so that the number of crew positions was 576. In 2011 the number of general category crew positions has begun to rise adding 24 more crew positions.

A crew trip is another indicator of employment opportunity in the scallop fishery that examines the number of opportunities a crew member has to earn a share of the landing revenue. The crew trip is informative because while the number of crew positions is an indicator of the availability of jobs, the crew position provides no information about the quality of those jobs and whether the positions are part-time or full-time. Total crew trips were calculated by summing the crew size of all trips taken in each fishing year for both limited access and general category vessels across home port state (Table 49 and Table 50). Total crew trips declined for limited access vessels from 30,409 in 2007 to 22,526 in 2011 (a 26% decline, Table 49). The decline in limited access crew trips is in contrast to the increase in the number of crew positions during the same period. The number of crew trips on general category vessels followed a similar pattern as the general category crew positions, with large declines in 2008 and 2010, but then an increase in 2011(Table 51).

One final indicator of employment opportunity in the scallop fishery is the crew day, which is calculated by multiplying a trip's crew size by the days absent from port. A crew day provides additional information about the time a crew spends at sea to earn a share of the revenues. Because there is an opportunity cost associated with time spent at sea, a crew day can be viewed as an indicator of time invested in earning a share of a the revenues received at the end of a trip. For example, if crew trips and crew earnings remain constant, a decline in crew days would reveal a benefit to crew in that less time was forgone for the same amount of earnings. In the limited access fishery, from 2007 to 2011 the number of crew days declined from 207,088 to 160,355 (23%, Table 50). The number of crew days on general category vessels followed a similar pattern as the general category crew positions and trips, with large declines in 2008 and 2010, but then an increase in days in 2011(Table 52). Oftentimes the number of general category crew days is smaller than the number of crew trips, which is because many of the general category trips are shorter than a single day which results in a fraction of a crew day.

**Table 47. Number of crew positions (sum of average number of crew per vessel) on active limited access vessels. [Average vessel crew level calculated from just scallop trips and separately from all trips.]**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Scallop crew positions | 2172 | 2160 | 2236 | 2234 | 2262 |
| ME | 19 | 20 | 20 | 19 | 19 |
| MA | 969 | 980 | 992 | 979 | 1015 |
| RI | 19 | 19 | 20 | 19 | 15 |

| | | | | | |
|---|---|---|---|---|---|
| CT | 64 | 66 | 67 | 66 | 67 |
| NY | 14 | 16 | 18 | 17 | 12 |
| NJ | 490 | 476 | 521 | 561 | 564 |
| PA | 28 | 30 | 31 | 24 | 18 |
| VA | 302 | 299 | 296 | 299 | 296 |
| NC | 243 | 230 | 247 | 224 | 232 |
| FL | 24 | 24 | 25 | 24 | 25 |
| All crew positions | 2099 | 2090 | 2160 | 2139 | 2161 |
| ME | 19 | 20 | 20 | 19 | 19 |
| MA | 961 | 971 | 983 | 970 | 998 |
| RI | 16 | 14 | 15 | 15 | 11 |
| CT | 62 | 65 | 68 | 65 | 66 |
| NY | 14 | 13 | 17 | 14 | 10 |
| NJ | 466 | 455 | 494 | 522 | 532 |
| PA | 27 | 27 | 29 | 24 | 16 |
| VA | 298 | 293 | 297 | 297 | 292 |
| NC | 213 | 208 | 214 | 188 | 192 |
| FL | 24 | 24 | 24 | 24 | 25 |

**Table 48. Number of crew positions (sum of average number of crew per vessel) on active general category vessels. [Average vessel crew level calculated from scallop trips and separately from all trips.]**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Total GC crew positions | 1276 | 731 | 751 | 576 | 600 |
| ME | 107 | 35 | 31 | 19 | 13 |
| NH | 27 | 10 | 12 | 11 | 8 |
| MA | 383 | 239 | 195 | 137 | 164 |
| RI | 113 | 54 | 65 | 49 | 57 |
| CT | 20 | 6 | 9 | 8 | 3 |
| NY | 57 | 40 | 64 | 52 | 48 |
| NJ | 323 | 197 | 203 | 172 | 195 |
| PA | 16 | 8 | 8 | 18 | 23 |
| DE | 7 | 8 | 4 | 8 | 8 |
| MD | 58 | 33 | 33 | 17 | 11 |
| VA | 28 | 13 | 15 | 14 | 11 |
| NC | 113 | 77 | 104 | 69 | 58 |
| Other Homeport states | 23 | 11 | 8 | 3 | 0 |
| Total GC crew positions | 2283 | 1239 | 1366 | 1262 | 1173 |
| ME | 281 | 120 | 127 | 112 | 102 |
| NH | 66 | 39 | 46 | 44 | 34 |
| MA | 785 | 476 | 497 | 481 | 422 |
| RI | 170 | 89 | 121 | 104 | 100 |
| CT | 45 | 9 | 10 | 7 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| NY | 133 | 62 | 78 | 74 | 87 |
| NJ | 397 | 238 | 252 | 233 | 254 |
| PA | 25 | 12 | 15 | 18 | 23 |
| DE | 15 | 8 | 4 | 8 | 8 |
| MD | 64 | 33 | 38 | 27 | 20 |
| VA | 62 | 25 | 21 | 21 | 14 |
| NC | 215 | 117 | 148 | 131 | 105 |
| Other Homeport states | 26 | 11 | 8 | 3 | 0 |

**Table 49. Number of crew trips (sum of crew on all trips) on active limited access vessels. [Calculated for trips with scallop landings and for all trips made by vessels with a valid LA permit]**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Scallop crew trips | 30409 | 25282 | 25082 | 23378 | 22526 |
| ME | 205 | 184 | 167 | 167 | 183 |
| MA | 11340 | 9290 | 8913 | 9132 | 8791 |
| RI | 204 | 159 | 159 | 156 | 119 |
| CT | 777 | 680 | 665 | 598 | 643 |
| NY | 540 | 169 | 270 | 161 | 95 |
| NJ | 9189 | 8630 | 8172 | 7711 | 7146 |
| PA | 538 | 427 | 489 | 387 | 275 |
| VA | 4097 | 2873 | 2868 | 2808 | 2831 |
| NC | 3115 | 2549 | 3109 | 2004 | 2184 |
| FL | 404 | 321 | 270 | 254 | 259 |
| All crew trips | 32911 | 28604 | 28215 | 26914 | 26105 |
| ME | 205 | 184 | 167 | 167 | 183 |
| MA | 11636 | 9591 | 9222 | 9470 | 9289 |
| RI | 392 | 424 | 366 | 351 | 282 |
| CT | 787 | 704 | 672 | 613 | 659 |
| NY | 540 | 309 | 276 | 200 | 116 |
| NJ | 10144 | 9874 | 9400 | 9372 | 8897 |
| PA | 569 | 470 | 531 | 415 | 331 |
| VA | 4140 | 2963 | 3039 | 2883 | 2939 |
| NC | 4094 | 3764 | 4269 | 3189 | 3150 |
| FL | 404 | 321 | 273 | 254 | 259 |

**Table 50. Number of crew trips (sum of crew on all trips) on active general category vessels. [Calculated for trips with scallop landings and for all trips made by vessels with a valid GC permit (including incidental permits)]**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Scallop crew trips | 42396 | 24531 | 27918 | 17132 | 23000 |
| ME | 3318 | 1066 | 901 | 475 | 434 |
| NH | 577 | 352 | 279 | 111 | 106 |

| | | | | | |
|---|---|---|---|---|---|
| MA | 9146 | 3813 | 5200 | 4473 | 7291 |
| RI | 1008 | 461 | 452 | 279 | 581 |
| CT | 596 | 270 | 364 | 126 | 52 |
| NY | 1155 | 1131 | 1160 | 1352 | 1743 |
| NJ | 17621 | 10587 | 10678 | 6708 | 8543 |
| PA | 272 | 127 | 171 | 273 | 520 |
| DE | 418 | 207 | 99 | 191 | 294 |
| MD | 1987 | 1797 | 1998 | 493 | 343 |
| VA | 1114 | 645 | 937 | 382 | 546 |
| NC | 3761 | 2643 | 5018 | 2175 | 2547 |
| Other homeport states | 1423 | 1432 | 661 | 94 | 0 |
| All crew trips | 119341 | 71886 | 84598 | 68900 | 69821 |
| ME | 15181 | 7515 | 8021 | 7054 | 6266 |
| NH | 4676 | 3916 | 4566 | 3543 | 2802 |
| MA | 35865 | 21308 | 24509 | 22337 | 22614 |
| RI | 10615 | 7434 | 8754 | 8144 | 7847 |
| CT | 1782 | 332 | 688 | 510 | 445 |
| NY | 9230 | 5182 | 7874 | 6360 | 6561 |
| NJ | 26208 | 15664 | 17262 | 13568 | 15892 |
| PA | 361 | 135 | 226 | 333 | 593 |
| DE | 646 | 287 | 103 | 203 | 318 |
| MD | 2512 | 2130 | 2622 | 1109 | 738 |
| VA | 2544 | 1167 | 1310 | 665 | 769 |
| NC | 8099 | 5313 | 7993 | 4980 | 4976 |
| Other homeport states | 1622 | 1503 | 670 | 94 | 0 |

**Table 51. Total number of crew days (product of a trip's crew size and the days absent from port) by homeport state for limited access vessels.**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Scallop crew days | 207088 | 166768 | 179523 | 184372 | 160355 |
| ME | 1855 | 1655 | 1653 | 1620 | 1465 |
| MA | 88946 | 77630 | 80365 | 84986 | 70208 |
| RI | 1701 | 1035 | 1255 | 1331 | 926 |
| CT | 6324 | 5374 | 5914 | 5487 | 5094 |
| NY | 2124 | 969 | 1722 | 1186 | 688 |
| NJ | 44513 | 36889 | 40321 | 44845 | 38744 |
| PA | 2774 | 2008 | 2432 | 1750 | 1197 |
| VA | 32761 | 22162 | 23974 | 24887 | 23563 |
| NC | 23482 | 17003 | 19763 | 16363 | 16439 |
| FL | 2608 | 2044 | 2125 | 1917 | 2031 |
| All crew days | 217797 | 180430 | 192461 | 198038 | 176293 |
| ME | 1855 | 1655 | 1653 | 1620 | 1465 |

| | | | | | |
|---|---|---|---|---|---|
| MA | 90614 | 79414 | 82190 | 87123 | 72787 |
| RI | 2933 | 2662 | 2293 | 2422 | 2052 |
| CT | 6375 | 5480 | 5916 | 5506 | 5121 |
| NY | 2124 | 1239 | 1732 | 1314 | 760 |
| NJ | 47379 | 40101 | 43863 | 48991 | 44231 |
| PA | 2889 | 2113 | 2636 | 1905 | 1422 |
| VA | 32887 | 22585 | 25171 | 25244 | 24316 |
| NC | 28134 | 23135 | 24858 | 21995 | 22108 |
| FL | 2608 | 2044 | 2150 | 1917 | 2031 |

**Table 52. Total number of crew days (product of a trip's crew size and the days absent from port) by homeport state for general category vessels.**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Scallop crew days | 49344 | 26952 | 25560 | 15841 | 22348 |
| ME | 3093 | 1040 | 769 | 275 | 281 |
| NH | 650 | 349 | 296 | 102 | 81 |
| MA | 14019 | 6263 | 5704 | 4076 | 6153 |
| RI | 2399 | 659 | 1053 | 448 | 762 |
| CT | 766 | 240 | 295 | 80 | 38 |
| NY | 1609 | 1142 | 877 | 1043 | 1207 |
| NJ | 16971 | 9738 | 8139 | 6103 | 9235 |
| PA | 367 | 226 | 272 | 406 | 809 |
| DE | 661 | 319 | 185 | 311 | 453 |
| MD | 1546 | 1361 | 1543 | 409 | 182 |
| VA | 1436 | 900 | 961 | 475 | 741 |
| NC | 4351 | 3385 | 4997 | 2023 | 2406 |
| Other homeport states | 1477 | 1331 | 468 | 89 | 0 |
| All crew days | 173599 | 99883 | 115540 | 100852 | 103570 |
| ME | 18069 | 7488 | 7650 | 7193 | 7178 |
| NH | 2773 | 1984 | 2257 | 1755 | 1249 |
| MA | 61952 | 42349 | 47435 | 43148 | 42668 |
| RI | 20208 | 9828 | 15075 | 13233 | 12374 |
| CT | 3070 | 295 | 581 | 381 | 294 |
| NY | 13054 | 5114 | 7060 | 6219 | 6676 |
| NJ | 25506 | 16130 | 15856 | 14122 | 17940 |
| PA | 1038 | 239 | 356 | 495 | 921 |
| DE | 1216 | 424 | 192 | 329 | 481 |
| MD | 1929 | 1632 | 2024 | 890 | 463 |
| VA | 3279 | 1677 | 1585 | 1133 | 1586 |
| NC | 19495 | 11339 | 14961 | 11864 | 11740 |
| Other homeport states | 2010 | 1384 | 506 | 89 | 0 |

### 1.1.13 Trends in the Number of Seafood Dealers

Examining vessel logbooks to find which seafood dealers are accepting scallop landings gives some indication of a particular state's involvement in the scallop fishery beyond the actual harvest of the resource. Dealer data shows that the actual landings of scallops are highly concentrated in the states of Massachusetts (58%), New Jersey (24%) and Virginia (13%), but that dealers from all over New England and the Mid Atlantic are buying these scallops. Table 53 shows that Massachusetts is still the state with the most dealers purchasing scallops at 48, but states like New York, New Jersey and Maine also have large numbers of dealers and seafood processors buying scallops. In recent years the total number of dealers purchasing scallops has declined, from a high of 303 dealers in 2005, to 161 dealers in 2011. Without more information about these seafood related businesses it is difficult to draw any conclusions about the recent decline in the number of dealers, but it is interesting to note that the largest declines in dealers accepting scallops has been in Massachusetts, which had 107 dealers in 2005, but had only 48 in 2011.

**Table 53. Number of seafood dealers accepting/purchasing scallops by year and state**

| State | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|
| ME | 29 | 37 | 26 | 29 | 21 | 9 | 14 | 17 |
| NH | 4 | 4 | 6 | 4 | 3 | 4 | 3 | 4 |
| MA | 93 | 107 | 91 | 75 | 70 | 58 | 49 | 48 |
| RI | 21 | 23 | 22 | 19 | 16 | 15 | 12 | 12 |
| CT | 7 | 5 | 6 | 5 | 5 | 7 | 7 | 4 |
| NY | 31 | 39 | 33 | 36 | 37 | 31 | 26 | 29 |
| NJ | 27 | 34 | 43 | 37 | 35 | 38 | 37 | 24 |
| DE | 2 | 4 | 3 | 1 | 1 | 2 | 2 | 2 |
| MD | 5 | 7 | 6 | 5 | 6 | 8 | 5 | 0 |
| VA | 22 | 16 | 12 | 9 | 9 | 10 | 9 | 10 |
| NC | 15 | 18 | 11 | 9 | 13 | 14 | 12 | 11 |
| Other States | 4 | 9 | 6 | 2 | 4 | 0 | 2 | 0 |
| Total | 260 | 303 | 265 | 231 | 220 | 196 | 178 | 161 |

### 1.1.14 Trends in scallop landings by state and port

Statistics that describe changes in the scallop fishery at the community level have been examined by both port of landing, home state and port. A port of landing is the actual port where fish and shellfish have been landed, where a home port is the port identified by a vessel owner on a vessel permit application and is where supplies are purchased and crew is hired. Statistics based on port of landing begin to describe the benefits that other fishing related businesses (such as dealers and processors) derive from the landings made in their port. Alternatively, statistics based on homeport give an indication of the benefits received by vessel owners and crew from that port.

In terms homestate, the vessels from MA landed over 45% of scallops in 2010 and 2011 fishing years, followed by NJ with about 24.5% of all scallops landed by vessels homeported in this state (Table 54, Table 55). Scallops also comprise a significant proportion of revenue (and landings) from all species with over 90% of total revenue in VA, over 75% of total revenue in NC, over 60% of total revenue in MA and over 68% of total revenue in NJ (Table 56 and Table 57).

Table 58 shows the ex-vessel value of scallops for the top 30 ports where scallops were landed, 2001 – 2011. Over 300 million dollars of scallops were landed in New Bedford, MA alone this past year. In 2011 New Bedford accounted for 53% of all scallop landings and it continues to be the number one port for scallop landings. Included in the top five scallop ports are: Cape May, NJ; Newport News, VA; Barnegat Light/Long Beach NJ; and Seaford, VA. It is also fair to describe the fishing activities in these ports as highly reliant on the ex-vessel revenue generated from scallop landings as scallop landings represent greater than 75% of all ex-vessel revenue for each of the ports (Table 59). There are also a number of ports with a comparatively small amount of ex-vessel revenue from scallops but where that scallop revenue represents a vast majority of the revenue from landings of all species (Table 60). In 2011, in the ports of Newport News, VA and Seaford, VA; revenue from scallop landings accounted for 89.0% and 99.9% of all ex-vessel revenue respectively (Table 60).

Table 61 shows the ex-vessel revenue from scallop landings in the top 30 home ports 2001 - 2011. In 2011, the top five home ports with the highest revenue from scallop landings were also the top five ports of landing. Highlighting the difference between port of landing and home port however, are ports like New Bern, NC and Wanchese, NC, both of which are the home ports of a number of vessels with scallop landings but where no (or very little) landings were made. As in previous years, the largest numbers of permitted limited access scallop vessels have home ports of New Bedford, MA and Cape May, NJ, which represent 39% and 21% of all limited access vessels, respectively (Table 62). New Bedford also has the greatest number of general category scallop vessels, but while limited access vessels are mostly concentrated in the ports of New Bedford and Cape May, general category vessels are more evenly distributed throughout coastal New England. In addition to New Bedford, Point Judith, RI, Gloucester, MA, Boston, MA, Cape May, NJ and Barnegat Light, NJ, are all the homeport of at least 20 vessels with general category scallop permits (Table 63). Relying on many small home ports instead of a few centralized ports is also part of the general category fleet's fishing strategy which is less mobile and where vessels tend to fish closer to shore. With a few exceptions, Table 64 shows that the

average general category vessels are smaller, by length and weight, than the limited access vessels in the same port.

**Table 54. Scallop landings by Home State identified in the permit database**

| | Fishing year | | | | |
|---|---|---|---|---|---|
| **Homeport state** | **2007** | **2008** | **2009** | **2010** | **2011** |
| **CT** | 546542 | 1623322 | 1734044 | 1602132 | 1720437 |
| **DE** | 15655 | 7186 | 7356 | 10498 | 15421 |
| **FL** | 659766 | 625141 | 650270 | 530135 | 673092 |
| **GA** | 89319 | 49266 | 38840 | 8149 | |
| **MA** | 26373451 | 22873829 | 25504891 | 26110751 | 26656287 |
| **MD** | 304774 | 328721 | 297816 | 65942 | 54067 |
| **ME** | 700496 | 677582 | 555687 | 479074 | 498636 |
| **NC** | 5671348 | 4791439 | 5581722 | 4723899 | 5538809 |
| **NH** | 56746 | 53910 | 33944 | 12990 | 10960 |
| **NJ** | 15001631 | 13159595 | 13668183 | 13984139 | 14327469 |
| **NY** | 712069 | 574030 | 864323 | 509770 | 553278 |
| **PA** | 767243 | 607475 | 735669 | 639482 | 435027 |
| **RI** | 350252 | 126350 | 196098 | 354239 | 419636 |
| **VA** | 7818445 | 6200381 | 6766780 | 6770529 | 6865074 |
| **Unidentified** | 1905041 | 859195 | 1424587 | 1189143 | 672646 |
| **All Scallop landings** | 60972778 | 52557422 | 58060210 | 56990872 | 58440839 |

**Table 55. Scallop landings as a proportion of total scallop landings by Home State identified in the permit database**

| | Fishing Year | | | | |
|---|---|---|---|---|---|
| **Homeport State** | **2007** | **2008** | **2009** | **2010** | **2011** |
| **CT** | 0.90% | 3.09% | 2.99% | 2.81% | 2.94% |
| **DE** | 0.03% | 0.01% | 0.01% | 0.02% | 0.03% |
| **FL** | 1.08% | 1.19% | 1.12% | 0.93% | 1.15% |
| **MA** | 43.25% | 43.52% | 43.93% | 45.82% | 45.61% |
| **MD** | 0.50% | 0.63% | 0.51% | 0.12% | 0.09% |
| **ME** | 1.15% | 1.29% | 0.96% | 0.84% | 0.85% |
| **NC** | 9.30% | 9.12% | 9.61% | 8.29% | 9.48% |
| **NH** | 0.09% | 0.10% | 0.06% | 0.02% | 0.02% |
| **NJ** | 24.60% | 25.04% | 23.54% | 24.54% | 24.52% |
| **NY** | 1.17% | 1.09% | 1.49% | 0.89% | 0.95% |
| **PA** | 1.26% | 1.16% | 1.27% | 1.12% | 0.74% |
| **RI** | 0.57% | 0.24% | 0.34% | 0.62% | 0.72% |
| **VA** | 12.82% | 11.80% | 11.65% | 11.88% | 11.75% |
| **Unidentified** | 3.12% | 1.63% | 2.45% | 2.09% | 1.15% |
| **All Scallop landings** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

**Table 56. Scallop landings as a proportion of landings of all species by the Home State identified in the permit database**

| | Fishing Year | | | | |
|---|---|---|---|---|---|
| **Homeport State** | **2007** | **2008** | **2009** | **2010** | **2011** |
| **CT** | 23.83% | 37.06% | 34.45% | 26.91% | 29.89% |
| **DE** | 0.38% | 0.28% | 0.42% | 0.44% | 0.77% |
| **FL** | 98.55% | 99.55% | 99.57% | 99.34% | 99.12% |
| **MA** | 10.28% | 9.03% | 10.34% | 13.12% | 11.47% |
| **MD** | 7.59% | 8.53% | 7.56% | 0.62% | 2.04% |
| **ME** | 0.80% | 0.60% | 0.47% | 0.43% | 0.36% |
| **NC** | 31.48% | 30.73% | 31.64% | 25.92% | 26.43% |
| **NH** | 0.25% | 0.22% | 0.12% | 0.09% | 0.04% |
| **NJ** | 11.30% | 8.97% | 10.10% | 10.10% | 9.42% |
| **NY** | 3.09% | 2.14% | 2.99% | 1.68% | 1.67% |
| **PA** | 5.04% | 4.87% | 7.70% | 6.52% | 6.29% |
| **RI** | 0.59% | 0.21% | 0.33% | 0.65% | 0.63% |
| **VA** | 54.22% | 56.67% | 60.03% | 58.08% | 54.73% |
| **Unidentified** | 0.26% | 0.14% | 0.46% | 0.88% | 0.09% |
| **Scallop % of all landings** | 4.47% | 4.01% | 5.94% | 7.65% | 4.14% |

**Table 57. Scallop revenue as a proportion of revenue from all species by the Home State identified in the permit database**

| | Fishing year | | | | |
|---|---|---|---|---|---|
| **Homeport State** | **2007** | **2008** | **2009** | **2010** | **2011** |
| **CT** | 66.14% | 78.32% | 78.67% | 76.04% | 79.03% |
| **DE** | 2.77% | 2.01% | 3.04% | 4.01% | 7.85% |
| **FL** | 99.56% | 99.89% | 99.90% | 99.77% | 99.74% |
| **MA** | 55.35% | 53.49% | 56.28% | 60.50% | 61.96% |
| **MD** | 35.60% | 41.73% | 36.16% | 16.94% | 17.09% |
| **ME** | 6.44% | 4.17% | 2.78% | 2.14% | 2.45% |
| **NC** | 69.31% | 81.06% | 76.88% | 80.76% | 75.92% |
| **NH** | 1.98% | 1.71% | 1.19% | 0.57% | 0.51% |
| **NJ** | 62.07% | 60.36% | 61.33% | 64.83% | 68.33% |
| **NY** | 15.88% | 13.65% | 17.23% | 12.09% | 13.06% |
| **PA** | 39.28% | 39.98% | 48.68% | 50.51% | 54.50% |
| **RI** | 4.68% | 1.76% | 2.84% | 5.57% | 7.18% |
| **VA** | 89.61% | 91.26% | 91.44% | 92.53% | 93.51% |
| **Unidentified** | 1.98% | 1.11% | 2.14% | 3.17% | 1.28% |
| **Scallop % of all revenue** | 28.16% | 27.26% | 30.04% | 36.42% | 34.70% |

**Table 58. Landed value of scallops (in thousands of dollars) for the top 30 ports of landing, FY 2001 - 2011**

| State | City/town | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MA | NEW BEDFORD | 80357 | 96011 | 232614 | 332720 | 415324 | 210634 | 211847 | 172603 | 185048 | 239029 | 306263 |
| NJ | CAPE MAY | 18626 | 20237 | 709001 | 938804 | 720102 | 216404 | 455107 | 555203 | 527306 | 650695 | 814504 |
| VA | NEWPORT NEWS | 25526 | 30494 | 808502 | 885404 | 631002 | 227004 | 333606 | 373203 | 342949 | 435959 | 442301 |
| NJ | BARNEGAT LIGHT/LONG BEACH | 67503 | 80701 | 227901 | 337106 | 382609 | 179301 | 166901 | 172703 | 161201 | 201503 | 252001 |
| VA | SEAFORD | 10404 | 11801 | 292801 | 335404 | 287302 | 117004 | 153406 | 144003 | 142401 | 166904 | 197401 |
| MA | FAIRHAVEN | 0 | 0 | 0 | 508400 | 151807 | 101003 | 889206 | 916603 | 109403 | 116504 | 173104 |
| NJ | POINT PLEASANT | 31907 | 35307 | 738501 | 209906 | 151006 | 755904 | 874606 | 811603 | 992301 | 107101 | 148400 |
| VA | HAMPTON | 91905 | 13803 | 338008 | 338700 | 242006 | 907903 | 155103 | 136200 | 128800 | 103804 | 132503 |
| CT | NEW LONDON | 94303 | 88606 | 210901 | 275704 | 318907 | 146504 | 165906 | 345606 | 460503 | 396606 | 650804 |
| CT | STONINGTON | 49406 | 56609 | 158001 | 163104 | 124707 | 499703 | 768006 | 524303 | 389303 | 558404 | 646501 |
| NJ | AVALON | 0 | 0 | 0 | 106300 | 252006 | 156303 | 346808 | 280803 | 354103 | 523006 | 538001 |
| NJ | OTHER CAPE MAY | 0 | 14 | 2 | 15 | 81006 | 82503 | 10406 | 27603 | 139103 | 413503 | 534801 |
| NJ | WILDWOOD | 12406 | 20506 | 535201 | 734606 | 615307 | 211303 | 369006 | 383603 | 328403 | 500103 | 530601 |
| RI | POINT JUDITH | 59606 | 8303 | 87501 | 519801 | 119906 | 739603 | 283506 | 137103 | 76903 | 186703 | 420701 |
| MA | GLOUCESTER | 15403 | 78303 | 114301 | 152401 | 184006 | 88703 | 48703 | 35203 | 20903 | 51603 | 382801 |
| NY | MONTAUK | 800 | 0 | 43601 | 176101 | 315406 | 188004 | 218703 | 134603 | 140003 | 255203 | 298601 |
| MA | CHATHAM | 58806 | 11703 | 230101 | 483601 | 606806 | 316103 | 205606 | 171503 | 78403 | 201703 | 244501 |
| NJ | ATLANTIC CITY | 900 | 0 | 26701 | 203601 | 360306 | 206203 | 270606 | 151803 | 120503 | 93903 | 222701 |
| MA | PROVINCETOWN | 97506 | 54006 | 109401 | 217501 | 267106 | 104803 | 59503 | 32003 | 58603 | 132404 | 209701 |
| RI | OTHER NEWPORT | 0 | 0 | 0 | 900 | 900 | 0 | 0 | 200 | 0 | 0 | 165901 |
| RI | NEWPORT | 0 | 300 | 90601 | 907101 | 216606 | 130704 | 603106 | 74703 | 160503 | 5103 | 140501 |
| NY | POINT LOOKOUT | 0 | 0 | 1701 | 3901 | 2706 | 101 | 107501 | 300103 | 251803 | 20004 | 130801 |
| MA | BARNSTABLE | 0 | 0 | 3101 | 16303 | 69606 | 61003 | 32606 | 10803 | 11503 | 46903 | 103901 |
| NJ | BRIELLE | 0 | 0 | 0 | 10901 | 12806 | 4303 | 14703 | 6903 | 5003 | 31603 | 90101 |
| NY | HAMPTON BAYS | 45406 | 9403 | 41201 | 166201 | 253506 | 84604 | 42206 | 57403 | 80003 | 73204 | 84001 |
| NC | HOBUCKEN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78501 |
| MA | TRURO | 0 | 0 | 0 | 100 | 100 | 0 | 0 | 100 | 1803 | 11303 | 68101 |
| MA | SANDWICH | 21806 | 24903 | 39201 | 38901 | 55406 | 40503 | 70706 | 33703 | 50003 | 57004 | 54101 |
| NJ | OTHER ATLANTIC | 0 | 0 | 0 | 13201 | 96006 | 87403 | 101706 | 54203 | 45303 | 34703 | 49601 |
| MD | OCEAN CITY | 7906 | 9903 | 62101 | 452801 | 966406 | 563203 | 281506 | 350403 | 316403 | 123204 | 39701 |

**Table 59. Proportion of total revenue from scallop landings for the top 30 ports of landing, FY 2001 - 2011**

| State | City/town | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MA | NEW BEDFORD | 53.35% | 57.58% | 64.34% | 72.56% | 77.09% | 77.56% | 76.33% | 72.93% | 74.89% | 77.91% | 80.57% |
| NJ | CAPE MAY | 68.27% | 69.14% | 77.51% | 80.33% | 75.64% | 62.56% | 79.80% | 78.82% | 81.85% | 84.18% | 81.72% |
| VA | NEWPORT NEWS | 84.11% | 89.09% | 92.43% | 94.23% | 94.25% | 91.54% | 89.37% | 92.97% | 95.45% | 95.51% | 89.03% |
| NJ | BARNEGAT LIGHT/LONG BEACH | 46.84% | 56.60% | 65.40% | 75.89% | 77.87% | 74.21% | 69.23% | 74.76% | 74.24% | 74.56% | 75.75% |
| VA | SEAFORD | 99.70% | 99.51% | 99.72% | 99.79% | 99.70% | 99.47% | 99.44% | 99.58% | 99.72% | 99.82% | 99.86% |
| MA | FAIRHAVEN | | 0.00% | | 44.73% | 78.75% | 89.62% | 90.18% | 86.21% | 75.81% | 71.79% | 73.55% |
| NJ | POINT PLEASANT | 16.72% | 18.03% | 19.09% | 29.09% | 36.97% | 34.27% | 37.65% | 37.50% | 47.44% | 43.29% | 54.68% |
| VA | HAMPTON | 74.73% | 82.14% | 81.62% | 78.35% | 76.39% | 74.15% | 77.77% | 83.92% | 79.60% | 74.24% | 68.11% |
| CT | NEW LONDON | 24.37% | 21.50% | 21.98% | 25.24% | 31.85% | 33.88% | 38.79% | 78.61% | 88.66% | 82.37% | 75.68% |
| CT | STONINGTON | 51.98% | 67.41% | 78.63% | 77.06% | 72.21% | 65.89% | 78.44% | 67.89% | 62.57% | 69.55% | 70.07% |
| NJ | AVALON | | | | 99.16% | 99.13% | 98.76% | 98.45% | 98.47% | 99.45% | 99.81% | 99.64% |
| NJ | OTHER CAPE MAY | | 1.01% | 0.08% | 0.67% | 22.08% | 35.23% | 7.89% | 21.84% | 99.57% | 98.97% | 98.74% |
| NJ | WILDWOOD | 20.54% | 31.96% | 41.28% | 60.13% | 78.27% | 75.39% | 90.47% | 96.33% | 96.69% | 96.29% | 90.90% |
| RI | POINT JUDITH | 1.79% | 0.27% | 1.53% | 7.89% | 15.30% | 16.35% | 7.65% | 3.80% | 2.44% | 5.84% | 10.20% |
| MA | GLOUCESTER | 3.85% | 1.97% | 1.58% | 1.84% | 2.18% | 1.93% | 0.96% | 0.67% | 0.41% | 0.94% | 6.18% |
| NY | MONTAUK | 0.06% | 0.00% | 1.98% | 6.55% | 10.17% | 11.15% | 13.65% | 8.98% | 9.40% | 13.41% | 13.74% |
| MA | CHATHAM | 4.70% | 1.09% | 11.14% | 18.84% | 19.46% | 19.16% | 13.92% | 11.40% | 6.24% | 14.47% | 15.09% |
| NJ | ATLANTIC CITY | 0.04% | | 0.74% | 5.97% | 9.13% | 8.49% | 9.57% | 6.44% | 5.75% | 5.05% | 12.25% |
| MA | PROVINCETOWN | 21.63% | 13.49% | 15.95% | 26.93% | 32.11% | 28.22% | 16.76% | 9.77% | 15.75% | 23.05% | 29.48% |
| RI | OTHER NEWPORT | | | | 1.62% | 1.34% | | | 1.03% | | | 99.98% |
| RI | NEWPORT | 0.00% | 0.04% | 5.62% | 42.75% | 64.42% | 63.80% | 49.21% | 11.53% | 22.70% | 0.74% | 16.20% |
| NY | POINT LOOKOUT | | | 3.25% | 3.22% | 1.65% | 0.13% | 59.76% | 81.02% | 82.68% | 13.25% | 46.83% |
| MA | BARNSTABLE | | | 0.98% | 5.88% | 20.37% | 29.03% | 19.32% | 4.99% | 5.53% | 15.26% | 27.39% |
| NJ | BRIELLE | | | | 99.77% | 99.95% | 99.86% | 87.79% | 66.14% | 100.00% | 99.71% | 98.87% |
| NY | HAMPTON BAYS | 5.24% | 1.14% | 3.43% | 13.35% | 18.32% | 11.68% | 7.36% | 12.16% | 16.26% | 14.93% | 10.98% |
| NC | HOBUCKEN | | | | | | | | | | | 59.19% |
| MA | TRURO | | | | 0.53% | 0.44% | 0.25% | | 0.77% | 8.72% | 57.27% | 87.31% |
| MA | SANDWICH | 3.54% | 3.63% | 3.41% | 3.56% | 5.65% | 9.48% | 19.67% | 11.10% | 17.66% | 17.76% | 11.60% |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NJ | OTHER ATLANTIC | | | | 3.42% | 20.84% | 35.33% | 38.44% | 26.94% | 90.73% | 90.11% | 94.20% |
| MD | OCEAN CITY | 0.88% | 1.27% | 1.20% | 8.07% | 44.67% | 46.23% | 25.73% | 33.25% | 33.42% | 13.12% | 6.21% |

**Table 60. Proportion of total landed value from scallops landings for the 15 ports with the highest 11 year average, FY 2001 - 2011**

| State | City/town | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 11 year Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA | SEAFORD | 99.70% | 99.51% | 99.72% | 99.79% | 99.70% | 99.47% | 99.44% | 99.58% | 99.72% | 99.82% | 99.86% | 99.67% |
| VA | NEWPORT NEWS | 84.11% | 89.09% | 92.43% | 94.23% | 94.25% | 91.54% | 89.37% | 92.97% | 95.45% | 95.51% | 89.03% | 91.64% |
| VA | HAMPTON | 74.73% | 82.14% | 81.62% | 78.35% | 76.39% | 74.15% | 77.77% | 83.92% | 79.60% | 74.24% | 68.11% | 77.37% |
| NJ | CAPE MAY | 68.27% | 69.14% | 77.51% | 80.33% | 75.64% | 62.56% | 79.80% | 78.82% | 81.85% | 84.18% | 81.72% | 76.35% |
| NJ | AVALON | | | | 99.16% | 99.13% | 98.76% | 98.45% | 98.47% | 99.45% | 99.81% | 99.64% | 72.08% |
| MA | NEW BEDFORD | 53.35% | 57.58% | 64.34% | 72.56% | 77.09% | 77.56% | 76.33% | 72.93% | 74.89% | 77.91% | 80.57% | 71.37% |
| NJ | WILDWOOD | 20.54% | 31.96% | 41.28% | 60.13% | 78.27% | 75.39% | 90.47% | 96.33% | 96.69% | 96.29% | 90.90% | 70.75% |
| NJ | BARNEGAT LIGHT/LONG BEACH | 46.84% | 56.60% | 65.40% | 75.89% | 77.87% | 74.21% | 69.23% | 74.76% | 74.24% | 74.56% | 75.75% | 69.58% |
| CT | STONINGTON | 51.98% | 67.41% | 78.63% | 77.06% | 72.21% | 65.89% | 78.44% | 67.89% | 62.57% | 69.55% | 70.07% | 69.25% |
| NJ | BRIELLE | | | | 99.77% | 99.95% | 99.86% | 87.79% | 66.14% | 100.00% | 99.71% | 98.87% | 68.37% |
| MA | FAIRHAVEN | | 0.00% | | 44.73% | 78.75% | 89.62% | 90.18% | 86.21% | 75.81% | 71.79% | 73.55% | 55.51% |
| CT | NEW LONDON | 24.37% | 21.50% | 21.98% | 25.24% | 31.85% | 33.88% | 38.79% | 78.61% | 88.66% | 82.37% | 75.68% | 47.54% |
| VA | CHINCOTEAGUE | 33.36% | 38.57% | 54.54% | 72.84% | 76.57% | 72.46% | 27.10% | 14.45% | 25.91% | 33.13% | 4.69% | 41.24% |
| NJ | OTHER ATLANTIC | | | | 3.42% | 20.84% | 35.33% | 38.44% | 26.94% | 90.73% | 90.11% | 94.20% | 36.37% |
| NJ | OTHER CAPE MAY | | 1.01% | 0.08% | 0.67% | 22.08% | 35.23% | 7.89% | 21.84% | 99.57% | 98.97% | 98.74% | 35.10% |
| Proportion of scallop revenue from all landings | | 23.77% | 27.86% | 32.08% | 37.12% | 42.55% | 43.92% | 38.57% | 36.28% | 40.67% | 44.58% | 45.37% | 37.53% |

**Table 61. Landed value of scallops (in thousands of dollars) for the top 30 registered homeports, FY 2001 - 2011**

| State | City/town | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MA | NEW BEDFORD | 61354 | 73056 | 180050 | 247187 | 286055 | 139123 | 152136 | 141942 | 147971 | 189780 | 240218 |
| NJ | CAPE MAY | 15775 | 21110 | 65506 | 92518 | 113197 | 56078 | 69181 | 59509 | 57418 | 75302 | 98053 |
| VA | NEWPORT NEWS | 14089 | 16327 | 36645 | 45886 | 47698 | 20803 | 21909 | 18929 | 17291 | 23218 | 26525 |
| NJ | BARNEGAT LIGHT | 6390 | 7175 | 18613 | 26372 | 33596 | 16477 | 16276 | 16044 | 16335 | 19722 | 24666 |
| VA | SEAFORD | 383 | 2399 | 6774 | 8211 | 8679 | 2693 | 5540 | 4603 | 5395 | 6600 | 18108 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC | NEW BERN | 3292 | 4235 | 13082 | 14262 | 15567 | 8320 | 12113 | 10785 | 11657 | 13221 | 16600 |
| NC | WANCHESE | 2769 | 3378 | 10287 | 12130 | 11880 | 5074 | 7053 | 6560 | 7287 | 7657 | 11729 |
| VA | HAMPTON | 4103 | 4318 | 8937 | 14394 | 8091 | 5427 | 5213 | 4030 | 4898 | 6254 | 9646 |
| MA | FAIRHAVEN | 6012 | 5842 | 12723 | 15876 | 16654 | 7406 | 6344 | 4583 | 5267 | 7104 | 9351 |
| NC | BEAUFORT | 20 | 6 | 326 | 2358 | 3037 | 843 | 1483 | 2240 | 5565 | 5688 | 8761 |
| CT | NEW LONDON | 0 | 0 | 796 | 9 | 3907 | 4389 | 3142 | 5799 | 6112 | 5675 | 8617 |
| VA | NORFOLK | 14287 | 16563 | 37624 | 40160 | 25423 | 11109 | 12474 | 11390 | 11567 | 12905 | 7759 |
| NC | LOWLAND | 1786 | 2176 | 6281 | 9940 | 10131 | 4443 | 4773 | 4692 | 3589 | 4297 | 7651 |
| MA | BOSTON | 6095 | 8123 | 18393 | 14903 | 16387 | 7779 | 7928 | 5784 | 6701 | 8687 | 7353 |
| CT | STONINGTON | 698 | 1004 | 1661 | 3892 | 94 | 59 | 464 | 4337 | 4028 | 5879 | 6581 |
| NJ | POINT PLEASANT | 1399 | 1499 | 3707 | 5699 | 9520 | 5054 | 4137 | 5043 | 5947 | 8908 | 6076 |
| NJ | ATLANTIC CITY | 58 | 0 | 14 | 1558 | 5748 | 3547 | 3932 | 3126 | 2678 | 3685 | 4491 |
| PA | PHILADELPHIA | 3446 | 3319 | 9667 | 13575 | 11021 | 4957 | 5004 | 4219 | 4980 | 5273 | 4321 |
| RI | POINT JUDITH | 283 | 12 | 187 | 1395 | 5461 | 3246 | 2265 | 842 | 1122 | 2611 | 4073 |
| NJ | POINT PLEASANT BEACH | 0 | 7 | 4 | 139 | 231 | 720 | 1584 | 2725 | 1632 | 1205 | 3435 |
| FL | CAPE CANAVERAL | 954 | 1223 | 3707 | 5683 | 5442 | 2446 | 2260 | 2441 | 2268 | 2308 | 3435 |
| NY | MONTAUK | 19 | 6 | 220 | 617 | 1661 | 255 | 2332 | 2230 | 2814 | 2616 | 3212 |
| MA | CHATHAM | 296 | 38 | 318 | 1029 | 2101 | 1220 | 1483 | 854 | 1098 | 1791 | 3202 |
| MA | PROVINCETOWN | 921 | 603 | 455 | 1232 | 2206 | 933 | 638 | 247 | 753 | 1101 | 2746 |
| VA | CARROLLTON | 1106 | 1386 | 3654 | 4480 | 4228 | 1853 | 2217 | 1868 | 2003 | 2268 | 2654 |
| MA | BEDFORD | 1113 | 970 | 2151 | 2494 | 2790 | 1309 | 1436 | 1212 | 1220 | 1622 | 1994 |
| CT | ESSEX | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1028 | 1066 | 1362 | 1955 |
| NJ | WILDWOOD | 253 | 229 | 1298 | 2073 | 1586 | 376 | 1094 | 1042 | 1263 | 1272 | 1950 |
| NC | BAYBORO | 671 | 998 | 3547 | 4216 | 1273 | 1235 | 1643 | 1260 | 1327 | 1441 | 1886 |
| NC | AURORA | 891 | 779 | 3307 | 4052 | 3674 | 2017 | 1196 | 984 | 0 | 824 | 1845 |
| Total | | 172704 | 201514 | 525895 | 716745 | 790676 | 371524 | 402507 | 364910 | 374058 | 460247 | 583135 |

**Table 62. Number of permitted limited access scallop vessels. By homeport, 2001-2011.**

| State | Homeport | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MA | NEW BEDFORD | 90 | 97 | 102 | 111 | 125 | 131 | 133 | 132 | 134 | 133 | 137 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NJ | CAPE MAY | 36 | 42 | 50 | 54 | 68 | 71 | 73 | 68 | 67 | 67 | 73 |
| VA | NEWPORT NEWS | 21 | 21 | 21 | 22 | 23 | 19 | 19 | 18 | 17 | 18 | 16 |
| VA | SEAFORD | 2 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 7 | 12 |
| NC | NEW BERN | 8 | 8 | 8 | 8 | 13 | 12 | 14 | 11 | 12 | 11 | 11 |
| NJ | BARNEGAT LIGHT | 9 | 8 | 8 | 10 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| NC | WANCHESE | 8 | 7 | 7 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 |
| NC | LOWLAND | 7 | 7 | 8 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 7 |
| NJ | POINT PLEASANT | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 6 | 7 | 9 | 6 |
| VA | HAMPTON | 6 | 6 | 6 | 7 | 4 | 8 | 6 | 6 | 6 | 5 | 6 |
| CT | NEW LONDON | 1 | 1 | 1 | 1 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| MA | BOSTON | 12 | 11 | 10 | 7 | 7 | 7 | 7 | 6 | 5 | 6 | 5 |
| MA | FAIRHAVEN | 10 | 8 | 8 | 7 | 8 | 7 | 5 | 4 | 4 | 4 | 5 |
| NC | BEAUFORT | | | | | | | 1 | 2 | 5 | 4 | 5 |
| VA | NORFOLK | 27 | 27 | 27 | 22 | 13 | 11 | 11 | 11 | 11 | 12 | 5 |
| CT | STONINGTON | 4 | 6 | 7 | 7 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| PA | PHILADELPHIA | 5 | 5 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 3 |
| RI | POINT JUDITH | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |

**Table 63. Number of permitted general category scallop vessels by homeport, 2001-2011. All ports with at least 3 GC permits in 2011 are included (not including those vessels with LA permits).**

| State | Homeport | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MA | NEW BEDFORD | 96 | 105 | 101 | 113 | 115 | 115 | 113 | 59 | 72 | 69 | 67 |
| RI | POINT JUDITH | 60 | 61 | 69 | 72 | 73 | 78 | 87 | 26 | 30 | 30 | 30 |
| MA | GLOUCESTER | 161 | 177 | 179 | 180 | 177 | 178 | 192 | 28 | 33 | 37 | 29 |
| MA | BOSTON | 226 | 207 | 192 | 166 | 133 | 120 | 107 | 29 | 38 | 31 | 27 |
| NJ | CAPE MAY | 34 | 34 | 39 | 53 | 67 | 71 | 76 | 19 | 28 | 23 | 23 |
| NJ | BARNEGAT LIGHT | 38 | 46 | 52 | 55 | 62 | 59 | 60 | 23 | 25 | 25 | 20 |
| NJ | ATLANTIC CITY | 11 | 15 | 13 | 18 | 23 | 27 | 24 | 12 | 14 | 16 | 16 |
| NJ | POINT PLEASANT | 22 | 26 | 24 | 30 | 34 | 36 | 37 | 14 | 20 | 15 | 16 |
| MA | CHATHAM | 62 | 76 | 78 | 76 | 69 | 65 | 70 | 7 | 13 | 16 | 12 |
| NY | NEW YORK | 69 | 66 | 60 | 66 | 61 | 60 | 57 | 11 | 12 | 12 | 10 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NY | MONTAUK | 39 | 41 | 47 | 55 | 58 | 56 | 65 | 8 | 9 | 8 | 10 |
| MA | PROVINCETOWN | 22 | 24 | 25 | 30 | 26 | 20 | 18 | 9 | 13 | 11 | 9 |
| ME | PORTLAND | 54 | 49 | 56 | 65 | 59 | 56 | 59 | 6 | 7 | 7 | 9 |
| NC | NEW BERN | | | | 1 | 2 | 5 | 4 | 3 | 8 | 9 | 7 |
| MA | SCITUATE | 32 | 32 | 33 | 36 | 26 | 27 | 29 | 8 | 9 | 8 | 7 |
| MD | OCEAN CITY | 8 | 8 | 12 | 16 | 22 | 25 | 24 | 7 | 9 | 8 | 7 |
| NY | SHINNECOCK | 14 | 14 | 14 | 19 | 16 | 15 | 14 | 5 | 8 | 8 | 7 |
| NC | WANCHESE | 14 | 18 | 22 | 28 | 32 | 31 | 28 | 3 | 6 | 8 | 7 |
| NC | SWAN QUARTER | 3 | 5 | 5 | 7 | 10 | 11 | 8 | 4 | 6 | 8 | 7 |
| PA | PHILADELPHIA | 34 | 30 | 33 | 28 | 22 | 19 | 17 | 7 | 7 | 7 | 7 |
| NH | SEABROOK | 24 | 27 | 20 | 20 | 17 | 27 | 26 | 4 | 7 | 7 | 6 |
| NC | BELHAVEN | 4 | 6 | 8 | 10 | 16 | 13 | 11 | 5 | 6 | 6 | 6 |
| ME | SOUTH BRISTOL | 8 | 7 | 5 | 9 | 11 | 14 | 11 | 5 | 6 | 6 | 5 |
| NJ | BELFORD | 22 | 22 | 22 | 26 | 26 | 26 | 23 | 8 | 6 | 6 | 5 |
| NC | BEAUFORT | 11 | 11 | 14 | 15 | 17 | 17 | 12 | 9 | 7 | 7 | 4 |
| NH | PORTSMOUTH | 36 | 36 | 36 | 46 | 45 | 48 | 44 | 6 | 6 | 6 | 4 |
| MD | TILGHMAN | | | | 5 | 11 | 10 | 8 | 3 | 4 | 4 | 4 |
| NJ | POINT PLEASANT BEACH | 1 | 3 | 3 | 3 | 3 | 4 | 4 | 2 | 3 | 3 | 4 |
| NH | HAMPTON | 18 | 20 | 18 | 22 | 22 | 17 | 16 | 5 | 5 | 5 | 3 |
| NH | RYE | 9 | 12 | 15 | 18 | 19 | 19 | 23 | 5 | 5 | 4 | 3 |
| NC | ENGELHARD | 5 | 4 | 5 | 9 | 12 | 9 | 9 | 5 | 5 | 4 | 3 |
| NY | GREENPORT | 6 | 6 | 7 | 7 | 8 | 5 | 5 | 3 | 4 | 3 | 3 |
| NJ | WILDWOOD | 10 | 11 | 9 | 9 | 8 | 8 | 8 | 4 | 3 | 3 | 3 |
| MA | ROCKPORT | 20 | 28 | 27 | 24 | 21 | 17 | 16 | 4 | 3 | 3 | 3 |
| MA | NEWBURYPORT | 18 | 23 | 23 | 20 | 20 | 18 | 16 | 3 | 3 | 3 | 3 |
| NY | FREEPORT | 5 | 6 | 7 | 10 | 12 | 11 | 9 | 1 | 3 | 3 | 3 |
| NY | HAMPTON BAYS | 9 | 8 | 8 | 8 | 6 | 11 | 10 | 1 | 2 | 2 | 3 |
| NJ | PORT NORRIS | 2 | 3 | 8 | 14 | 15 | 11 | 11 | 1 | 1 | 2 | 3 |

**Table 64. Average GRT (gross registered tons), average length, and number of permitted scallop vessels in the top 20 homeports by landings, 2001-2011.**

| State | Homeport | Plan | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NJ | ATLANTIC CITY | LA | Average vessel length | | | | | | 75 | 73 | 75 | 75 | 75 | 76 |
| NJ | ATLANTIC CITY | LA | Average gross tonnage | | | | | | 121 | 123 | 123 | 123 | 123 | 121 |
| NJ | ATLANTIC CITY | LA | Number of permits | | | | | | 2 | 2 | 3 | 3 | 3 | 2 |
| NJ | ATLANTIC CITY | GC | Average vessel length | 66 | 78 | 75 | 72 | 71 | 82 | 81 | 100 | 94 | 85 | 90 |
| NJ | ATLANTIC CITY | GC | Average gross tonnage | 83 | 126 | 125 | 113 | 101 | 121 | 121 | 163 | 146 | 129 | 139 |
| NJ | ATLANTIC CITY | GC | Number of permits | 11 | 15 | 13 | 18 | 23 | 28 | 24 | 12 | 14 | 16 | 16 |
| NJ | BARNEGAT LIGHT | LA | Average vessel length | 64 | 68 | 68 | 69 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| NJ | BARNEGAT LIGHT | LA | Average gross tonnage | 92 | 103 | 103 | 103 | 102 | 101 | 101 | 101 | 101 | 101 | 101 |
| NJ | BARNEGAT LIGHT | LA | Number of permits | 9 | 8 | 8 | 9 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| NJ | BARNEGAT LIGHT | GC | Average vessel length | 53 | 50 | 53 | 51 | 54 | 49 | 49 | 53 | 53 | 53 | 51 |
| NJ | BARNEGAT LIGHT | GC | Average gross tonnage | 59 | 52 | 54 | 47 | 48 | 36 | 36 | 46 | 49 | 49 | 42 |
| NJ | BARNEGAT LIGHT | GC | Number of permits | 39 | 47 | 52 | 55 | 62 | 59 | 60 | 23 | 25 | 25 | 20 |
| NC | BEAUFORT | LA | Average vessel length | | | | | | | | 91 | 84 | 84 | 87 |
| NC | BEAUFORT | LA | Average gross tonnage | | | | | | | | 147 | 124 | 124 | 127 |
| NC | BEAUFORT | LA | Number of permits | | | | | | | | 1 | 5 | 5 | 5 |
| NC | BEAUFORT | GC | Average vessel length | 70 | 70 | 70 | 70 | 69 | 66 | 70 | 69 | 68 | 68 | 67 |
| NC | BEAUFORT | GC | Average gross tonnage | 103 | 103 | 105 | 102 | 98 | 93 | 105 | 108 | 101 | 101 | 97 |
| NC | BEAUFORT | GC | Number of permits | 12 | 12 | 15 | 16 | 18 | 17 | 13 | 10 | 8 | 8 | 5 |
| MA | BOSTON | LA | Average vessel length | 88 | 90 | 91 | 91 | 91 | 91 | 91 | 91 | 93 | 91 | 87 |
| MA | BOSTON | LA | Average gross tonnage | 166 | 173 | 181 | 183 | 183 | 183 | 183 | 183 | 195 | 186 | 184 |
| MA | BOSTON | LA | Number of permits | 12 | 12 | 10 | 7 | 7 | 7 | 7 | 7 | 5 | 6 | 5 |
| MA | BOSTON | GC | Average vessel length | 49 | 50 | 51 | 48 | 49 | 50 | 51 | 67 | 65 | 65 | 66 |
| MA | BOSTON | GC | Average gross tonnage | 50 | 50 | 54 | 49 | 53 | 56 | 57 | 104 | 98 | 100 | 99 |
| MA | BOSTON | GC | Number of permits | 226 | 207 | 192 | 166 | 133 | 119 | 107 | 29 | 38 | 31 | 27 |
| NJ | CAPE MAY | LA | Average vessel length | 79 | 78 | 74 | 73 | 74 | 74 | 74 | 77 | 77 | 77 | 77 |
| NJ | CAPE MAY | LA | Average gross tonnage | 144 | 141 | 132 | 129 | 128 | 128 | 128 | 133 | 131 | 130 | 130 |
| NJ | CAPE MAY | LA | Number of | 36 | 40 | 47 | 53 | 61 | 67 | 67 | 69 | 66 | 66 | 72 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | permits | | | | | | | | | | | | |
| NJ | CAPE MAY | GC | Average vessel length | 57 | 58 | 52 | 52 | 52 | 54 | 55 | 63 | 58 | 58 | 54 |
| NJ | CAPE MAY | GC | Average gross tonnage | 75 | 75 | 62 | 57 | 56 | 61 | 65 | 86 | 74 | 71 | 62 |
| NJ | CAPE MAY | GC | Number of permits | 34 | 34 | 39 | 53 | 67 | 72 | 76 | 19 | 28 | 23 | 23 |
| MA | FAIRHAVEN | LA | Average vessel length | 86 | 85 | 82 | 88 | 88 | 86 | 86 | 89 | 95 | 95 | 93 |
| MA | FAIRHAVEN | LA | Average gross tonnage | 163 | 155 | 145 | 164 | 164 | 156 | 156 | 169 | 183 | 183 | 184 |
| MA | FAIRHAVEN | LA | Number of permits | 14 | 13 | 9 | 7 | 7 | 7 | 7 | 6 | 4 | 4 | 5 |
| MA | FAIRHAVEN | GC | Average vessel length | 45 | 44 | 44 | 45 | 45 | 44 | 41 | 66 | 52 | 52 | 52 |
| MA | FAIRHAVEN | GC | Average gross tonnage | 39 | 36 | 35 | 35 | 32 | 30 | 24 | 118 | 72 | 72 | 72 |
| MA | FAIRHAVEN | GC | Number of permits | 19 | 22 | 25 | 27 | 24 | 25 | 23 | 1 | 2 | 2 | 2 |
| VA | HAMPTON | LA | Average vessel length | 77 | 77 | 77 | 76 | 76 | 75 | 74 | 65 | 73 | 73 | 79 |
| VA | HAMPTON | LA | Average gross tonnage | 162 | 162 | 162 | 158 | 152 | 124 | 120 | 100 | 112 | 112 | 129 |
| VA | HAMPTON | LA | Number of permits | 6 | 6 | 6 | 7 | 9 | 7 | 6 | 6 | 6 | 6 | 5 |
| VA | HAMPTON | GC | Average vessel length | 39 | 37 | 39 | 37 | 40 | 43 | 44 | 42 | 42 | 42 | 43 |
| VA | HAMPTON | GC | Average gross tonnage | 19 | 14 | 16 | 15 | 26 | 31 | 35 | 21 | 21 | 21 | 23 |
| VA | HAMPTON | GC | Number of permits | 22 | 23 | 19 | 22 | 26 | 20 | 20 | 5 | 5 | 5 | 3 |
| NC | LOWLAND | LA | Average vessel length | 73 | 73 | 73 | 75 | 77 | 78 | 80 | 81 | 81 | 81 | 81 |
| NC | LOWLAND | LA | Average gross tonnage | 106 | 106 | 106 | 103 | 112 | 114 | 116 | 118 | 118 | 118 | 118 |
| NC | LOWLAND | LA | Number of permits | 7 | 7 | 7 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 7 |
| NC | LOWLAND | GC | Average vessel length | 66 | 66 | 62 | 75 | 68 | 68 | 69 | | | | |
| NC | LOWLAND | GC | Average gross tonnage | 73 | 73 | 73 | 110 | 89 | 92 | 92 | | | | |
| NC | LOWLAND | GC | Number of permits | 2 | 2 | 2 | 4 | 5 | 6 | 7 | | | | |
| MA | NEW BEDFORD | LA | Average vessel length | 85 | 84 | 85 | 85 | 82 | 83 | 83 | 84 | 84 | 84 | 84 |
| MA | NEW BEDFORD | LA | Average gross tonnage | 170 | 164 | 164 | 163 | 154 | 154 | 155 | 157 | 159 | 158 | 158 |
| MA | NEW BEDFORD | LA | Number of permits | 86 | 93 | 102 | 111 | 119 | 127 | 132 | 129 | 133 | 133 | 136 |
| MA | NEW BEDFORD | GC | Average vessel length | 66 | 65 | 64 | 62 | 59 | 59 | 57 | 69 | 65 | 63 | 61 |
| MA | NEW BEDFORD | GC | Average gross tonnage | 100 | 100 | 98 | 94 | 90 | 91 | 87 | 120 | 109 | 105 | 102 |
| MA | NEW BEDFORD | GC | Number of permits | 96 | 105 | 101 | 113 | 115 | 112 | 113 | 59 | 72 | 68 | 66 |
| NC | NEW BERN | LA | Average vessel length | 74 | 75 | 77 | 79 | 84 | 78 | 71 | 81 | 81 | 82 | 81 |
| NC | NEW BERN | LA | Average gross | 105 | 106 | 111 | 113 | 123 | 115 | 109 | 122 | 120 | 118 | 119 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | tonnage | | | | | | | | | | | | |
| NC | NEW BERN | LA | Number of permits | 9 | 8 | 9 | 8 | 12 | 12 | 14 | 11 | 12 | 9 | 11 |
| NC | NEW BERN | GC | Average vessel length | | | | 43 | 57 | 59 | 62 | 74 | 60 | 57 | 51 |
| NC | NEW BERN | GC | Average gross tonnage | | | | 18 | 68 | 77 | 86 | 105 | 79 | 70 | 62 |
| NC | NEW BERN | GC | Number of permits | | | | 1 | 2 | 6 | 4 | 3 | 8 | 9 | 7 |
| CT | NEW LONDON | LA | Average vessel length | 86 | 86 | 86 | 86 | 86 | 83 | 83 | 81 | 81 | 81 | 81 |
| CT | NEW LONDON | LA | Average gross tonnage | 147 | 147 | 147 | 147 | 147 | 188 | 188 | 168 | 168 | 168 | 168 |
| CT | NEW LONDON | LA | Number of permits | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 5 | 5 | 5 | 5 |
| CT | NEW LONDON | GC | Average vessel length | 47 | 46 | 49 | 47 | 49 | 50 | 46 | 50 | 50 | 50 | 56 |
| CT | NEW LONDON | GC | Average gross tonnage | 39 | 37 | 39 | 35 | 37 | 38 | 34 | 30 | 30 | 30 | 31 |
| CT | NEW LONDON | GC | Number of permits | 7 | 9 | 8 | 10 | 9 | 8 | 9 | 2 | 2 | 2 | 1 |
| VA | NEWPORT NEWS | LA | Average vessel length | 79 | 78 | 78 | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 |
| VA | NEWPORT NEWS | LA | Average gross tonnage | 147 | 146 | 145 | 142 | 142 | 141 | 141 | 142 | 141 | 144 | 143 |
| VA | NEWPORT NEWS | LA | Number of permits | 20 | 21 | 22 | 22 | 24 | 23 | 21 | 17 | 18 | 18 | 18 |
| VA | NEWPORT NEWS | GC | Average vessel length | | 63 | 63 | 54 | 54 | 60 | 64 | 48 | 48 | 48 | 48 |
| VA | NEWPORT NEWS | GC | Average gross tonnage | | 86 | 86 | 50 | 61 | 84 | 86 | 33 | 33 | 33 | 33 |
| VA | NEWPORT NEWS | GC | Number of permits | | 1 | 1 | 3 | 5 | 6 | 6 | 1 | 1 | 1 | 1 |
| VA | NORFOLK | LA | Average vessel length | 79 | 80 | 80 | 81 | 82 | 79 | 80 | 80 | 80 | 80 | 78 |
| VA | NORFOLK | LA | Average gross tonnage | 133 | 135 | 136 | 140 | 141 | 139 | 141 | 141 | 141 | 138 | 137 |
| VA | NORFOLK | LA | Number of permits | 27 | 27 | 28 | 23 | 20 | 13 | 11 | 11 | 11 | 12 | 5 |
| VA | NORFOLK | GC | Average vessel length | 59 | 60 | 57 | 55 | 52 | 53 | 48 | 86 | 86 | 86 | 86 |
| VA | NORFOLK | GC | Average gross tonnage | 72 | 72 | 62 | 58 | 49 | 50 | 39 | 129 | 129 | 129 | 129 |
| VA | NORFOLK | GC | Number of permits | 17 | 20 | 18 | 19 | 17 | 15 | 11 | 2 | 2 | 2 | 2 |
| PA | PHILADELPHIA | LA | Average vessel length | 80 | 82 | 78 | 78 | 79 | 79 | 79 | 79 | 79 | 79 | 76 |
| PA | PHILADELPHIA | LA | Average gross tonnage | 153 | 163 | 152 | 152 | 153 | 153 | 153 | 153 | 153 | 153 | 146 |
| PA | PHILADELPHIA | LA | Number of permits | 6 | 5 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| PA | PHILADELPHIA | GC | Average vessel length | 68 | 72 | 72 | 75 | 79 | 77 | 73 | 93 | 93 | 93 | 93 |
| PA | PHILADELPHIA | GC | Average gross tonnage | 90 | 101 | 99 | 106 | 110 | 102 | 99 | 138 | 138 | 138 | 138 |
| PA | PHILADELPHIA | GC | Number of permits | 33 | 30 | 33 | 28 | 22 | 19 | 17 | 7 | 7 | 7 | 7 |
| RI | POINT JUDITH | LA | Average vessel | 85 | 79 | 72 | 72 | 79 | 78 | 78 | 78 | 78 | 78 | 79 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | length | | | | | | | | | | | | |
| RI | POINT JUDITH | LA | Average gross tonnage | 176 | 157 | 137 | 137 | 157 | 151 | 151 | 151 | 151 | 151 | 159 |
| RI | POINT JUDITH | LA | Number of permits | 2 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 2 |
| RI | POINT JUDITH | GC | Average vessel length | 57 | 57 | 57 | 56 | 56 | 55 | 54 | 62 | 64 | 63 | 62 |
| RI | POINT JUDITH | GC | Average gross tonnage | 71 | 70 | 70 | 67 | 66 | 66 | 65 | 83 | 90 | 87 | 82 |
| RI | POINT JUDITH | GC | Number of permits | 60 | 61 | 69 | 72 | 73 | 75 | 87 | 26 | 30 | 30 | 30 |
| NJ | POINT PLEASANT | LA | Average vessel length | 88 | 82 | 82 | 82 | 82 | 82 | 82 | 76 | 71 | 72 | 66 |
| NJ | POINT PLEASANT | LA | Average gross tonnage | 124 | 116 | 116 | 116 | 116 | 116 | 116 | 106 | 96 | 96 | 78 |
| NJ | POINT PLEASANT | LA | Number of permits | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 7 | 6 | 6 |
| NJ | POINT PLEASANT | GC | Average vessel length | 46 | 47 | 49 | 54 | 52 | 58 | 62 | 76 | 69 | 77 | 75 |
| NJ | POINT PLEASANT | GC | Average gross tonnage | 39 | 41 | 41 | 51 | 50 | 60 | 68 | 97 | 84 | 102 | 98 |
| NJ | POINT PLEASANT | GC | Number of permits | 22 | 26 | 24 | 30 | 34 | 36 | 37 | 14 | 20 | 15 | 16 |
| NJ | POINT PLEASANT BEACH | LA | Average vessel length | 71 | 71 | 71 | 71 | 71 | 75 | 79 | 81 | 79 | 79 | 76 |
| NJ | POINT PLEASANT BEACH | LA | Average gross tonnage | 134 | 134 | 134 | 134 | 134 | 142 | 149 | 145 | 149 | 149 | 135 |
| NJ | POINT PLEASANT BEACH | LA | Number of permits | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 3 |
| NJ | POINT PLEASANT BEACH | GC | Average vessel length | 32 | 44 | 40 | 40 | 56 | 60 | 70 | 71 | 62 | 62 | 57 |
| NJ | POINT PLEASANT BEACH | GC | Average gross tonnage | 10 | 30 | 26 | 26 | 52 | 55 | 91 | 81 | 56 | 56 | 49 |
| NJ | POINT PLEASANT BEACH | GC | Number of permits | 1 | 3 | 3 | 3 | 3 | 4 | 4 | 2 | 3 | 3 | 4 |
| VA | SEAFORD | LA | Average vessel length | 83 | 83 | 84 | 84 | 86 | 87 | 87 | 87 | 87 | 84 | 83 |
| VA | SEAFORD | LA | Average gross tonnage | 141 | 141 | 147 | 147 | 148 | 142 | 145 | 145 | 148 | 143 | 143 |
| VA | SEAFORD | LA | Number of permits | 2 | 2 | 4 | 4 | 4 | 6 | 5 | 5 | 6 | 7 | 12 |
| VA | SEAFORD | GC | Average vessel length | | | | | | 50 | 35 | | | | |
| VA | SEAFORD | GC | Average gross tonnage | | | | | | 48 | 26 | | | | |
| VA | SEAFORD | GC | Number of permits | | | | | | 1 | 2 | | | | |
| CT | STONINGTON | LA | Average vessel length | 85 | 86 | 81 | 81 | 81 | 77 | 76 | 80 | 80 | 80 | 80 |
| CT | STONINGTON | LA | Average gross tonnage | 193 | 194 | 168 | 168 | 168 | 154 | 140 | 158 | 158 | 158 | 158 |
| CT | STONINGTON | LA | Number of permits | 2 | 4 | 7 | 7 | 7 | 4 | 5 | 4 | 4 | 4 | 4 |
| CT | STONINGTON | GC | Average vessel length | 45 | 45 | 42 | 42 | 42 | 43 | 45 | 49 | 45 | 38 | 48 |
| CT | STONINGTON | GC | Average gross tonnage | 33 | 32 | 24 | 24 | 25 | 28 | 31 | 42 | 39 | 29 | 44 |
| CT | STONINGTON | GC | Number of | 24 | 25 | 24 | 33 | 40 | 36 | 27 | 4 | 6 | 4 | 2 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | permits | | | | | | | | | | | | |
| NC | WANCHESE | LA | Average vessel length | 79 | 78 | 80 | 81 | 81 | 81 | 81 | 81 | 81 | 81 | 81 |
| NC | WANCHESE | LA | Average gross tonnage | 143 | 145 | 151 | 152 | 152 | 151 | 151 | 151 | 151 | 151 | 151 |
| NC | WANCHESE | LA | Number of permits | 8 | 7 | 7 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 |
| NC | WANCHESE | GC | Average vessel length | 65 | 59 | 57 | 55 | 54 | 54 | 54 | 61 | 70 | 57 | 64 |
| NC | WANCHESE | GC | Average gross tonnage | 91 | 75 | 67 | 64 | 63 | 63 | 62 | 77 | 102 | 77 | 88 |
| NC | WANCHESE | GC | Number of permits | 14 | 18 | 22 | 28 | 32 | 30 | 28 | 3 | 6 | 8 | 7 |

## 1.1 APPENDIX II – ECONOMIC MODEL

### 1.1.1 ESTIMATION OF PRICES, COSTS, PROFITS AND NATIONAL BENEFITS

The economic model includes an ex-vessel price equation, a cost function and a set of equations describing the consumer and producer surpluses. The ex-vessel price equation is used in the simulation of the ex-vessel prices, revenues, and consumer surplus along with the landings and average meat count from biological projections. The cost function is used for projecting harvest costs and thereby for estimating the producer benefits as measured by the producer surplus. The set of equations also includes the definition of the consumer surplus, producer surplus, profits to vessels, and total economic benefits.

### 1.1.2 Estimation of annual ex-vessel prices

Fish prices constitute one of the important channels through which fishery management actions affect fishing revenues, vessel profits, consumer surplus, and net economic benefits for the nation. The degree of change in ex-vessel price in response to a change in variables affected by management, i.e., scallop landings and meat count, is estimated by a price model, which also takes into account other important determinants of price, such as disposable income of consumers and price of imports.

Given that there could be many variables that could affect the price of scallops, it is important to identify the objectives in price model selection for the purposes of cost-benefit analyses. These objectives (in addition to developing a price model with sound statistical properties) are as follows:

- To develop a price model that uses inputs of the biological model and available data. Since the biological model projects annual (rather than monthly) landings, the corresponding price model should be estimated in terms of annual values.
- To select a price model that will predict prices within a reasonable range without depending on too many assumptions about the exogenous variables. For example, the import price of scallops from Japan could impact domestic prices differently than the price of Chinese imports, but making this separation in a price model would require prediction about the future import prices from these countries. This in turn would complicate the model and increase the uncertainty regarding the future estimates of domestic scallop prices.

In addition to the changes in size composition and landings of scallops, other determinants of ex-vessel price include level of imports, import price of scallops, disposable income of seafood consumers, and the demand for U.S. scallops by other countries. The main substitutes of sea scallops are the imports from Canada, which are almost identical to the domestic product, and imports from other countries, which are generally smaller in size and less expensive than the domestic scallops. An exception is the Japanese imports, which have a price close to the Canadian imports and could be a close substitute for the domestic scallops as well.

The ex-vessel price model estimated below includes the price, rather than the quantity of imports as an explanatory variable, based on the assumption that the prices of imports are, in general,

determined exogenously to the changes in domestic supply. This is equivalent to assuming that the U.S. market conditions have little impact on the import prices. An alternative model would estimate the price of imports according to world supply and demand for scallops, separating the impacts of Canadian and Japanese imports from other imports since U.S. and Canadian markets for scallops, being in proximity, are highly connected and Japanese scallops tend to be larger and closer in quality to the domestic scallops. The usefulness of such a simultaneous equation model is limited for our present purposes, however, since it would be almost impossible to predict how the landings, market demand, and other factors such as fishing costs or regulations in Canada or Japan and in other exporting countries to the U.S. would change in future years.

Since the average import price is equivalent to a weighted average of import prices from all countries weighted by their respective quantities, the import price variable takes into account the change in composition of imports from Canadian scallops to less expensive smaller scallops imported from other countries. This specification also prevents the problem of multi-colinearity among the explanatory variables, i.e., prices of imports from individual countries and domestic landings. In terms of prediction of future ex-vessel prices, this model only requires assignment of a value for the average price of imports, without assuming anything about the composition of imports, or the prices and the level of imports from individual countries. The economic impact analyses of the fishery management actions usually evaluate the impact on ex-vessel prices by holding the average price of imports constant. The sensitivity of the results affected by declining or increasing import prices could also be examined, however, using the price model presented in this section.

The price model presented below estimates annual average scallop ex-vessel price by market category (PEXMRKT) as a function of

- Meat count (MCOUNT)
- Average price of all scallop imports (PIMPORT)
- Per capita personal disposable income (PCDPI)
- Total annual landings of scallop minus exports (SCLAND-SCEXP)
- Percent share of landings by market category in total landings (PCTLAND)
- A dummy variable as a proxy for price premium for Under 10 count scallops (DU10).
- Dummy variables for 2005 and 2010 to take into account the problems with the Japanese aquaculture in those years that reduced the supply of large scallops from this country and increased the demand for US sea scallops.
- A dummy variable for 2010 as a proxy

Because the data on scallop landings and revenue by meat count categories were mainly collected since 1998 through the dealers' database, this analysis included the 1999-2011 period. All the price variables were corrected for inflation and expressed in 2011 prices by deflating current levels by the consumer price index (CPI). The ex-vessel prices are estimated in semi-log form to restrict the estimated price to positive values only as follows:

Log (PEXMRKT) = f(MCOUNT, PIMPORT, PCDPI, SCLAND-SCEXP, PCTLAND, DU10, D2005, D2010)

The coefficients of this model are shown in Table 1. Adjusted R2 indicates that changes in meat count, composition of landings by size of scallops, domestic landings net of exports, average price of all imports, disposable income, and price premium on under 10 count scallops and 2005 and 2010 dummy variables explain about 75 percent of the variation in ex-vessel prices by market category.

**Table 1. Regression results for price model**

| Regression Statistics | |
|---|---|
| R Square | 0.7697 |
| Adjusted R Square | 0.7467 |
| Observations | 89 |

**Table 2. Coefficients of the Price Model**

| Variables | Coefficients | Standard Error | t Stat |
|---|---|---|---|
| INTERCEPT | 0.7043 | 0.41678 | 1.69 |
| MCOUNT | -0.00441 | 0.00118 | -3.74 |
| PIMPORT | 0.13216 | 0.04359 | 3.03 |
| PCDPI | 0.02547 | 0.00773 | 3.3 |
| SCLAND-SCEXP | -0.00131 | 0.00458 | -0.29 |
| DU10 | 0.07795 | 0.04863 | 1.6 |
| PCTLAND | -0.17497 | 0.09234 | -1.89 |
| d05 | 0.21204 | 0.05374 | 3.95 |
| d10 | 0.16506 | 0.05156 | 3.2 |

These numerical results should be interpreted with caution, however, since the analysis covers only 10 years of annual data from a period during which the scallop fishery underwent major changes in management policy including area closures, controlled access, and rotational area management.

### 1.1.3 Estimation of trip costs

### 1.1.4 Trip Costs

Data for variable costs, i.e., trip expenses include food, fuel, oil, ice, water and supplies. The trip costs per day-at-sea (ffiwospda) is postulated to be a function of vessel crew size (CREW), vessel size in gross tons (GRT), fuel prices (FUELP), and dummy variables for trawl (TRW) and small dredge (DFT) vessels. This cost equation was assumed to take a double-

logarithm form and estimated with data obtained from observer database. The empirical equation presented in Table 3 estimated more than 52% of the variation in trip costs and has proper statistical properties using the observer data from 1991 to 2011 for the limited access vessels. Table 4 shows the estimated trip cost equation for the general category vessels.

**Table 3. Estimation of total trip costs per DAS used for the limited access vessels**

Number of Observations Used 737

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 7 | 65.64625 | 9.37804 | 115.43 | <.0001 |
| Error | 729 | 59.22687 | 0.08124 | | |
| Corrected Total | 736 | 124.87312 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 0.28503 | R-Square | 0.5257 |
| Dependent Mean | 7.38478 | Adj R-Sq | 0.5211 |
| Coeff Var | 3.85974 | | |

Parameter Estimates

| Variable | DF | Parameter Estimate | Standard Error | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | 3.52415 | 0.46519 | 7.58 | <.0001 |
| lngrt | 1 | 0.17117 | 0.05258 | 3.26 | 0.0012 |
| lncrew | 1 | 0.33820 | 0.11947 | 2.83 | 0.0048 |
| lnfuelpr | 1 | 0.87065 | 0.03487 | 24.97 | <.0001 |
| DFT | 1 | -0.27185 | 0.04461 | -6.09 | <.0001 |
| lnlpue | 1 | -0.08526 | 0.02310 | -3.69 | 0.0002 |
| TRW | 1 | -0.08347 | 0.07383 | -1.13 | 0.2586 |
| lnlen | 1 | 0.50159 | 0.12508 | 4.01 | <.0001 |

**Table 4. Estimation of total trip costs per DAS used for the limited access vessels**

Number of Observations Used 354

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 5 | 87.10877 | 17.42175 | 189.37 | <.0001 |
| Error | 348 | 32.01539 | 0.09200 | | |
| Corrected Total | 353 | 119.12416 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 0.30331 | R-Square | 0.7312 |
| Dependent Mean | 7.16597 | Adj R-Sq | 0.7274 |
| Coeff Var | 4.23267 | | |

Parameter Estimates

| Variable | DF | Parameter Estimate | Standard Error | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | 1.70875 | 0.50105 | 3.41 | 0.0007 |
| lngrt | 1 | 0.15862 | 0.04007 | 3.96 | <.0001 |

| | | | | | |
|---|---|---|---|---|---|
| lnlen | 1 | 0.64666 | 0.14805 | 4.37 | <.0001 |
| lncrew | 1 | 0.47231 | 0.07295 | 6.47 | <.0001 |
| lnfuelpr | 1 | 0.63481 | 0.06969 | 9.11 | <.0001 |
| lnlpue | 1 | 0.07744 | 0.03042 | 2.55 | 0.0113 |

### 1.1.5 Estimation of fixed costs

The fixed costs include those expenses that are not usually related to the level of fishing activity or output. These are insurance, maintenance, license, repairs, office expenses, professional fees, dues, taxes, utility, interest, communication costs, association fees and dock expenses. According to the observer data on fixed costs for the period 2001 to 2007, the fixed costs including maintenance, repairs, engine and gear replacement and hull and liability insurance averaged $162,000 per full-time vessel (Table 5). Table 6 shows that fixed costs of the vessels varies by the ton class and larger vessels have higher fixed costs than the smaller boats. Fixed costs for years after 2007 will be updated after NMFS completes 2012 Cost Survey.

**Table 5. Annual fixed costs for full-time limited access scallop vessels by year (in 2006 inflation-adjusted prices and includes only those observations for insurance cost was available)**

| Data | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2001-2007 |
|---|---|---|---|---|---|---|---|---|
| Number of vessels | 7 | 20 | 36 | 50 | 40 | 24 | 39 | 216 |
| Maintenance ($) | 96,659 | 52,308 | 79,108 | 49,953 | 69,048 | 91,045 | 38,717 | 63,452 |
| Repairs and replacement ($) | 86,912 | 65,400 | 81,452 | 73,349 | 44,287 | 38,714 | 33,414 | 58,283 |
| Insurance ($) | 40,980 | 35,127 | 60,501 | 57,117 | 61,933 | 65,896 | 62,129 | 57,941 |
| Total fixed costs ($ ) | 224,552 | 141,719 | 206,304 | 155,711 | 159,542 | 171,252 | 122,631 | 161,819 |
| GRT | 148 | 156 | 157 | 156 | 156 | 144 | 150 | 153 |
| HP | 876 | 799 | 832 | 825 | 813 | 792 | 840 | 822 |

**Table 6. Annual fixed costs of full-time limited access scallop vessels by ton class (2006 inflation adjusted prices, including only those observations for which insurance data were available)**

| Data | 51-100 GRT | 101-150 GRT | >150 | Average (2001-07) |
|---|---|---|---|---|
| Number of vessels | 18 | 75 | 123 | 216 |
| GRT | 75 | 129 | 180 | 153 |
| HP | 461 | 690 | 957 | 822 |
| Maintenance ($) | 32,657 | 60,145 | 70,585 | 63,452 |
| Repairs ($) | 26,152 | 47,860 | 70,255 | 58,283 |
| Insurance ($) | 46,784 | 48,615 | 65,295 | 57,941 |
| Total fixed cost ($) | 100,780 | 142,482 | 182,652 | 161,819 |
| Ratio of fixed costs to the average for the fleet | 0.62 | 0.88 | 1.13 | 1.0 |

The 2006 and 2007 fixed cost survey data included other cost items such as office, accounting, and interest payments in addition to the repairs, maintenance and insurance.

The model shown in Table 7 is based on the fixed cost survey data and estimates fixed costs as a function of length, year built, horse power and a dummy variable for boats that have multispecies permit. The data included 196 observations and the fixed costs are estimated by using the 97 observations for vessels with dredge and trawl gear. Because the data on communications costs and association fees were missing for most observations, these costs were not included in the estimation but their average values for the scallop vessels were deducted from the gross stock when estimating net boat and crew shares (Table 8).

**Table 7. Estimation of basic fixed costs**

GMM with HCCME=1 235

The MODEL Procedure

Nonlinear GMM Summary of Residual Errors

| Equation | DF Model | DF Error | SSE | MSE | Root MSE | R-Square | Adj R-Sq | Durbin Watson |
|---|---|---|---|---|---|---|---|---|
| lnfcbasic | 5 | 92 | 15.8206 | 0.1720 | 0.4147 | 0.7283 | 0.7165 | 2.2736 |

Nonlinear GMM Parameter Estimates

| Parameter | Estimate | Approx Std Err | t Value | Approx Pr > \|t\| |
|---|---|---|---|---|
| intc | -242.988 | 65.7063 | -3.70 | 0.0004 |
| lenco | 1.588635 | 0.1986 | 8.00 | <.0001 |
| bltco | 32.51993 | 8.6562 | 3.76 | 0.0003 |
| d10co | -0.51566 | 0.1039 | -4.96 | <.0001 |
| hpco | 0.168211 | 0.1174 | 1.43 | 0.1554 |

| Number of Observations | | Statistics for System | |
|---|---|---|---|
| Used | 97 | Objective | 2.3E-18 |

**Table 8. Average association fee and communication costs by vessel size**

| | Average annual association fee | Average annual Communication Costs |
|---|---|---|
| All Vessels | 1610 | 3446 |
| Large (>=80 feet) | 1895 | 3939 |
| Medium (<80 feet) | 1459 | 3185 |

Using the survey cost data, total fixed costs are estimated to be $176,516 per full-time vessel in 2006 constant dollars and $188,343 in 2008 dollars (Table 9). These estimates exclude vessel improvement costs (other than repairs and maintenance) which could be considered as discretionary investment and could be postponed when there is a temporary shortfall in cash earnings. Using this survey data information for the estimated value for fixed costs for 2011, i.e., $191,167 and assuming a vessel share for 48% of gross revenue, it could be estimated that in order to cover the fixed costs in full, a vessel has to earn a gross revenue of $398,264 (break-even revenue) any amount above that would egnerate profits. If instead average fixed costs were equal to the averages values ($161,819, Table 5), estimated from the observer data for 2001-2007, then adjusting this value for 2011 would result in a total fixed cost of $180,424 and a break-even revenue of $376,313.

**Table 9. Estimated fixed costs per full-time vessel**

| Data | 2007 | In 2011 Inflation adjusted prices |
|---|---|---|
| Estimated basic fixed costs | $176,516 | $191,167 |
| Improvement Costs (Difference) | $50,023 | $54,175 |

### 1.1.6 Profits and crew incomes

As it is well known, the net income and profits could be calculated in various ways depending on the accounting conventions applied to gross receipts and costs. The gross profit estimates used in the economic analyses in the FSEIS simply show the difference of gross revenue over variable (including the crew shares) and fixed expenses rather than corresponding to a specific accounting procedure. It is in some ways similar to the net income estimated from cash-flow statements since depreciation charges are not subtracted from income because they are not out-of-pocket expenses.

Gross profits per vessel are estimated as the boat share (after paying crew shares) minus the fixed expenses such as maintenance, repairs and insurance (hull and liability). Based on the input from the scallop industry members and Dan Georgianna on the lay system, the profits and crew incomes are estimated as follows:

- The association fees, communication costs and a captain bonus of 5% are deducted from the gross stock to obtain the net stock.
- Boat share is assumed to be 48% and the crew share is assumed to be 52% of the net stocks.
- Profits are estimated by deducting fixed costs from the boat share.
- Net crew income is estimated by deducting the trip costs from the crew shares.

### 1.1.7 Consumer surplus

Consumer surplus measures the area below the demand curve and above the equilibrium price. For simplicity, consumer surplus is estimated here by approximating the demand curve between the intercept and the estimated price with a linear line as follows:

CS= (PINT*SCLAN-EXPR*SCLAN)/2

$$PVCS = \sum_{t=2000}^{t=2008} (CS_t /(1+r)^t)$$

Where: r=Discount rate.

$CS_t$= Consumer surplus at year "t" in 1996 dollars.

PVCS= Present value of the consumer surplus in 1996 dollars.

EXPR= Ex-vessel price corresponding to landings for each policy option.
PINT=Price intercept i.e., estimated price when domestic landings are zero.
SCLAN= Sea scallop landings for each policy option.

Although this method may overestimate consumer surplus slightly, it does not affect the ranking of alternatives in terms of highest consumer benefits or net economic benefits.

### 1.1.8 Producer surplus

The producer surplus (PS) is defined as the area above the supply curve and the below the price line of the corresponding firm and industry (Just, Hueth & Schmitz (JHS)-1982). The supply curve in the short-run coincides with the short-run MC above the minimum average variable cost (for a competitive industry). This area between price and the supply curve can then be approximated by various methods depending on the shapes of the MC and AVC cost curves. The economic analysis presented in this section used the most straightforward approximation and estimated PS as the excess of total revenue (TR) over the total variable costs (TVC). It was assumed that the number of vessels and the fixed inputs would stay constant over the time period of analysis. In other words, the fixed costs were not deducted from the producer surplus since the producer surplus is equal to profits plus the rent to the fixed inputs. Here fixed costs include various costs associated with a vessel such as depreciation, interest, insurance, half of the repairs (other half was included in the variable costs), office expenses and so on. It is assumed that these costs will not change from one scenario to another.

PS=EXPR*SCLAN- ΣOPC
ΣOPC = Sum of operating costs for the fleet.

$$PVPS = \sum_{t=2000}^{t=2008} (PS_t / (1+r)^t)$$

Where: r=Discount rate.

$PS_t$= Producer surplus at year "t" in 1996 dollars.
PVPS= Present value of the producer surplus in 1996 dollars.
SCALN= Sea scallop landings for each policy option.
EXPR= Price of scallops at the ex-vessel level corresponding to landings for each policy option in 1996 dollars.

Producer Surplus also equals to sum of rent to vessels and rent to labor. Therefore, rent to vessels can be estimated as:

RENTVES=PS – CREWSH

Rentves= Quasi rent to vessels
Crewsh= Crew Shares

### 1.1.9 Total economic benefits

Total economic benefits (TOTBEN) is estimated as a sum of producer and consumer surpluses and its value net of status quo is employed to measure the impact of the management alternatives on the national economy.

TOTBEN=PS+CS

Present value of the total benefits= PVTOTBEN= PVPS+PVCS

### 1.1.10 REFERENCES

Daniel Georgianna and Debra Shrader (2005); “Employment, Income and Working Conditions in New Bedford’s Offshore Fisheries”. Final Report for Contract No. NA03NMF4270265, Saltonstall-Kennedy Program, NMFS, June 22, 2005.

Daniel Georgianna, A.Caas and P.Amaral (1999); The Cost of Fishing for Sea Scallops in the Northeastern United States. University of Massachusetts Dartmouth, Cooperative Marine Education and Research Program, NMFS, Contract Number NA67FE0420. December 16, 1999.

Steve Edwards. 2005. Accounting for Rents in the U.S. Atlantic Sea Scallop FisheryMarine Resource Economics, Volume 20, pp. 61–76

## 1.1 APPENDIX III - DEVELOPMENT AND ANALYSIS OF GEORGES BANK ACCESS AREA SEASONAL RESTRICTION ALTERNATIVES IN FRAMEWORK 24

### 1.1.1 Modify GB access area seasonal restrictions

Based on two primary sources of analyses the options in this section were developed. The first source of information is an analysis the Scallop PDT completed using observer data in and around access areas on GB. A generalized linear model (GLM) was developed to estimate bycatch rates by month using observer data from months the access areas have been open and modeling the bycatch rates for months the areas have been closed using data observer data from surrounding open areas.

The second source of information is based on results from a 2011 RSA project titled, "*Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch.*" Fourteen research trips were conducted in both Closed Area I and II from October 2010 through April 2012. Seasonal variations in scallop meat weights and YT flounder bycatch rates were evaluated. The Research Steering Committee reviewed the methods and results for this final report submitted in June 2012 and deemed it sufficient for the PDTs to use in developing management measures, even though additional data will be collected over the next year.

### 1.1.2 Scallop PDT Analysis

The Scallop PDT considered a wide range of information when developing the range of alternatives for the GB access area seasonal closures. First, YT bycatch rates were assessed from NMFS observer data. Second, bycatch rates and YT abundance by month were also evaluated using data from a 2011 RSA project that studied seasonal bycatch patterns in Closed Area I and II. Third, the PDT evaluated seasonal variations in scallop meat weights to identify seasons with the highest meat weights. The sections below summarize the various analyses and general conclusions.

#### 1.1.2.1 Spatial and temporal bycatch rates from observer data

The PDT evaluated monthly bycatch rates in CA1, CA2 and NL from all available observer data (1999-2011). These areas have always been closed to the scallop fishery between February 1 and June 14, so there are no observed trips for those months. The PDT decided to address this issue two ways: 1) develop a model to estimate bycatch rates for the months with no data points; and 2) calculate bycatch rates for missing data points with observer data from surrounding areas during the months the areas were closed. In addition, the PDT also explored using monthly bycatch rate data from a 2011 RSA funded project that estimated bycatch rates for several important bycatch species in Closed Area I and II. Ultimately, the model results were blended with bycatch rates from surrounding areas to "fill in" the months with no observer data points.

A generalized linear model (GLM) was developed to address the month and year effects observed from the data. The model estimated a mean d:k ratio by month and year for each area. Figure 1 has the model outputs by month and year including the variance for Closed Area II, I and Nantucket Lightship for the months with data. The PDT also explored estimating a d:k ratio for the months these areas have been closed using observer data from surrounding areas. For Georges Bank all observed trips within the YT stock area were combined (statistical areas 522, 525, 561 and 562 – including CA1 and CA2 observed trips). Input data varies based on the access area schedule, but the raw data suggests that d:k ratios were highest in 1999 and 2000, years with high effort levels in Closed Area II, and the months of June and July compared to other months during the year (Figure 2).

**Figure 1 – Discard to Kept ratio for yellowtail flounder:scallop catch by month and year for Closed Area II, Closed Area I and Nantucket Lightship using all observer data (1999-2011)**

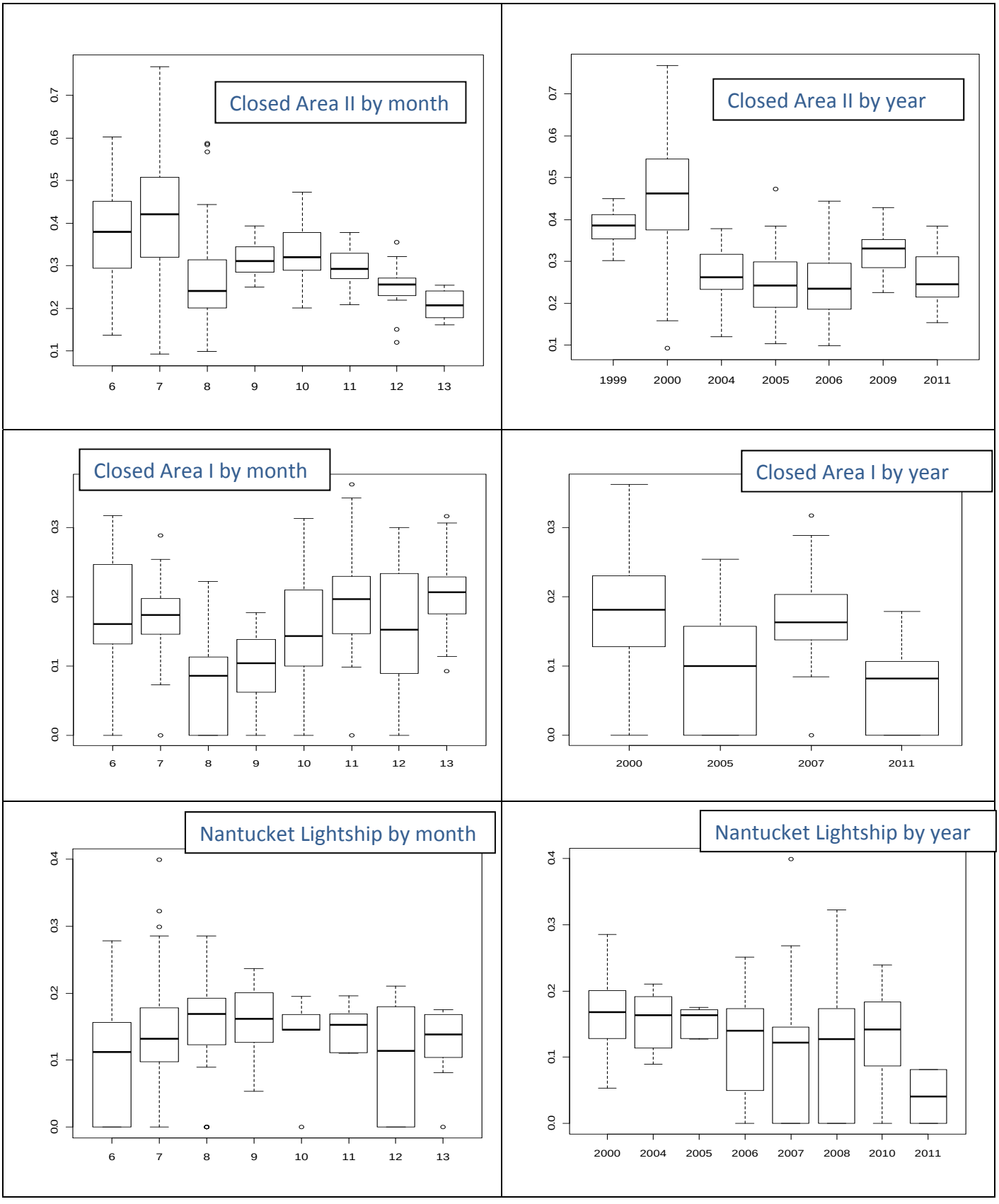
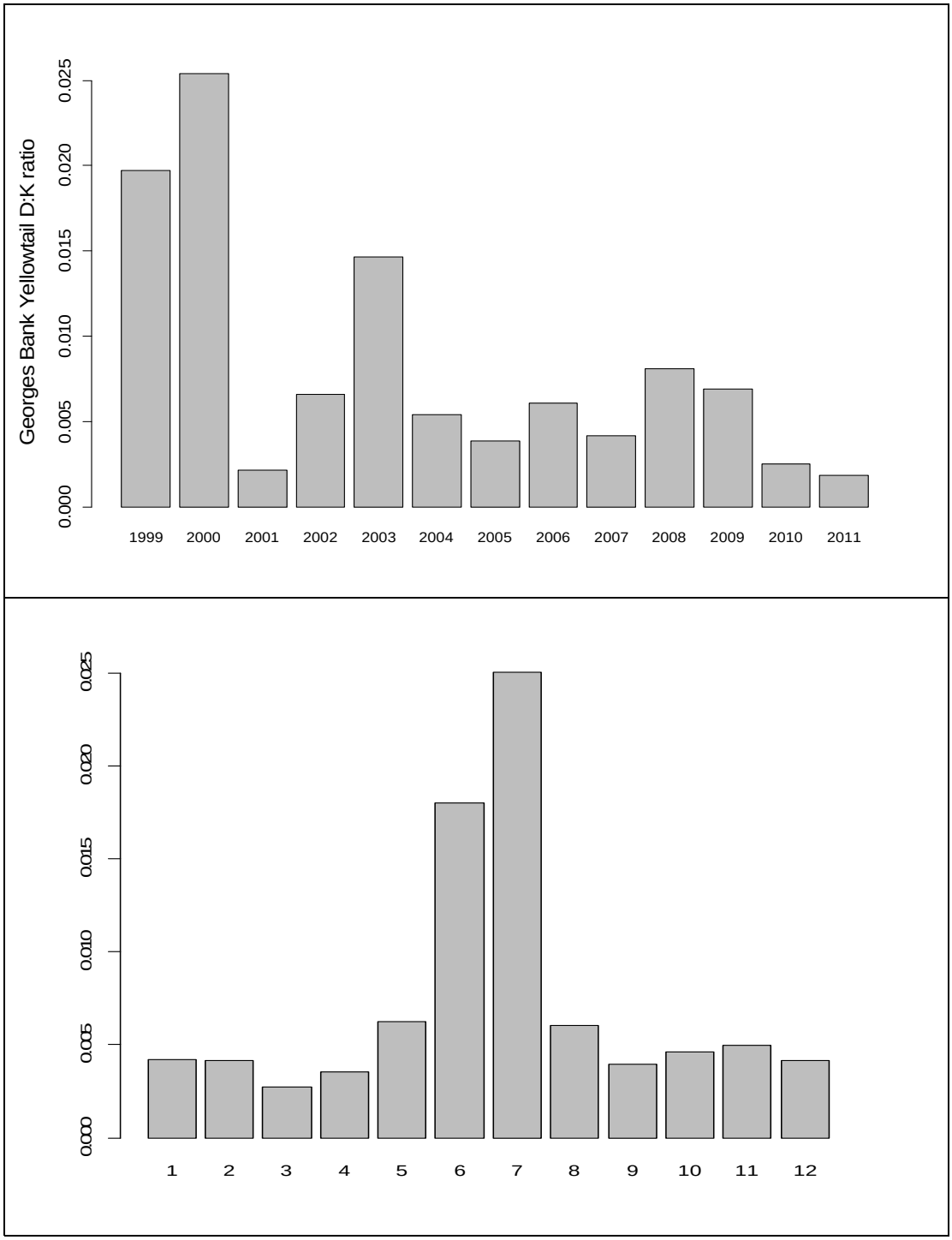


**Figure 2 – D:K ratios for yellowtail flounder in the scallop fishery from all observed trips within the GB YT stock area (1999-2011)**



#### 1.1.2.1.1 Results

- *Closed Area II*

The analyses from observer data within the closed areas only suggests that for Closed Area 2 bycatch rates are highest in October and lowest in May-July. For Closed Area II the model suggests a strong year effect with tight error bars: highest bycatch rates in 2001 and 2009 and lowest rates in 2005 and 2006 (Figure 3). The model suggests an increase in bycatch rate as the season progresses (depletion effect) but the error bars are relatively large later in the season when the number of observed trips declines and data points are fewer, so these findings are not very compelling (Figure 4).

For the months the area is open, June 15 – Jan 31, there seems to be a month effect - highest bycatch in October (Figure 5). The model also assessed if there is a location effect within the access area and the results suggest that bycatch is highest in the northwest corner of the access area. The analyses were expanded to include trips in open areas for the months CA2 is closed and this did not add much to the overall conclusion. Similar year effects for the observer data in open areas on southern GB (stat areas 525 and 562 open) (Figure 6). Discard rates slightly higher in the fall and lowest in July, but many months are uncertain because there is limited data by month in these areas (Figure 7). Based on results from observer data in and around Closed Area II, an earlier opening date and closure in the fall could help reduce YT and improve scallop yield.

**Figure 3 – GAM model for observer data in CA2 from 1999-2011 (Year Effect)**

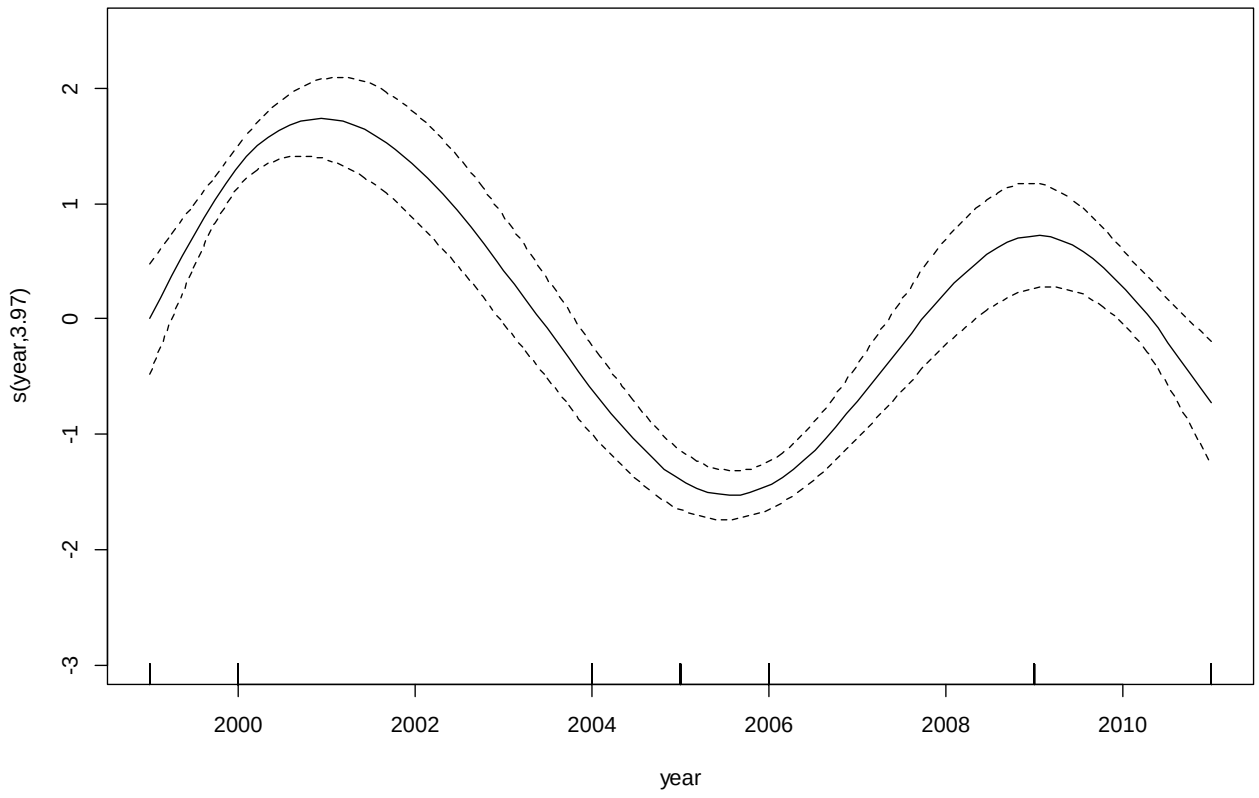


**Figure 4 – GAM model results for CA2 observer data – depletion effect (D:K ratio increases with time after opening)**

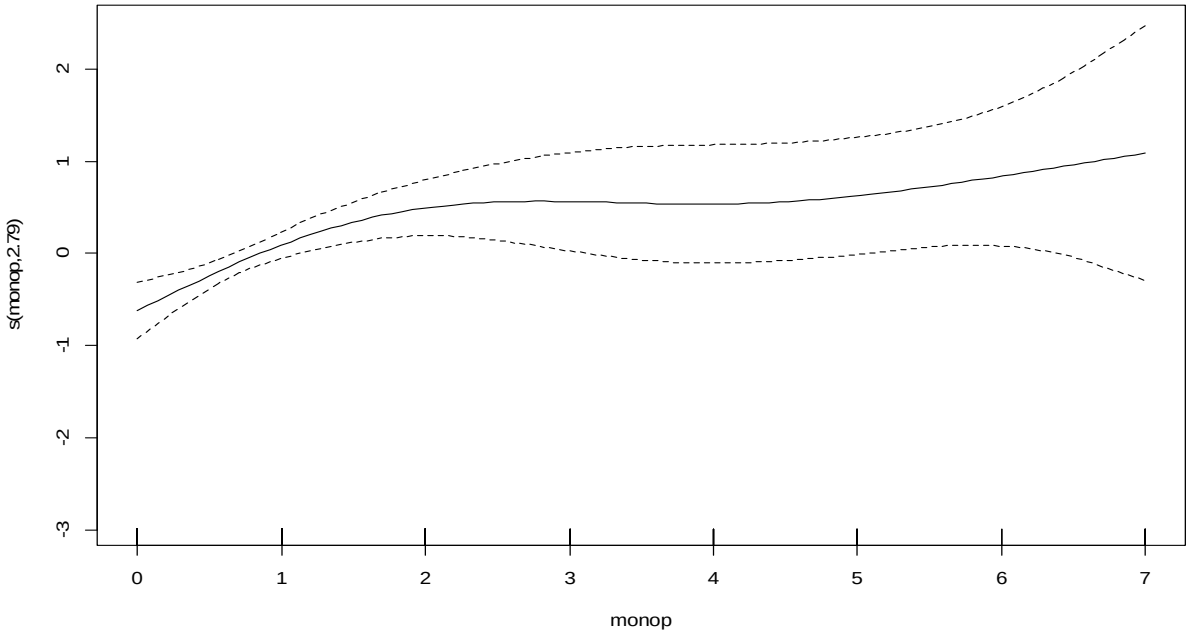



**Figure 5 – GAM model for observer data in CA2 June-January only – month effect**

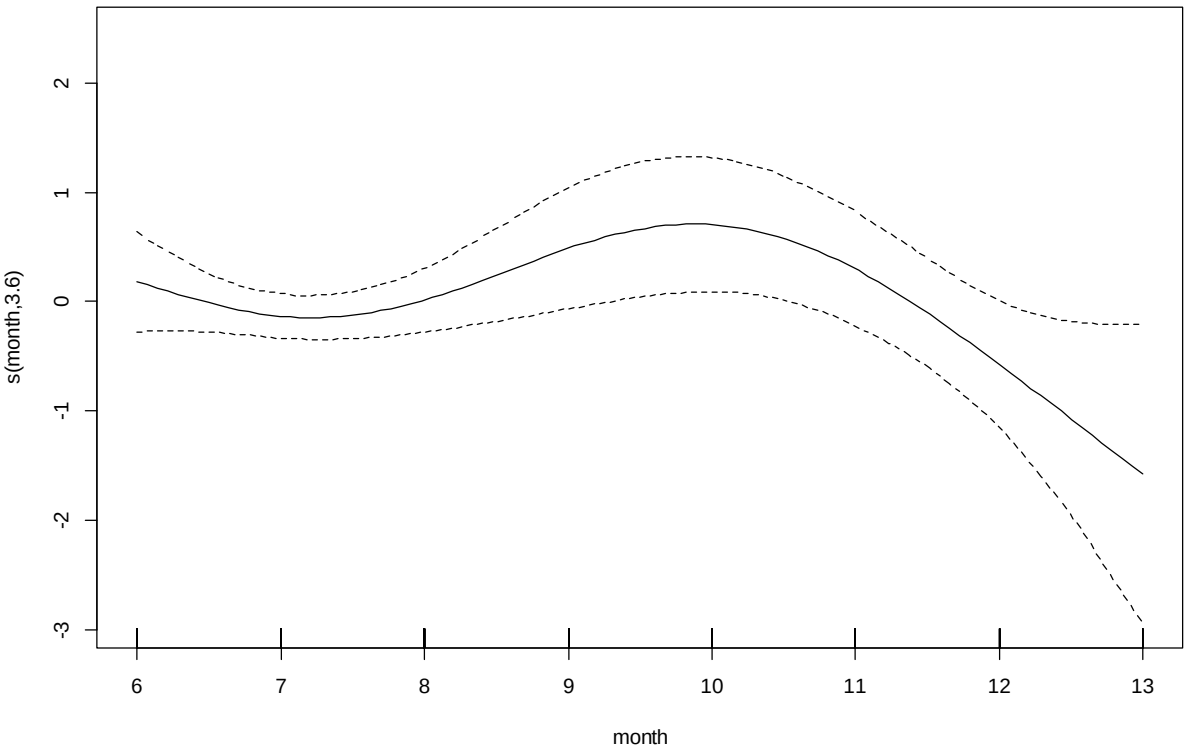


Figure 6 – GAM model for observer data in areas outside of CA2 (southern GB areas 525 and 562) – Year effect

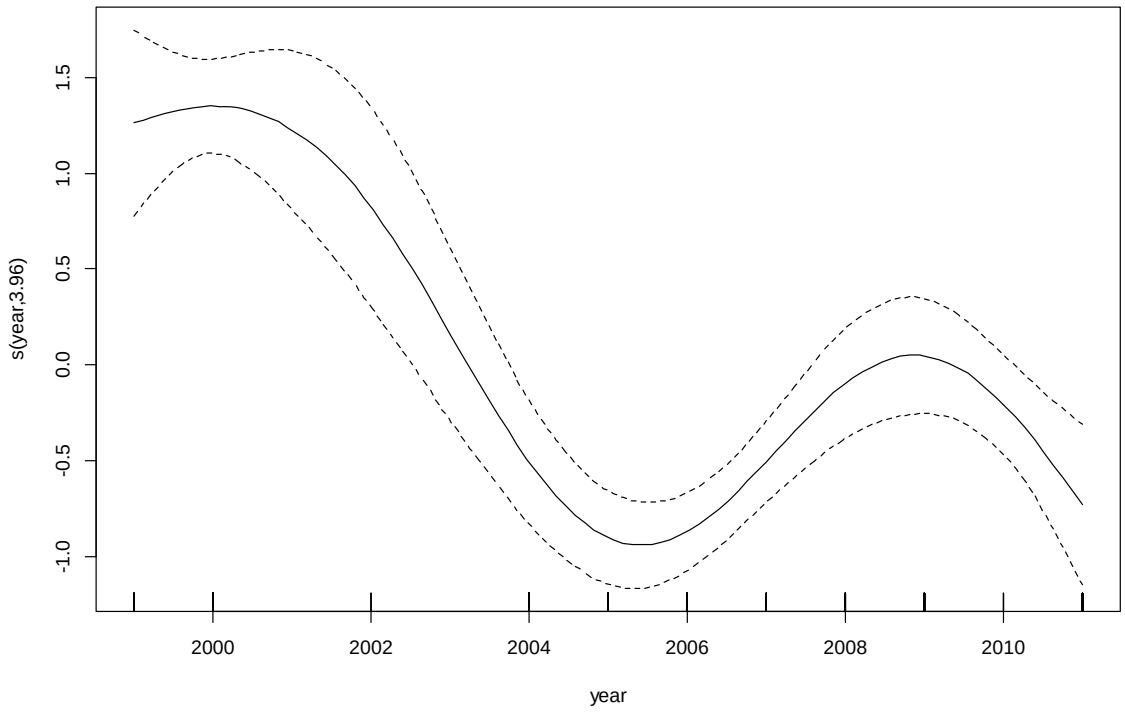
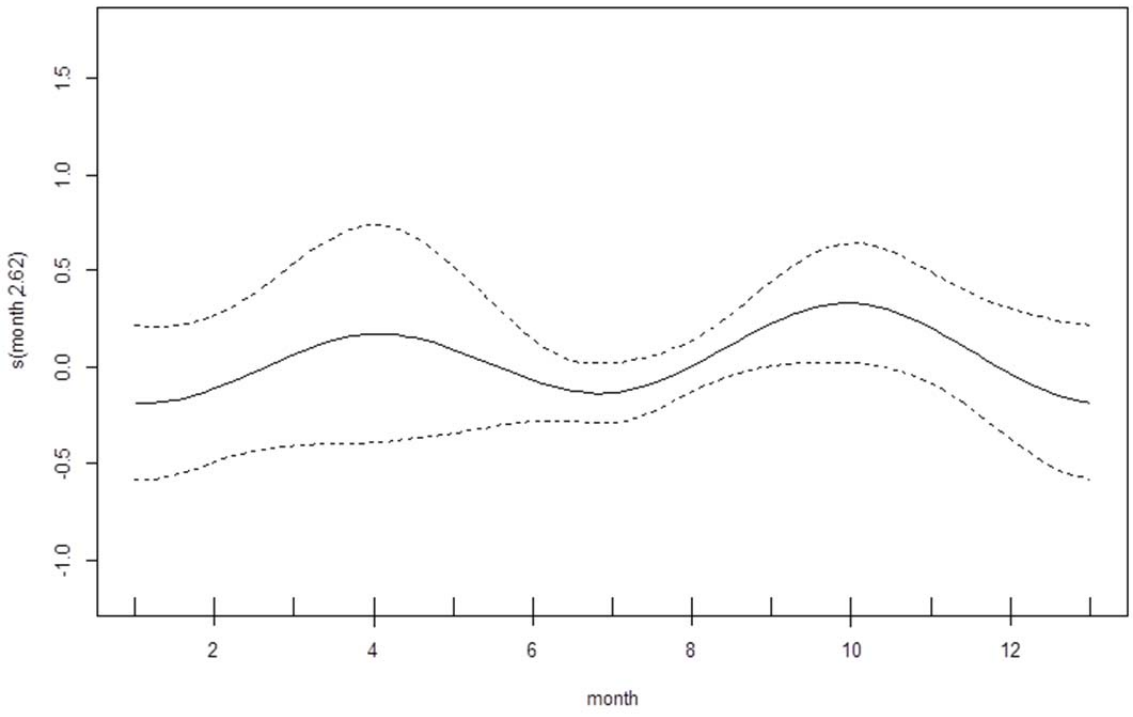


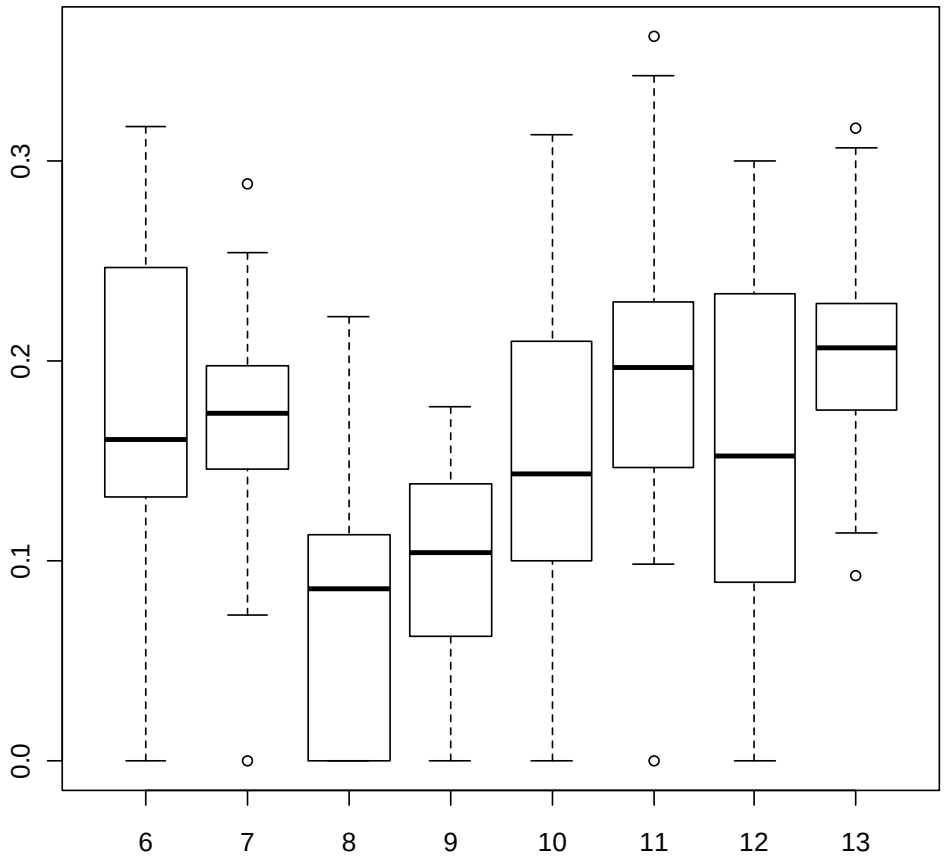

Figure 7 - GAM model for observer data in areas outside of CA2 (southern GB areas 525 and 562) – Month effect



- *Closed Area I*

Moving to Closed Area I, the preliminary results are not as clear. Bycatch rates are much lower overall in CA1 compared to CA2, and there does not seem to be a strong seasonal trend in this area. The months of November and January are the highest, but since overall bycatch is relatively low these results are likely driven more by meat weight variations (Figure 8). The results did not change much when the analyses are expanded to include observer data from surrounding areas (GB open) to populate the months when Closed Area I is closed.

Figure 8 – Box plots of D:K ratios for CA1 observer data by month (June-January only)




- *Nantucket Lightship*

For Nantucket Lightship the observer data from within the area suggests that discard rates highest in late summer (September) but fairly uncertain since there is limited observer coverage during that time of year(Figure 10). NL has had a series of openings and closures during this time series: the area was open in 2000, closed 2001-2003, open in 2004, closed in 2005, open in 2006-2008, closed in 2009, open in 2010, and closed in 2011(Figure 9). Overall the model estimates declines in discard rates as biomass accumulates until 2006 when the area was open for three years in a row with higher bycatch rates from depletion.

When these analyses were expanded with observer data from open areas in SNE for months NL was closed (stat areas 526, 539 and 537) bycatch rates declined over time and only a slight increase in bycatch rates in the fall compared to other months(Figure 11 and Figure 12). The error bars around the SNE observer data are relatively tight starting in 2003 since there is more observer data in all months for this area. Overall, bycatch rates fairly constant by month, especially in open areas, with potential higher rates in August/September from within NL and SNE open areas.

**Figure 9 – GAM model for observer data in NL (2000-2011 when area open) – Year effect**

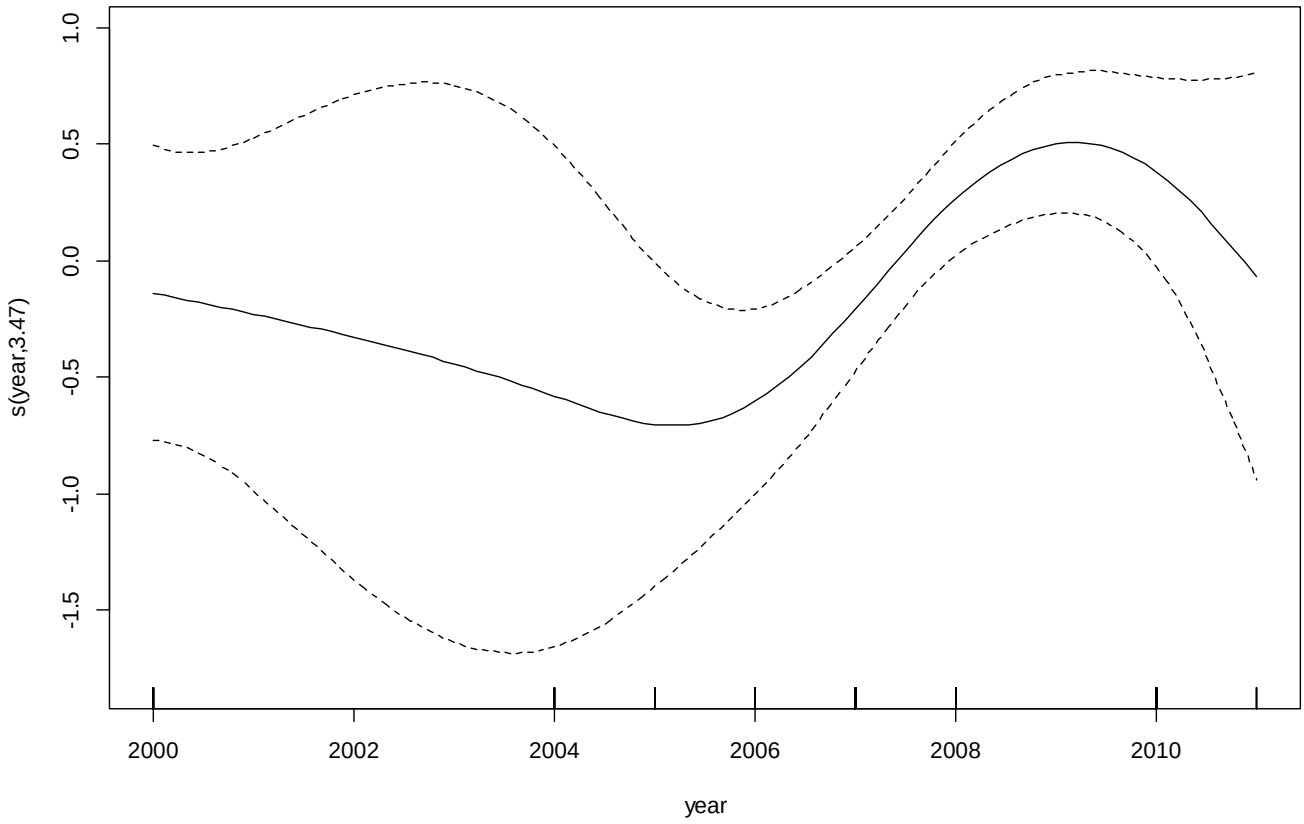


Figure 10 – GAM model for observer data in NL – Month effect

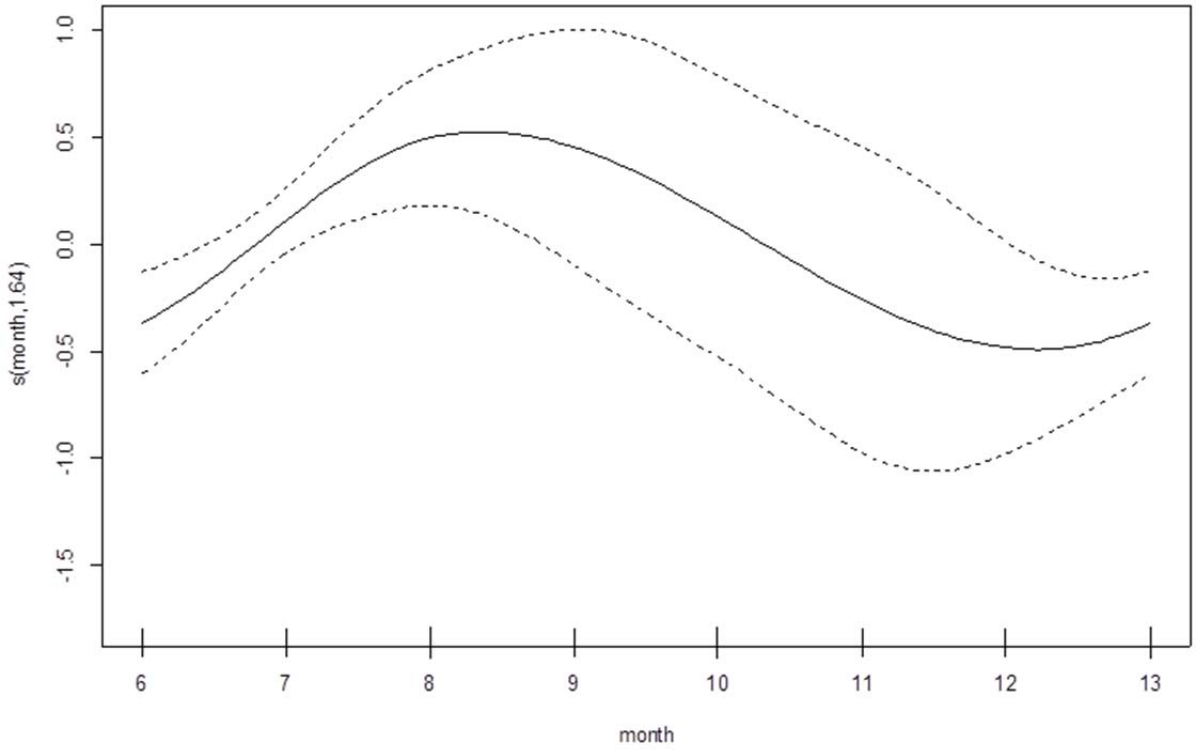



Figure 11 – GAM model for observer data, open areas in SNE (1999-2011) – Year effect

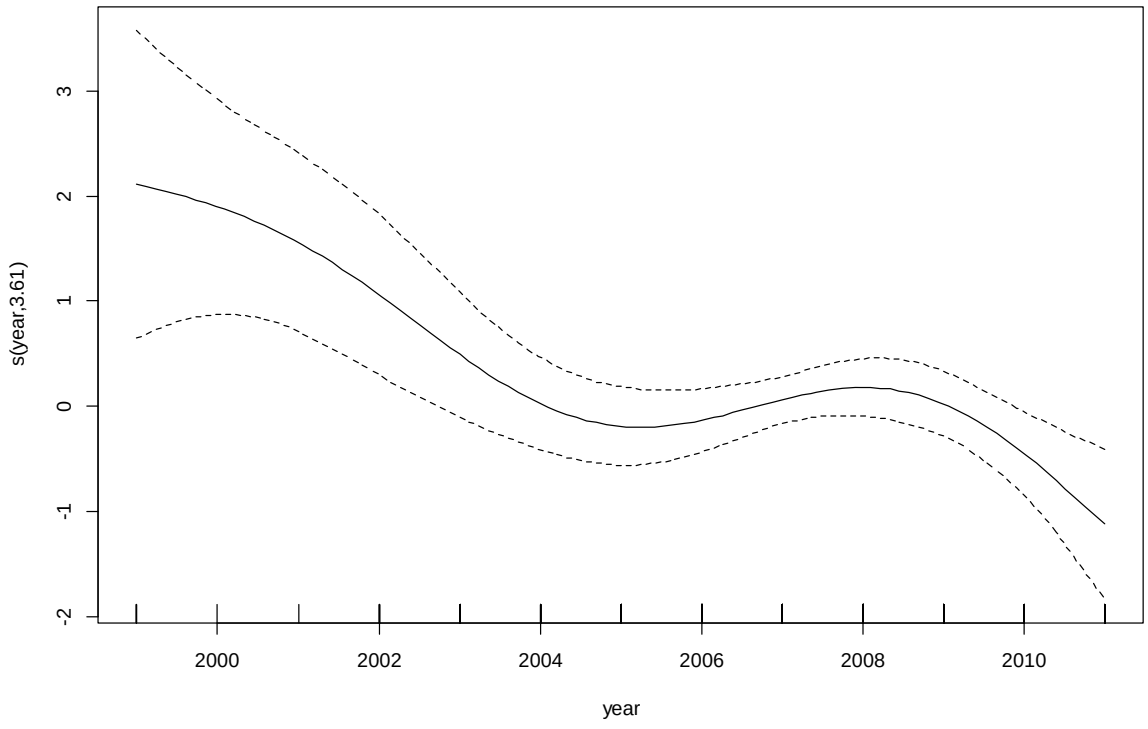
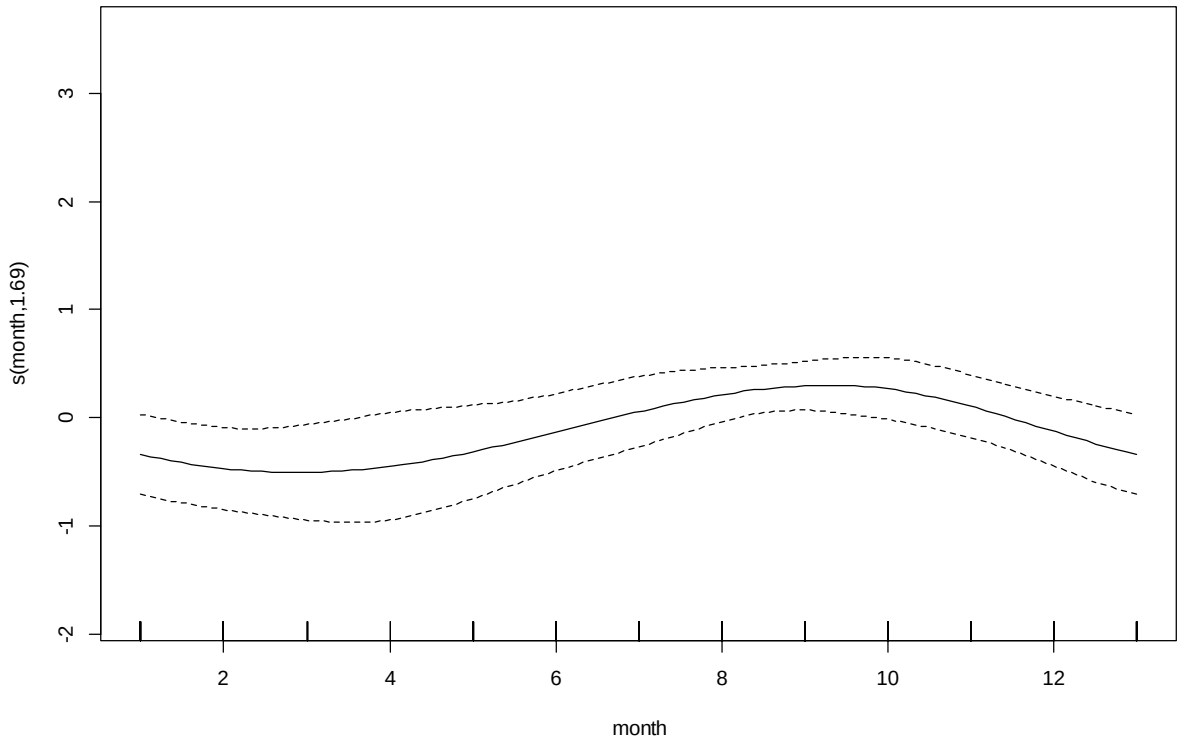


**Figure 12 - GAM model for observer data, open areas in SNE (1999-2011) – Month effect**



#### 1.1.2.2 Results from seasonal bycatch study in CA1 and CA2 (2011 RSA Award)

A 2011 RSA award examined seasonal changes in yellowtail bycatch rates in Closed Area I and II, among other research objectives. The results from that study were reviewed by the NEFMC Research Steering Committee on June 25, 2012. The Committee deemed several relative data sets to be sufficient for PDT use in developing management measures, even though additional data will be collected over the next year.

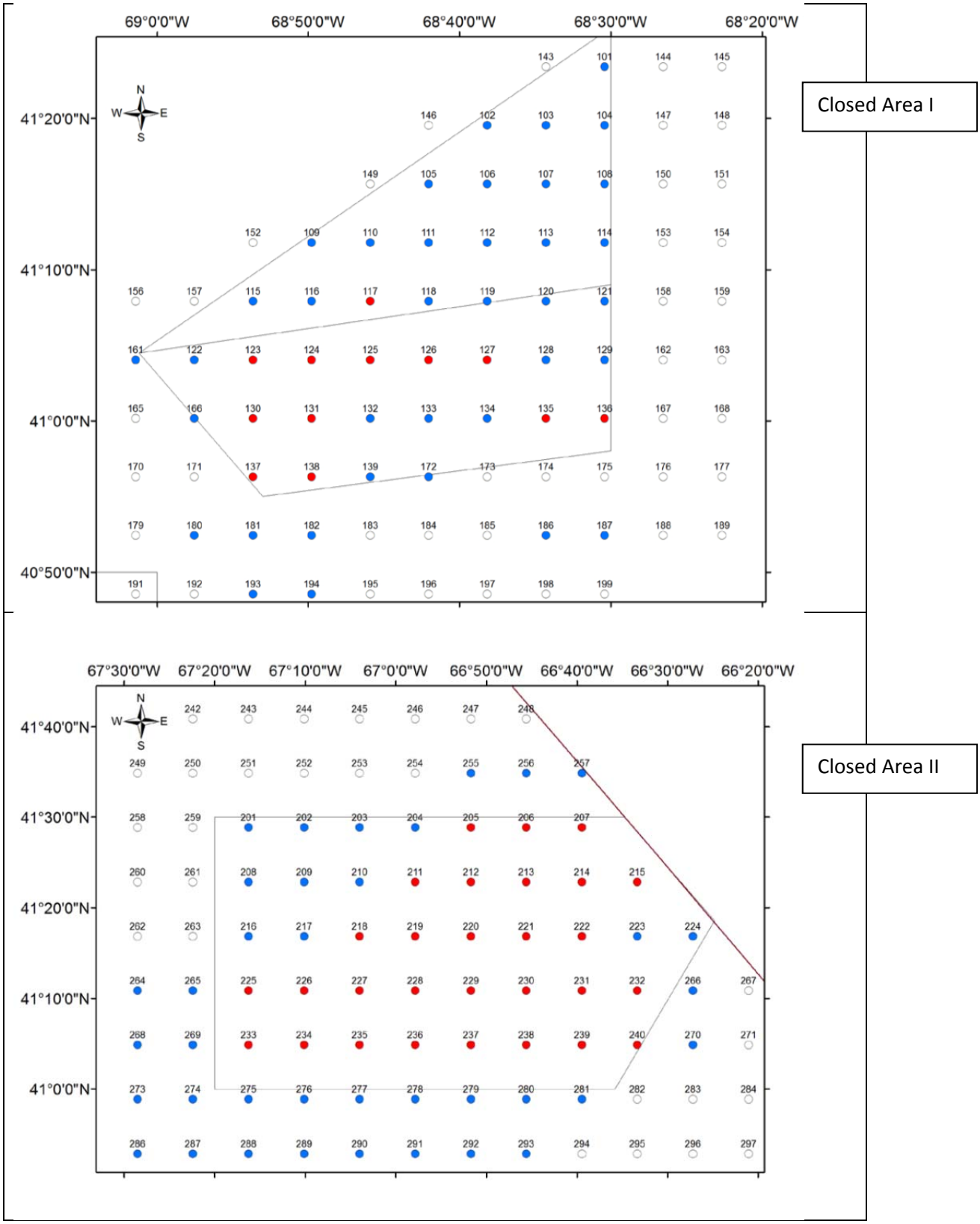
In summary, fourteen research trips have been completed to date on eleven distinct commercial vessels (October 2010, and each month starting in March 2011-April 2012). The researchers also plan to forward results from May and June 2012, which are part of the 2012 RSA project, but are important months to evaluate bycatch rates since those months are before the access areas open on June 15. The project has four overall objectives: 1) quantify seasonal bycatch rates of important bycatch species; 2) characterize fishing gear performance by comparing a turtle deflector dredge to a commercial dredge; 3) biology of important bycatch species including RAMP discard mortality analysis, maturity analysis, and fungal infection analysis; and 4) biology of scallops including seasonal effects on sea scallop reproduction and energetics and growth (scallop shell height: meat weight relationship analysis). For the purposes of this action only several components are directly relative: maturity of bycatch analysis, seasonal scallop growth (shell height:meat weight relationships), and bycatch rate and distribution analysis.

The study is a paired tow grid design with one standard 15-foot wide turtle deflector dredge towed from one side of the vessel that was constant throughout the project, and a second commercial dredge provided by each vessel. The specifications of the various commercial dredges used for each trip is summarized in Table 1. Each trip was about 80 stations, 40 in each closed area, taking approximately seven days per trip. Over the course of the study some stations were dropped that had no YT or scallops, high concentrations of sand dollars, or rocky bottom; and several stations were added outside the access areas. Therefore, the results were presented two ways: a “standardized group” with only stations successfully occupied on all 14 trips inside the access areas, and a second group with all successful stations (Figure 13). Only the results from the standardized group using the turtle deflector dredge were used for the bycatch rate analysis between trips, not the results from the commercial dredge with stations that varied between trips.

**Table 1 – Gear specifications for the vessels that participated in the 2011 Seasonal bycatch study**

| | | Celtic | Westport | Arcturus | Turtle | Liberty | Endeavour | Regulus | Resolution | Ranger | Horizon | Wisdom | Venture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dredge Width (ft) | | 15 | 15 | 15 | 15 | 13 | 15 | 15 | 15 | 15 | 15 | 15 | 13 |
| Pressure Plate Width (inches) | | 8 | 8 | 8 | 8 | 8 | 8 | 9.5 | 8 | 9 | 1.5 | 1 | 8.5 |
| Wheel Diameter (inches) | | 16 | none | 18 | 16 | 17 | 20 | 17 | 23 | 22 | 18 | 8 | 16 |
| Dredge Builder | | Quinn | unknown | Dockside | Dockside | Blue Fleet | Blue Fleet | Blue Fleet | Dockside | Dockside | Dockside | Dockside | Blue Fleet |
| Turtle Chains | # up/downs | | | | | 11 | 13 | 13 | 13 | 14 | 19 | 11 | 18 (trawlex |
| | # ticklers | | | | | 6 | 8 | 10 | 9 | 10 | 9 | 7 | 9 |
| | Chain Link size | | | | | 3/8 | 3/8 | 3/8" | 1/2 | 2.25 in | 3/8 | | 5/8 |
| Bag (Belly) | | 10 x 40 | 9 x 40 | 9 x 40 | 10 x 40 | 9 x 38 | 7 x 40 | 7 x 38 | 10 x 42 | 8 x 38 | 9 x 44 | 10 x 38 | 9 x 36 |
| Apron | | 8 x 40 | 13 x 40 | 10 x 40 | 8 x 40 | 7 x 38 | 8 x 40 | 8 x 38 | 8 x 42 | 7 x 38 | 8 x 44 | 10 x 38 | 7 x 36 |
| Side Piece | | 6 x 17 | 5 x 16 | 5 x 17 | 6 x 17 | 6 x 18 | 5 x 19 | 5 x 25 | 4 x 20 | 5 x 20 | 4 x 44 | 5 x 18 | 5 x 19 |
| Diamond # rings/side | | 14 | 14 | 13 | 14 | 13 | 14 | 13 | 14 | 14 | 15 | 13 | 13 |
| Skirt | | 3 x 38 | 2 x 36 | dog chains | 3 x 38 | | 3 | | | 3 links | 4 x 18 | | 2 links |
| Sweep | # of links | 125 | 121 long | 141 | 125 | 127 | 113 | 105 | 147 | 139 | 149 | 154 | 117 |
| | Link size | | | | | 5/8 | 5/8 | 5/8 | 5/8 | 3 inches | 5/8 | long | 5/8 |
| | Dog chains | | | | | | | 1/4 | | None; shackles | 22 link, 5/8 inch | 1 inch | None; shackles |
| Standard Twine Top | | 7.5 x 60 | 8.5 x 80 | 8.5 x 90 | 8.5 x 60 | 8.5 x 90 | 8.5 x 80 | 7.5 x 43 | 10.5 x 36 | 9 x 33 | 8 x 96 | 11 x 90 | 7.5 x 80 |
| Twine top mesh size (inches) | | 11.5 | 11.5 | 11.5 | 11.5 | 11 | 10.5 | 11 | 11 | 10.5 | 12 | | 10 |

**Figure 13 – Stations in and around the access areas surveyed. Stations occupied successfully on every trip within the access areas in red (standardized group)**



#### 1.1.2.2.1 Summary of maturity results

Maturity data was collected on all valid tows. Fish were sampled using the NEFSC 6-stage maturity technique (Burnett et al. 1989). The level of training varied for scientific crew on each trip, so some results were dropped. For YT over 4,700 fish were measured and staged for maturity. Results indicated a spawning event in the spring peaking in May/June 2011, followed by YT resting until January when they began to develop for next year spawn. See Table 4 and Figures 3-15 of report. The maturity results by month for the YT sampled in this study have been included below in

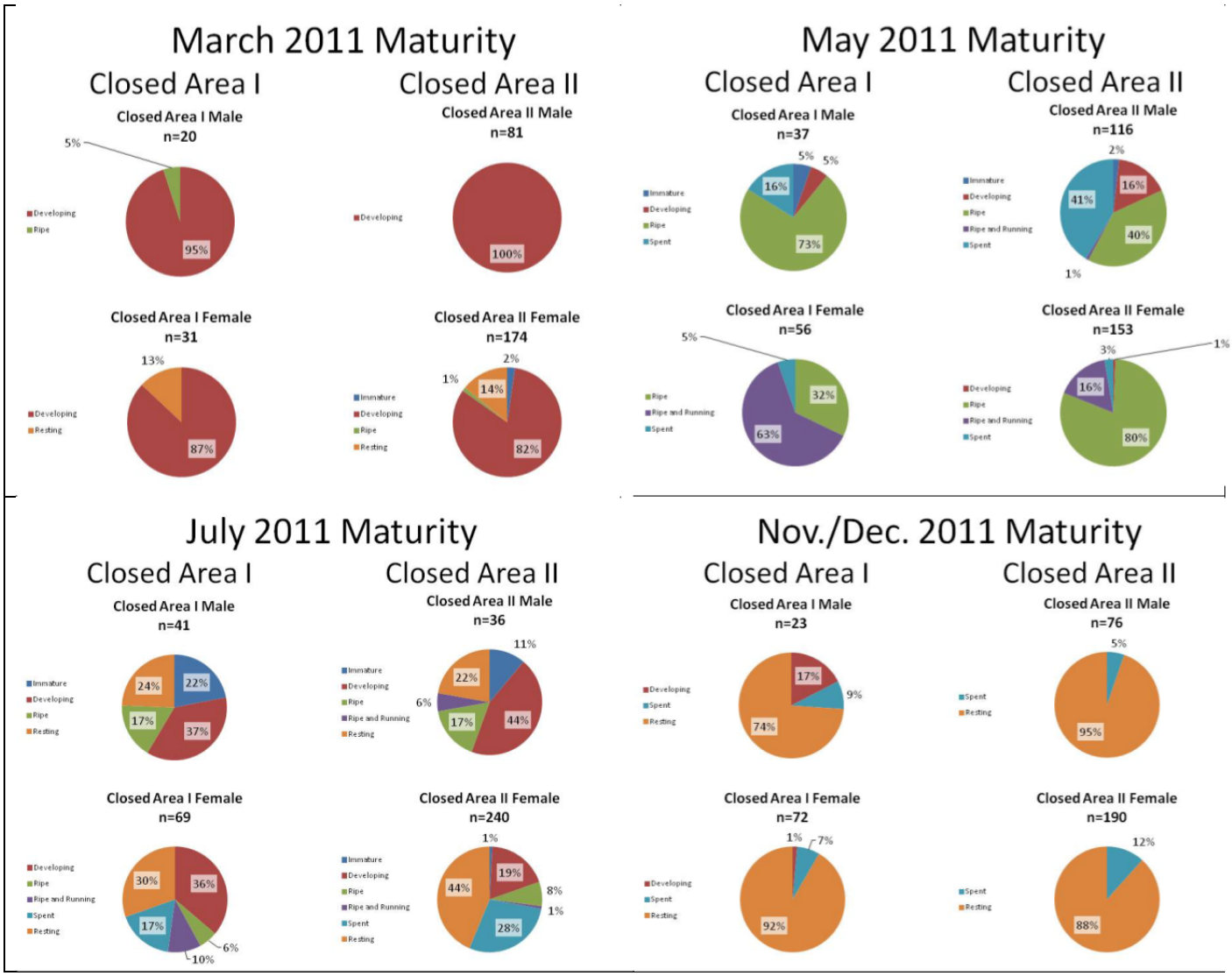
Table 2. A sample of the monthly YT maturity pie charts in the RSA study have been included as well: March showing the majority of fish developing; May showing a large percent of YT ripe and running; July the fish maturity is mixed; and in Nov/Dec most fish are spent or resting (Figure 14).

For winter flounder over 1,300 fish were measures and staged. Results indicated a spawning event in Feb/March, with most fish resting in August, and staring to develop for the next spawn in Nov/Dec.

**Table 2 – Maturity results for YT including sample size and mean size for each month of the survey and totals for sample size and grand mean for each sex (March 2011 through April 2012)**

| | Yellowtail Flounder | | | |
|---|---|---|---|---|
| Month | Female n | Female Mean | Male n | Male Mean |
| 3 | 205 | 38.6 | 101 | 33.7 |
| 4 | 253 | 38.7 | 94 | 33.9 |
| 5 | 209 | 37.6 | 153 | 35.5 |
| 6 | 203 | 37.3 | 139 | 36.1 |
| 7 | 309 | 37.6 | 77 | 33.6 |
| 8 | 282 | 38.3 | 118 | 33.7 |
| 9 | 294 | 38.5 | 122 | 34.1 |
| 10 | 346 | 38.8 | 85 | 33.9 |
| 11 | 30 | 38.9 | 5 | 33.4 |
| 12 | 232 | 39.0 | 95 | 34.7 |
| 1 | 263 | 38.6 | 114 | 34.5 |
| 2 | 164 | 39.0 | 77 | 34.9 |
| 3 | 175 | 38.6 | 120 | 34.4 |
| 4 | 361 | 38.4 | 112 | 33.8 |
| Total | 3326 | 38.4 | 1412 | 34.4 |

Figure 14 – Sample of monthly maturity for YT from 2011 RSA project




### 1.1.2.2.2 Summary of shell height: meat weight results

Over 4,300 scallops were measured in this study. Scallop shell heights ranged from 82mm to 176 mm and meat weights varied from 5-121 g. For results see Tables 10-13 and Figures 19-23 of the report. Meat weights were always higher in Closed Area I relative to Closed Area II and overall meat weights peaked from May-July and decreased to their through from August – February. Several key figures from the report have been included below to highlight the meat weight variation by month.

Figure 15 – Temporal trends for the predicted meat weight of a 125mm shell height scallop from two areas

Depth was calculated as the mean depth of each area (CAI=65.06m, CAII=73.02m).

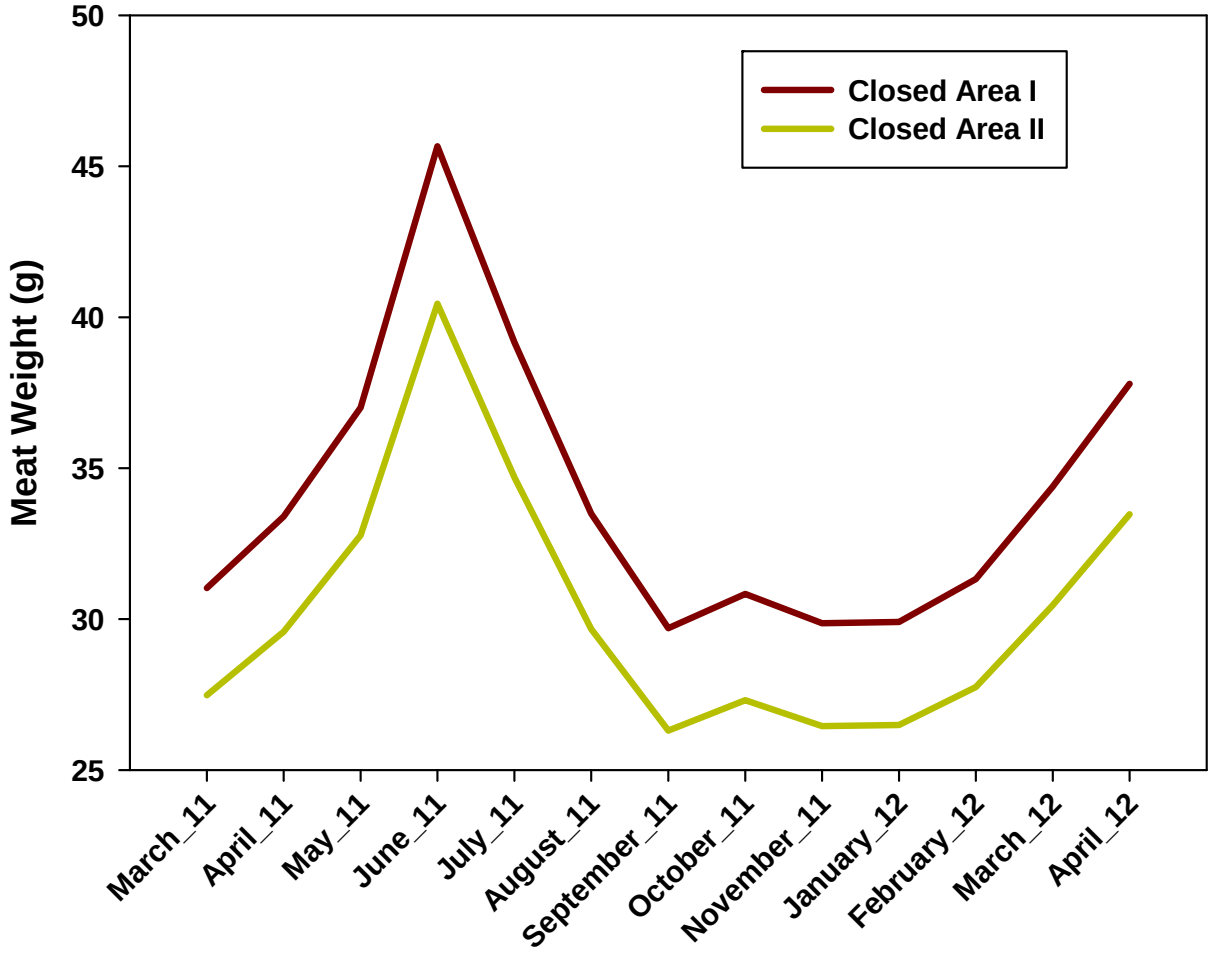


Figure 16 – Comparison of estimated curves for each month in Closed Area I (two l:w relationships for GB from NEFSC SARC included for comparison)

Depth was calculated as the mean depth of each area (CAI=65.06m).

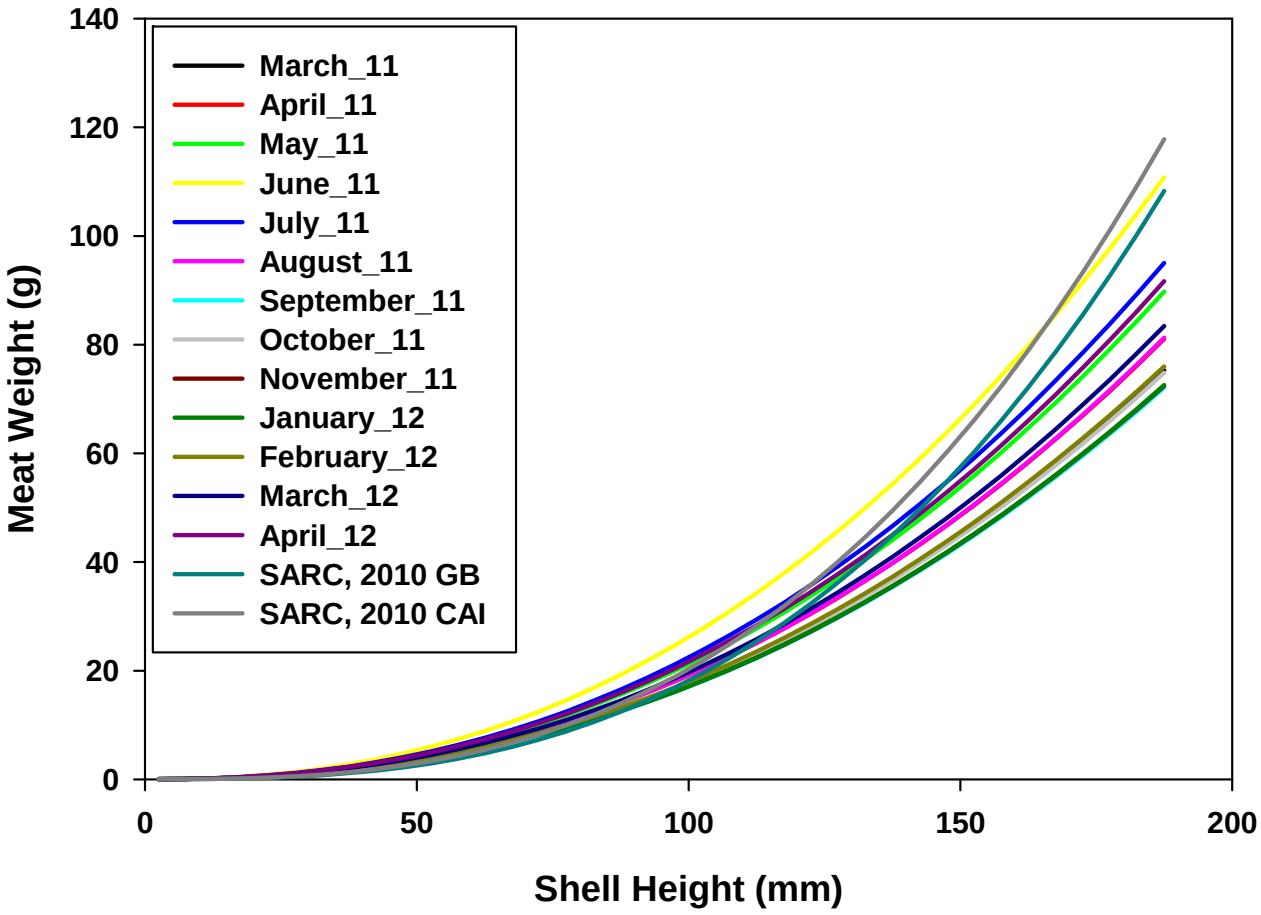
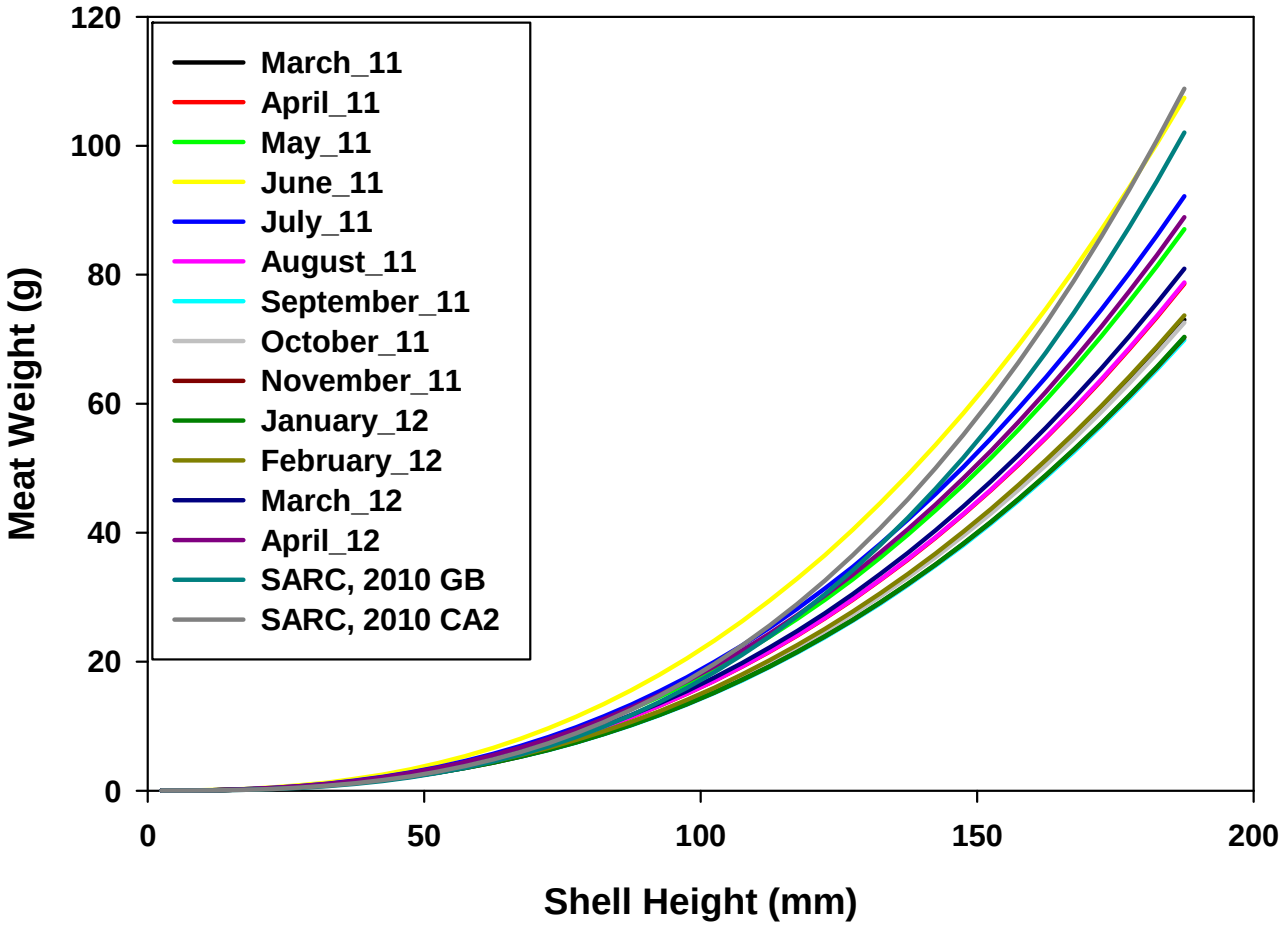


Figure 17 - Comparison of estimated curves for each month in Closed Area II (two l:w relationships for GB from NEFSC SARC included for comparison)

Depth was calculated as the mean depth of each area (CAII=73.02m).




### 1.1.2.2.3 Summary of bycatch rate analysis results

Bycatch rate was determined for each trip by dividing the weight of the bycatch species (based on length measurements and converted to weights from derived tables (NOAA, 20113)) by the meat weights of scallop catch from the turtle deflector dredge tows. The results are for 41 selected stations that were sampled on all 14 trips inside of CA1 and CA2. See Tables 14-21 and Figures 24-42 of the report for the average rates per trip and Figures 43-46 have the distribution of bycatch rates within each area by station for YT flounder only.

The total scallop meat weights in pounds from the standardized stations is summarized in Table 3. Table 4 shows that these is higher abundance of YT in CA2 compared to CA1 and in CA2 the largest numbers were in the months of Aug-Oct, and the highest bycatch rate was in October 2011. The length frequencies

of important bycatch species are included in Appendix A. The distribution of bycatch ratios by month and by station for each access area have been included in this summary as well ().

Table 3 – Totals of scallop meat weights in pounds from selected standardized stations inside CA1 and CA2 (TDD only)

| | CAI | CAII | Total |
|---|---|---|---|
| **Oct 10** | 2290.76 | 2220.05 | 4510.81 |
| **Mar 11** | 2530.92 | 2058.03 | 4588.95 |
| **Apr 11** | 2353.29 | 1638.51 | 3991.81 |
| **May 11** | 3800.49 | 3214.34 | 7014.84 |
| **Jun 11** | 4527.96 | 4150.00 | 8677.96 |
| **Jul 11** | 2877.04 | 2652.85 | 5529.89 |
| **Aug 11** | 2033.12 | 1704.40 | 3737.51 |
| **Sep 11** | 1554.05 | 1526.99 | 3081.04 |
| **Oct 11** | 1808.48 | 1670.68 | 3479.16 |
| **Dec 11** | 1328.73 | 1482.48 | 2811.21 |
| **Jan 12** | 1514.82 | 1391.33 | 2906.15 |
| **Feb 12** | 928.88 | 1385.16 | 2314.05 |
| **Mar 12** | 1185.19 | 1340.22 | 2525.41 |
| **Apr 12** | 1340.33 | 1565.82 | 2906.15 |

Table 4 – YT flounder catch from TDD from standardized stations only (12 in CA1 and 29 in CA2) Oct2010-April2012

| | CAI | | CAII | | Bycatch Rate | |
|---|---|---|---|---|---|---|
| **Date** | # | lbs | # | lbs | CAI | CAII |
| **Oct 10** | 0 | 0 | 537 | 574.4 | 0.00000 | 0.25873 |
| **Mar 11** | 3 | 3.15 | 186 | 201.2 | 0.00124 | 0.09776 |
| **Apr 11** | 8 | 6.2 | 172 | 172.7 | 0.00263 | 0.10540 |
| **May 11** | 17 | 15.6 | 116 | 109.1 | 0.00410 | 0.03394 |
| **Jun 11** | 23 | 18.1 | 123 | 123.3 | 0.00400 | 0.02971 |
| **Jul 11** | 17 | 13.5 | 108 | 104.4 | 0.00469 | 0.03935 |
| **Aug 11** | 8 | 7.55 | 450 | 431.7 | 0.00371 | 0.25329 |
| **Sep 11** | 1 | 1.35 | 445 | 457.2 | 0.00087 | 0.29941 |
| **Oct 11** | 16 | 16.75 | 527 | 560 | 0.00926 | 0.33519 |
| **Dec 11** | 24 | 27.1 | 201 | 222.65 | 0.02040 | 0.15019 |
| **Jan 12** | 9 | 9.3 | 188 | 209.1 | 0.00614 | 0.15029 |
| **Feb 12** | 2 | 1.8 | 169 | 192.1 | 0.00194 | 0.13868 |
| **Mar 12** | 2 | 1.3 | 197 | 213 | 0.00110 | 0.15893 |
| **Apr 12** | 5 | 5.8 | 253 | 258.45 | 0.00433 | 0.16506 |

Figure 18 – Box and whisker plot of the distribution of the bycatch ratio by station of YT in CA1 for each month of the survey. The mean, 25 and 75 percentiles (interquartile range), and outliers shown. Data from multiple years combined.

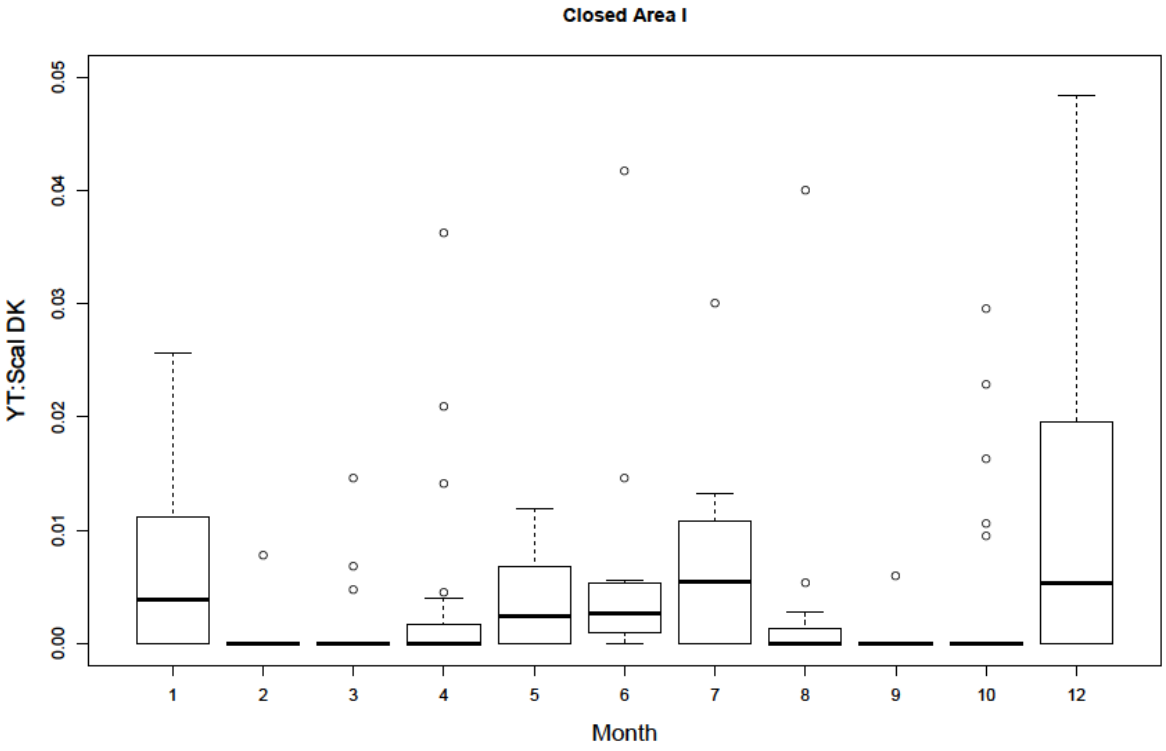



Figure 19 – Distribution of YT bycatch ratio by station in CA1 for each of the 14 survey trips

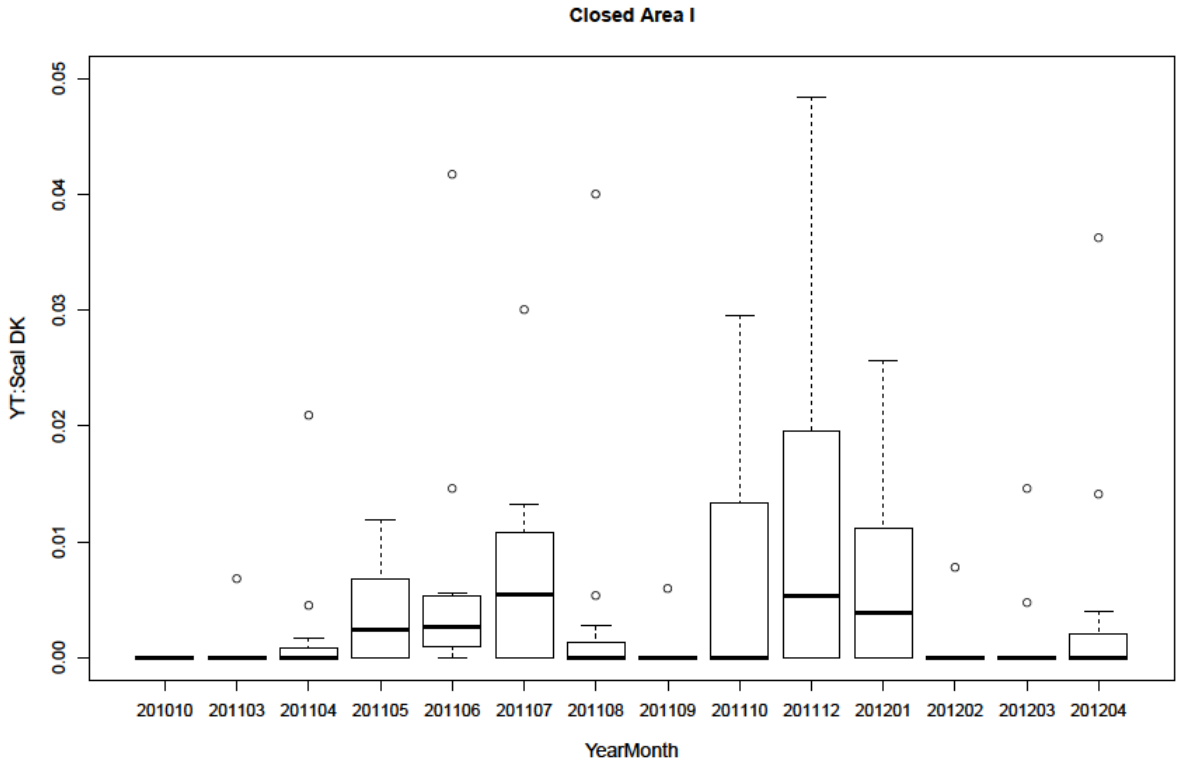


Figure 20 - Box and whisker plot of the distribution of the bycatch ratio by station of YT in CA2 for each month of the survey. The mean, 25 and 75 percentiles (interquartile range), and outliers shown. Data from multiple years combined.

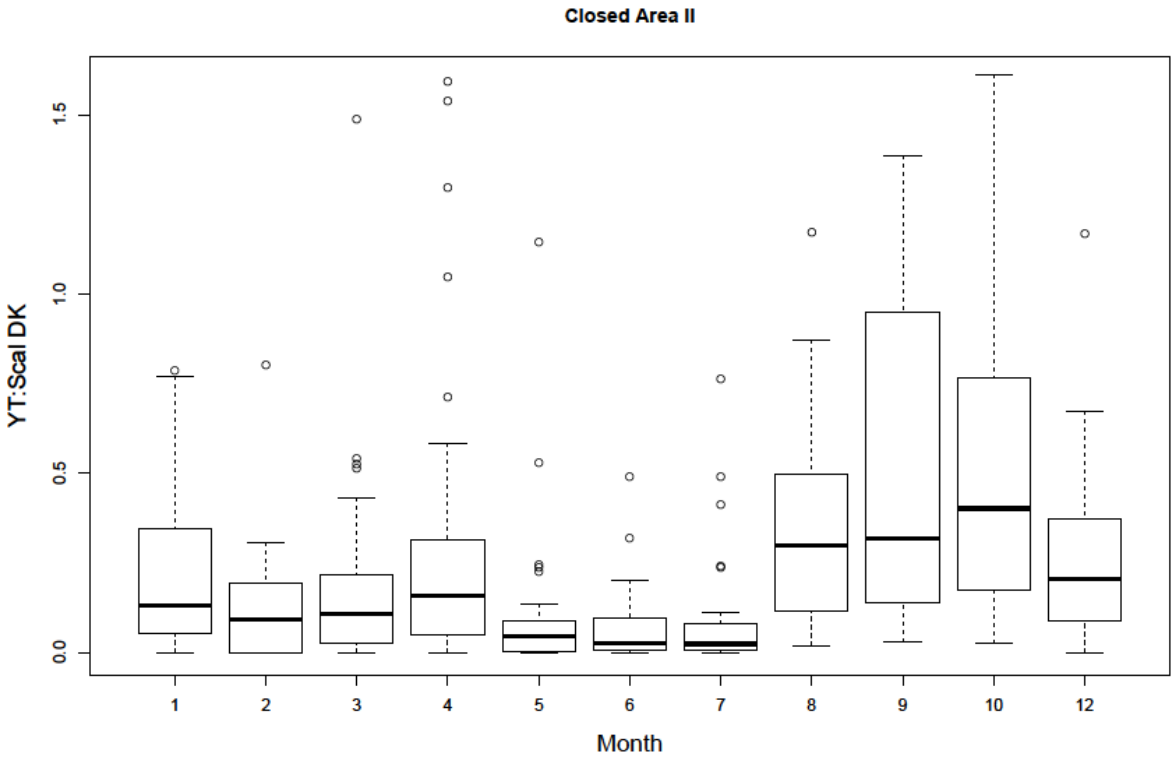
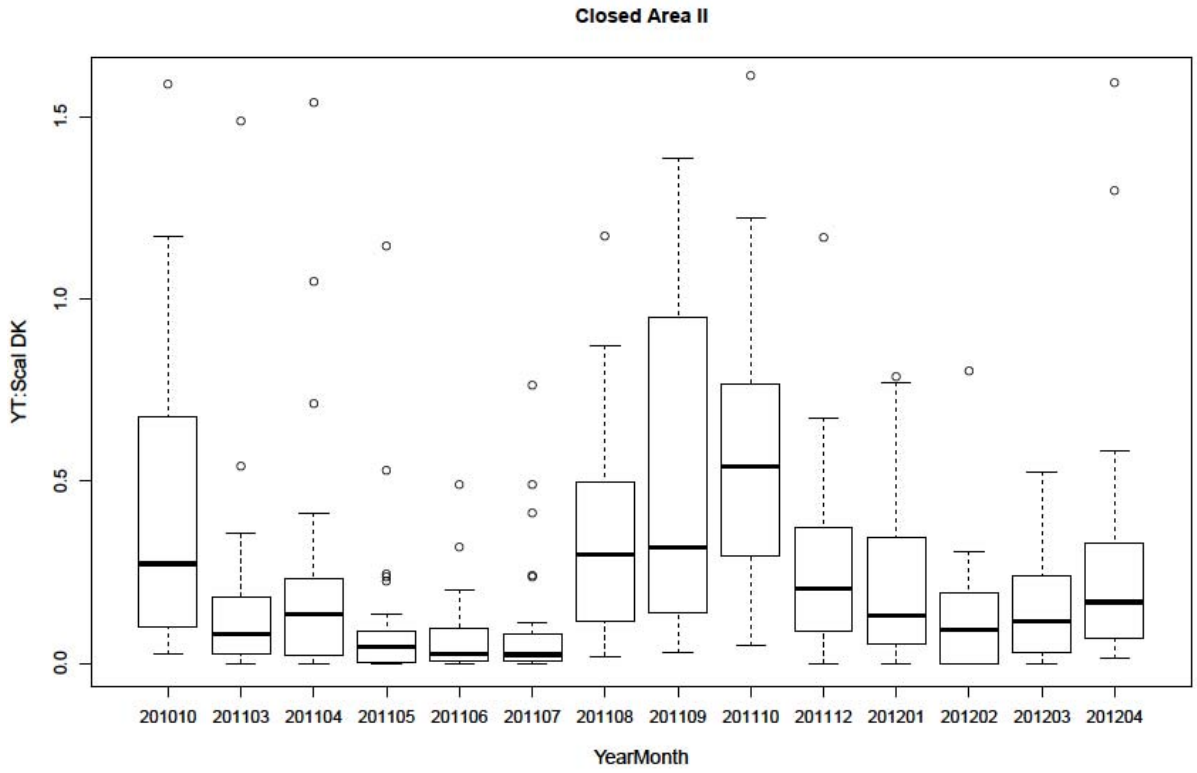



Figure 21 - Distribution of YT bycatch ratio by station in CA2 for each of the fourteen survey trips



#### 1.1.2.2.4 Overall summary of analysis from RSA seasonal bycatch study

**Input from RSC**

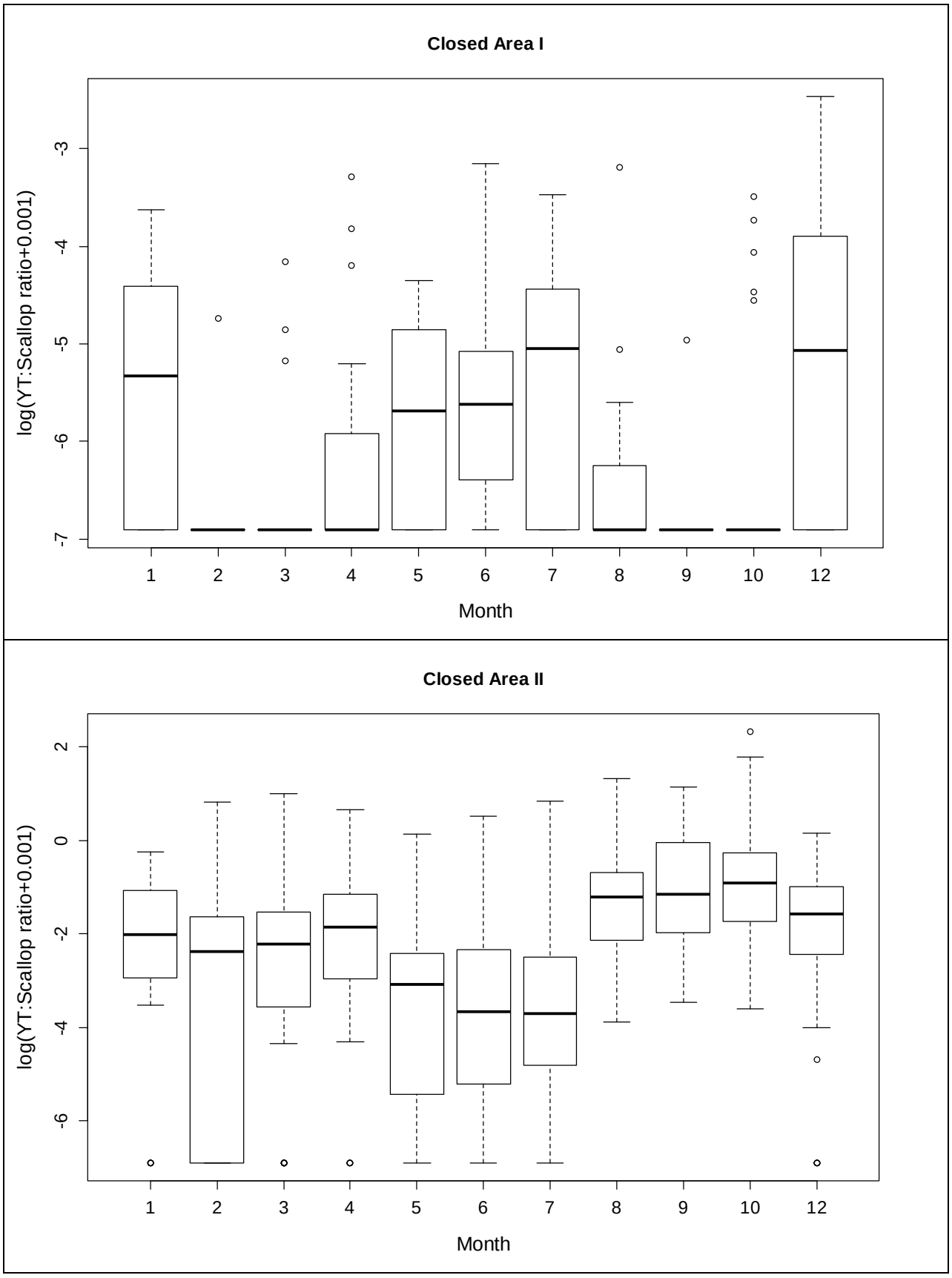
The RSC reviewed the 2011 RSA project, "Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch", on June 25, 2012. Some concerns were raised about the thoroughness of the NEFSC technical review and suggested that more work should be done to look at the data on a tow by tow basis, rather than simply taking mean YT bycatch rates per month for each area.

> ***RSC Consensus***
> ***The Committee agreed that the report is not yet a final report in the traditional sense, but some components have immediate application to some current management needs. The RAMP component results are not sufficient for application to setting mortality rates in the assessment. The PDTs have access to all of the data, and that data are sufficient for the PDTs to use in developing management measures, even though additional data will be collected over the next year. The report also raises a number of questions for future research or investigation.***

**Additional analyses of 2011 RSA data by the Scallop PDT**

The PDT took the monthly bycatch data and ran it in the same GAM model that was developed for the observer data. Due to the relatively large number of zero tows of YT and several large outliers with large tows of YT in CA2 (Figure 18 - Figure 21), the PDT completed log-transform boxplots using the same data to get rid of all the zero tows (Figure 22). The updated boxplots show that D:K rates in CA2 are higher in the fall compared to other months. Bycatch rates in Closed Area I are not as consistent by month and seasonal changes in scallop meat weights are likely a larger driver than seasonal changes in YT.

Figure 22 – Log-transformed boxplots of bycatch ratios by month for Closed Area I and 2 using 2011 RSA data



### 1.1.2.3 Alternatives developed by the Scallop PDT

The PDT discussed that moving the opening date earlier in May would improve scallop yield and reduce fishing mortality. Since there is a possession limit in access areas fishing for scallops when meat weights are largest also reduces bottom contact time and bycatch because fewer scallops are needed to harvest the possession limit.

In general, there are two ways to approach these seasonal restrictions: develop a fixed opening and closing date, or leave the areas open all year and identify a fixed time period to close the areas when bycatch rates are highest. The PDT discussed that having the areas open longer could have beneficial impacts of spreading effort out, but in access areas there is a fixed possession limit so there is less incentive to fish in high meat weight months compared to open areas. Therefore, there may be advantages to have shorter windows when meat weights are higher to reduce fishing mortality, bycatch, and associated impacts.

**Based on these analyses the Scallop PDT developed several options (1, 2, 3A) (Table 5). The AP developed Option 3B, and Option 4 was included to eliminate the seasonal closures to complete the range of alternatives under consideration. See Section 2.2.1 of FW24 alternatives for more details.**

**Table 5 – Summary of GB Access Area seasonal restriction alternatives under consideration in FW24**

| | No Action | Modify Season | | | | | Eliminate Season |
|---|---|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3A** | Option 3B | | |
| Access Area | All areas | All areas | All areas | All areas | CA2 | CA1/NL | All Areas |
| Mar | C | C | O | C | O | O | O |
| Apr | C | C | O | C | O | O | O |
| May | C | O | O | O | O | O | O |
| Jun | O (6/15) | O | O | O | O | O | O |
| Jul | O | O | O | O | O | O | O |
| Aug | O | O | O | O | C (Aug 15) | O | O |
| Sep | O | C | C | C | C | O | O |
| Oct | O | C | C | C | C | O | O |
| Nov | O | C | C | C | C (Nov 15) | O | O |
| Dec | O | C | O | O | O | O | O |
| Jan | O | C | O | C | O | O | O |
| Feb | C | C | O | C | O | O | O |
| Total Months Closed | 4.5 | 8 | 3 | 7 | 3 | 0 | 0 |

** Scallop Cmte replaced Option 3A with 3B, and Council did not include 3a for consideration, thus it was not fully analyzed in Framework 24.

### 1.1.3 Input from GF PDT about potential impacts on groundfish mortality and spawning

The Groundfish PDT has also prepared separate analyses using the 2011 RSA seasonal bycatch report. The GF PDT has evaluated differences in YT and WP monthly bycatch rates on a tow by tow basis from that study. Detailed analyses will be appended to FW24. The bullets below summarize input from the GF PDT from their meeting summary (GF PDT meeting October 12, 2012). The separate working papers prepared by the GF PDT are attached at the end of this Appendix.

**Timing of Scallop Fishery Access to GB Closed Areas**

8. Scallop FW 24 will be a joint action that considers changing the dates that scallop vessels are allowed access to the GB access areas (CAI, CAII, NLCA). The PDT reviewed the following sources of information to evaluate the impact of the alternatives on groundfish resources (primarily yellowtail flounder and windowpane flounder).

a. "An analysis of Georges Bank yellowtail flounder monthly catch rates in closed area 1 and closed area 2 from the bycatch survey"; PDT analysis prepare by Steve Correia. This report uses data from "Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch; Final Report prepared for the 2011 Sea Scallop Research Set Aside"; Smolowitz, Ronald, Kathryn Goetting, Farrell Davis, and Dan Ward; 2011.

b. "An analysis of Georges Bank windowpane monthly catch per tow in Closed Area 2 from the scallop dredge bycatch survey"; PDT analysis prepared by Steve Correia. This report uses data from Smolowitz et al. 2011.

c. Scallop fishery time/area closure to reduce yellowtail flounder bycatch on Georges Bank in 2007; Canadian Science Advisory Secretariat Science Response 2007/001.

d. Evaluation of Closed Areas Using Yellowtail Flounder Tagging Studies; summary of a presentation given by Dr. Steve Cadrin at the Northeast Regional Tagging Symposium, 2008

e. NMFS/NOAA EFH Source Documents for yellowtail flounder and windowpane flounder

9. The PDT's discussion focused on two issues. The first was the likely effects of changing the access dates on catches of yellowtail and windowpane flounder. The second was on the likely effects of changing the access dates on the effects of scallop fishing on yellowtail flounder spawning activity. The two yellowtail stocks that may be most affected by the changes are SNE/MA yellowtail flounder (NLCA) and GB yellowtail flounder (CAI and CAII). GB YTF is overfished and in a rebuilding program; overfishing is occurring. Recent recruitment is the lowest on record (TRAC 2012). SNEMA YTF is not overfished and overfishing is not occurring (SAW 54, 2012). Compared to historic levels, the stock is at a low stock size, partly as the result of poor recruitment for the last 20 years. Northern windowpane flounder is overfished and overfishing was occurring in 2010.

*Discards*

10. The main source for information on seasonal differences in scallop dredge catches of yellowtail and windowpane flounder are the two papers prepared by Steve Correia (attached). These papers analyze data from an ongoing experiment that uses commercial scallop dredges to sample stations in CAI and CAII. The conclusions are comparable to a different analytic approach used by the Scallop PDT. Because of inconsistent sampling of stations in CAI, the PDT does not believe that conclusions can be drawn about seasonal changes in catch rates. Only some of the stations in this area were sampled each month and they cover only part of the area fished by the scallop industry. In CAII, most of the stations were sampled each month and generally the stations not sampled were in areas that are not typically fished by scallop vessels. The stations used for the analyses are shown in Figure 1 from the PDT report. The results cited below are only applicable for the consistently sampled stations.

11. In CAII, the experimental results indicate that yellowtail flounder catch rates per tow are lowest in the May – July period, and are highest in the August – October period. Pairwise comparisons of catch by month indicate that catch rates in August – October are significantly different (higher) than catch rates from March through July. Catch rates in May/June/July are not significantly lower than catch rates in March and April. Figure 2 gives a quick overview of these results.

12. In CAI, the months with the highest discard rates are May, June, July, and December; months with lower rate are April, August, and September. Because of small sample sizes and inconsistent sampling, the PDT does not believe that statistical inferences are sound for this area.

13. In CAII, windowpane flounder catch rates peaked in March. Other months where catches wee high included April and December. Windowpane flounder catches were lowest from June through September. Figure 3 gives a quick overview of these results. There were insufficient data to draw conclusions for CAI.

14. There is no new information for the seasonal trends of yellowtail flounder catches in the NLCA. Analyses in FW 11 (1999) concluded that catch rates were highest in the spring and early summer.

*Spawning of Yellowtail Flounder*

15. Numerous sources document that yellowtail flounder spawning on GB peaks in May and June on Georges Bank. There is little detailed information on the location of spawning aggregations. There is no information on whether fishing activity – including scallop dredges - interferes with spawning behavior of yellowtail flounder. This is different than the case for cod, where some studies suggest that fishing activity disrupts spawning activity.

16. Since the mid-1990's, the NMFS surveys have indicated that yellowtail flounder is primarily located in survey stratum 16, which overlaps CAII. In the last four or five years there has been some expansion into stratum 13. If yellowtail flounder aggregated in CAII during spawning season, though, the expectation would be that the catch rates in the ongoing experiment would peak in May and June. This was not the case; as shown in Figure 2 of the PDT report, catches in May and June were lower than in other months. While a high percentage of fish in these months were developing or ripe and running, the experiment suggests that spawning aggregations may be located elsewhere.

*Recommendations*

17. The PDT was advised that FW 24 will consider the following options for the timing of access to the GB access areas. Some of the options are considering slight variations of the dates shown.

a. No Action (access allowed June 15 – January 31)
b. Modify dates: Option 1: areas closed October 1 – April 30
Option 2: areas close September 1 – November 30
Option 3A: NLCA closed September 1 – November 30 and March 1 – April 15; CAI and CAII closed September 1 – April 15
Option 3B: CAII closed August 15 – November 15; no closure for CAI and the NLCA
c. No access date restrictions

18. For CAII, From the standpoint of groundfish bycatch, the months of May, June, and July appear to be those most likely to minimize catches of YTF and windowpane flounder. For YTF, the months of August – November should be avoided to reduce catches of YTF. For WINP, the months of March and April should be avoided.

19. At present, scallop fishery catches of GOM/GB windowpane flounder are small but not inconsequential. In FY 2011, catches were estimated as 33 mt out of the total catch of 161 mt, or 20 pct. The scallop experiment catch per tow in CAII increased by a factor of ten in March and April when compared to June and July. This is a concern as the ACL was exceeded in FY 2011 and the stock is overfished. It is possible that allowing dredge activity in CAII in March and April could accelerate the need to allocate a sub-ACL for this stock to the scallop fishery.

20. From the standpoint of avoiding any possible interference with YTF spawning, the months to avoid fishing in GB access areas are May/June. However, to date the PDT has not found research on the impacts of fishing activity on YTF spawning and no research is available that identifies specific spawning locations within the CAI or CAII scallop access areas. The PDT also notes that FW 48 will consider allowing groundfish sectors to request access to parts of CAI, CAII, and the NLCA between May 1 and February 15; the PDT is doubtful that scallop dredges will have greater impacts on spawning activity than groundfish trawls.

21. Scallop management options 1 and 3A address concerns over GOM/GB windowpane flounder to some extent. Options 2, 3A, and 3B would reduce activity in CAII during the period when yellowtail flounder catch rates would be expected to be highest.

22. In the context of a system that allocates a sub-ACL to the scallop fishery, it can be argued that the seasonal differences in catch rates are unimportant as long as the scallop fishery is held to the sub-ACL through effective AMs. The PDT notes, however, that the Council may base the allocation on the amount the scallop fishery is expected to catch. In this case, then, moving the fishery to periods of lower catches may benefit the groundfish fishery by reducing the expected catch. More problematic is the difference in accountability between the two fisheries. If the scallop fishery exceeds its sub-ACL, and this leads to an overage of the overall ACL, the provisions of the US/CA Understanding require a 1 for 1 reduction in the quota the following year. This immediately results in a reduction in the quota available to the groundfish fleet, even if that fleet stayed within its sub-ACL. The scallop fishery AM, on the other hand, does not get implemented until the following year and while it may limit access to certain areas it does not necessarily reduce overall scallop fishing effort.

### 1.1.4 Preliminary economic impacts of the alternatives under consideration on the scallop fishery

Framework 24 includes several options to modify GB seasonal restrictions to provide access during months with highest scallop meat weights and to minimize yellowtail bycatch. Under no action, access to GB areas starts on June 15$^{th}$ and they stay open until the end of January of the following year. Overall, those areas would be closed to fishing for 4.5 months with no action (**Table 5**).

#### 1.1.4.1.1 Option 1 - Closure period would be modified to provide access during months with highest scallop meat weights to reduce fishing time and scallop fishing mortality

This option would provide access earlier starting in May because that would improve scallop yield and reduce fishing mortality. Since there is a possession limit in access areas, fishing for scallops when meat weights are largest also reduces bottom contact time and bycatch because fewer scallops are needed to harvest the possession limit. However, this alternative would reduce the months GB access areas open to fishing to four months keeping the area closed after August. The net economic impacts of this alternative compared to no action will depend whether the positive impacts on the scallop yield will outweigh the costs associated with reduced flexibility with narrowing the fishing season to 4 months under this option.

It is evident from **Table 7** and **Table 8** that as a result of late opening of the GB access areas in 2011 (in August) a major proportion (78% of all landings in CA1 and 48% of all landings in CA2) of the scallop lb. were landed in the month of August. Comparison with **Table 9** indicates that when those areas were opened on June 15$^{th}$ in 2012, the landings were more evenly spread among months from June to September 12. Considering that 62% of CA2 TAC, 67% of the CA1 TAC and 30% of the NLS TAC were landed so far by September 12, closing these areas will result in a shift of effort from September –January to May-August under Option1. This is expected to have both positive and negative economic impacts on the scallop fishery. Narrowing fishing season to four months will reduce the flexibility for vessel owners to choose when to fish and to adjust their fishing patterns to the changes in prices and fuel costs from one months to another with a possible increase in fishing costs and some negative impacts on the revenues. On the other hand, shifting effort to months with high meat weights could reduce the fishing time to land the possession limit and have a favorable impact on fishing costs outweighing some of the negative impacts.

Containing effort to 4 months from May to August (instead of spreading the effort through June 15 to January under no action) could also have some negative impacts on the average prices and revenues

scallop fishermen receive from these areas. Table 6 shows that average ex-vessel prices from May to August window were higher compared to prices in months from January to April, but lower than the prices in the period from September to December in 2010 and 2011. Even though, during those months scallop landings include more of larger scallops with a price premium, increase in the supply of those scallops in a shorter period of time (due to the closures) could have some dampening impact on their prices holding other factors (including the changes in demand for exports, import prices, income and preferences of consumers) that affect price constant. However, it is uncertain, to what extent the price premium associated with larger scallops over the May to August period could offset some of the negative effects of the effort shifts.

Over the long-term, opening the access areas early and shifting effort from low meat weights months (October is the lowest) to high meat weight months (June is highest) will have positive impacts on the scallop resource and future yield from the scallop fishery with positive economic impacts. It will also reduce bottom contact time and bycatch because fewer scallops would be needed to harvest the possession limit reducing the risk for triggering AMs in case yellowtail ACL is exceeded. Thus, the net economic impacts of Option 1 compared to no action is uncertain in the short-term, ranging from a small negative impact to a slight positive impact. However, the positive impacts on the scallop yield and reduction of the risk of triggering yellowtail AMs could result in positive economic impacts over the long-term.

**Table 6. Average Ex-vessel scallop prices by month**

| Month | 2010 | 2011 | 2010-2011 Average |
|---|---|---|---|
| 1 | 6.25 | 9.79 | 7.79 |
| 2 | 6.99 | 9.46 | 8.35 |
| 3 | 7.20 | 9.29 | 8.30 |
| 4 | 6.77 | 9.75 | 8.11 |
| **Average of 1 to 4** | **6.86** | **9.55** | **8.17** |
| 5 | 6.54 | 9.85 | 8.31 |
| 6 | 7.14 | 9.51 | 8.38 |
| 7 | 9.83 | 9.93 | 9.86 |
| 8 | 8.45 | 9.80 | 9.31 |
| **Average of 5 to 8** | **7.99** | **9.77** | **8.91** |
| 9 | 8.56 | 10.45 | 9.52 |
| 10 | 8.67 | 10.25 | 9.49 |
| 11 | 9.43 | 10.60 | 9.99 |
| 12 | 9.77 | 10.95 | 10.35 |
| **Average of 9 to 12** | **8.96** | **10.50** | **9.73** |

**Table 7. Monthly distribution of landings in CA1 and CA2 in 2011 (Open from August 2011 to January 2011)**

| Area | Month | Scallop lb. | Percentage distribution of landings by month |
|---|---|---|---|
| CA1 | 8 | 6,500,546 | 78% |
| | 9 | 1,059,078 | 13% |
| | 10 | 508,716 | 6% |
| | 11 | 146,577 | 2% |
| | 12 | 161,585 | 2% |
| Total | | 8,376,502 | 100% |
| CA2 | 8 | 1,284,116 | 48% |
| | 9 | 654,057 | 24% |
| | 10 | 405,058 | 15% |
| | 11 | 257,353 | 10% |
| | 12 | 70,979 | 3% |
| Total | | 2,671,563 | 100% |

**Table 8. Monthly distribution of landings in Nantucket Lightship area in 2010 (Open from June 28 to January 2011)**

| Area | Month | Scallop lb. | Percentage distribution of landings by month |
|---|---|---|---|
| NSA | 6 | 13,465 | 0% |
| | 7 | 5,553,301 | 97% |
| | 8 | 79,042 | 1% |
| | 9 | 24,462 | 0% |
| | 10 | 4,280 | 0% |
| | 12 | 72,401 | 1% |
| | Total | 5,746,951 | 100% |

**Table 9. Monthly distribution of landings in Nantucket Lightship, CA1 and CA2 area in 2012 (Open from June 15 to January 2011)**

| Date | Closed Area I | Closed Area II | Nantucket Lightship | All Areas |
|---|---|---|---|---|
| June-12 | 666,124 | 988,169 | 268,991 | 1,923,284 |
| July-12 | 1,499,011 | 1,331,517 | 724,315 | 3,554,843 |
| August-12 | 660,261 | 902,787 | 538,940 | 2,101,988 |
| September-12 | 803,308 | 694,523 | 209,123 | 1,706,954 |
| Total | 3,628,704 | 3,916,996 | 1,741,369 | 9,287,069 |
| Area TAC | 5,886,000 | 5,886,000 | 2,943,000 | 14,715,000 |
| % of Total TAC | | | | |
| June-12 | 11% | 17% | 5% | 13% |
| July-12 | 25% | 23% | 12% | 24% |
| August-12 | 11% | 15% | 9% | 14% |
| September-12 | 14% | 12% | 4% | 12% |
| Total | 62% | 67% | 30% | 63% |
| Area TAC | 100% | 100% | 50% | 100% |

**Option 2 - Closure period would be modified to only the months with highest yellowtail flounder bycatch**

This option would allow access to the GB areas for nine months and keep it closed only in the months of September to November. Thus, it would provide more flexibility to vessels about when to fish compared to both Option 1 and no action with positive impacts on profits. Furthermore, it will shift effort from some of the low meat weight months (November) to high meat weight months benefiting the scallop resource. This could reduce the fishing time and the trip costs since fewer scallops will be needed to harvest the possession limit.

**Option 3a - Closure period would take into account scallop meat weights, YT bycatch, and traditional fishing trends**

The Scallop PDT also discussed that it could be beneficial to consider an alternative that is based on the months when meat weights are poor, YT bycatch is high, and also takes into account traditional fishing trends. Specifically, this alternative would close the areas consistent with Option 2 when YT bycatch rates are highest, but it would be more restrictive to also limit fishing when scallop meats are poor to reduce scallop fishing mortality. Finally, this alternative would also provide for a very limited amount of fishing in the winter when some vessels traditionally take a "Christmas trip". Thus this option would have higher economic benefits compared to Option 1, but will provide less flexibility for vessels compared to Option 2 with uncertain economic impacts in the short-term and possibly positive economic impacts over the long-term.

**Option 3b – Advisory Panel recommendation**

Based on an AP recommendation, the Committee revised one of the GB seasonal closure alternatives so that only CA2 would be closed from Aug15-Nov15 (a combination of the lowest meat weights and highest YT) and no closures for CA1 and NL. The main rationale provided from the AP meeting was that overall bycatch is low in CA1 and there does not seem to be a strong seasonal difference. Therefore, imposing a seasonal restriction may not do much and could actually shift effort into higher bycatch areas if vessels fish in open areas when NL is closed.

This option would provide higher flexibility to vessels compared to no action and other options since CA2 would close for only 3 months and CA1 and NL would be open all year, resulting in positive economic benefits for the scallop fishery. It is more likely, however, the long-term benefits of this option would be somewhat lower compared to Options 1 to 3a since the effort could occur in CA1 and NL during the low-meat weight seasons as well.

**Eliminate GB access area seasonal restrictions**

This alternative would remove any seasonal restriction for scallop fishing in portions of the existing GF closed areas. This alternative may be selected if it is found that limited scallop fishing in portions of the GF closed areas year round would not have substantial negative impacts on groundfish mortality and spawning. This option would provide higher flexibility to vessels compared to no action and all the other options including 3b above with some positive economic benefits for the scallop fishery in the short-term. It is more likely, however, for the long-term benefits of this option to be lower compared to the economic benefits from other options since fishing effort could occur in the access areas during the low-meat weight seasons resulting in higher fishing costs and lower benefits for the scallop resource. In addition, this option is not pro-active and does not avoid fishing during the high YT bycatch months.

# An analysis of Georges Bank windowpane monthly catch per tow in Closed Area 2 from the scallop dredge bycatch survey

Prepared for the Groundfish PDT

By

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The research set aside project: Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch conducted standardized survey of bycatch in scallop trawls in closed areas I and II in 2010-2012 provides estimates of windowpane catches. I used a dataset provided by Deirdre Boelke (NEFMC) to estimate differences in monthly catches of windowpane in the study area. The dataset consists of only "standardized selected" stations (Figure 2, Table 1) as described in (Smolowitz et al, 2012). Focusing on windowpane catch per tow rather than the windowpane: scallop discard ratio, eliminates the confounding effects of changes in scallop yields on the seasonal availability of windowpane in the closed areas.

| | Closed Area II | | |
|---|---|---|---|
| | | | year |
| month | 2010 | 2011 | 2012 |
| Jan | 0 | 0 | 28 |
| Feb | 0 | 0 | 28 |
| Mar | 0 | 28 | 28 |
| Apr | 0 | 28 | 28 |
| May | 0 | 28 | 0 |
| June | 0 | 28 | 0 |
| July | 0 | 28 | 0 |
| Aug | 0 | 28 | 0 |
| Sept | 0 | 28 | 0 |
| Oct | 28 | 28 | 0 |
| Nov | 0 | 0 | 0 |
| Dec | 0 | 28 | 0 |

**Table 1. Count of sampling "standardized selected" stations by area, month and year. These totals do not include station 218, which was sampled in all months in 2011 but not 2012.**

## Methods

The number of stations sampled varied by month and year, with incomplete sampling in all years. Sampling occurred in all months but January, February and November in 2011 (Table 1). I used an analysis of variance to compare windowpane catch per tow by month for 2011 for "standardized selected" stations only. This eliminates the confounding year effects with month effects for incomplete sampling years of 2010 and 2012.

The windowpane data are significantly different from normal and monthly variances are heterogeneous and do not meet assumptions of either the ANOVA or the Tukey range test. Therefore, I used the Kruskal-Wallace non-parametric test to test for homogeneity of location of windowpane catch rates by month. I used pairwise Wilcoxon tests to test for shifts in location of catch rates by month and controlled the family-wise error rate at 5% using Bonferroni adjustment procedure to account for the 36 A-posteriori monthly comparisons.

**Results**

Boxplots of the windowpane catch per tow by month for closed Area II in 2011 are shown in Figure 1. The distributions of catch rates are shifted higher in March, April and May relative to summer months of June, July and August. Catches distribution are shifted higher for October and December compared with the summer months. The inter-quartile range of the distributions appears relatively heterogeneous for all months. No sampling occurred in January, February or November in 2011.

An ANOVA of windowpane catch per tow rates for closed area II indicated significant month effect (Table 2). Diagnostics indicated that distribution of residuals was significantly different from normal and variances were heteroscedastic. Differences between monthly mean catch rates are shown in Table 3. Confidence limits and p-values are not provided as inference from the Tukey-Range test is not likely valid giving inability for these data to meet assumptions of the test.

Results from the Kruskal-Wallace test ($p<0.001$) indicated that location was heterogeneous among months. Pairwise Wilcoxon tests (Table 4 and Table 5) resulted in significantly median differences in location for 22 out of 36 monthly comparisons. Note that many ties occur in the ranking of monthly catch per tow, mostly because of many zero catch values. Probability values from the Wilcoxon test are not exact because of ties. However, the confidence intervals are constructed using a different algorithm than p-values derived from the distribution of Wilcoxon test statistics. Months with significant differences in location can be determined by having confidence intervals that do not overlap zero. The paired month comparisons with significant median differences in location are the same whether P-values are used or confidence intervals that do not overlap zero criteria are used to make inferences in shifts in location.

Windowpane catch rates in March were higher than all other months. April was also significantly higher than all months but December. Median difference in location was significantly higher in May than June, August and September. However, the shifts in location were small (1 lb). Median differences in location were higher in December compared to June, July, August, September and October. For closed area II, monthly catch per tow for windowpane is higher during spring months (March-May) compared with catch per tow during summer months (June-October).

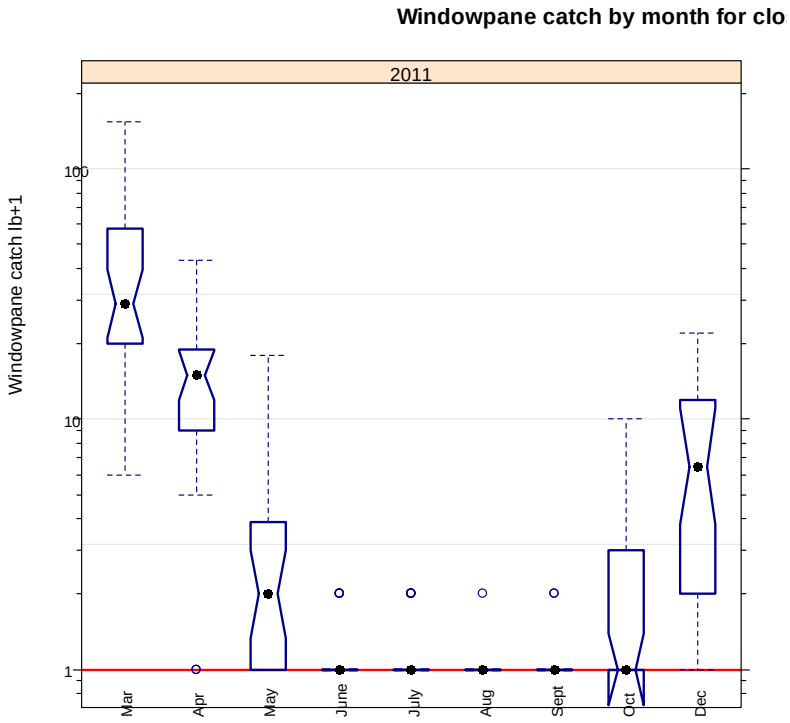


**Figure 1. Boxplots of windowpane catch (lb+1) for standardized selected stations in closed area II by month for 2011. Y-axis scale is logarithmic. Black dots are medians and non-overlapping notches indicate approximately 95% confidence interval for differences in median. Folded notch for October indicates that notch for that month may not be reliable as indicator of differences in median. Red line is median yellowtail catch rate for all months pooled. No sampling occurred in January, February or November in 2011.**

| | DF | Sum sq | Mean square | F-value | P(>F) |
|---|---|---|---|---|---|
| Month | 8 | 39694 | 4962 | 31.96 | <0.001 |
| Residuals | 243 | 37722 | 155 | | |

**Table 2. Summary results of ANOVA of windowpane catch per tow by month for closed area II for 2011.**

| | monthly mean | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | no data | no data | 40.5 | 14.4 | 2.9 | 0.1 | 0.2 | 0.0 | 0.1 | 1.3 | no data | 7.3 |
| Jan | **no data** | 0 | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** |
| Feb | **no data** | **na** | 0 | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** |
| Mar | **40.5** | **na** | **na** | 0.0 | -26.1 | -37.7 | -40.4 | -40.3 | -40.5 | -40.5 | -39.3 | **na** | **na** |
| Apr | **14.4** | **na** | **na** | 26.1 | 0.0 | -11.6 | -14.3 | -14.2 | -14.4 | -14.4 | -13.1 | **na** | **na** |
| May | **2.9** | **na** | **na** | 37.7 | 11.6 | 0.0 | -2.7 | -2.6 | -2.8 | -2.8 | -1.6 | **na** | **na** |
| Jun | **0.1** | **na** | **na** | 40.4 | 14.3 | 2.7 | 0.0 | 0.1 | -0.1 | -0.1 | 1.1 | **na** | **na** |
| July | **0.2** | **na** | **na** | 40.3 | 14.2 | 2.6 | -0.1 | 0.0 | -0.2 | -0.1 | 1.1 | **na** | **na** |
| Aug | **0.0** | **na** | **na** | 40.5 | 14.4 | 2.8 | 0.1 | 0.2 | 0.0 | 0.0 | 1.3 | **na** | **na** |
| Sep | **0.1** | **na** | **na** | 40.5 | 14.4 | 2.8 | 0.1 | 0.1 | 0.0 | 0.0 | 1.2 | **na** | **na** |
| Oct | **1.3** | **na** | **na** | 39.3 | 13.1 | 1.6 | -1.1 | -1.1 | -1.3 | -1.2 | 0.0 | **na** | **na** |
| Nov | **no data** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | 0 | **na** |
| Dec | **7.3** | **na** | **na** | 33.3 | 7.1 | -4.4 | -7.1 | -7.1 | -7.3 | -7.2 | -6.0 | **na** | **0** |

**Table 3. Difference between monthly column mean and monthly row means for in closed area II in 2011. Monthly mean catch per tow are in lb. na indicates that sampling did not occur during that month in 2011.**

| Month pair | Median difference | Lower limit | Upper limit | P-value |
|---|---|---|---|---|
| March-Aug | 28.00 | 20.00 | 54.00 | <0.001 |
| March-Sept | 28.00 | 20.00 | 54.00 | <0.001 |
| March-June | 28.00 | 20.00 | 54.00 | <0.001 |
| March-July | 28.00 | 19.00 | 54.00 | <0.001 |
| April-Aug | 13.51 | 8.00 | 18.00 | <0.001 |
| March-Oct | 27.00 | 18.00 | 54.00 | <0.001 |
| April-Sept | 13.49 | 8.00 | 18.00 | <0.001 |
| April-June | 13.45 | 8.00 | 18.00 | <0.001 |
| April-July | 13.40 | 8.00 | 18.00 | <0.001 |
| March-May | 27.00 | 15.00 | 53.00 | <0.001 |
| Aug-Dec | -5.00 | -11.00 | -1.00 | <0.001 |
| Sept-Dec | -5.00 | -11.00 | -1.00 | <0.001 |
| April-Oct | 13.00 | 6.00 | 17.00 | <0.001 |
| June-Dec | -5.00 | -11.00 | -1.00 | <0.001 |
| March-Dec | 22.00 | 9.00 | 48.00 | <0.001 |
| July-Dec | -5.00 | -11.00 | -1.00 | <0.001 |
| April-May | 11.00 | 4.00 | 16.00 | <0.001 |
| May-Aug | 1.00 | 0.00 | 2.00 | <0.001 |
| Oct-Dec | -5.00 | -11.00 | 0.00 | <0.001 |
| May-Sept | 1.00 | 0.00 | 2.00 | <0.001 |
| March-April | 16.00 | 3.00 | 42.00 | <0.001 |
| May-June | 1.00 | 0.00 | 2.00 | <0.001 |
| Aug-Oct | 0.00 | -2.00 | 0.00 | 0.001 |
| Sept-Oct | 0.00 | -2.00 | 0.00 | 0.003 |
| May-Dec | -4.00 | -10.00 | 0.00 | 0.004 |
| May-July | 0.00 | 0.00 | 2.00 | 0.004 |
| April-Dec | 7.00 | -1.00 | 14.00 | 0.004 |
| June-Oct | 0.00 | -1.00 | 0.00 | 0.017 |
| July-Aug | 0.00 | 0.00 | 0.00 | 0.047 |
| July-Oct | 0.00 | -1.00 | 0.00 | 0.059 |
| July-Sept | 0.00 | 0.00 | 0.00 | 0.134 |
| June-Aug | 0.00 | 0.00 | 0.00 | 0.169 |
| May-Oct | 0.00 | -1.00 | 2.00 | 0.253 |
| June-Sept | 0.00 | 0.00 | 0.00 | 0.400 |
| June-July | 0.00 | 0.00 | 0.00 | 0.497 |
| Aug-Sept | 0.00 | 0.00 | 0.00 | 0.571 |

**Table 4. Summary of results from pairwise Wilcoxon test for paired monthly windowpane catch per tow in closed area II in 2011. Cells with yellow highlighting have median difference (first month – second month) in location that is significantly different from 0 using a Bonferroni adjusted critical value (1.004) to obtain a family-wise error rate of 5%. Cells with pink highlighting have significantly different location, but the magnitude of difference is small. Confidence limits are also adjusted for family-wise error rate using Bonferroni adjustment to the 95% confidence limits (adjusted to a 0.9986 CI).**

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | **0** | | | | | | | | | | | |
| Feb | **na** | **0** | | | | | | | | | | |
| Mar | **na** | **na** | **0** | | | | | | | | | |
| Apr | **na** | **na** | 16 | **0** | | | | | | | | |
| May | **na** | **na** | 27 | 11 | **0** | | | | | | | |
| Jun | **na** | **na** | 28 | 13 | 1 | **0** | | | | | | |
| July | **na** | **na** | 28 | 13 | 0 | 0 | **0** | | | | | |
| Aug | **na** | **na** | 28 | 14 | 1 | 0 | 0 | **0** | | | | |
| Sep | **na** | **na** | 28 | 13 | 1 | 0 | 0 | 0 | **0** | | | |
| Oct | **na** | **na** | 27 | 13 | 1 | 0 | 0 | 0 | 0 | **0** | | |
| Nov | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **na** | **0** | |
| Dec | **na** | **na** | 22 | 7.0 | -4 | -5 | -5 | -5 | -5 | -5 | **na** | **0** |

**Table 5. Median difference of catch per tow distribution (lb) from Wilcoxon test (column month-row month). Cells with yellow highlights have a statistically significant shift in location using Bonferroni adjusted critical value. Cells with pink highlights are also statistically significant shift in location, but median differences in locations are small. No sampling in January, February and November in 2011 in Closed Area II.**

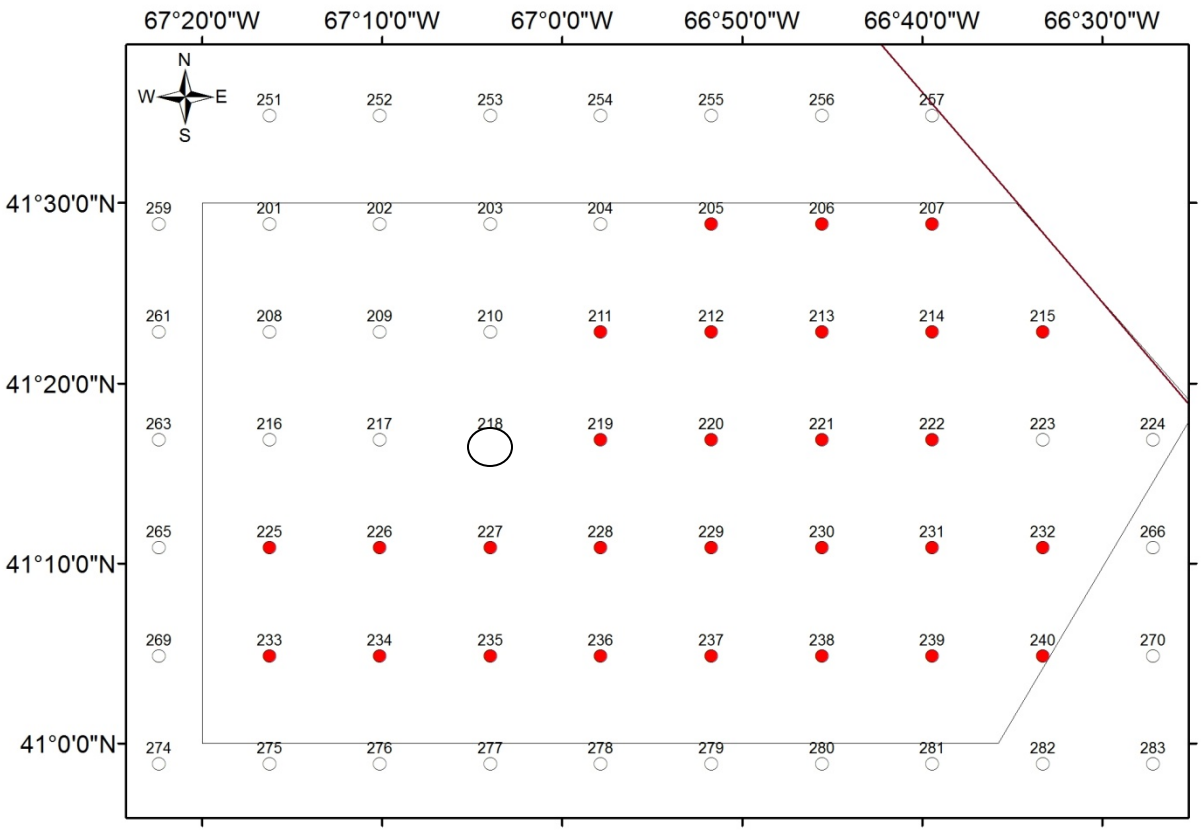


**Figure 2. Station locations within Closed Area II. Red dots indicate consistently sampled stations that were used in the analysis. Open dots represents stations that were dropped during the study. Note that station 218 was not included in the analysis of windowpane because it was not included in the standard**

## Literature cited

Smolowitz, R.; Goetting, K.; Davis, F.; and Ward D. (May 2012). Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch. Final Report.

# An analysis of Georges Bank yellowtail flounder monthly catch rates in Closed Area 1 and Closed Area 2 from the bycatch survey

Prepared for the Groundfish PDT

By

Steven Correia

Massachusetts Division of Marine Fisheries

August 17, 2012

The research set aside project: Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch conducted standardized survey of bycatch in scallop trawls in Closed Areas I and II in 2010-2012 provides estimates of yellowtail catches. I used a dataset provided by Devora Hart (NEFSC) to estimate differences in monthly catches of yellowtail flounder in the study area. The dataset consists of only "standardized selected" stations (Figures 5and 6) as described in (Smolowitz et al, 2012). Focusing on yellowtail catches rather than the yellowtail: scallop discard ratio, eliminates the confounding effects of changes in scallop yields on the seasonal availability of yellowtail in the closed areas.

| | Closed Area I | | | Closed Area II | | |
|---|---|---|---|---|---|---|
| | Year | | | year | | |
| month | 2010 | 2011 | 2012 | 2010 | 2011 | 2012 |
| Jan | 0 | 0 | 11 | 0 | 0 | 29 |
| Feb | 0 | 0 | 11 | 0 | 0 | 29 |
| Mar | 0 | 11 | 11 | 0 | 29 | 29 |
| Apr | 0 | 11 | 11 | 0 | 29 | 29 |
| May | 0 | 11 | 0 | 0 | 29 | 0 |
| June | 0 | 11 | 0 | 0 | 29 | 0 |
| July | 0 | 11 | 0 | 0 | 29 | 0 |
| Aug | 0 | 11 | 0 | 0 | 29 | 0 |
| Sept | 0 | 11 | 0 | 0 | 29 | 0 |
| Oct | 11 | 11 | 0 | 29 | 29 | 0 |
| Nov | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec | 0 | 11 | 0 | 0 | 29 | 0 |

**Table 1. Count of sampling "standardized selected" stations by area, month and year.**

## Methods

The number of stations sampled varied by month and year, with incomplete sampling in all years. Sampling occurred in all months but January, February and November in 2011 (Table 1). I used an analysis of variance to compare $\log_e$ yellowtail catch per tow by month for 2011 for "standardized selected" stations only. I evaluated A- posteriori paired monthly mean $\log_e$ YT catches using Tukey-Range method to account for simultaneous testing procedures. I set the familywise error rate set at 0.05 for the 36 paired monthly comparisons. I separately analyzed each closed area because sample sizes differed by area, and the Tukey Range method (also known as Tukey's honestly significant difference test) assumes equal sample sizes.

## Results

Boxplots of the yellowtail catch per tow by month for closed Area II in 2011 are shown in Figure 1. The distributions of catch rates are shifted higher in August, September and October relative to the overall median and the distribution s of catches per tow for April, May and June are below the overall median. The inter-quartile range of the distributions appears relatively homogeneous for all months. Boxplots of the yellowtail catch per tow by month for Closed Area I in 2011 are shown in Figure 2. These boxplots are more difficult to interpret. The small sample size (11) causes the notch to exceed the inter-quartile range in all months but December. Both March and December have only 1 tow with yellowtail. Median catch rates are higher in spring and December than in the late summer/ early fall months (August-October). As with Closed Area II, no sampling occurred in January, February or November in 2011.

An ANOVA of yellowtail catch rates for Closed Area II indicated significant month effect (Table 2). Diagnostics indicated that distribution of residuals was significantly different from normal and that station s225 in September 2011 was an outlier and had influence. Other diagnostics were not remarkable. Summaries of paired month comparison of mean catch rates are shown in Tables 4 and 5 and Figure 2. Sixteen out of the thirty six paired comparisons had statistically significant differences at the adjusted 0.05 p-value. Catch rates in October were significantly higher than March, April, May, June, July, and December. Similarly, yellowtail catch rates for September were significantly higher than March, April, May, June, and July. The paired monthly comparisons for August were also similar, with August having significantly higher mean catch rate than March, April, May, June, and July. For Closed Area II, monthly mean catch rates are higher for late summer-early fall than winter-spring. Information is not available for November, January and February. This seasonal pattern is consistent with Devora Hart's analysis of yellowtail: scallop catch ratio.

An ANOVA of yellowtail catch rates for Closed Area I indicated a significant month effect (Table 3). Diagnostics indicated heterogeneous variance and the distribution of residuals was not normal (leptokurtosis was present). None of the paired month comparisons were significantly different according to the Tukey range test (Table 6; Figure 4). Smaller sample sizes within the month (11 stations) may have contributed to the finding of no significant differences in comparison of monthly means, even though month effects are statistically significant.

## Conclusions

Mean yellowtail catches are significantly higher for late summer-early fall months than spring months in Closed Area II in 2011. Although month effects were significant for mean yellowtail catch in Closed Area I, diagnostics suggest that some assumptions of ANOVA may not be met and the model may be unreliable for testing month effects or monthly comparisons.

## Literature cited

Smolowitz, R.; Goetting, K.; Davis, F.; and Ward D. (May 2012). Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch. Final Report.

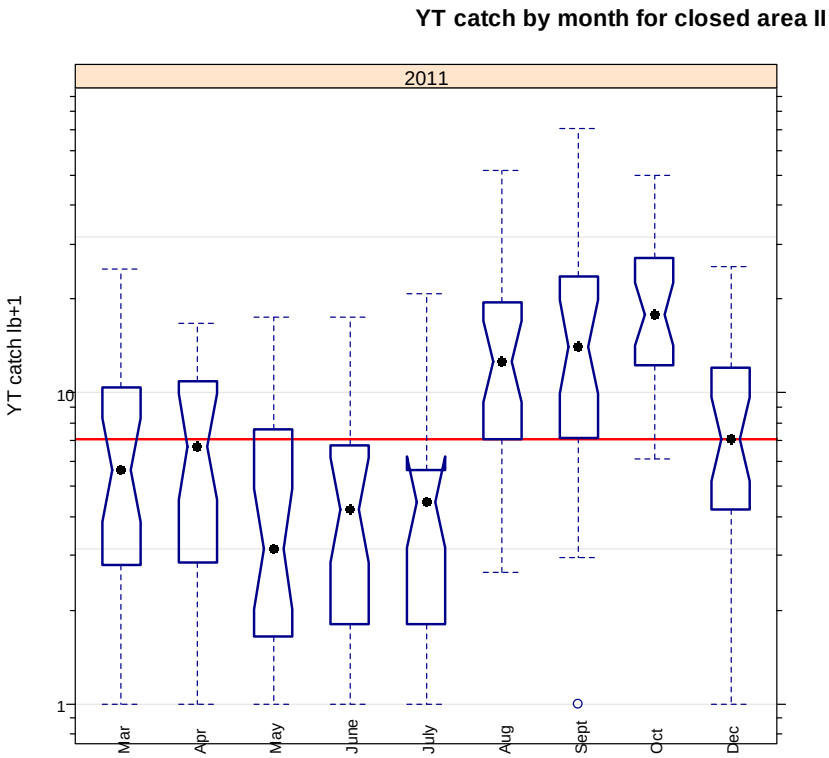


**Figure 1. Boxplots of yellowtail catch (lb+1) per two in Closed Area II by month for 2011. Y-axis scale is logarithmic. Black dots are medians and non-overlapping notches indicate approximately 95% confidence interval for differences in median. Folded notch for July indicates that notch for that month may not be reliable as indicator of differences in median. Red line is median yellowtail catch rate for all months pooled. No sampling occurred in January, February or November in 2011.**

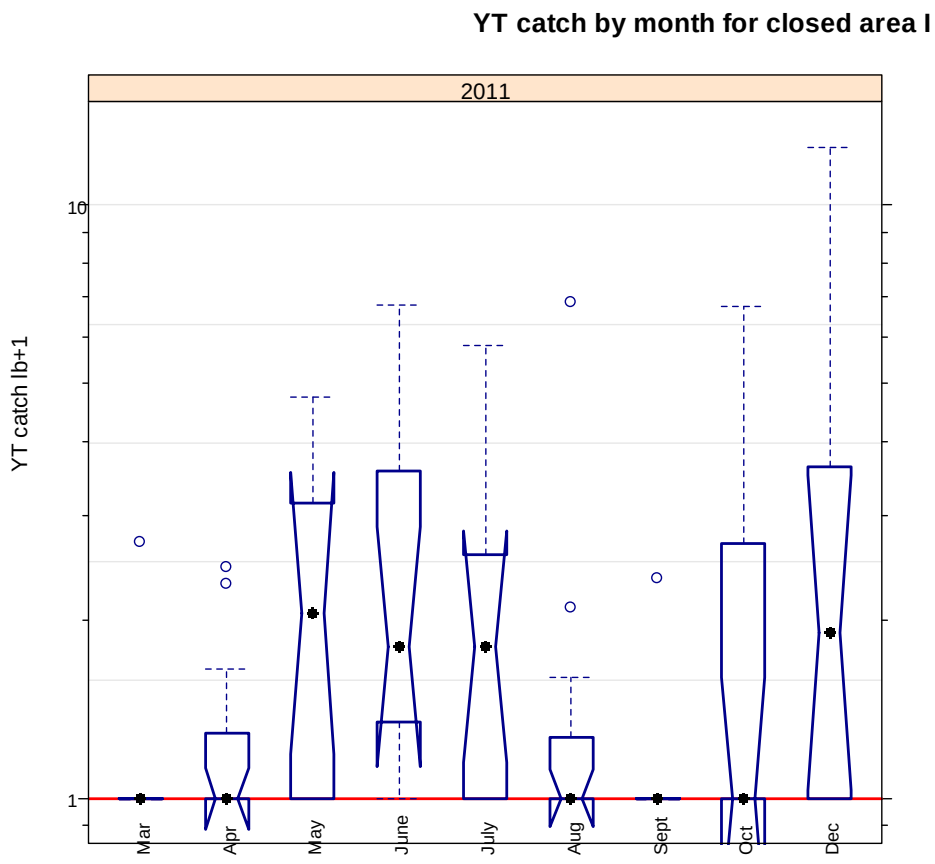


**Figure 2. Boxplots of yellowtail catch (lb) +1 per two in Closed Area I by month. Y-axis scale is logarithmic. Black dots are medians and non-overlapping notches indicate approximately 95% confidence interval for differences in median. Folded notch for April-October indicates that notches for that month may not be reliable as confidence limits for comparing differences in medians. Red line is median yellowtail catch rate for all months pooled. No sampling occurred in January, February or November. Only 1 trip caught yellowtail in March and September.**

| | DF | Sum sq | Mean square | F-value | P(>F) |
|---|---|---|---|---|---|
| month | 8 | 86.54 | 10.817 | 14.36 | <0.001 |
| residuals | 252 | 189.8 | 0.753 | | |

**Table 2. Summary results of ANOVA of $\log_e$(catch+1) by month for Closed Area II for 2011.**

| | Df | Sum sq | mean square | F-value | P(>F) |
|---|---|---|---|---|---|
| month | 8 | 7.16 | 0.8947 | 2.512 | 0.0164 |
| residuals | 90 | 32.06 | 0.3562 | | |

**Table 3. Summary results of ANOVA of $\log_e$(catch+1) by month for Closed Area I for 2011.**

| | monthly mean | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | no data | no data | 1.69 | 1.62 | 1.21 | 1.28 | 1.22 | 2.45 | 2.46 | 2.86 | no data | 1.82 |
| Jan | no data | 1.00 | na | na | na | na | na | na | na | na | na | na | na |
| Feb | no data | na | 1.00 | na | na | na | na | na | na | na | na | na | na |
| Mar | 1.69 | na | na | 1.00 | 0.62 | 0.62 | 0.66 | 0.62 | 2.14 | 2.16 | 3.23 | na | 1.13 |
| Apr | 1.62 | na | na | 1.08 | 1.00 | 0.66 | 0.72 | 0.67 | 2.30 | 2.33 | 3.48 | na | 1.22 |
| May | 1.21 | na | na | 1.62 | 1.50 | 1.00 | 1.08 | 1.00 | 3.46 | 3.51 | 5.23 | na | 1.83 |
| Jun | 1.28 | na | na | 1.51 | 1.40 | 0.93 | 1.00 | 0.93 | 3.22 | 3.26 | 4.86 | na | 1.70 |
| July | 1.22 | na | na | 1.61 | 1.50 | 1.00 | 1.07 | 1.00 | 3.45 | 3.49 | 5.21 | na | 1.82 |
| Aug | 2.45 | na | na | 0.47 | 0.43 | 0.29 | 0.31 | 0.29 | 1.00 | 1.01 | 1.51 | na | 0.53 |
| Sep | 2.46 | na | na | 0.46 | 0.43 | 0.26 | 0.28 | 0.29 | 0.99 | 1.00 | 1.49 | na | 0.52 |
| Oct | 2.86 | na | na | 0.31 | 0.29 | 0.19 | 0.21 | 0.19 | 0.66 | 0.67 | 1.00 | na | 0.35 |
| Nov | no data | na | na | na | na | na | na | na | na | na | na | 1.00 | na |
| Dec | 1.82 | na | na | 0.88 | 0.82 | 0.55 | 0.59 | 0.55 | 1.89 | 1.92 | 2.86 | na | 1.00 |

**Table 4. Backtransformed differences between monthly column mean and monthly row means for in Closed Area II in 2011. Monthly means are in log (lbs+1). Yellow highlighted cells are significantly different at family wise error rate of 0.05. na indicates that sampling did not occur in January, February or November in 2011.**

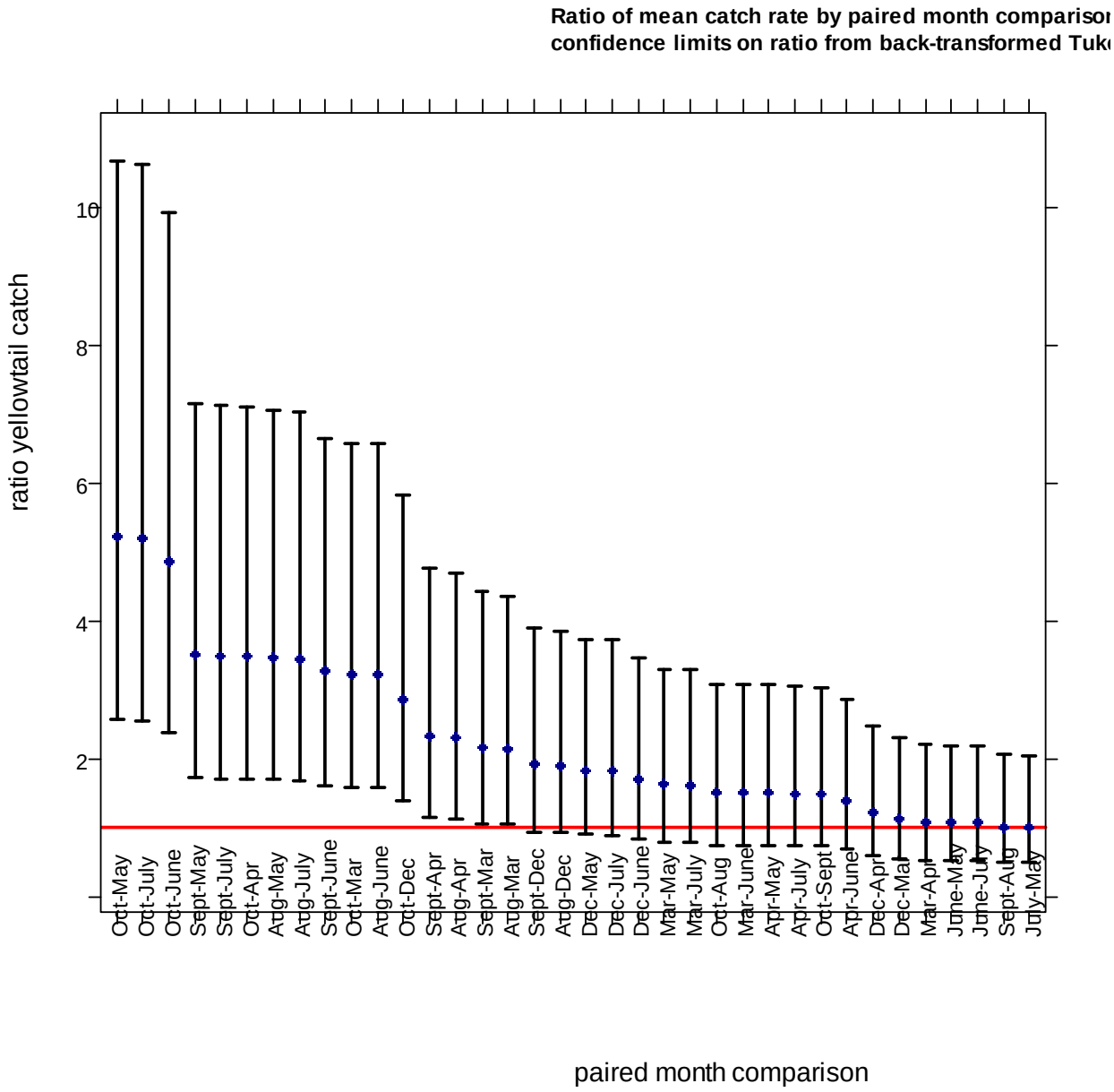


**Figure 3. Ratio of mean yellowtail catch rates between paired month comparisons with 95% confidence limits for Closed area II. Red line=1. Ratio's are significantly different from 1 at familywise error rate =0.05 if confidence limits do not overlap red line.**

| Month comparison | Mean ratio | Lower 95% CL | Upper 95% CL | Adjusted P value |
|---|---|---|---|---|
| Oct-May | 5.23 | 2.59 | 10.56 | 0.000 |
| Oct-June | 4.86 | 2.41 | 9.81 | 0.000 |
| Oct-July | 5.21 | 2.58 | 10.51 | 0.000 |
| Sept-May | 3.83 | 1.89 | 7.78 | 0.000 |
| Sept-July | 3.81 | 1.88 | 7.75 | 0.000 |
| Sept-June | 3.56 | 1.75 | 7.23 | 0.000 |
| Oct-Apr | 3.48 | 1.72 | 7.03 | 0.000 |
| Aug-May | 3.46 | 1.71 | 6.99 | 0.000 |
| Aug-July | 3.45 | 1.71 | 6.96 | 0.000 |
| Oct-Mar | 3.23 | 1.60 | 6.52 | 0.000 |
| Aug-June | 3.22 | 1.59 | 6.50 | 0.000 |
| Oct-Dec | 2.86 | 1.41 | 5.77 | 0.000 |
| Sept-Apr | 2.55 | 1.25 | 5.18 | 0.002 |
| Sept-Mar | 2.36 | 1.16 | 4.80 | 0.006 |
| Aug-Apr | 2.30 | 1.14 | 4.65 | 0.008 |
| Aug-Mar | 2.14 | 1.06 | 4.31 | 0.023 |
| Sept-Dec | 2.09 | 1.03 | 4.25 | 0.034 |
| Dec-Aug | 0.53 | 0.26 | 1.07 | 0.111 |
| Dec-May | 1.83 | 0.91 | 3.70 | 0.155 |
| Dec-July | 1.82 | 0.90 | 3.68 | 0.162 |
| Dec-June | 1.70 | 0.84 | 3.44 | 0.306 |
| May-Mar | 0.62 | 0.31 | 1.25 | 0.442 |
| July-Mar | 0.62 | 0.31 | 1.25 | 0.455 |
| Oct-Aug | 1.51 | 0.75 | 3.05 | 0.657 |
| June-Mar | 0.66 | 0.33 | 1.34 | 0.667 |
| May-Apr | 0.67 | 0.33 | 1.34 | 0.673 |
| July-Apr | 0.67 | 0.33 | 1.35 | 0.686 |
| June-Apr | 0.72 | 0.35 | 1.45 | 0.860 |
| Oct-Sept | 1.37 | 0.67 | 2.77 | 0.907 |
| Dec-Apr | 1.22 | 0.60 | 2.46 | 0.994 |
| Dec-Mar | 1.13 | 0.56 | 2.28 | 1.000 |
| Sept-Aug | 1.11 | 0.54 | 2.25 | 1.000 |
| Apr-Mar | 0.93 | 0.46 | 1.87 | 1.000 |
| June-May | 1.08 | 0.53 | 2.17 | 1.000 |
| July-June | 0.93 | 0.46 | 1.88 | 1.000 |
| July-May | 1.00 | 0.50 | 2.03 | 1.000 |

**Table 5. Summary of results from Tukey range test for paired monthly yellowtail catches in Closed Area II in 2011. Cells with yellow highlighting have ratio of monthly mean significantly different from 1 at familywise error rate of 0.05.**

| Month | Ratio | Lower CL | Upper CL | p adjusted |
|---|---|---|---|---|
| Sept-June | 0.50 | 0.22 | 1.12 | 0.15 |
| Dec-Sept | 2.00 | 0.89 | 4.50 | 0.15 |
| June-Mar | 1.98 | 0.88 | 4.45 | 0.17 |
| Dec-Mar | 1.98 | 0.88 | 4.44 | 0.17 |
| Sept-May | 0.56 | 0.25 | 1.25 | 0.35 |
| May-Mar | 1.78 | 0.79 | 3.99 | 0.37 |
| June-Apr | 1.77 | 0.79 | 3.98 | 0.39 |
| Dec-Apr | 1.77 | 0.79 | 3.97 | 0.39 |
| Sept-July | 0.58 | 0.26 | 1.31 | 0.47 |
| July-Mar | 1.69 | 0.75 | 3.80 | 0.50 |
| Aug-June | 0.61 | 0.27 | 1.38 | 0.60 |
| Dec-Aug | 1.63 | 0.73 | 3.66 | 0.60 |
| Oct-Sept | 1.60 | 0.71 | 3.60 | 0.65 |
| May-Apr | 1.59 | 0.71 | 3.57 | 0.67 |
| Oct-Mar | 1.58 | 0.71 | 3.55 | 0.68 |
| July-Apr | 1.51 | 0.67 | 3.40 | 0.79 |
| Aug-May | 0.68 | 0.30 | 1.53 | 0.85 |
| Oct-Apr | 1.41 | 0.63 | 3.18 | 0.91 |
| Aug-July | 0.72 | 0.32 | 1.61 | 0.93 |
| Oct-Aug | 1.30 | 0.58 | 2.93 | 0.98 |
| Oct-June | 0.80 | 0.36 | 1.79 | 0.99 |
| Dec-Oct | 1.25 | 0.56 | 2.81 | 0.99 |
| Sept-Aug | 0.81 | 0.36 | 1.82 | 1.00 |
| Aug-Mar | 1.22 | 0.54 | 2.73 | 1.00 |
| July-June | 0.85 | 0.38 | 1.92 | 1.00 |
| Dec-July | 1.17 | 0.52 | 2.62 | 1.00 |
| Sept-Apr | 0.88 | 0.39 | 1.98 | 1.00 |
| Oct-May | 0.89 | 0.40 | 2.00 | 1.00 |
| Apr-Mar | 1.12 | 0.50 | 2.51 | 1.00 |
| June-May | 1.11 | 0.50 | 2.50 | 1.00 |
| Dec-May | 1.11 | 0.50 | 2.50 | 1.00 |
| Aug-Apr | 1.09 | 0.48 | 2.44 | 1.00 |
| Oct-July | 0.93 | 0.42 | 2.10 | 1.00 |
| July-May | 0.95 | 0.42 | 2.14 | 1.00 |
| Sept-Mar | 0.99 | 0.44 | 2.22 | 1.00 |
| Dec-June | 1.00 | 0.44 | 2.24 | 1.00 |

**Table 6. Summary of results from Tukey range test for yellowtail catches in Closed Area I in 2011. None of the paired monthly comparisons have a ratio of monthly means significantly different from 1 at familywise error rate of 0.05.**

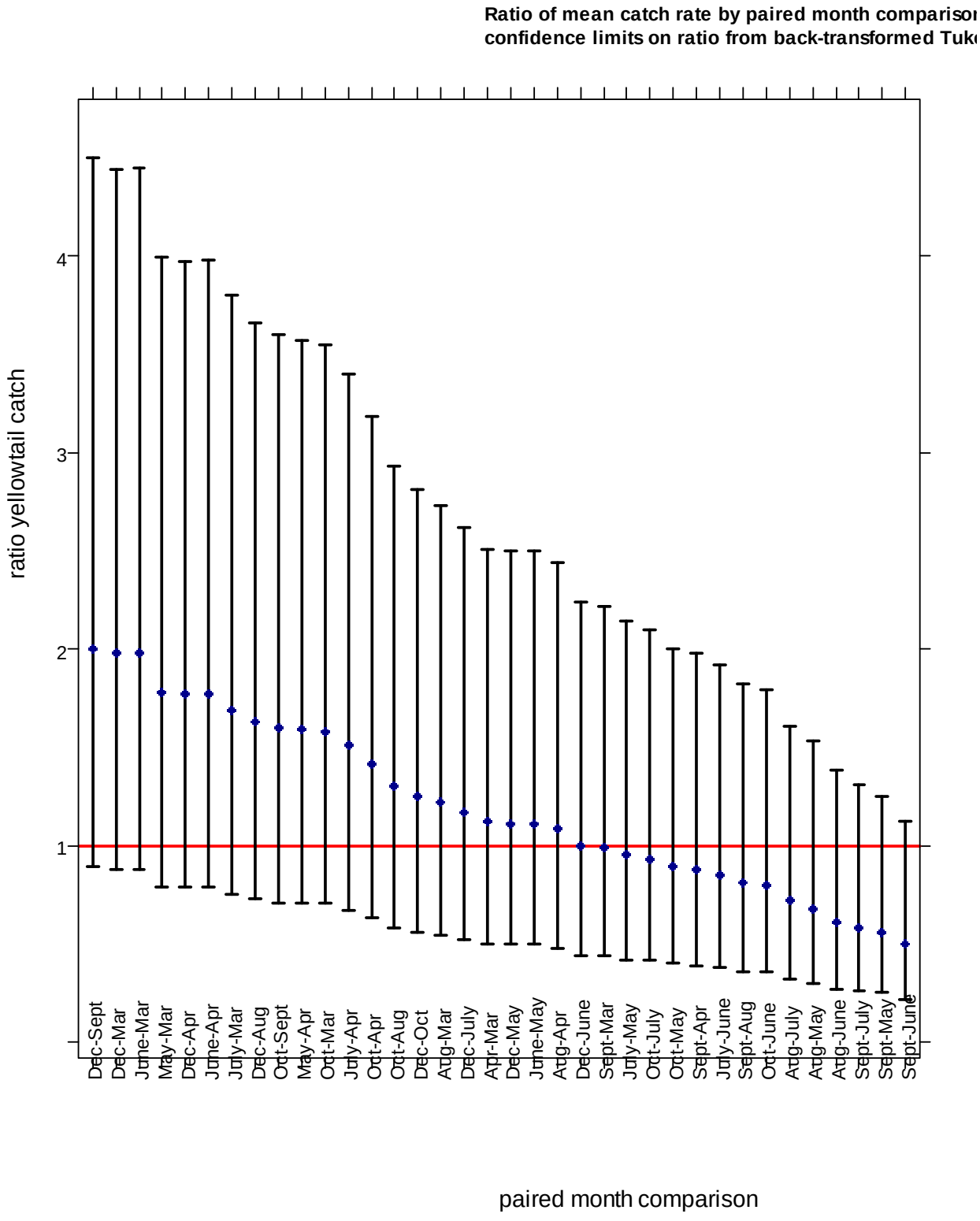


**Figure 4. Mean ratio of yellowtail catch rates between paired month comparisons with 95% confidence limits. Red line=1. Ratio's are significantly different from 1 at family wise error rate =0.05 if confidence limits do not overlap red line.**

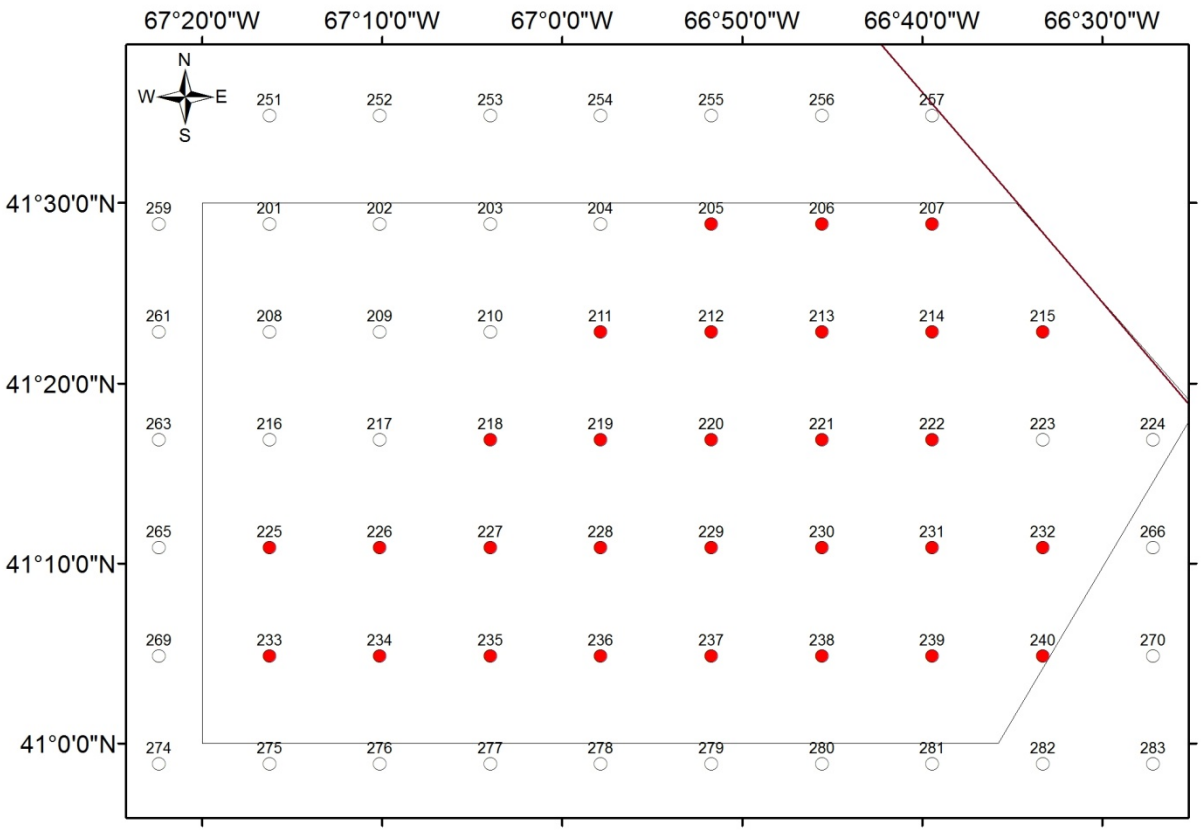


**Figure 5. Station locations within Closed Area II. Red dots indicate consistently sampled stations that were used in the analysis. Open dots represents stations that were dropped during the study.**

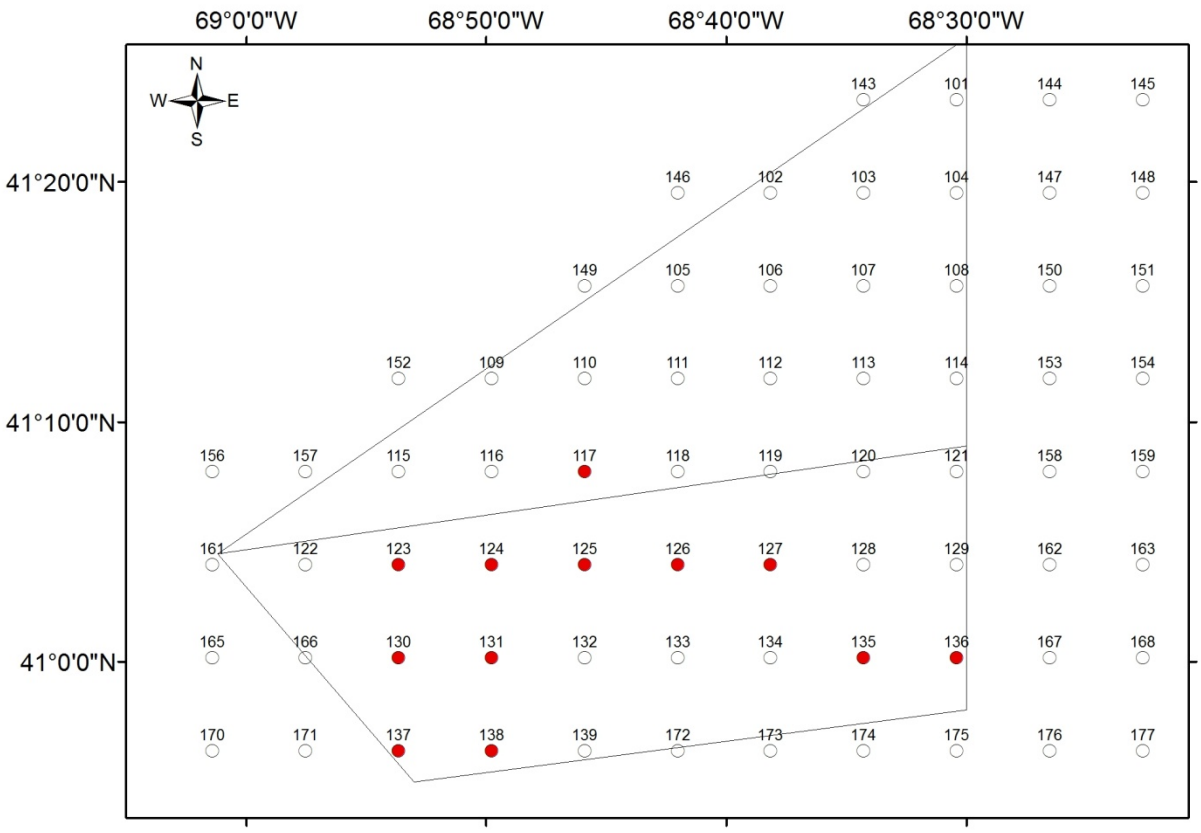


**Figure 6. Station locations within Closed Area I. Red dots indicate consistently sampled stations that were used in the analysis. Open dots represents stations that were dropped during the study.**

# Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch

**Final Report**

**Prepared for the 2011**

**Sea Scallop Research Set-Aside**

August 2012

Submitted By

**Ronald Smolowitz, Kathryn Goetting, Farrell Davis, Dan Ward**

**Coonamessett Farm Foundation, Inc**

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NOAA Grant Number: NA11NMF4540027

A. Grantee: Coonamessett Farm Foundation, Inc

**B.** Project Title: **Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch**

C. Amount of Grant $: $1,847,700.00

D. Award Start Date: 03/01/2011 - 02/29/2012

E. Period Covered by Report: 03/01/2011-05/01/2012

*Executive Summary:*

Fourteen trips were made to Georges Bank CAI and CAII scallop access areas from October 2010 through April 2012. On each trip approximately 80 stations were surveyed using two scallop dredges following standardized procedures. Yellowtail flounder bycatch rates were found to be highest during the August through October period. Scallop meat growth is highest in the April through June period. Yellowtail flounder suffer high rates of discard mortality (85%); discard mortality of winter flounder is much lower (36%). Results indicate that peak spawning for yellowtail flounder on Georges Bank is around May/June; for winter flounder it is February/March. Evidence supports past experience that the CFarm turtle deflector dredge (CFTDD) frame increases the catch of scallops and decreases the bycatch of flatfish. Additionally, lower twine top ratios and shorter aprons also reduce the bycatch rate of flatfish.

**Trips analyzed in this report:**

| | |
|---|---|
| F/V Celtic | Oct. 12 – 18, 2010 |
| F/V Arcturus | March 9 – 15, 2011 |
| F/V Celtic | April 14 – 20, 2011 |
| F/V Westport | May 11 – 17, 2011 |
| F/V Liberty | June 1 – 7, 2011 |
| F/V Endeavor | July 6 – 12, 2011 |
| F/V Regulus | Aug 15 – 21, 2011 |
| F/V Resolution | Sept 10 – 16, 2011 |
| F/V Ranger | Oct. 4 – 10, 2011 |
| F/V Horizon | Nov 29 - Dec 5, 2011 |
| F/V Wisdom | Jan 4 – 10, 2012 |
| F/V Venture | Feb 16 – 22, 2012 |
| F/V Regulus | March 10 – 16, 2012 |
| F/V Endeavor | April 10 – 16, 2012 |

## Introduction

The sea scallop is one of the most economically valuable commercial species in the northeast United States and supports the most valuable wild scallop fishery in the world (Hart and Chute, 2004). The stock has been rebuilt and no overfishing is occurring. However, the harvest of this important resource is currently restricted due to bycatch of yellowtail flounder on Georges Bank and in Southern New England. Management measures to constrain the harvest of sea scallops have resulted in the loss of millions of dollars to the communities of the Northeast and Mid-Atlantic regions of the United States.

Under Amendment 10 to the Sea Scallop Fishery Management Plan (FMP) (NEFMC, 2004a) the scallop resource is harvested through rotational area-based management to allow for identification and protection of juvenile scallops. Despite the success of this program for scallop harvest, the spatial and temporal influences on bycatch of groundfish species has not been quantified. Currently, there are large aggregations of harvestable scallops in the three Closed Areas of Georges Bank that contain populations of yellowtail flounder. Restrictions on the timing of scallop harvest in these areas may result in high bycatch ratios of yellowtail flounder and reduced meat yield of scallops.

Framework 16/39 to the Scallop and Groundfish FMPs defined the access season for scallop vessels from June 15 to January 31 (NEFMC, 2004b). According to the rationale in the joint Framework, the Council made this decision based on unknown but potential risks to spawning groundfish and unknown but potential higher bycatch rates during the spring "when bycatch could not be predicted based on existing data". The document pointed out as part of the rationale that data may become available from future research. The scallop industry, according to the document, supported year round access to reduce the effect of concentrating landings in a shorter season, improve meat yields by avoiding harvest during scallop spawning in the fall, and address safety and weather concerns during the fall and winter seasons.

A report was prepared for the NEFMC (January 27, 2004) by the Ad Hoc Working Group examining ways to limit incidental catches of yellowtail flounder in scallop access programs. The Working Group noted that "neither the Groundfish Oversight Committee nor the Scallop Oversight Committee had recommended restricting the seasons of access" to the three groundfish closures on Georges Bank. Furthermore, the report indicated that "all the available data on bycatch in scallop dredges in those areas came from the period mid-June to January." The report made the Council aware that "bycatch rates in the late winter and through the spring could be very different from the available estimates based on summer and fall data."

The reauthorized Magnuson-Stevens Act (U.S. DOC, 2007) established new requirements to end and prevent overfishing through the implementation of ACLs and Accountability Measures (Section 303(a)(15)) for all stocks and stock areas. For the US sea scallop fishery, these requirements apply to the target stock, Atlantic sea scallops, as well as to non-target species,

including three yellowtail flounder stocks (Georges Bank, Cape Cod/Gulf of Maine and Southern New England/Mid Atlantic).

There is currently limited information pertaining to groundfish bycatch and scallop meat yield in the Georges Bank closed areas from February through mid-June due to the absence of fishing during this time period. Furthermore, minimal information exists on the optimization of scallop catch and yellowtail bycatch reduction in open areas. Spatial and temporal variation in scallop meat yield has been observed on Georges Bank in relation to depth, flow velocity and water temperature (Sarro and Stokesbury, 2009). Also, variations in yellowtail flounder bycatch rates have been noted in the open and closed areas of Georges Bank through observer data (Bachman, 2009). The lack of spatially and temporally specific data on meat yield and bycatch rates needed to be addressed and that was the major focus of this project.

As the project developed the opportunity for additional sampling was recognized and incorporated into the program; one effort was examining discard mortality. Discard survival rates are currently assumed for several stock assessments in the Northeast United States including the Southern New England Mid-Atlantic (SNEMA) winter flounder (*Pseudopleuronectes americanus*) and southern summer flounder (*Paralichthys dentatus*) stock assessments (NEFSC, 2011; NEFSC, 2008). Including information on discard mortality allows for a more accurate estimate of the stock abundance as well as more representative Biological Reference Points (BRPs), which may change the overfished and overfishing status of these stocks (Barkley et al., 2010).

Estimated rates of discard mortality range widely. In stock assessments, discard mortality rates are often assumed to be 100% as a conservative approach, while mark-recapture studies typically assume low discard mortality rates (e.g. Alade, 2008). The 2008 stock assessment for SNEMA yellowtail flounder assumed a 100% discard mortality rate (Alade et al., 2008), while a recent yellowtail flounder tagging study performed in the SNEMA estimated a negligible capture mortality rate (Alade, 2008) from short research trawls and field protocols that were designed to minimize mortality. Assumed discard mortality rates of 0% and 100% are unlikely in a complex fishery that spans multiple gear types and differing catch sorting methods. Robinson and Carr (1993) reported that discarded yellowtail flounder exhibited high survival rates with survival estimated to be 67% or greater. Similarly, Carr et al. (1995) showed that yellowtail flounder had the greatest survival rates of the three fish species studied: yellowtail flounder, American plaice (*Hippoglossoides platessoides*), and Atlantic cod (*Gadus morhua*), with survival rates of 66% and higher.

Reflex Action Mortality Predictors (RAMP) provides a tool to address the estimation of discard mortality using direct observations aboard fishing vessels. The RAMP approach is based on behavioral reflexes, involuntary actions or responses to a stimulus (Berube et al., 2001). Davis and Ottmar (2006) and Davis (2007) identified behavioral reflexes that are observed in unstressed fish, but absent in near-dead fish. In all of their experiments, reflex impairment (RAMP scores) increased with mortality (Davis, 2007). Reflex impairment of yellowtail flounder was examined by Barkley and Cadrin (2012), who also found a significant positive relationship between reflex impairment and mortality using a suite of seven reflexes (Table 1).

A study of the seasonal effects on sea scallop reproduction and energetics was supported by this project. Georges Bank supports the largest wild scallop fishery in the world (Caddy, 1989), yet little is known about spawning patterns in this region. Generally Georges Bank scallops are considered fall spawners. However, there have been several reports of semiannual spawning in this area (DiBacco et al., 1995; Almeida et al., 1994). Semiannual spawning would be an important distinction as current management is based on annual spawning (DiBacco et al., 1995) and semiannual spawning could alter yield per recruit estimates.

Scallops have a sequential skeletal deposition which provides a good medium for archiving environmental and physiological changes in growth. Oxygen isotopes are thermodynamically sensitive and the fractionation of $^{18}O/^{16}O$ ($\delta^{18}O$) is mediated by the reaction temperature (Tan et al., 1988; Krantz et al., 1984). Numerous studies have shown that the sequential $\delta^{18}O$ signature in bivalve shell carbonate fluctuates with water temperature (Goewert and Surge, 2008; Owen et al., 2002; Jones and Quitmyer, 1996; Tan et al., 1988; Krantz et al., 1984). In the summer, at warmer sea water temperatures fewer of the heavier $^{18}O$ isotopes are incorporated into the shell carbonate resulting in a "lighter or depleted" isotope value. In the winter, the opposite is true and more of the heavier isotope is deposited in the shell producing a "heavier or enriched" isotope signature. Thus, the $\delta^{18}O$ signature in scallop shells can provide an estimate of seasonal growth and age (Jones and Quitmyer, 1996; Krantz et al., 1984). As the carbonate $\delta^{18}O$ signature reflects the water temperature when the shell was deposited, the $\delta^{18}O$ value from the umbo can indicate if a scallop originated from a spring or fall spawning event.

Studies suggest that scallop meat weight fluctuates annually (Sarro and Stokesbury, 2009; Penney and McKenzie, 1996). Seasonal changes in meat weight and gonad weight are inversely related (Sarro and Stokesbury 2009), with energy reserves in the form of glycogen and lipids reallocated from the adductor muscle to the gonad during gametogenesis (Gould et al., 1988; MacDonald and Thompson, 1986; Robinson et al., 1981). The timing and the extent of this energy transfer is important for scallop growth and recruitment. Thus, seasonal glycogen levels may be an indicator of scallop condition and reproductive potential.

Sea scallop shell height and meat weight data were collected on all cruises during the course of the study. The purpose of these collections was to estimate area and time specific relationships in an effort to document the annual variation in scallop meat weight. These estimates will provide a relative measure of scallop yield and when comparing these findings to the relative abundance of major bycatch species, forms a baseline for an optimized harvest strategy.

## Methods

The project consisted of fourteen research trips aboard commercial scallop vessels; each trip was approximately seven days in duration. Initially, the strategy was to cover 80 stations per trip; 40 in and around CAI (Figure 1) and 40 in and around CAII (Figure 2). As the project progressed we dropped stations that had no yellowtail or scallops, where the dredges loaded up with sand dollars, or where the bottom was too hard to tow successfully (rocks). We added stations that had

scallops and yellowtail and thus more stations were fished in and around CAII as the project progressed. The bycatch data was analyzed in two groupings. The first data set was only stations that were successfully occupied on all 14 trips and were located inside the existing boundaries of CAI and CAII. This is referred to as the standardized selected stations in this report. The second grouping was all the data from all stations successfully occupied. In addition, when possible, we added data from the May 2012 and the June 2012 trips to certain tables and figures.

Each vessel was outfitted with a 15-foot wide Cfarm turtle deflector dredge (CFTDD) rigged with a standardized bag that was held constant throughout the project. The second dredge was provided by the vessel and was a New Bedford dredge rigged the way the vessel desired to fish the gear. The vessels were told to tow at 4.6-4.8 knots using 3:1 wire scope. The tows were 30 minutes in duration and the captain was instructed to pass through the center point of the station sometime during the tow. All tow parameters were recorded including start and end positions, depth, and sea conditions. Only the data from the standard Cfarm dredge was used in the bycatch rate analysis between trips. On each trip a relative comparison was made between the two gear types for catch and bycatch.

For each paired tow, the catch from each dredge was separated by species and individually counted. The entire scallop catch was recorded as bushels (bu=35.2 liters). A one bushel subsample of scallops from each dredge was picked at random from each tow. These subsamples were measured in 5 mm incremental groups to estimate the length frequency of the entire catch. This method allows for the determination of the size frequency of the entire catch by expanding the catch at each shell height by the fraction of total number of baskets sampled. All of the commercially important finfish species and barndoor skates were measured to the nearest centimeter and counts were taken of winter and little skates.

RAMP Discard Mortality

Reflex Action Mortality Predictors (RAMP) were tested as described in Barkley and Cadrin (2012) on every tow that yellowtail or winter flounder were captured, on a monthly basis for 11 months.

As the dredge came aboard the vessel, the catch was dumped on deck and sorted as would be done during a standard commercial trip. All yellowtail flounder that were tested were handpicked from the pile and placed in a tub of seawater. After the deck was sorted reflex testing began. Each fish was placed in a fish tote partially filled with seawater to minimize handling effects, followed by being tested for the seven reflexes (Barkley and Cadrin 2012; Table 1). Each reflex was determined to be either present, or absent and recorded as a 0 or 1, respectively, which combined creates the RAMP score (four of seven reflexes absent is expressed as 4/7 or a RAMP score of 0.57). Each mean RAMP score was then applied to the lab-based reflex impairment-mortality relationship to calculate an estimate of discard mortality, as well as lower and upper confidence intervals at ±1 standard deviation (Barkley and Cadrin 2012).

## Maturity

Maturity data was collected monthly on all valid tows. All fish (if less than 10 fish) or a sub-sample of 10 fish per species were sampled using the NEFSC 6-stage maturity (Burnett et al., 1989). Sampling began in March 2011; this report is based on data through April 2012. The level of training on maturity staging of each scientific crew varied which may have led to some differences in staging over the months.

## Seasonal Effects on Sea Scallop Reproduction and Energetics

Monthly samples were collected to examine seasonal effects on sea scallop reproduction and energetics on Georges Bank. Live scallops (n=30-50) in good condition and approximately 130 mm in shell height (SH) were collected from CA126 (backup station: CA133) and CA222 (backup station: CA223) during March 2011-March 2012 survey cruises and immediately frozen whole. A subset (n=10) of these samples was removed for glycogen analysis.

The remaining samples were thawed, shell height measured using digital calipers, and the gonad separated from the somatic tissue using a scalpel. The crystalline style, intestinal contents and foot were removed from the gonads prior to drying and included with viscera weight. Gonads were oven-dried for approximately 72 hours until reaching constant weight and dry gonad weight was recorded. Gonosomatic index (GSI) was calculated (GSI = [Gonad Weight/Total Tissue Weight]*100, Barber and Blake 2006). Spawning events will be identified by a significant decrease in GSI between months.

Samples collected for glycogen content are currently being processed. The shell height and reproductive condition is recorded and then the semi-frozen tissues are separated into adductor muscle, gonad, mantle gills and digestive gland. These tissues are freeze dried to a constant weight to obtain dry tissue weights. Adductor muscle and gonad tissues are then assayed for glycogen using the BioVision Glycogen Assay Kit and colorimetric (absorbance 570 nm) methods to evaluate seasonal energy partitioning. The results from these samples will be available in June 2012.

Gonad tissue samples (n = 15, 10 females + 5 males) were collected at each station and preserved in formalin for histological analysis from June 2011 – April 2012. Following the criteria of Naidu (1970), the slides are examined and the oocyte diameter measured in order to determine the reproductive stage. A significant difference in oocyte diameter between months will provide additional evidence of spawning.

Two temperature loggers (Minilog V3.09, Vemco) were deployed in steel sheaths welded to the dredges to measure depth and water temperature at the time of sample collection. Measurements were compared with Finite-Volume Coastal Ocean Model FVCOM (Chen et al., 2006) data to provide annual profiles of the bottom water temperature at these two stations. Harmonic regression will be performed to smooth the curves and a two-dimensional Kolmogorov-Smirnov

statistical test will determine whether there is significant difference in bottom temperature between areas.

The top shell from the samples for energetic analysis and a subset of top shells from the meat weight component of the bycatch survey were processed for isotope analysis. These shells were scrubbed clean of any exterior organic debris, rinsed with distilled water and then air dried. Shell carbonate powder was collected using a Dremel® diamond head drill with a flexible arm attachment. The outer shell layer was micro drilled every 0.5-1.0 mm along and parallel to the axis of maximum growth from umbo to shell margin. A minimum of 100 micrograms were collected from each sample site on the shell. The carbonate powder was transferred to a micro centrifuge tube and the samples have been submitted to a laboratory for $^{18}O$ isotope analysis. The samples will be analyzed using Finnigan MAT 251 triple-collector gas source mass spectrometer coupled to a Finnigan Kiel automated preparation device. The isotope values will be reported in the conventional delta δ notation as the enrichment or depletion of $^{18}O$ (parts per thousand ‰) relative to the Peedee belemnite (PDB) carbonate standard (Peterson and Fry, 1987). The results are expected from the laboratory in June-July 2012.

The predicted water temperature during shell formation will be determined using the paleotemperature equation by Epstein et al. (1953) and modified by Craig (1965):

Equation 1:

$$\delta^{18}O_{(calcite)} = \delta^{18}O_{(water)} + \frac{4.2 - \sqrt{17.64 - 0.52(16.9 - T)}}{0.26}$$

where T= ambient temperature (°C).

This value will be correlated with the actual temperature from the FVCOM model providing an estimated date of shell formation for each calcite sample site.

Flounder Disease Study

Yellowtail Flounder collected from various locations in the sampling grid were noted to contain variable sized nodules in the liver parenchyma and on the serosal surfaces during the first sampling trip of the year. Therefore, samples of affected livers were collected in the following trips. Samples were placed in 10% neutral buffered formalin and processed in paraffin, using standard methods, when the boats returned.

Scallop shell height/meat weight relationship

A subset of roughly 30 stations (15 per area) within the study areas were randomly selected prior to the second survey cruise in March 2011. At each of these stations 12 scallops comprising a representative range of observed shell sizes were selected for analysis. The top shell of each animal was measured to the nearest millimeter and the animal was then carefully shucked. The

meat was blotted dry, placed in a pint ZipLoc bag and then individually frozen. For each animal, station number, shell size, sex and reproductive stage was recorded. Upon return to port, each animal was weighed to the nearest 0.1 gram. In addition to the animal specific information recorded for each sample, associated tow specific information was linked to each sample. This information included depth, closed area and date of collection. For each cruise, the same stations were occupied on each survey cruise.

Sea scallop meat weight was predicted using a generalized linear mixed model (gamma distribution, log link). Scallop shell height, depth, sampling area (either CAI or CAII) and sampling time (month year) were used as explanatory variables. The mixed modeling approach used a true likelihood based estimation that has multiple advantages. Traditionally, data of this type have been analyzed by least squares regression of the linearized data (i.e. lnMW*lnSH). Some advantages of the mixed modeling approach are the ability to define the underlying distribution of the data. The distribution that was used in this analysis was the gamma distribution and is generally considered a more appropriate distribution for data of this type. This modeling approach also avoids the bias involved with back-transformations from log-linear models. In addition, random variation in the data can occur as a result of temporal and fine scale spatial variability in the process. Incorporating a random effect in the model accounts for this variability by evaluating the data at the station level and allows the intercept to be estimated for every time and station grouping. The station grouping variable consists of a unique code that included the year, month (temporal component) and station number (spatial component) from which the sample originated. This approach tends to capture and account for this variability more effectively relative to a model with only fixed effects. Akaike Information Criteria (AIC) was used to select the best model configuration. Statistical analyses were completed using PROC GLIMMIX on the SAS v. 9.2 System.

Gear Comparisons

The objective of these experiments was to determine if the two different scallop dredges performed differently and how those differences might affect catch rates and size selection of both scallops and the major finfish bycatch species. To examine the comparative data, we used a Generalized Linear Mixed Model (GLMM) to analyze the paired catch data and test for differences in both the pooled length catch data as well as test for differences in the length composition of the catch. Within this modeling framework, the random effects acknowledge the potential for differences that may have occurred at both the trip and individual tow levels. The GLMM groups all the data and gives an overall perspective on how the two gears compare over the entire experiment. Then, a Student t-test was used to compare the separate dredges on each individual trip.

The paired tow experiments were conducted within the context of a bycatch survey of the Georges Bank Closed Areas I and II covering a wide range of fishery conditions. This approach has the advantage of mirroring the actual biotic and abiotic conditions under which the dredge will operate. Multiple vessels and slight variations in gear handling and design were included in

the experimental design and, while this variability exists, the GLMM modeling approach detailed in the next section accounts for the variability and allows for a more broad inference (relative to vessels) to be made. In contrast, the Student t-test approach is trip specific and therefore is not an appropriate methodology for comparing data from two or more different trips.

*Statistical Models – GLMM*

Scallop catch data from the paired tows provided the information to estimate differences in the fishing power of each vessel/gear combination tested and is based on the analytical approach in Cadigan et al. (2006). Assume that each vessel/gear combination tested in this experiment has a unique catchability. Let $q_r$ equal the catchability of the CFTDD and $q_f$ equal the catchability of the standard dredge used in the study. The efficiency of the CFTDD relative to the standard dredge will be equivalent to the ratio of the two catchabilities:

$$\rho_l = \frac{q_r}{q_f} \qquad (1)$$

The catchabilities of each gear are not measured directly. However, within the context of the paired design, assuming that spatial heterogeneity in scallop and fish density is minimized, observed differences in scallop catch for each vessel will reflect differences in the catchabilities of the vessel/gear combinations tested. Our analysis of the efficiency of the CFTDD relative to the standard dredge consisted of two levels of examination. The first analysis examined potential differences in the total catch per tow. Subsequent analyses investigated whether size (i.e. length) was a significant factor affecting relative efficiency. Each analysis assumes a hierarchy of random variation and nests tow by tow variation within trip level variation.

Let $C_{iv}$ represent the scallop catch at station $i$ by dredge $v$, where $v=r$ denotes the CFTDD and $v=f$ denotes the standard New Bedford style dredge. Let $\lambda_{ir}$ represent the scallop/fish density for the $i^{th}$ station by the CFTDD and $\lambda_{if}$ the scallop/fish density encountered by the standard dredge. We assume that due to random, small scale variability in animal density as well as the vagaries of gear performance at tow $i$, the densities encountered by the two gears may vary as a result of small-scale spatial heterogeneity as reflected by the relationship between scallop patch size and coverage by a paired tow. The probability that a scallop is captured during a standardized tow is given as $q_r$ and $q_f$. These probabilities can be different for each vessel, but are expected to be constant across stations. Assuming that capture is a Poisson process with mean equal to variance, then the expected catch by the CFTDD is given by:

$$E(C_{if}) = q_f \lambda_{if} = \mu_i \qquad (2)$$

The catch by the standard dredge is also a Poisson random variable with:

$$E(C_{ir}) = q_r \lambda_{ir} = \rho \mu_i \exp(\delta_i) \qquad (3)$$

where $\delta_i = \log(\lambda_{ir}/\lambda_{if})$. For each station, if the standardized density of scallops encountered by both vessels is the same, then $\delta_i=0$.

If the dredges encounter the same scallop density for a given tow, (i.e. $\lambda_{ir}=\lambda_{if}$), then $\rho$ can be estimated via a Poisson generalized linear model (GLM). This approach, however, can be complicated especially if there are large numbers of stations and scallop lengths (Cadigan et al., 2006). The preferred approach is to use the conditional distribution of the catch by the CFTDD at station *i*, given the total non-zero catch of both vessels at that station. Let $c_i$ represent the observed value of the total catch. The conditional distribution of $C_{ir}$ given $C_i=c_i$ is binomial with:

$$\Pr\left(C_{ic}=x\middle|C_i=c_i\right)=\binom{c_i}{x}p^x(1-p)^{r_i-x} \tag{4}$$

where $p=\rho/(1+\rho)$ is the probability that a scallop taken in the survey is captured by the CFTDD. In this approach, the only unknown parameter is $\rho$ and the requirement to estimate $\mu$ for each station is eliminated as would be required in the direct GLM approach (equations 2 & 3). For the binomial distribution $E(C_{ir})=c_ip$ and $Var(C_ir)=c_ip/(1-p)$. Therefore:

$$\log\left(\frac{p}{1-p}\right)=\log(\rho)=\beta \tag{5}$$

The model in equation 5, however, does not account for spatial heterogeneity in the densities encountered by the two gears for a given tow. If such heterogeneity does exist then the model becomes:

$$\log\left(\frac{p}{1-p}\right)=\beta+\delta_i \tag{6}$$

where $\delta_i$ is a random effect assumed to be normally distributed with a mean=0 and variance=$\sigma^2$. This model is the formulation used to estimate the gear effect $exp(\beta_0)$ when scallop catch per tow is pooled over lengths.

Often, modifications can result in changes to the length based relative efficiency of the two gears. In those instances, the potential exists for the catchability of scallops at length (*l)* to vary. Models to describe length effects are extensions of the models in the previous section to describe the total scallop catch per tow. Again, assuming that between-pair differences in standardized scallop density exist, a binomial logistic regression GLMM for a range of length groups would be:

$$\log\left(\frac{p_i}{1-p_i}\right)=\beta_0+\delta_i+\beta_1 l,\delta_i\sim N(0,\sigma^2),i=1,...,n. \tag{7}$$

In this model, the intercept ($\beta_0$) is allowed to vary randomly with respect to cruise/station. The potential exists, however, that there will be variability in both the number as well as the length distributions of scallops encountered within a tow pair. In this situation, a random effects model that again allows the intercept to vary randomly between tows is appropriate (Cadigan and Dowden 2009). This model is given below:

$$\log\left(\frac{p_i}{1-p_i}\right)=\beta_0+\delta_{i0}+\beta_1 * l,\delta_{ij}\sim N(0,\sigma_j^2),i=1,...,n,\ j=0,1. \tag{8}$$

*Adjustments for sub-sampling of the catch*

Additional adjustments to the models were required to account for sub-sampling of the catch. In most instances, due to high volume, catches for particular tows were sub-sampled. This is accomplished by randomly selecting a one bushel sample for length frequency analysis. One approach to accounting for this practice is to use the expanded catches. For example, if half of the total catch was measured for length frequency, multiplying the observed catch by two would result in an estimate of the total catch at length for the tow. This approach would overinflate the sample size resulting in an underestimate of the variance, increasing the chances of spurious statistical inference (Holst and Revill, 2009; Millar et al., 2004). In our experiment, the proportion sub-sampled was not consistent between tows as only a one bushel sub-sample was taken regardless of catch size. This difference must be accounted for in the analysis to ensure that common units of effort are compared.

Let $q_{ir}$ equal the sub-sampling fraction at station $i$ for the vessel $r$. This adjustment results in a modification to the logistic regression model:

$$\log\left(\frac{p_i}{1+p_i}\right) = \beta_0 + \delta_{i0} + (\beta_1 + \delta_{i1})l_i + \log\left(\frac{q_{ir}}{q_{if}}\right), \delta_{ij} \sim N(0, \sigma_j^2), i = 1,...,n,\ j = 0,1. \quad (9)$$

The last term in the model represents an offset in the logistic regression (Littell et al., 2006). We used SAS/STAT® PROC GLIMMIX to fit the generalized linear mixed effects models.

*Statistical approach – Student T-Test*

Paired student t-tests were used for trip by trip comparisons to test for significance between the experimental and control dredges in terms of catch of scallops and ten other species. Significance was evaluated as a difference from zero. The methodology of towing two dredges simultaneously provided for the assumptions necessary to analyze the data using a paired t-test. Zar (1984) states, "the paired-sample t-test does not have the normality and equality of variances assumptions of the two sample t-test, but assumes only that the differences (d(t)) come from a normally distributed population of differences.... Whenever the paired-sample t-test is applicable, the Wilcoxon paired-sample test is also applicable. If, however, the d(t) values are from a normal distribution, then the latter (Wilcoxon) has only a 95% of detecting differences as the former (paired t-test)." Although Zar seems to suggest the paired student t-test as the better test, there is not universal agreement on this issue. Because of this, we also evaluated comparisons using the non-parametric Wilcoxon matched pairs test and found that the results were consistent with those provided by the paired Student t-tests. Catch ratios for each dredge were calculated in order to compare the total count of each bycatch species per sampled scallop bushel.

## Results

RAMP discard mortality

*Yellowtail flounder*

The monthly estimates of RAMP score for the scallop fleet indicate that the estimated discard mortality rates range from 64% to 90%. There were three months that varied from relatively stable estimates of discard mortality, which were June 2011, July 2011, and January 2012. These months were excluded from the analyses because limited or no training of the scientific crew took place prior to the beginning of the trips. The remaining trips had a scientific crew that was trained prior to leaving on the trip or had previously performed RAMP sampling. The time series of discard mortality estimates and confidence intervals excluding January, June and July shows a fairly stable estimate of discard mortality near 85% (Table 2).

*Winter Flounder*

During the scallop dredge field trials, reflex actions were tested on 586 fish, with an average RAMP score of 0.47. The months that were eliminated from the yellowtail flounder results were also removed for winter flounder, due to limited RAMP training of the crew prior to departing on the trip. Excluding those three months (June 2011, July 2011, and January 2012) the mean RAMP score was 0.57 which correlated to a discard mortality estimate of 36%, with lower and upper confidence intervals of 16% and 60% (Table 3).

Maturity

*Yellowtail Flounder*

In total, 4738 yellowtail flounder were measured and staged for maturity with 3326 females and 1412 males. The mean size of all females sampled was 38.4cm and 34.4cm for male yellowtail flounder (Table 4). The maturity of yellowtail indicated a spawning event in the spring peaking around May/June 2011, followed by yellowtail flounder resting until around January when they began to develop for the next spawning season (Figures 3-15).

*Winter Flounder*

The winter flounder sample size was 1349 fish measured and staged for maturity split between 857 females and 492 males. The mean size of all females sampled was 43.2cm and 39.4cm for male winter flounder (Table 5). Winter flounder peak spawning seemed to be around February and March, with most fish visibly spent or resting beginning in August and then starting to develop in November and December (Tables 6-9).

Seasonal Effects on Sea Scallop Reproduction and Energetics

Semiannual spawning occurred both at Station 126 and Station 222 on Georges Bank in 2011, since there were both spring and autumn spawning events (Figure 16). At both stations, scallops were ripe in April 2011 and spring spawning occurred in late April and May, reaching minimum GSI in June (Figure 16). There was a significant difference ($p < 0.05$) when GSI was tested with Welsh's two-sample t-test between April-May and May-June in both areas.

Gonads recovered in late June-July, reaching maximum ripeness in August at 126, and in September at 222 (Figure 16). Fall spawning took place from September through November (Figure 16). There was a significant difference ($p < 0.05$) in monthly GSI from August through November at 126, representing a protracted spawning period. In 222 there was a significant difference in monthly GSI from September through November, suggesting delayed spawning initiation compared with 126. In November, GSI was lowest for both areas during the reproductive resting period (Figure 16). GSI increased from January-March 2012, potentially indicating preparation for spring spawning in 2012 (Figure 16).

Examination of June slides confirms that spring spawning occurred in 2011. Vacancies in the center of follicles indicate gamete release (Figure 17).

Results from the temperature loggers suggest that bottom temperature patterns are different between areas from July-October (Figure 18). Different bottom temperature patterns at Station 126 and Station 222 represent differing physical oceanographical conditions, which could explain the disparity in fecundity between areas. Depth at 126 and 222 only differs by approximately 15 m, however varying oceanographical dynamics could result in much lower food availability at 222 than at 126.

Flounder Disease Study

Yellowtail Flounder collected from various locations in the sampling grid were noted to contain variable sized nodules in the liver parenchyma and on the serosal surfaces. Grossly, small, white/tan nodules of 3-5 mm in diameter were noted in the formalin fixed samples of liver tissue. Histological sections (6µm thick) were stained with hematoxylin and eosin and were evaluated by Dr. Smolowitz. Histologically, the nodules seen grossly consisted primarily of granulomas containing *Ichthyophonus* sp. organisms, most likely *I. irregularis* (Rand et al., 2000). Most organisms appeared to be contained within the granulomas, however, occasionally the infected organisms showed early extension from the granulomas into the surrounding hepatic parenchyma. In addition to *Ichthyophonus* sp. organisms, some of the hepatic serosal granulomas contained ascarids consistent with *Anasarcis* sp. nematodes.

Scallop shell height/meat weight relationship

Over 13 cruises from March 2011 through April 2012, a total of 4,359 scallops were sampled at 374 unique stations. Scallop shell heights ranged from 82 mm to 176 mm and meat weights

varied from 5 g to 121 g. For CAI depths ranged from 43.9 m to 91.4 m with a mean depth of 65.1 m. Depths in CAII ranged from 54.9 m to 95.1 m with a mean depth of 73.0 m. Log transformed shell height and meat weight data is shown in Figure 19.

Candidate models were evaluated and the model that produced the lowest AIC value was chosen as the model that best fit the data. Combinations of explanatory variables that were evaluated and resulting AIC values are shown in Table 10. The selected model is shown below:

$$MW = e^{(\beta_0+\delta+\beta_1 \ln(SH)+\beta_2 \ln(D)+\beta_3 (A)+\beta_4 (MY)+\beta_5 \ln(SH)*\ln(D)+\epsilon)}$$

Where δ is the random effect term (intercept), MW is scallop meat weight in grams, SH is shell height in millimeters, D is depth in meters, A is area (CAI or CAII) and MY is the month and year when the sample was taken and an interaction term between shell height and depth. Based on an examination of residuals and QQ plot (Figure 20) model fit appears to be reasonable. A few outliers appear that consist of both heavier and lighter than expected meats. These observations could represent natural anomalies such as a diseased or senescent animal or simply an extraordinarily robust animal. While every effort was made to verify the quality of the data, some measurement error could exist in the data set. Regardless, the outliers were few and had minimal impact on parameter estimates.

Parameter estimates, shown in Table 11 were reasonably precise and predicted increasing meat weight as a function of increased shell height and decreasing depth. Parameter estimates by area and month are shown in Table 12-13 with a comparison to estimates for Georges Bank in general and the specific closed area. Meat weights were always higher in Closed Area I relative to Closed Area II and the temporal trend indicated that meat weights were elevated through their peak from May – July and decreased to a trough from August – February. Temporal trends of a modeled 125 mm scallop for the two areas are shown in Figure 21. Comparisons with the estimated meats weights from the subarea specific NEFSC (2010) document are shown in Figures 22-23. The data for the NEFSC estimates generally comes from the June and July time frame, so that is an appropriate time to compare results.

Spatially and temporally explicit fishery independent length weight information tends to be difficult to obtain on the scale that was collected by this study. These results document trends between the two areas on a monthly basis, demonstrating the differences between the two areas and can be used in combination with the bycatch data included in this study to formulate a strategy to optimize the harvest of sea scallops in the Georges Bank Closed Areas.

Bycatch Rates

The bycatch rate was determined for each month (trip) by dividing the weight (lbs) of the bycatch species by the meat weight of the scallop catch from the Cfarm turtle deflector dredge tows. The fish weight was derived from tables (NOAA, 2003) using 3cm increments and the scallop meat weight was from the actual sampling by trip using 5 mm increments (Tables 14 &

15; Figs. 24 & 25). All bycatch rates shown are for the 41 selected stations that were sampled on all trips inside of the CAI and CAII scallop access area boundary lines.

Yellowtail flounder was found in higher abundance in CAII than in CAI. In CAII the largest numbers and pounds of yellowtail were found in the August thru October period (Tables 16 &17; Figs. 26 & 27). The highest bycatch rate in CAII was in October 2011 (Fig. 28).

Windowpane flounder abundance differs between the two study areas. In CAI there was a high catch in October 2010 and again in January 2012 (122 and 114 fish respectively). In CAII the highest numbers of windowpane occur in February-April and all but vanish during the summer months. However, in CAI there is a presence throughout the summer but lower numbers in the February through May period (Table 18; Figs. 29-31).

Winter flounder were most abundant in CAI. The two months with the highest abundance in CAI were July 2011 (71 fish) and December 2011 (70 fish). Winter flounder seemed to be present most of the year in CAI with the exception of the February through April period. The two highest months in CAII were August 2011 (10 fish) and October 2011 (16 fish) (Figs. 32 & 33). The highest bycatch rates in CAI were in December (0.1221), and in October in CAII (0.0228) (Table 19; Fig. 34).

Monkfish were more abundant in CAII (548 fish) than in CAI (243 fish) (Table 20). CAI catches were lowest in the February thru April period and highest during June and July. The bycatch rate peaked in December (0.13856). In CAII the lowest catch rates were also in the February through April period and high catch rates ran from July until October; the highest bycatch rate being October 2011 (0.28653) (Figs. 35-37).

Summer flounder were caught in limited numbers in CAI (62 fish) and CAII (111 fish) (Table 21). In CAI they were present from May to October and in CAII the best catches were October thru February (Figs. 38 & 39). The highest bycatch rates in CAI was September (0.0334) and CAII in January (0.0621). The lowest bycatch rates in both areas were in the February thru April period (Fig. 40).

Little and winter skate seem to be in both areas in high numbers. There is some evidence that the skate catch may be less over the winter months in CAI (Figs. 41 & 42).

Distribution

The bycatch rates presented above reflect the average for each trip by area. The data was further analyzed for yellowtail flounder to determine the distribution of the bycatch rates within each area by station (Figures 43-46). This analysis provides the mean bycatch rate for yellowtail flounder for each trip and is also grouped by month. A series of maps of the number of scallops and the number of bycatch by species for each trip is provided in Appendix A.

Scallop distribution over the study period was affected by weather (catchability), scallop growth, and the fishery opening in August 2011. Yellowtail flounder distribution in CAII was scattered

over the selected stations but there was a clear increase in bycatch in August 2011 through October 2011; high bycatch also occurred in October 2010 at the start of the study period. Windowpane flounder were abundant and widely distributed in CAII from January through April; then the numbers were very low through the end of the year. In CAII winter flounder catches were low and scattered but seemed to increase at a pair of stations in August and more so in October. Summer flounder distribution shifts throughout the year in each area, with catch low or nonexistent in CAI from January to April, and highest catches in CAI from June to October. The highest catches for both areas combined occurs from October to December, with most of the catch coming from CAII. Monkfish are present throughout the year but the lowest numbers were seen in February to April. In addition, monkfish appear to be in CAI in June to August, then move to CAII from September to January. Barndoor skate catches increased in June to October, with more skates caught in CAI than CAII in October. Winter and little skates are found in both areas consistently throughout the year. All of the figures for the above species can be found in Appendix A.

Gear Observations

We had the opportunity to compare eleven different New Bedford style dredges against a standardized Cfarm turtle deflector dredge (CFTDD) (Table 22). There were many variations between the New Bedford dredges but we attempted to hold towing parameters relatively constant between trips. The catch data for each trip (Table 23) is for all stations occupied during those trips where the tows were considered good. Overall it seems that the CFTDD may catch more scallops and less fish.

The turtle dredge, which was compared to the New Bedford dredge on each trip, had a twine top that was 60 meshes across. To further refine the analysis we grouped the comparisons based on twine top widths: vessel with greater than 60 meshes (Table 24) and vessels with less than 60 meshes (Table 25). The F/V Celtic had a 60 mesh twine top so we dropped that vessel from the comparison. From this analysis on trips with hanging ratios greater than 2:1 (greater than 60 meshes) we found that the CFTDD caught more scallops and less flatfish. On trips where the New Bedford dredge had a hanging ratio less than (2:1) the New Bedford dredge out-performed the CFTDD on flatfish reduction, though the latter still led in scallops.

In examining the bycatch rate of yellowtail (Table 26) on all trips regardless of hanging ratio we did not find a significant difference between dredge types. When the data was grouped by twine top hanging ratio (Table 27) for the selected stations there were lower flatfish bycatch rates with the lower hanging ratios.

Another key aspect of the dredge design that we examined was the height of the apron (Table 28). The vessels that had long aprons (10-13 rings) had much higher bycatch ratios than those with 7-8 ring aprons for selected stations.

GLMM Dredge Performance Comparisons

The performance of the two dredge frame designs (a standardized CFTDD and multiple New Bedford style dredges) were compared via an examination of the overall catch rates and catch at length of sea scallops and finfish bycatch species encountered during the course of the 14 survey cruises. In addition, we examined the effect of area (CAI and CAII) as well as cruise level effects on the relative performance of the two frame types. It is very important for the reader to remember that the bags on the New Bedford dredge frames varied considerably and heavily influence the results presented in this section of the report. We used an iterative model building strategy to identify the most appropriate model for the data. Akaike Information Criteria (AIC) was used to select the model that provided the best fit to the data and for a given species, the parameter estimates for that model fit was reported.

*Pooled data*

The first level of examination of relative catch rates used the scaled catch data for each species. This data was examined with generalized linear mixed models (GLMM) and can generally be interpreted as analysis to determine whether differences existed in the overall catch rates of the two gears. In addition, covariates specifying area and cruise were added to the model in an effort to better predict the proportion of the total catch attributed to the CFTDD. Interpretation of results which are output from the model on the logit scale can be converted to the probability scale. Exponentiation of parameter estimates to provide a measure of the relative efficiency of the two gears.

Parameter estimates by species for models that best fit the catch data are shown in Tables 29-39. Scatter plots showing the raw catch data as well as the estimated relative efficiency value are shown in figures 47-62. These figure use model output from the intercept only model to portray the estimated relative efficiency model. While not always the best fit to the data, this model provided a means to capture the signal for the entire data set and portray the results for a single species in one graphic. While this model generally performed well in many cases a strong cruise effect was present, probably related to the variations in bag design on the NB dredges. For most cases there was little evidence to support differences in dredge performance as a function of area (i.e. the relative performance of the dredges was the same in the two areas fished). Visual examination of the scatterplots as well as model output indicates that the CFTDD performed differentially with respect to species. For example, the CFTDD was more efficient with respect to scallop catch and yellowtail flounder and less efficient in a relative sense for winter flounder, fourspot flounder, windowpane flounder and barndoor skate. There appeared to be no clear patterns, however with general trends for being more efficient in the capture of the skate complex and less efficient in the capture of flatfish. As shown earlier, some of the NB dredges had lower twine top hanging ratios which can impact these results significantly.

*Unpooled data*

The second level of examination attempted to analyze the catch at length data to assess whether the two dredge configurations captured animals of similar length frequencies. Parameter estimates by species for models that best fit the catch data are shown in Tables 40-46. Plots that overlaid the observed length frequencies, observed proportion retained in the CFTDD and the predicted proportion from the model output are shown in Figures 63-73. Again these figures used the output from the model that only included animal length to portray differences in the length based composition of the two dredges. In many cases the effect of cruise was significant while area was not. This suggests that the performance of the dredges on individual cruises was different enough to result in statistical significance for some of the species (scallops, barndoor skates and some flatfish).

With the exception of scallops, yellowtail flounder and winter flounder, the two dredges captured animals with statistically similar length frequency distributions. This might be expected as differences in the catches would be manifested as reductions or gains in overall catch rather than changes in the size selectivity of the gear. Dredge bag components and rigging generally dictate the size selectivity characteristics of the gear for scallops and flatfish. However, it is possible that the frame itself may possess an attribute that could reduce the probability of capture for a size class of animal. For example, the CFTDD appears to more efficient overall relative to the standard dredge with respect to sea scallops. The CFTDD was shown to be significantly more efficient on smaller animals and that relative efficiency decreases as a function of increasing scallop size. This trend is similar for all instances where length was a significant factor.

Overall, the analysis of the relative performance of the CFTDD and NB style dredges demonstrated two gears that fished fairly equally, with a couple of important distinctions. First, with respect to scallop catch, the CFTDD captured more scallops; however the length composition of the catch appeared to contain a larger proportion of smaller scallops. Secondly, with respect to flatfish that represents a major consideration for current bycatch reduction efforts. Results for the CFTDD were a bit mixed with some success in the reduction some species but not others. From a conservation engineering standpoint, reducing the scallop fisheries impact on the flatfish complex represents a major focal point for future efforts.

## Discussion

RAMP discard mortality

*Yellowtail flounder*

The results from the scallop vessels exhibit the ability to collect reflex impairment data in the field to obtain discard mortality estimates. The discard mortality estimates varied and there was a lack of training on three of the trips (June 2011, July 2011, and January 2012). We propose that these 3 months be excluded from the analysis. This set of data indicated stable and consistent results and covered all seasons (winter, spring, summer and fall). The estimate of discard mortality from the scallop dredge vessels using all data excluding January, June and July is 85% with lower and upper confidence intervals ranging from 72%-93%. Based on the RAMP results and the possibility for additional sources of mortality not accounted for by the RAMP method, the group agreed to assume a discard mortality of 90% for the southern New England/Mid Atlantic yellowtail flounder stock assessment.

*Winter Flounder*

Our estimate of discard mortality for winter flounder in the scallop fishery (36%) is lower than the currently assumed 50% for all commercial fishing. The accepted value of 50% falls within our confidence interval range, indicating that the 50% used in the stock assessments may not be an overestimate for the scallop fleet. Although the basis of the 50% discard mortality assumption is not well documented, it appears to be an approximation based on an estimate of discard mortality of yellowtail flounder off Canada (Mark Gibson, *Pers. Comm.).* Our results show that the currently accepted value used in the winter flounder stock assessments may be an accurate representation of the true discard mortality rate for the scallop industry.

Maturity

*Yellowtail flounder*

The results of the maturity staging for yellowtail flounder on Georges Bank indicate that peak spawning is around May/June, followed by resting until January when they begin to develop for spawning the following spring. This is relatively consistent with the spawning period indicated by Collette and Klein-MacPhee (2002), who indicate peak spawning on Georges Bank and SNEMA occurs during April/May. Our results may indicate that spawning on GB occurs about a month later then Collette and Klein-MacPhee (2002), peaking in May/June as compared to April/May.

*Winter Flounder*

The maturity staging results suggest that winter flounder spawning on Georges Bank peaks around February and March, with development starting in November. These results are similar to those reported by Collette and Klein-MacPhee (2002), which indicates spawning time differs

as you travel north along the coast but still occurs between December and March. The sample sizes of winter flounder from this study are quite low, but were determined based on the total number of winter flounder caught on each tow.

## Seasonal Effects on Sea Scallop Reproduction and Energetics

Although Georges Bank scallops are known to spawn in the fall, this research has shown that semiannual spawning does occur in this area. If spring spawning is a Bank-wide event, optimum CPUE would be attained by avoiding spawning events and maximizing fishing effort when meat yield is highest.

When managing a commercial fishery, it is essential to consider both the natural and anthropogenic impacts on the life history of the species. Understanding the effects of temperature on scallop growth and fecundity can help evaluate how seasonal temperature fluctuations and interannual variability may influence the status of the resource. Although temperature differences between CAI and CAII are expected, warmer temperatures and a well-mixed water column at Station 126 may result in greater productivity than at Station 222. Variable food availability may explain the observed differences in GSI between these locations and further investigation is recommended.

## Flounder Disease Study

Some yellowtail flounder were found to be infected with granulomas containing *Ichthyophonus* sp. Organisms. *I. irregularis* was identified in 2000 as a species found only in yellowtail flounder from Nova Scotia, Canada using ssu-rDNA sequences in PCR methods. Co-infections with *I. hoferi* were not identified in this study. *I. hoferi* is responsible for significant disease in some species of fish, such a herring, but is quiescent in others that are mostly top of the food chain predators. In species of fish significantly affected by disease due to the *I. hoferi*, the disease usually occurs annually during stressful certain times of year. Disease results when the infectious organisms "escape" from the granulomas and extend fungal-like elements throughout infected tissues and infected organs are destroyed. The rest of the year, *I. hoferi*, remains in quiescent granulomas in the tissues of infected animals. *I. hoferi* does infect multiple host species and can be directly passed from one fish to the next. *I. irregularis*, however, is thought to be specific for yellowtail flounder. The ability of *I. irregularis* or *I. hoferi* to cause disease in wild yellowtail flounder is not known. For the 2012 RSA Bycatch Survey, we will sample yellowtail flounder for the disease to determine the area of incidence as well as the effects on the population.

## Scallop and Bycatch species distribution

The data collected during the 14 trips included in this project analysis showed that the highest number of yellowtail flounder are caught on Georges Bank (primarily in CAII) during August through October, with the highest bycatch rate occurring in October. Since the GB scallop fishery is affected by yellowtail flounder bycatch amounts, understanding the changes in

distribution of this species as well as other potentially important commercial species can inform managers to implement closures that are appropriate for both the harvested species as well as commercial fishers. This data is being considered in changes to Framework 24 to increase scallop meat yield while decreasing bycatch.

Because of the large scope of this project, there is additional funding to continue the survey in 2012, with some modifications implemented to increase sampling standardization and decrease inconsistencies from trip to trip.

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## Tables and Figures

**Table 1.** Reflexes monitored for yellowtail flounder.

| Reflex | Description |
|---|---|
| Resistance | Resistance to being restrained |
| Mouth | Resistance to the forced opening of the mouth |
| Operculum | Resistance to the forced opening of the operculum |
| Gag | Response to insertion of probe into the throat |
| Fin control | Response to a brushing stimulus on the fins |
| Natural righting | Attempts to dorso-ventrally right itself within 5 seconds |
| Evade | Attempts to actively swim away after reflex testing |

**Table 2.** Mean RAMP score and discard mortality estimates for yellowtail flounder including upper and lower confidence intervals for the scallop dredge fleet. Lower and Upper CI indicate confidence intervals and Exc. Total is excluding January, June and July.

| Month | n | RAMP | Mortality | Lower CI | Upper CI |
|---|---|---|---|---|---|
| January | 170 | 0.43 | 66% | 50% | 78% |
| February | 130 | 0.62 | 85% | 72% | 92% |
| March | 149 | 0.69 | 90% | 77% | 96% |
| April | 154 | 0.65 | 88% | 75% | 94% |
| May | 168 | 0.57 | 82% | 68% | 91% |
| June | 160 | 0.45 | 68% | 52% | 80% |
| July | 188 | 0.42 | 64% | 48% | 77% |
| August | 163 | 0.65 | 88% | 75% | 94% |
| September | 192 | 0.61 | 85% | 72% | 92% |
| October | 188 | 0.54 | 78% | 64% | 88% |
| Nov./Dec. | 116 | 0.64 | 87% | 74% | 94% |
| Total | 1778 | 0.53 | 81% | 67% | 89% |
| Exc. Total | 1260 | 0.62 | 85% | 72% | 93% |

**Table 3.** Mean RAMP score and discard mortality estimates for winter flounder including upper and lower confidence intervals for the scallop dredge fleet. Lower and Upper CI indicate confidence intervals and Exc. Total is excluding January, June and July.

| Winter Flounder Discard Mortality Estimates | | | | | |
|---|---|---|---|---|---|
| Month | n | Average RAMP | Discard Mortality | Lower CI | Upper CI |
| 1 | 42 | 0.27 | 2% | 0% | 15% |
| 2 | 20 | 0.44 | 12% | 4% | 34% |
| 3 | 25 | 0.61 | 48% | 26% | 69% |
| 4 | 22 | 0.60 | 45% | 24% | 66% |
| 5 | 37 | 0.47 | 17% | 7% | 39% |
| 6 | 47 | 0.40 | 9% | 2% | 28% |
| 7 | 92 | 0.30 | 3% | 1% | 16% |
| 8 | 73 | 0.59 | 42% | 22% | 65% |
| 9 | 72 | 0.53 | 29% | 14% | 51% |
| 10 | 77 | 0.49 | 22% | 10% | 44% |
| 12 | 79 | 0.57 | 36% | 17% | 60% |
| Total | 586 | 0.47 | 17% | 7% | 39% |
| Exc. Total | 405 | 0.57 | 36% | 17% | 60% |

**Table 4.** Maturity results for yellowtail flounder including sample size and mean size for each month of the survey and totals for sample size and grand mean for each sex.

| Yellowtail Flounder | | | | | |
|---|---|---|---|---|---|
| | Month | Female n | Female Mean | Male n | Male Mean |
| 2011 | 3 | 205 | 38.6 | 101 | 33.7 |
| | 4 | 253 | 38.7 | 94 | 33.9 |
| | 5 | 209 | 37.6 | 153 | 35.5 |
| | 6 | 203 | 37.3 | 139 | 36.1 |
| | 7 | 309 | 37.6 | 77 | 33.6 |
| | 8 | 282 | 38.3 | 118 | 33.7 |
| | 9 | 294 | 38.5 | 122 | 34.1 |
| | 10 | 346 | 38.8 | 85 | 33.9 |
| | 11 | 30 | 38.9 | 5 | 33.4 |
| | 12 | 232 | 39.0 | 95 | 34.7 |
| 2012 | 1 | 263 | 38.6 | 114 | 34.5 |
| | 2 | 164 | 39.0 | 77 | 34.9 |
| | 3 | 175 | 38.6 | 120 | 34.4 |
| | 4 | 361 | 38.4 | 112 | 33.8 |
| | Total | 3326 | 38.4 | 1412 | 34.4 |

**Table 5.** Maturity results for winter flounder including sample size and mean size for each month of the survey and totals for sample size and grand mean for each sex.

| | Winter Flounder | | | | |
|---|---|---|---|---|---|
| | Month | Female n | Female Mean | Male n | Male Mean |
| 2011 | 3 | 28 | 40.8 | 18 | 38.9 |
| | 4 | 34 | 40.8 | 15 | 38.5 |
| | 5 | 3 | 46.3 | 73 | 40.0 |
| | 6 | 48 | 41.6 | 40 | 42.1 |
| | 7 | 113 | 43.9 | 65 | 40.0 |
| | 8 | 118 | 43.2 | 53 | 37.6 |
| | 9 | 110 | 44.1 | 49 | 39.5 |
| | 10 | 120 | 43.7 | 47 | 38.0 |
| | 11 | 87 | 43.7 | 17 | 37.8 |
| | 12 | 68 | 46.6 | 29 | 41.6 |
| 2012 | 1 | 71 | 40.0 | 45 | 38.6 |
| | 2 | 12 | 43.9 | 15 | 38.4 |
| | 3 | 18 | 41.8 | 22 | 38.3 |
| | 4 | 27 | 41.1 | 4 | 38.8 |
| | Total | 857 | 43.2 | 492 | 39.4 |

**Table 6.** Maturity staging results for female winter flounder in closed area I including sample size and number at each stage for each month of the survey and totals for sample size. D- denotes developing, I- immature, R-ripe, S- spent, T-resting, U-ripe and running.

| Closed Area I | | Stages | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Month | D | I | R | S | T | U | Total |
| 2011 | 3 | 17 | 0 | 0 | 0 | 0 | 0 | 17 |
| | 4 | 7 | 2 | 2 | 0 | 12 | 0 | 23 |
| | 5 | 2 | 0 | 1 | 0 | 0 | 0 | 3 |
| | 6 | 41 | 0 | 0 | 5 | 0 | 1 | 47 |
| | 7 | 5 | 0 | 0 | 68 | 40 | 0 | 113 |
| | 8 | 0 | 0 | 0 | 33 | 67 | 0 | 100 |
| | 9 | 0 | 0 | 0 | 30 | 63 | 0 | 93 |
| | 10 | 0 | 0 | 0 | 0 | 96 | 0 | 96 |
| | 11 | 87 | 0 | 0 | 0 | 0 | 0 | 87 |
| | 12 | 56 | 0 | 0 | 0 | 0 | 0 | 56 |
| 2012 | 1 | 47 | 7 | 7 | 0 | 0 | 0 | 61 |
| | 2 | 5 | 0 | 3 | 0 | 0 | 0 | 8 |
| | 3 | 1 | 2 | 11 | 1 | 0 | 0 | 15 |
| | 4 | 0 | 0 | 1 | 13 | 0 | 1 | 15 |
| | Totals | 268 | 11 | 25 | 150 | 278 | 2 | 734 |

**Table 7.** Maturity staging results for male winter flounder in closed area I including sample size and number at each stage for each month of the survey and totals for sample size. D- denotes developing, I- immature, R-ripe, S- spent, T-resting, U-ripe and running.

| Closed Area I | | Stages | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Month | D | I | R | S | T | U | Total |
| 2011 | 3 | 3 | 0 | 6 | 0 | 0 | 0 | 9 |
| | 4 | 0 | 1 | 0 | 0 | 4 | 3 | 8 |
| | 5 | 23 | 0 | 3 | 42 | 0 | 0 | 68 |
| | 6 | 20 | 0 | 1 | 16 | 0 | 0 | 37 |
| | 7 | 0 | 2 | 0 | 33 | 29 | 0 | 64 |
| | 8 | 0 | 1 | 0 | 42 | 0 | 0 | 43 |
| | 9 | 0 | 0 | 0 | 0 | 41 | 0 | 41 |
| | 10 | 0 | 0 | 0 | 1 | 39 | 0 | 40 |
| | 11 | 8 | 1 | 0 | 0 | 8 | 0 | 17 |
| | 12 | 20 | 0 | 1 | 0 | 0 | 0 | 21 |
| 2012 | 1 | 10 | 1 | 23 | 0 | 0 | 2 | 36 |
| | 2 | 0 | 0 | 13 | 0 | 0 | 0 | 13 |
| | 3 | 0 | 1 | 4 | 0 | 0 | 12 | 17 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| | Totals | 84 | 7 | 51 | 134 | 121 | 20 | 417 |

**Table 8.** Maturity staging results for female winter flounder in closed area II including sample size and number at each stage for each month of the survey and totals for sample size. D- denotes developing, I- immature, R-ripe, S- spent, T-resting, U-ripe and running.

| Closed Area II | | Stages | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Month | D | I | R | S | T | U | Total |
| 2011 | 3 | 11 | 0 | 0 | 0 | 0 | 0 | 11 |
| | 4 | 2 | 0 | 0 | 0 | 9 | 0 | 11 |
| | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 8 | 0 | 0 | 0 | 5 | 13 | 0 | 18 |
| | 9 | 0 | 0 | 0 | 3 | 14 | 0 | 17 |
| | 10 | 0 | 0 | 0 | 0 | 24 | 0 | 24 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 12 |
| 2012 | 1 | 5 | 0 | 5 | 0 | 0 | 0 | 10 |
| | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 4 |
| | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| | 4 | 0 | 0 | 0 | 11 | 0 | 1 | 12 |
| | Totals | 32 | 0 | 11 | 19 | 60 | 1 | 123 |

**Table 9.** Maturity staging results for male winter flounder in closed area II including sample size and number at each stage for each month of the survey and totals for sample size. D- denotes developing, I- immature, R-ripe, S- spent, T-resting, U-ripe and running.

| Closed Area II | | Stages | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Month | D | I | R | S | T | U | Total |
| 2011 | 3 | 1 | 0 | 8 | 0 | 0 | 0 | 9 |
| | 4 | 0 | 0 | 1 | 0 | 0 | 6 | 7 |
| | 5 | 1 | 0 | 1 | 3 | 0 | 0 | 5 |
| | 6 | 1 | 0 | 0 | 2 | 0 | 0 | 3 |
| | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 8 | 0 | 0 | 0 | 9 | 1 | 0 | 10 |
| | 9 | 0 | 0 | 0 | 0 | 8 | 0 | 8 |
| | 10 | 0 | 0 | 0 | 1 | 6 | 0 | 7 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 12 | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| 2012 | 1 | 0 | 0 | 8 | 0 | 0 | 1 | 9 |
| | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| | 3 | 0 | 0 | 1 | 0 | 0 | 4 | 5 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Totals | 11 | 1 | 21 | 15 | 15 | 12 | 75 |

**Table 10**: Results from iterative model building. Model with the minimum AIC value is shown in bold. Fixed effects are shown to the right of the ~ symbol. This symbol separates the response (Meat Weight) from the predictor variables used in the analysis. Interaction terms are denoted with the factor1*factor2 nomenclature. For the models that included a random effect, this effect was always evaluated at the station level. The best model was also evaluated without a random effect to assess the impact of including a random effect in the model.

| **Fixed Effects** | **Random Effect** | **AIC** | **BIC** | **-2 Log Likelihood** |
|---|---|---|---|---|
| ***Meat Weight~Shell Height, Depth, Area, Month_Year, Shell Height*Depth*** | ***Intercept*** | ***28750*** | ***28836*** | ***-28712*** |
| Meat Weight~Shell Height, Depth, Area, Month_Year | Intercept | 28768 | 28849 | -28732 |
| Meat Weight~Shell Height, Month_Year | Intercept | 28847 | 28919 | -28815 |
| Meat Weight~Shell Height, Depth, Area, Shell Height*Depth | Intercept | 28994 | 29025 | -28980 |
| Meat Weight~Shell Height, Depth, Shell Height*Depth | Intercept | 29005 | 29032 | -28993 |
| Meat Weight~Shell Height, Depth, Area | Intercept | 29028 | 29056 | -29016 |
| Meat Weight~Shell Height, Area | Intercept | 29041 | 29064 | -29031 |
| Meat Weight~Shell Height, Depth | Intercept | 29042 | 29065 | -29032 |
| Meat Weight~Shell Height | Intercept | 29068 | 29086 | -29060 |
| Meat Weight~Shell Height, Depth, Area, Month_Year, Shell Height*Depth | None | 29485 | 29600 | -29449 |
| Meat Weight~Depth, Area, Month_Year | Intercept | 33583 | 33660 | -33549 |
| Meat Weight~Depth, Month_Year | Intercept | 33588 | 33661 | -33556 |
| Meat Weight~Area, Month_Year | Intercept | 33593 | 33665 | -33561 |
| Meat Weight~Month_Year | Intercept | 33606 | 33674 | -33576 |
| Meat Weight~Depth, Area | Intercept | 33637 | 33660 | -33627 |
| Meat Weight~Depth | Intercept | 33641 | 33659 | -33633 |
| Meat Weight~Area | Intercept | 33647 | 33665 | -33639 |

**Table 11:** Parameter estimates for the best model as described by minimum AIC value. For the categorical variables (Area, Month Year), differences within that category are relative to the value with a 0 parameter estimate (i.e. CAII and September 2011). Similarly, p-values within a category are relative to that standard and not for the whole model. All included fixed effects were highly significant overall.

| Effect | Month_Year | Area | Estimate | Standard Error | DF | t-statistic | p-value |
|---|---|---|---|---|---|---|---|
| Intercept | | | 34.9204 | 3.1857 | 360 | 10.96177 | 0.0000 |
| Shell Height | | | -6.2263 | 0.6455 | 3982 | -9.64494 | 0.0000 |
| Depth | | | -10.2388 | 0.7491 | 3982 | -13.6677 | 0.0000 |
| Area | | CAI | 0.0819 | 0.0131 | 3982 | 6.234638 | 0.0000 |
| Area | | CAII | 0 | - | - | - | - |
| Month_Year | March 2011 | | 0.0436 | 0.0311 | 3982 | 1.4027 | 0.1608 |
| Month_Year | April 2011 | | 0.1174 | 0.0315 | 3982 | 3.7271 | 0.0002 |
| Month_Year | May 2011 | | 0.2198 | 0.0325 | 3982 | 6.7609 | 0.0000 |
| Month_Year | June 2011 | | 0.4302 | 0.0310 | 3982 | 13.8783 | 0.0000 |
| Month_Year | July 2011 | | 0.2767 | 0.0317 | 3982 | 8.7329 | 0.0000 |
| Month_Year | August 2011 | | 0.1201 | 0.0310 | 3982 | 3.8722 | 0.0001 |
| Month_Year | September 2011 | | 0 | - | - | - | - |
| Month_Year | October 2011 | | 0.0375 | 0.0310 | 3982 | 1.2103 | 0.2262 |
| Month_Year | November 2011 | | 0.0054 | 0.0310 | 3982 | 0.1752 | 0.8609 |
| Month_Year | January 2012 | | 0.0068 | 0.0342 | 3982 | 0.1992 | 0.8422 |
| Month_Year | February 2012 | | 0.0533 | 0.0310 | 3982 | 1.7190 | 0.0857 |
| Month_Year | March 2012 | | 0.1467 | 0.0309 | 3982 | 4.7397 | 0.0000 |
| Month_Year | April 2012 | | 0.2408 | 0.0307 | 3982 | 7.8386 | 0.0000 |
| Shell Height*Depth | | | 2.0415 | 0.1519 | 3982 | 13.4420 | 0.0000 |

**Table 12:** Closed Area I parameter estimates for all months. The parameters estimated are: the intercept ($\beta_0$), shell height coefficient ($\beta_1$), depth coefficient ($\beta_2$) , area coefficient ($\beta_3$), month year coefficient ($\beta_4$) and the coefficient for the interaction between shell height and depth ($\beta_5$). Parameter estimates for length weight relationships for the Georges Bank in general and Closed Area I specifically from NEFSC (2010) are shown for comparison.

| | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ |
|---|---|---|---|---|---|---|
| March_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0436 | 2.0415 |
| April_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.1174 | 2.0415 |
| May_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.2198 | 2.0415 |
| June_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.4302 | 2.0415 |
| July_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.2767 | 2.0415 |
| August_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.1201 | 2.0415 |
| September_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0000 | 2.0415 |
| October_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0375 | 2.0415 |
| November_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0054 | 2.0415 |
| January_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0068 | 2.0415 |
| February_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.0533 | 2.0415 |
| March_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.1467 | 2.0415 |
| April_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0819 | 0.2408 | 2.0415 |
| SARC 2011 GB | -8.0500 | 2.8400 | -0.5100 | - | - | - |
| SARC 2010 CAI | -6.3757 | 2.7999 | -0.8405 | - | - | - |

**Table 13:** Closed Area II parameter estimates for all months. The parameters estimated are: the intercept ($\beta_0$), shell height coefficient ($\beta_1$), depth coefficient ($\beta_2$) , area coefficient ($\beta_3$), month year coefficient ($\beta_4$) and the coefficient for the interaction between shell height and depth ($\beta_5$). Parameter estimates for length weight relationships for the Georges Bank in general and Closed Area II specifically from NEFSC (2010) are shown for comparison.

| | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ |
|---|---|---|---|---|---|---|
| March_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0436 | 2.0415 |
| April_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.1174 | 2.0415 |
| May_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.2198 | 2.0415 |
| June_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.4302 | 2.0415 |
| July_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.2767 | 2.0415 |
| August_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.1201 | 2.0415 |
| September_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0000 | 2.0415 |
| October_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0375 | 2.0415 |
| November_2011 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0054 | 2.0415 |
| January_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0068 | 2.0415 |
| February_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.0533 | 2.0415 |
| March_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.1467 | 2.0415 |
| April_2012 | 34.9204 | -6.2263 | -10.2388 | 0.0000 | 0.2408 | 2.0415 |
| SARC 2011 GB | -8.0500 | 2.8400 | -0.5100 | - | - | - |
| SARC 2010 CAII | -8.7026 | 2.8338 | -0.3354 | - | - | - |

**Table 14:** Totals of scallop meat weights in pounds from the selected standardized stations inside CAI and CAII (Turtle CFTDD dredge only).

| | CAI | CAII | Total |
|---|---|---|---|
| Oct 10 | 2290.76 | 2220.05 | 4510.81 |
| Mar 11 | 2530.92 | 2058.03 | 4588.95 |
| Apr 11 | 2353.29 | 1638.51 | 3991.81 |
| May 11 | 3800.49 | 3214.34 | 7014.84 |
| Jun 11 | 4527.96 | 4150.00 | 8677.96 |
| Jul 11 | 2877.04 | 2652.85 | 5529.89 |
| Aug 11 | 2033.12 | 1704.40 | 3737.51 |
| Sep 11 | 1554.05 | 1526.99 | 3081.04 |
| Oct 11 | 1808.48 | 1670.68 | 3479.16 |
| Dec 11 | 1328.73 | 1482.48 | 2811.21 |
| Jan 12 | 1514.82 | 1391.33 | 2906.15 |
| Feb 12 | 928.88 | 1385.16 | 2314.05 |
| Mar 12 | 1185.19 | 1340.22 | 2525.41 |
| Apr 12 | 1340.33 | 1565.82 | 2906.15 |

**Table 15:** Scallop meat weights in pounds from all surveyed stations inside and outside of CAI and CAII (Turtle CFTDD dredge only).

| | CAI | CAII | Total |
|---|---|---|---|
| **Oct 10** | 5025.02 | 2549.96 | 7574.98 |
| **Mar 11** | 4656.53 | 2703.66 | 7360.18 |
| **Apr 11** | 5002.18 | 2075.75 | 7077.93 |
| **May 11** | 5872.19 | 3925.89 | 9798.07 |
| **Jun 11** | 10369.32 | 5147.39 | 15516.70 |
| **Jul 11** | 6592.65 | 3243.50 | 9836.16 |
| **Aug 11** | 3930.66 | 2248.40 | 6179.06 |
| **Sep 11** | 3250.21 | 2206.21 | 5456.42 |
| **Oct 11** | 3857.86 | 2227.44 | 6085.30 |
| **Dec 11** | 2273.25 | 2227.92 | 4501.18 |
| **Jan 12** | 2458.35 | 2158.32 | 4616.66 |
| **Feb 12** | 2353.53 | 1934.14 | 4287.67 |
| **Mar 12** | 2398.26 | 1641.42 | 4039.67 |
| **Apr 12** | 2694.86 | 2510.47 | 5205.33 |

**Table 16**: The yellowtail flounder catch from the CFTDD from all successful stations in and around the two access areas (CAI and CAII). The Station (#) column is the number of stations occupied and the catch is the combined catch from those stations in pounds.

| Vessel | Date | Stations (#) | | Total Weights in Lbs | | |
|---|---|---|---|---|---|---|
| | | CAI | CAII | CAI | CAII | Total |
| Celtic | Oct '10 | 31 | 40 | 2 | 617 | 619 |
| Arcturus | Mar '11 | 38 | 39 | 19 | 230 | 249 |
| Celtic | Apr '11 | 37 | 37 | 19 | 205 | 224 |
| Westport | May '11 | 25 | 42 | 39 | 143 | 182 |
| Liberty | Jun '11 | 32 | 45 | 58 | 173 | 231 |
| Endeavour | Jul '11 | 36 | 47 | 45 | 176 | 222 |
| Regulus | Aug '11 | 29 | 40 | 17 | 527 | 544 |
| Resolution | Sep '11 | 33 | 44 | 30 | 606 | 637 |
| Ranger | Oct '11 | 34 | 42 | 34 | 729 | 763 |
| Horizon | Dec '11 | 30 | 48 | 61 | 384 | 445 |
| Wisdom | Jan '12 | 33 | 47 | 41 | 293 | 334 |
| Venture | Feb '12 | 37 | 42 | 8 | 324 | 332 |
| Regulus | Mar '12 | 34 | 43 | 8 | 296 | 304 |
| Endeavour | Apr '12 | 31 | 47 | 40 | 406 | 446 |

**Table 17:** The yellowtail flounder catch from the CFTDD from only the selected standardized stations (12 stations in CAI and 29 stations inside CAII). The bycatch rate is pounds of yellowtail divided by pounds of scallop meats. The scallop meat weight was determined monthly by area during the project period. The yellowtail weights were from the NEFSC.

| | CAI | | CAII | | Bycatch Rate | |
|---|---|---|---|---|---|---|
| **Date** | # | lbs | # | lbs | CAI | CAII |
| **Oct 10** | 0 | 0 | 537 | 574.4 | 0.00000 | 0.25873 |
| **Mar 11** | 3 | 3.15 | 186 | 201.2 | 0.00124 | 0.09776 |
| **Apr 11** | 8 | 6.2 | 172 | 172.7 | 0.00263 | 0.10540 |
| **May 11** | 17 | 15.6 | 116 | 109.1 | 0.00410 | 0.03394 |
| **Jun 11** | 23 | 18.1 | 123 | 123.3 | 0.00400 | 0.02971 |
| **Jul 11** | 17 | 13.5 | 108 | 104.4 | 0.00469 | 0.03935 |
| **Aug 11** | 8 | 7.55 | 450 | 431.7 | 0.00371 | 0.25329 |
| **Sep 11** | 1 | 1.35 | 445 | 457.2 | 0.00087 | 0.29941 |
| **Oct 11** | 16 | 16.75 | 527 | 560 | 0.00926 | 0.33519 |
| **Dec 11** | 24 | 27.1 | 201 | 222.65 | 0.02040 | 0.15019 |
| **Jan 12** | 9 | 9.3 | 188 | 209.1 | 0.00614 | 0.15029 |
| **Feb 12** | 2 | 1.8 | 169 | 192.1 | 0.00194 | 0.13868 |
| **Mar 12** | 2 | 1.3 | 197 | 213 | 0.00110 | 0.15893 |
| **Apr 12** | 5 | 5.8 | 253 | 258.45 | 0.00433 | 0.16506 |

**Table 18:** The windowpane flounder catch from the CFTDD from only the selected standardized stations (12 stations in CAI and 29 stations inside CAII). The bycatch rate is pounds of windowpane divided by pounds of scallop meats. The scallop meat weight was determined monthly by area during the project period. The windowpane weights were from the NEFSC.

| | CAI | | CAII | Bycatch Rate | | |
|---|---|---|---|---|---|---|
| **Date** | **#** | **lbs** | **#** | **lbs** | **CAI** | **CAII** |
| Oct 10 | 122 | 60.25 | 7 | 3.50 | 0.0263 | 0.0016 |
| Mar 11 | 32 | 16.6 | 599 | 340.13 | 0.0066 | 0.1653 |
| Apr 11 | 27 | 13.2 | 365 | 190.25 | 0.0056 | 0.1161 |
| May 11 | 12 | 6.3 | 86 | 44.60 | 0.0017 | 0.0139 |
| Jun 11 | 16 | 8.6 | 3 | 2.60 | 0.0019 | 0.0006 |
| Jul 11 | 46 | 25.55 | 8 | 4.60 | 0.0089 | 0.0017 |
| Aug 11 | 81 | 37.85 | 1 | 0.55 | 0.0186 | 0.0003 |
| Sep 11 | 81 | 40.65 | 0 | 0.00 | 0.0262 | 0.0000 |
| Oct 11 | 55 | 26.35 | 64 | 34.10 | 0.0146 | 0.0204 |
| Dec 11 | 86 | 52.05 | 160 | 83.95 | 0.0392 | 0.0566 |
| Jan 12 | 114 | 61.55 | 483 | 266.62 | 0.0406 | 0.1916 |
| Feb 12 | 27 | 12.45 | 809 | 448.35 | 0.0134 | 0.3237 |
| Mar 12 | 30 | 16.85 | 576 | 323.81 | 0.0142 | 0.2416 |
| Apr 12 | 35 | 17.55 | 900 | 490.80 | 0.0131 | 0.3134 |
| | | | | | | |
| **Totals** | 764 | 395.8 | 4061 | 2233.86 | | |

**Table 19:** The winter flounder catch from the CFTDD from only the selected standardized stations (12 stations in CAI and 29 stations inside CAII). The bycatch rate is pounds of winter flounder divided by pounds of scallop meats. The scallop meat weight was determined monthly by area during the project period. The winter flounder weights were from the NEFSC.

| | CAI | | CAII | | Bycatch Rate | |
|---|---|---|---|---|---|---|
| **Date** | **#** | **lbs** | **#** | **lbs** | **CAI** | **CAII** |
| Oct 10 | 40 | 73.1 | 8 | 22.95 | 0.0319 | 0.0103 |
| Mar 11 | 2 | 3.2 | 5 | 10.65 | 0.0013 | 0.0052 |
| Apr 11 | 6 | 7.65 | 5 | 9.05 | 0.0033 | 0.0055 |
| May 11 | 30 | 47.65 | 4 | 8.85 | 0.0125 | 0.0028 |
| Jun 11 | 31 | 61.4 | 2 | 3.2 | 0.0136 | 0.0008 |
| Jul 11 | 71 | 128.6 | 0 | 0 | 0.0447 | 0.0000 |
| Aug 11 | 28 | 39.6 | 10 | 21.9 | 0.0195 | 0.0128 |
| Sep 11 | 22 | 34.5 | 5 | 10.35 | 0.0222 | 0.0068 |
| Oct 11 | 42 | 92.35 | 16 | 38.1 | 0.0511 | 0.0228 |
| Dec 11 | 70 | 162.3 | 4 | 9.7 | 0.1221 | 0.0065 |
| Jan 12 | 18 | 35.45 | 1 | 3.75 | 0.0234 | 0.0027 |
| Feb 12 | 6 | 10.2 | 3 | 6.6 | 0.0110 | 0.0048 |
| Mar 12 | 2 | 4.25 | 1 | 3.75 | 0.0036 | 0.0028 |
| Apr 12 | 4 | 4.3 | 4 | 8.4 | 0.0032 | 0.0054 |
| | | | | | | |
| **Totals** | 372 | 704.55 | 68 | 157.25 | | |

**Table 20:** The monkfish catch from the CFTDD from only the selected standardized stations (12 stations in CAI and 29 stations inside CAII). The bycatch rate is pounds of monkfish divided by pounds of scallop meats. The scallop meat weight was determined monthly by area during the project period. The monkfish weights were from the NEFSC.

| | CAI | | CAII | | Bycatch Rate | |
|---|---|---|---|---|---|---|
| **Date** | # | **lbs** | # | **lbs** | **CAI** | **CAII** |
| **Oct 10** | 10 | 80.95 | 56 | 365.4 | 0.03534 | 0.16459 |
| **Mar 11** | 0 | 0 | 3 | 22.2 | 0.00000 | 0.01079 |
| **Apr 11** | 2 | 1.65 | 6 | 45.8 | 0.00070 | 0.02795 |
| **May 11** | 9 | 33.05 | 35 | 204.85 | 0.00870 | 0.06373 |
| **Jun 11** | 53 | 214.8 | 40 | 247.05 | 0.04744 | 0.05953 |
| **Jul 11** | 62 | 211.45 | 71 | 399.3 | 0.07350 | 0.15052 |
| **Aug 11** | 27 | 141.3 | 63 | 462.1 | 0.06950 | 0.27112 |
| **Sep 11** | 17 | 115.75 | 66 | 418.65 | 0.07448 | 0.27417 |
| **Oct 11** | 17 | 102.45 | 70 | 478.7 | 0.05665 | 0.28653 |
| **Dec 11** | 30 | 183.45 | 36 | 253.5 | 0.13806 | 0.17100 |
| **Jan 12** | 11 | 52.95 | 41 | 171.4 | 0.03495 | 0.12319 |
| **Feb 12** | 0 | 0 | 12 | 56.4 | 0.00000 | 0.04072 |
| **Mar 12** | 2 | 1.9 | 13 | 19.1 | 0.00160 | 0.01425 |
| **Apr 12** | 3 | 4.9 | 36 | 162 | 0.00366 | 0.10346 |
| | | | | | | |
| **Totals** | 243 | 1144.6 | 548 | 3306.45 | | |

**Table 21:** The summer flounder catch from the CFTDD dredge from only the selected standardized stations (12 stations in CAI and 29 stations inside CAII). The bycatch rate is pounds of summer flounder divided by pounds of scallop meats. The scallop meat weight was determined monthly by area during the project period. The summer flounder weights were from the NEFSC.

| | CAI | | CAII | | Bycatch Rate | |
|---|---|---|---|---|---|---|
| **Date** | **#** | **lbs** | **#** | **lbs** | **CAI** | **CAII** |
| Oct 10 | 5 | 24 | 8 | 28.55 | 0.0105 | 0.0129 |
| Mar 11 | 0 | 0 | 1 | 1.9 | 0.0000 | 0.0009 |
| Apr 11 | 0 | 0 | 0 | 0 | 0.0000 | 0.0000 |
| May 11 | 6 | 9.95 | 3 | 6.55 | 0.0026 | 0.0020 |
| Jun 11 | 20 | 76.75 | 3 | 6.25 | 0.0170 | 0.0015 |
| Jul 11 | 5 | 22.75 | 0 | 0 | 0.0079 | 0.0000 |
| Aug 11 | 4 | 23.55 | 3 | 28.9 | 0.0116 | 0.0170 |
| Sep 11 | 12 | 51.95 | 7 | 23.7 | 0.0334 | 0.0155 |
| Oct 11 | 7 | 31.35 | 13 | 59.7 | 0.0173 | 0.0357 |
| Dec 11 | 3 | 17.1 | 21 | 68 | 0.0129 | 0.0459 |
| Jan 12 | 0 | 0 | 33 | 86.45 | 0.0000 | 0.0621 |
| Feb 12 | 0 | 0 | 12 | 22.3 | 0.0000 | 0.0161 |
| Mar 12 | 0 | 0 | 3 | 10.65 | 0.0000 | 0.0079 |
| Apr 12 | 0 | 0 | 4 | 7.45 | 0.0000 | 0.0048 |
| | | | | | | |
| **Totals** | 62 | 257.4 | 111 | 350.4 | | |

**Table 22:** Gear specifications for the New Bedford style dredges used on the research cruises.

| | | Celtic | Westport | Arcturus | Turtle | Liberty | Endeavour | Regulus | Resolution | Ranger | Horizon | Wisdom | Venture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dredge Width (ft) | | 15 | 15 | 15 | 15 | 13 | 15 | 15 | 15 | 15 | 15 | 15 | 13 |
| Pressure Plate Width (inches) | | 8 | 8 | 8 | 8 | 8 | 8 | 9.5 | 8 | 9 | 1.5 | 1 | 8.5 |
| Wheel Diameter (inches) | | 16 | none | 18 | 16 | 17 | 20 | 17 | 23 | 22 | 18 | 8 | 16 |
| Dredge Builder | | Quinn | unknown | Dockside | Dockside | Blue Fleet | Blue Fleet | Blue Fleet | Dockside | Dockside | Dockside | Dockside | Blue Fleet |
| Turtle Chains | # up/downs | | | | | 11 | 13 | 13 | 13 | 14 | 19 | 11 | 18 (trawlex) |
| | # ticklers | | | | | 6 | 8 | 10 | 9 | 10 | 9 | 7 | 9 |
| | Chain Link size | | | | | 3/8 | 3/8 | 3/8* | 1/2 | 2.25 in | 3/8 | | 5/8 |
| Bag (Belly) | | 10 x 40 | 9 x 40 | 9 x 40 | 10 x 40 | 9 x 38 | 7 x 40 | 7 x 38 | 10 x 42 | 8 x 38 | 9 x 44 | 10 x 38 | 9 x 36 |
| Apron | | 8 x 40 | 13 x 40 | 10 x 40 | 8 x 40 | 7 x 38 | 8 x 40 | 8 x 38 | 8 x 42 | 7 x 38 | 8 x 44 | 10 x 38 | 7 x 36 |
| Side Piece | | 6 x 17 | 5 x 16 | 5 x 17 | 6 x 17 | 6 x 18 | 5 x 19 | 5 x 25 | 4 x 20 | 5 x 20 | 4 x 44 | 5 x 18 | 5 x 19 |
| Diamond # rings/side | | 14 | 14 | 13 | 14 | 13 | 14 | 13 | 14 | 14 | 15 | 13 | 13 |
| Skirt | | 3 x 38 | 2 x 36 | dog chains | 3 x 38 | | 3 | | | 3 links | 4 x 18 | | 2 links |
| Sweep | # of links | 125 | 121 long | 141 | 125 | 127 | 113 | 105 | 147 | 139 | 149 | 154 | 117 |
| | Link size | | | | | 5/8 | 5/8 | 5/8 | 5/8 | 3 inches | 5/8 | long | 5/8 |
| | Dog chains | | | | | | | 1/4 | | None; shackles | 22 link, 5/8 inch | 1 inch | None; shackles |
| Standard Twine Top | | 7.5 x 60 | 8.5 x 80 | 8.5 x 90 | 8.5 x 60 | 8.5 x 90 | 8.5 x 80 | 7.5 x 43 | 10.5 x 36 | 9 x 33 | 8 x 96 | 11 x 90 | 7.5 x 80 |
| Twine top mesh size (inches) | | 11.5 | 11.5 | 11.5 | 11.5 | 11 | 10.5 | 11 | 11 | 10.5 | 12 | | 10 |

**Table 23**: Species comparisons between the CFTDD and New Bedford style dredges.

| | Scallops (bu) | Yellowtail flounder | Winter Flounder | Summer Flounder | Little Skate | Winter Skate | Monkfish | Barndoor Skate | Fourspot | Window pane | American Plaice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Celtic 2010-1** | | | | | | | | | | | |
| Standard | 946.55 | 491 | 106 | 16 | 3414 | 236 | 110 | 74 | 88 | 448 | 0 |
| Turtle | 1048 | 577 | 118 | 28 | 4208 | 272 | 114 | 85 | 106 | 463 | 0 |
| # diff | 101 | 86 | 12 | 12 | 794 | 36 | 4 | 11 | 18 | 15 | 0 |
| % diff | 110.7% | 117.5% | 111.3% | 175.0% | 123.3% | 115.3% | 103.6% | 114.9% | 120.5% | 103.3% | #DIV/0! |
| **Arcturus 2011-1** | | | | | | | | | | | |
| Standard | 1384.9 | 431 | 46 | 2 | 6778 | 324 | 5 | 5 | 0 | 1533 | 73 |
| Turtle | 1253.9 | 229 | 11 | 1 | 4888 | 301 | 3 | 6 | 0 | 751 | 31 |
| # diff | -131 | -202 | -35 | -1 | -1890 | -23 | -2 | 1 | 0 | -782 | -42 |
| % diff | 90.5% | 53.1% | 23.9% | 50.0% | 72.1% | 92.9% | 60.0% | 120.0% | | 49.0% | 42.5% |
| **Celtic 2011-1** | | | | | | | | | | | |
| Standard | 1191.05 | 307 | 35 | 1 | 5421 | 437 | 13 | 11 | 0 | 636 | 54 |
| Turtle | 1112.55 | 225 | 17 | 0 | 4943 | 541 | 11 | 8 | 0 | 554 | 38 |
| # diff | -79 | -82 | -18 | -1 | -478 | 104 | -2 | -3 | 0 | -82 | -16 |
| % diff | 93.4% | 73.3% | 48.6% | 0.0% | 91.2% | 123.8% | 84.6% | 72.7% | | 87.1% | 70.4% |
| **Westport 2011-1** | | | | | | | | | | | |
| Standard | 1344.5 | 294 | 80 | 13 | 5258 | 331 | 65 | 71 | 72 | 236 | 45 |
| Turtle | 1502.75 | 218 | 41 | 13 | 4751 | 363 | 69 | 37 | 79 | 214 | 40 |
| # diff | 158 | -76 | -39 | 0 | -507 | 32 | 4 | -34 | 7 | -22 | -5 |
| % diff | 111.8% | 74.1% | 51.3% | 100.0% | 90.4% | 109.7% | 106.2% | 52.1% | 109.7% | 90.7% | 88.9% |
| **Liberty 2011-1** | | | | | | | | | | | |
| Standard | 1358.54 | 213 | 54 | 38 | 5428 | 233 | 157 | 76 | 94 | 42 | 21 |
| Turtle | 1753.45 | 236 | 63 | 34 | 5622 | 388 | 180 | 79 | 115 | 51 | 43 |
| # diff | 395 | 23 | 9 | -4 | 194 | 155 | 23 | 3 | 21 | 9 | 22 |
| % diff | 129.1% | 110.8% | 116.7% | 89.5% | 103.6% | 166.5% | 114.6% | 103.9% | 122.3% | 121.4% | 204.8% |

**Table 23 (con't)**: Species comparisons between the CFTDD and New Bedford style dredges.

| | Scallops (bu) | Yellowtail flounder | Winter Flounder | Summer Flounder | Little Skate | Winter Skate | Monkfish | Barndoor Skate | Fourspot | Window pane | American Plaice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Endeavour 2011-1** | | | | | | | | | | | |
| Standard | 1130.81 | 264 | 133 | 35 | 6914 | 0 | 310 | 132 | 228 | 274 | 28 |
| Turtle | 1190.36 | 230 | 123 | 29 | 7765 | 0 | 318 | 141 | 232 | 141 | 30 |
| # diff | 60 | -34 | -10 | -6 | 851 | 0 | 8 | 9 | 4 | -133 | 2 |
| % diff | 105.3% | 87.1% | 92.5% | 82.9% | 112.3% | | 102.6% | 106.8% | 101.8% | 51.5% | 107.1% |
| **Regulus 2011-1** | | | | | | | | | | | |
| Standard | 881.3 | 511 | 150 | 21 | 5070 | 307 | 269 | 117 | 178 | 163 | 14 |
| Turtle | 956.4 | 565 | 119 | 12 | 5239 | 467 | 247 | 147 | 176 | 115 | 21 |
| # diff | 75 | 54 | -31 | -9 | 169 | 160 | -22 | 30 | -2 | -48 | 7 |
| % diff | 108.5% | 110.6% | 79.3% | 57.1% | 103.3% | 152.1% | 91.8% | 125.6% | 98.9% | 70.6% | 150.0% |
| **Resolution 2011-1** | | | | | | | | | | | |
| Standard | 947.54 | 377 | 104 | 32 | 4910 | 341 | 281 | 117 | 120 | 108 | 1 |
| Turtle | 932.91 | 633 | 161 | 31 | 6436 | 323 | 270 | 123 | 166 | 163 | 1 |
| # diff | -15 | 256 | 57 | -1 | 1526 | -18 | -11 | 6 | 46 | 55 | 0 |
| % diff | 98.5% | 167.9% | 154.8% | 96.9% | 131.1% | 94.7% | 96.1% | 105.1% | 138.3% | 150.9% | 100.0% |
| **Ranger 2011-1** | | | | | | | | | | | |
| Standard | 910.62 | 340 | 108 | 40 | 4582 | 326 | 301 | 99 | 99 | 176 | 1 |
| Turtle | 1063.56 | 721 | 143 | 38 | 6777 | 523 | 236 | 146 | 167 | 298 | 1 |
| # diff | 153 | 381 | 35 | -2 | 2195 | 197 | -65 | 47 | 68 | 122 | 0 |
| % diff | 116.8% | 212.1% | 132.4% | 95.0% | 147.9% | 160.4% | 78.4% | 147.5% | 168.7% | 169.3% | 100.0% |
| **Horizon 2011-1** | | | | | | | | | | | |
| Standard | 725.98 | 290 | 179 | 33 | 5161 | 377 | 171 | 56 | 52 | 565 | 1 |
| Turtle | 809.39 | 399 | 135 | 42 | 6336 | 430 | 177 | 77 | 96 | 410 | 2 |
| # diff | 83 | 109 | -44 | 9 | 1175 | 53 | 6 | 21 | 44 | -155 | 1 |
| % diff | 111.5% | 137.6% | 75.4% | 127.3% | 122.8% | 114.1% | 103.5% | 137.5% | 184.6% | 72.6% | 200.0% |

**Table 23 (con't)**: Species comparisons between the CFTDD and New Bedford style dredges.

| | Scallops (bu) | Yellowtail flounder | Winter Flounder | Summer Flounder | Little Skate | Winter Skate | Monkfish | Barndoor Skate | Fourspot | Window pane | American Plaice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wisdom 2011-1** | | | | | | | | | | | |
| Standard | 799.9 | 408 | 96 | 72 | 6282 | 245 | 136 | 43 | 69 | 1189 | 9 |
| Turtle | 801.95 | 309 | 37 | 49 | 5357 | 255 | 131 | 44 | 26 | 799 | 7 |
| # diff | 2 | -99 | -59 | -23 | -925 | 10 | -5 | 1 | -43 | -390 | -2 |
| % diff | 100.3% | 75.7% | 38.5% | 68.1% | 85.3% | 104.1% | 96.3% | 102.3% | 37.7% | 67.2% | 77.8% |
| **Venture 2011-1** | | | | | | | | | | | |
| Standard | 522.05 | 177 | 14 | 12 | 2500 | 77 | 21 | 2 | 12 | 832 | 28 |
| Turtle | 689.9 | 300 | 15 | 18 | 3931 | 231 | 33 | 16 | 41 | 1128 | 29 |
| # diff | 168 | 123 | 1 | 6 | 1431 | 154 | 12 | 14 | 29 | 296 | 1 |
| % diff | 132.2% | 169.5% | 107.1% | 150.0% | 157.2% | 300.0% | 157.1% | 800.0% | 341.7% | 135.6% | 103.6% |
| **Regulus 2012-1** | | | | | | | | | | | |
| Standard | 646.15 | 332 | 26 | 10 | 5211 | 307 | 46 | 18 | 19 | 1538 | 57 |
| Turtle | 673.25 | 290 | 12 | 10 | 4722 | 213 | 44 | 25 | 23 | 1014 | 37 |
| # diff | 27 | -42 | -14 | 0 | -489 | -94 | -2 | 7 | 4 | -524 | -20 |
| % diff | 104.2% | 87.3% | 46.2% | 100.0% | 90.6% | 69.4% | 95.7% | 138.9% | 121.1% | 65.9% | 64.9% |
| **Endeavour 2012-1** | | | | | | | | | | | |
| Standard | 708.86 | 367 | 17 | 18 | 7010 | 282 | 96 | 43 | 59 | 1554 | 69 |
| Turtle | 746.74 | 443 | 17 | 17 | 6093 | 266 | 108 | 58 | 35 | 1278 | 65 |
| # diff | 38 | 76 | 0 | -1 | -917 | -16 | 12 | 15 | -24 | -276 | -4 |
| % diff | 105.3% | 120.7% | 100.0% | 94.4% | 86.9% | 94.3% | 112.5% | 134.9% | 59.3% | 82.2% | 94.2% |
| **All 14 Trips Combined** | | | | | | | | | | | |
| Standard | 13498.8 | 4802.0 | 1148.0 | 343.0 | 73939.0 | 3823.0 | 1981.0 | 864.0 | 1090.0 | 9294.0 | 401.0 |
| Turtle | 14535.1 | 5375.0 | 1012.0 | 322.0 | 77068.0 | 4573.0 | 1941.0 | 992.0 | 1262.0 | 7379.0 | 345.0 |
| # diff | 1036 | 573 | -136 | -21 | 3129 | 750 | -40 | 128 | 172 | -1915 | -56 |
| % diff | 107.7% | 111.9% | 88.2% | 93.9% | 104.2% | 119.6% | 98.0% | 114.8% | 115.8% | 79.4% | 86.0% |

**Table 24**: All trips that had twine tops with a hanging ratio greater than 2:1.

| | Scallops (bu) | Yellowtail flounder | Winter Flounder | Summer Flounder | Little Skate | Winter Skate | Monkfish | Barndoor Skate | Fourspot | Window pane | American Plaice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Arcturus 2011-1** | | | | | | | | | | | |
| Standard | 1384.9 | 431 | 46 | 2 | 6778 | 324 | 5 | 5 | 0 | 1533 | 73 |
| Turtle | 1253.9 | 229 | 11 | 1 | 4888 | 301 | 3 | 6 | 0 | 751 | 31 |
| # diff | -131 | -202 | -35 | -1 | -1890 | -23 | -2 | 1 | 0 | -782 | -42 |
| % diff | 90.5% | 53.1% | 23.9% | 50.0% | 72.1% | 92.9% | 60.0% | 120.0% | | 49.0% | 42.5% |
| **Westport 2011-1** | | | | | | | | | | | |
| Standard | 1344.5 | 294 | 80 | 13 | 5258 | 331 | 65 | 71 | 72 | 236 | 45 |
| Turtle | 1502.75 | 218 | 41 | 13 | 4751 | 363 | 69 | 37 | 79 | 214 | 40 |
| # diff | 158 | -76 | -39 | 0 | -507 | 32 | 4 | -34 | 7 | -22 | -5 |
| % diff | 111.8% | 74.1% | 51.3% | 100.0% | 90.4% | 109.7% | 106.2% | 52.1% | 109.7% | 90.7% | 88.9% |
| **Liberty 2011-1** | | | | | | | | | | | |
| Standard | 1358.54 | 213 | 54 | 38 | 5428 | 233 | 157 | 76 | 94 | 42 | 21 |
| Turtle | 1753.45 | 236 | 63 | 34 | 5622 | 388 | 180 | 79 | 115 | 51 | 43 |
| # diff | 395 | 23 | 9 | -4 | 194 | 155 | 23 | 3 | 21 | 9 | 22 |
| % diff | 129.1% | 110.8% | 116.7% | 89.5% | 103.6% | 166.5% | 114.6% | 103.9% | 122.3% | 121.4% | 204.8% |
| **Endeavour 2011-1** | | | | | | | | | | | |
| Standard | 1130.81 | 264 | 133 | 35 | 6914 | 0 | 310 | 132 | 228 | 274 | 28 |
| Turtle | 1190.36 | 230 | 123 | 29 | 7765 | 0 | 318 | 141 | 232 | 141 | 30 |
| # diff | 60 | -34 | -10 | -6 | 851 | 0 | 8 | 9 | 4 | -133 | 2 |
| % diff | 105.3% | 87.1% | 92.5% | 82.9% | 112.3% | | 102.6% | 106.8% | 101.8% | 51.5% | 107.1% |
| **Horizon 2011-1** | | | | | | | | | | | |
| Standard | 725.98 | 290 | 179 | 33 | 5161 | 377 | 171 | 56 | 52 | 565 | 1 |
| Turtle | 809.39 | 399 | 135 | 42 | 6336 | 430 | 177 | 77 | 96 | 410 | 2 |
| # diff | 83 | 109 | -44 | 9 | 1175 | 53 | 6 | 21 | 44 | -155 | 1 |
| % diff | 111.5% | 137.6% | 75.4% | 127.3% | 122.8% | 114.1% | 103.5% | 137.5% | 184.6% | 72.6% | 200.0% |
| **Wisdom 2011-1** | | | | | | | | | | | |
| Standard | 799.9 | 408 | 96 | 72 | 6282 | 245 | 136 | 43 | 69 | 1189 | 9 |
| Turtle | 801.95 | 309 | 37 | 49 | 5357 | 255 | 131 | 44 | 26 | 799 | 7 |
| # diff | 2 | -99 | -59 | -23 | -925 | 10 | -5 | 1 | -43 | -390 | -2 |
| % diff | 100.3% | 75.7% | 38.5% | 68.1% | 85.3% | 104.1% | 96.3% | 102.3% | 37.7% | 67.2% | 77.8% |
| **Venture 2011-1** | | | | | | | | | | | |
| Standard | 522.05 | 177 | 14 | 12 | 2500 | 77 | 21 | 2 | 12 | 832 | 28 |
| Turtle | 689.9 | 300 | 15 | 18 | 3931 | 231 | 33 | 16 | 41 | 1128 | 29 |
| # diff | 168 | 123 | 1 | 6 | 1431 | 154 | 12 | 14 | 29 | 296 | 1 |
| % diff | 132.2% | 169.5% | 107.1% | 150.0% | 157.2% | 300.0% | 157.1% | 800.0% | 341.7% | 135.6% | 103.6% |
| **Endeavour 2012-1** | | | | | | | | | | | |
| Standard | 708.86 | 367 | 17 | 18 | 7010 | 282 | 96 | 43 | 59 | 1554 | 69 |
| Turtle | 746.74 | 443 | 17 | 17 | 6093 | 266 | 108 | 58 | 35 | 1278 | 65 |
| # diff | 38 | 76 | 0 | -1 | -917 | -16 | 12 | 15 | -24 | -276 | -4 |
| % diff | 105.3% | 120.7% | 100.0% | 94.4% | 86.9% | 94.3% | 112.5% | 134.9% | 59.3% | 82.2% | 94.2% |
| **Trips with twine tops greater than 60 meshes wide** | | | | | | | | | | | |
| Standard | 7975.54 | 2444 | 619 | 223 | 45331 | 1869 | 961 | 428 | 586 | 6225 | 274 |
| Turtle | 8748.44 | 2364 | 442 | 203 | 44743 | 2234 | 1019 | 458 | 624 | 4772 | 247 |
| # diff | 773 | -80 | -177 | -20 | -588 | 365 | 58 | 30 | 38 | -1453 | -27 |
| % diff | 109.7% | 96.7% | 71.4% | 91.0% | 98.7% | 119.5% | 106.0% | 107.0% | 106.5% | 76.7% | 90.1% |

**Table 25**: All trips with hanging ratios less than 2:1.

| | Scallops (bu) | Yellowtail flounder | Winter Flounder | Summer Flounder | Little Skate | Winter Skate | Monkfish | Barndoor Skate | Fourspot | Window pane | American Plaice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Regulus 2011-1** | | | | | | | | | | | |
| Standard | 881.3 | 511 | 150 | 21 | 5070 | 307 | 269 | 117 | 178 | 163 | 14 |
| Turtle | 956.4 | 565 | 119 | 12 | 5239 | 467 | 247 | 147 | 176 | 115 | 21 |
| # diff | 75 | 54 | -31 | -9 | 169 | 160 | -22 | 30 | -2 | -48 | 7 |
| % diff | 108.5% | 110.6% | 79.3% | 57.1% | 103.3% | 152.1% | 91.8% | 125.6% | 98.9% | 70.6% | 150.0% |
| **Resolution 2011-1** | | | | | | | | | | | |
| Standard | 947.54 | 377 | 104 | 32 | 4910 | 341 | 281 | 117 | 120 | 108 | 1 |
| Turtle | 932.91 | 633 | 161 | 31 | 6436 | 323 | 270 | 123 | 166 | 163 | 1 |
| # diff | -15 | 256 | 57 | -1 | 1526 | -18 | -11 | 6 | 46 | 55 | 0 |
| % diff | 98.5% | 167.9% | 154.8% | 96.9% | 131.1% | 94.7% | 96.1% | 105.1% | 138.3% | 150.9% | 100.0% |
| **Regulus 2012-1** | | | | | | | | | | | |
| Standard | 646.15 | 332 | 26 | 10 | 5211 | 307 | 46 | 18 | 19 | 1538 | 57 |
| Turtle | 673.25 | 290 | 12 | 10 | 4722 | 213 | 44 | 25 | 23 | 1014 | 37 |
| # diff | 27 | -42 | -14 | 0 | -489 | -94 | -2 | 7 | 4 | -524 | -20 |
| % diff | 104.2% | 87.3% | 46.2% | 100.0% | 90.6% | 69.4% | 95.7% | 138.9% | 121.1% | 65.9% | 64.9% |
| **Ranger 2011-1** | | | | | | | | | | | |
| Standard | 910.62 | 340 | 108 | 40 | 4582 | 326 | 301 | 99 | 99 | 176 | 1 |
| Turtle | 1063.56 | 721 | 143 | 38 | 6777 | 523 | 236 | 146 | 167 | 298 | 1 |
| # diff | 153 | 381 | 35 | -2 | 2195 | 197 | -65 | 47 | 68 | 122 | 0 |
| % diff | 116.8% | 212.1% | 132.4% | 95.0% | 147.9% | 160.4% | 78.4% | 147.5% | 168.7% | 169.3% | 100.0% |
| **Trips with twine tops less than 60 meshes wide** | | | | | | | | | | | |
| Standard | 3385.61 | 1560 | 388 | 103 | 19773 | 1281 | 897 | 351 | 416 | 1985 | 73 |
| Turtle | 3626.12 | 2209 | 435 | 91 | 23174 | 1526 | 797 | 441 | 532 | 1590 | 60 |
| # diff | 241 | 649 | 47 | -12 | 3401 | 245 | -100 | 90 | 116 | -395 | -13 |
| % diff | 107.1% | 141.6% | 112.1% | 88.3% | 117.2% | 119.1% | 88.9% | 125.6% | 127.9% | 80.1% | 82.2% |

**Table 26**: Summary of bycatch rates for yellowtail using all trips combined for both CAI and CAII for all stations.

| | | Yellowtail (lbs) | | Scallops (lbs) | | Bycatch Rate | |
|---|---|---|---|---|---|---|---|
| **Selected stations** | **Twine Top Size** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** |
| Celtic 2010 (Oct) | 7.5 x 60 | 574 | 490 | 4511 | 4262 | 0.127 | 0.115 |
| Arcturus (Mar) | 8.5 x 90 | 204 | 367 | 4589 | 5296 | 0.045 | 0.069 |
| Celtic 2011 (Apr) | 7.5 x 60 | 179 | 211 | 3992 | 4838 | 0.045 | 0.044 |
| Westport (May) | 8.5 x 80 | 125 | 194 | 7015 | 6880 | 0.018 | 0.028 |
| Liberty (June) | 8.5 x 90 | 141 | 143 | 8678 | 7067 | 0.016 | 0.020 |
| Endeavour (July) | 8.5 x 80 | 118 | 141 | 5530 | 5764 | 0.021 | 0.024 |
| Regulus (Aug) | 7.5 x 43 | 439 | 422 | 3738 | 3355 | 0.118 | 0.126 |
| Resolution (Sept) | 10.5 x 36 | 459 | 315 | 3081 | 3505 | 0.149 | 0.090 |
| Ranger (Oct) | 9 x 33 | 577 | 271 | 3479 | 3265 | 0.166 | 0.083 |
| Horizon (Dec) | 8 x 96 | 250 | 193 | 2811 | 2747 | 0.089 | 0.070 |
| Wisdom (Jan) | 11 x 90 | 218 | 284 | 2906 | 2966 | 0.075 | 0.096 |
| Venture (Feb) | 7.5 x 80 | 194 | 146 | 2314 | 1933 | 0.084 | 0.075 |
| Regulus (March) | 7.5 x 43 | 214 | 249 | 2525 | 2717 | 0.085 | 0.092 |
| Endeavour (April) | 8.5 x 80 | 264 | 242 | 2906 | | 0.091 | |
| **Totals** | | 3957 | 3668 | 58075 | 54596 | **0.068** | **0.067** |
| **All stations** | | | | | | | |
| Celtic 2010 (Oct) | 7.5 x 60 | 619 | 538 | 7575 | 6666 | 0.082 | 0.081 |
| Arcturus (Mar) | 8.5 x 90 | 249 | 477 | 7360 | 8495 | 0.034 | 0.056 |
| Celtic 2011 (Apr) | 7.5 x 60 | 224 | 282 | 7078 | 7777 | 0.032 | 0.036 |
| Westport (May) | 8.5 x 80 | 182 | 260 | 9798 | 9757 | 0.019 | 0.027 |
| Liberty (June) | 8.5 x 90 | 231 | 215 | 15517 | 12087 | 0.015 | 0.018 |
| Endeavour (July) | 8.5 x 80 | 222 | 270 | 9836 | 9185 | 0.023 | 0.029 |
| Regulus (Aug) | 7.5 x 43 | 544 | 514 | 6179 | 5565 | 0.088 | 0.092 |
| Resolution (Sept) | 10.5 x 36 | 637 | 400 | 5456 | 5638 | 0.117 | 0.071 |
| Ranger (Oct) | 9 x 33 | 763 | 372 | 6085 | 5491 | 0.125 | 0.068 |
| Horizon (Dec) | 8 x 96 | 445 | 336 | 4501 | 4338 | 0.099 | 0.077 |
| Wisdom (Jan) | 11 x 90 | 334 | 432 | 4617 | 4543 | 0.072 | 0.095 |
| Venture (Feb) | 7.5 x 80 | 332 | 201 | 4288 | 3102 | 0.077 | 0.065 |
| Regulus (March) | 7.5 x 43 | 304 | 360 | 4040 | 4166 | 0.075 | 0.086 |
| Endeavour (April) | 8.5 x 80 | 446 | 366 | 5205 | | 0.086 | |
| **Totals** | | 5530 | 5024 | 97535 | 86811 | **0.057** | **0.058** |
| **Turtle Dredge** | 8.5 x 60 | | | | | | |

**Table 27**: Bycatch rates for the selected stations inside CAI and CAII combined with the trips grouped by twine top width (greater than 60 meshes versus less than 60 meshes).

| | | Yellowtail (lbs) | | Scallops (lbs) | | Bycatch Rate | |
|---|---|---|---|---|---|---|---|
| **Selected stations** | **Twine Top Size** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** |
| Arcturus (Mar) | 8.5 x 90 | 204 | 367 | 4589 | 5296 | 0.045 | 0.069 |
| Westport (May) | 8.5 x 80 | 125 | 194 | 7015 | 6880 | 0.018 | 0.028 |
| Liberty (June) | 8.5 x 90 | 141 | 143 | 8678 | 7067 | 0.016 | 0.020 |
| Endeavour (July) | 8.5 x 80 | 118 | 141 | 5530 | 5764 | 0.021 | 0.024 |
| Horizon (Dec) | 8 x 96 | 250 | 193 | 2811 | 2747 | 0.089 | 0.070 |
| Wisdom (Jan) | 11 x 90 | 218 | 284 | 2906 | 2966 | 0.075 | 0.096 |
| Venture (Feb) | 7.5 x 80 | 194 | 146 | 2314 | 1933 | 0.084 | 0.075 |
| Endeavour (April) | 8.5 x 80 | 264 | 242 | 2906 | | 0.091 | |
| | | | | | | | |
| **Totals** | | 1515 | 1710 | 36749 | 32653 | **0.041** | **0.052** |
| | | | | | | | |
| Regulus (Aug) | 7.5 x 43 | 439 | 422 | 3738 | 3355 | 0.118 | 0.126 |
| Resolution (Sept) | 10.5 x 36 | 459 | 315 | 3081 | 3505 | 0.149 | 0.090 |
| Ranger (Oct) | 9 x 33 | 577 | 271 | 3479 | 3265 | 0.166 | 0.083 |
| Regulus (March) | 7.5 x 43 | 214 | 249 | 2525 | 2717 | 0.085 | 0.092 |
| | | | | | | | |
| **Totals** | | 1689 | 1258 | 12823 | 12843 | **0.132** | **0.098** |
| | | | | | | | |
| **Turtle Dredge** | **8.5 x 60** | | | | | | |

**Table 28:** Bycatch rates for the selected stations inside CAI and CAII combined with the trips grouped by apron height.

| | | | Yellowtail (lbs) | | Scallops (lbs) | | Bycatch Rate | |
|---|---|---|---|---|---|---|---|---|
| **All stations** | **Twine Top Size** | **Apron Size** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** | **Turtle** | **New Bedford** |
| Arcturus (Mar) | 8.5 x 90 | 10 x 40 | 249 | 477 | 7360 | 8495 | 0.034 | 0.056 |
| Westport (May) | 8.5 x 80 | 13 x 40 | 182 | 260 | 9798 | 9757 | 0.019 | 0.027 |
| Wisdom (Jan) | 11 x 90 | 10 x 38 | 334 | 432 | 4617 | 4543 | 0.072 | 0.095 |
| **Total** | | | 765 | 1170 | 21775 | 22796 | **0.035** | **0.051** |
| | | | | | | | | |
| Celtic 2010 (Oct) | 7.5 x 60 | 8 x 40 | 619 | 538 | 7575 | 6666 | 0.082 | 0.081 |
| Celtic 2011 (Apr) | 7.5 x 60 | 8 x 40 | 224 | 282 | 7078 | 7777 | 0.032 | 0.036 |
| Liberty (June) | 8.5 x 90 | 7 x 38 | 231 | 215 | 15517 | 12087 | 0.015 | 0.018 |
| Endeavour (July) | 8.5 x 80 | 8 x 40 | 222 | 270 | 9836 | 9185 | 0.023 | 0.029 |
| Regulus (Aug) | 7.5 x 43 | 8 x 38 | 544 | 514 | 6179 | 5565 | 0.088 | 0.092 |
| Resolution (Sept) | 10.5 x 36 | 8 x 42 | 637 | 400 | 5456 | 5638 | 0.117 | 0.071 |
| Ranger (Oct) | 9 x 33 | 7 x 38 | 763 | 372 | 6085 | 5491 | 0.125 | 0.068 |
| Horizon (Dec) | 8 x 96 | 8 x 44 | 445 | 336 | 4501 | 4338 | 0.099 | 0.077 |
| Venture (Feb) | 7.5 x 80 | 7 x 36 | 332 | 201 | 4288 | 3102 | 0.077 | 0.065 |
| Regulus (March) | 7.5 x 43 | 8 x 38 | 304 | 360 | 4040 | 4166 | 0.075 | 0.086 |
| Endeavour (April) | 8.5 x 80 | 8 x 40 | 446 | 366 | 5205 | | 0.086 | |
| **Total** | | | 4765 | 3854 | 75760 | 64015 | **0.063** | **0.060** |
| Turtle Dredge | 8 x 40 | | | | | | | |

**Table 29:** Mixed effects model pooled catch data for all bycatch survey cruises. Results are from species where the intercept only model provided the best fit to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Estimate | StdErr | DF | t | P value | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|
| Spiny Dogfish | Intercept Only | **1.972** | 0.627 | 62 | 3.146 | 0.003 | 0.05 | 0.719 | 3.225 |
| American Plaice | Intercept Only | -0.141 | 0.092 | 279 | -1.535 | 0.126 | 0.05 | -0.322 | 0.040 |
| Summer Flounder | Intercept Only | -0.143 | 0.104 | 255 | -1.369 | 0.172 | 0.05 | -0.349 | 0.063 |
| Grey Sole | Intercept Only | 0.217 | 0.119 | 149 | 1.825 | 0.070 | 0.05 | -0.018 | 0.451 |
| Monkfish | Intercept Only | 0.020 | 0.038 | 663 | 0.521 | 0.602 | 0.05 | -0.055 | 0.095 |
| Haddock | Intercept Only | 0.224 | 0.188 | 82 | 1.194 | 0.236 | 0.05 | -0.149 | 0.598 |

**Table 30:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for scallops from the model that provided the best fit (intercept and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | t | P-value | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Sea Scallops | Intercept | | 0.081 | 0.039 | 942 | 2.093 | 0.037 | 0.05 | 0.005 | 0.157 |
| Sea Scallops | CRUISEID | ARC-1-11 | -0.163 | 0.056 | 942 | -2.908 | 0.004 | 0.05 | -0.274 | -0.053 |
| Sea Scallops | CRUISEID | CEL-1-11 | -0.160 | 0.057 | 942 | -2.807 | 0.005 | 0.05 | -0.272 | -0.048 |
| Sea Scallops | CRUISEID | CEL-2-10 | 0.080 | 0.063 | 942 | 1.272 | 0.204 | 0.05 | -0.043 | 0.202 |
| Sea Scallops | CRUISEID | END-1-11 | -0.063 | 0.056 | 942 | -1.139 | 0.255 | 0.05 | -0.173 | 0.046 |
| Sea Scallops | CRUISEID | END-2-12 | -0.105 | 0.055 | 942 | -1.913 | 0.056 | 0.05 | -0.213 | 0.003 |
| Sea Scallops | CRUISEID | HOR-1-11 | -0.031 | 0.055 | 942 | -0.575 | 0.565 | 0.05 | -0.139 | 0.076 |
| Sea Scallops | CRUISEID | LIB-1-11 | 0.149 | 0.056 | 942 | 2.674 | 0.008 | 0.05 | 0.040 | 0.259 |
| Sea Scallops | CRUISEID | RAN-1-11 | 0.114 | 0.055 | 942 | 2.063 | 0.039 | 0.05 | 0.006 | 0.223 |
| Sea Scallops | CRUISEID | REG-1-11 | 0.052 | 0.056 | 942 | 0.926 | 0.355 | 0.05 | -0.058 | 0.161 |
| Sea Scallops | CRUISEID | REG-2-12 | -0.099 | 0.056 | 942 | -1.774 | 0.076 | 0.05 | -0.208 | 0.010 |
| Sea Scallops | CRUISEID | RES-1-11 | -0.014 | 0.056 | 942 | -0.259 | 0.796 | 0.05 | -0.123 | 0.095 |
| Sea Scallops | CRUISEID | VEN-1-12 | 0.313 | 0.055 | 942 | 5.708 | 0.000 | 0.05 | 0.205 | 0.420 |
| Sea Scallops | CRUISEID | WES-1-11 | -0.014 | 0.058 | 942 | -0.245 | 0.807 | 0.05 | -0.127 | 0.099 |
| Sea Scallops | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 31:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are unclassified skates from the model that provided the best fit (intercept and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | tValue | Probt | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Uncl. Skate | Intercept | | 0.265 | 0.074 | 134 | 3.563 | 0.001 | 0.05 | 0.118 | 0.412 |
| Uncl. Skate | CRUISEID | ARC-1-11 | -0.512 | 0.360 | 134 | -1.421 | 0.158 | 0.05 | -1.225 | 0.201 |
| Uncl. Skate | CRUISEID | CEL-1-11 | -0.455 | 0.107 | 134 | -4.249 | 0.000 | 0.05 | -0.667 | -0.243 |
| Uncl. Skate | CRUISEID | END-1-11 | 0.000 | | | | | | | |

**Table 32:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for yellowtail flounder from the model that provided the best fit (intercept and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | tValue | Probt | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Yellowtail Flounder | Intercept | | -0.259 | 0.106 | 707 | -2.442 | 0.015 | 0.05 | -0.468 | -0.051 |
| Yellowtail Flounder | CRUISEID | ARC-1-11 | -0.304 | 0.157 | 707 | -1.941 | 0.053 | 0.05 | -0.612 | 0.003 |
| Yellowtail Flounder | CRUISEID | CEL-1-11 | -0.073 | 0.160 | 707 | -0.456 | 0.649 | 0.05 | -0.386 | 0.241 |
| Yellowtail Flounder | CRUISEID | CEL-2-10 | 0.420 | 0.161 | 707 | 2.604 | 0.009 | 0.05 | 0.103 | 0.736 |
| Yellowtail Flounder | CRUISEID | END-1-11 | 0.255 | 0.162 | 707 | 1.571 | 0.117 | 0.05 | -0.064 | 0.574 |
| Yellowtail Flounder | CRUISEID | END-2-12 | 0.436 | 0.142 | 707 | 3.067 | 0.002 | 0.05 | 0.157 | 0.715 |
| Yellowtail Flounder | CRUISEID | HOR-1-11 | 0.508 | 0.150 | 707 | 3.388 | 0.001 | 0.05 | 0.213 | 0.802 |
| Yellowtail Flounder | CRUISEID | LIB-1-11 | 0.398 | 0.166 | 707 | 2.404 | 0.016 | 0.05 | 0.073 | 0.723 |
| Yellowtail Flounder | CRUISEID | RAN-1-11 | 1.140 | 0.147 | 707 | 7.753 | 0.000 | 0.05 | 0.852 | 1.429 |
| Yellowtail Flounder | CRUISEID | REG-1-11 | 0.355 | 0.144 | 707 | 2.465 | 0.014 | 0.05 | 0.072 | 0.638 |
| Yellowtail Flounder | CRUISEID | REG-2-12 | 0.119 | 0.156 | 707 | 0.762 | 0.447 | 0.05 | -0.187 | 0.424 |
| Yellowtail Flounder | CRUISEID | RES-1-11 | 0.889 | 0.147 | 707 | 6.067 | 0.000 | 0.05 | 0.601 | 1.176 |
| Yellowtail Flounder | CRUISEID | VEN-1-12 | 0.875 | 0.166 | 707 | 5.272 | 0.000 | 0.05 | 0.549 | 1.202 |
| Yellowtail Flounder | CRUISEID | WES-1-11 | -0.023 | 0.159 | 707 | -0.146 | 0.884 | 0.05 | -0.336 | 0.290 |
| Yellowtail Flounder | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 33:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for winter flounder from the model that provided the best fit (intercept and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | tValue | Probt | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Winter Flounder | Intercept | | -1.009 | 0.236 | 375 | -4.271 | 0.000 | 0.05 | -1.474 | -0.545 |
| Winter Flounder | CRUISEID | ARC-1-11 | -0.250 | 0.431 | 375 | -0.580 | 0.562 | 0.05 | -1.098 | 0.598 |
| Winter Flounder | CRUISEID | CEL-1-11 | 0.135 | 0.440 | 375 | 0.308 | 0.759 | 0.05 | -0.730 | 1.001 |
| Winter Flounder | CRUISEID | CEL-2-10 | 1.045 | 0.296 | 375 | 3.527 | 0.000 | 0.05 | 0.462 | 1.627 |
| Winter Flounder | CRUISEID | END-1-11 | 1.103 | 0.302 | 375 | 3.656 | 0.000 | 0.05 | 0.510 | 1.697 |
| Winter Flounder | CRUISEID | END-2-12 | 0.929 | 0.439 | 375 | 2.118 | 0.035 | 0.05 | 0.066 | 1.791 |
| Winter Flounder | CRUISEID | HOR-1-11 | 0.711 | 0.282 | 375 | 2.518 | 0.012 | 0.05 | 0.156 | 1.266 |
| Winter Flounder | CRUISEID | LIB-1-11 | 1.223 | 0.330 | 375 | 3.707 | 0.000 | 0.05 | 0.574 | 1.872 |
| Winter Flounder | CRUISEID | RAN-1-11 | 1.302 | 0.290 | 375 | 4.492 | 0.000 | 0.05 | 0.732 | 1.872 |
| Winter Flounder | CRUISEID | REG-1-11 | 0.845 | 0.287 | 375 | 2.948 | 0.003 | 0.05 | 0.282 | 1.409 |
| Winter Flounder | CRUISEID | REG-2-12 | 0.408 | 0.463 | 375 | 0.881 | 0.379 | 0.05 | -0.503 | 1.318 |
| Winter Flounder | CRUISEID | RES-1-11 | 1.356 | 0.293 | 375 | 4.631 | 0.000 | 0.05 | 0.780 | 1.931 |
| Winter Flounder | CRUISEID | VEN-1-12 | 0.025 | 0.459 | 375 | 0.055 | 0.956 | 0.05 | -0.877 | 0.928 |
| Winter Flounder | CRUISEID | WES-1-11 | 0.198 | 0.335 | 375 | 0.590 | 0.555 | 0.05 | -0.461 | 0.858 |
| Winter Flounder | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 34:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for windowpane flounder from the model that provided the best fit (intercept and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | tValue | Probt | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Windowpane Flounder | Intercept | | -0.452 | 0.071 | 652 | -6.325 | 0.000 | 0.05 | -0.592 | -0.311 |
| Windowpane Flounder | CRUISEID | ARC-1-11 | -0.354 | 0.101 | 652 | -3.516 | 0.000 | 0.05 | -0.552 | -0.156 |
| Windowpane Flounder | CRUISEID | CEL-1-11 | 0.301 | 0.110 | 652 | 2.740 | 0.006 | 0.05 | 0.085 | 0.516 |
| Windowpane Flounder | CRUISEID | CEL-2-10 | 0.488 | 0.149 | 652 | 3.281 | 0.001 | 0.05 | 0.196 | 0.780 |
| Windowpane Flounder | CRUISEID | END-1-11 | -0.138 | 0.169 | 652 | -0.820 | 0.413 | 0.05 | -0.469 | 0.193 |
| Windowpane Flounder | CRUISEID | END-2-12 | 0.252 | 0.093 | 652 | 2.699 | 0.007 | 0.05 | 0.069 | 0.435 |
| Windowpane Flounder | CRUISEID | HOR-1-11 | 0.117 | 0.109 | 652 | 1.078 | 0.281 | 0.05 | -0.096 | 0.331 |
| Windowpane Flounder | CRUISEID | LIB-1-11 | 0.521 | 0.291 | 652 | 1.789 | 0.074 | 0.05 | -0.051 | 1.093 |
| Windowpane Flounder | CRUISEID | RAN-1-11 | 0.945 | 0.143 | 652 | 6.613 | 0.000 | 0.05 | 0.664 | 1.226 |
| Windowpane Flounder | CRUISEID | REG-1-11 | 0.076 | 0.169 | 652 | 0.447 | 0.655 | 0.05 | -0.256 | 0.408 |
| Windowpane Flounder | CRUISEID | REG-2-12 | 0.006 | 0.096 | 652 | 0.057 | 0.954 | 0.05 | -0.183 | 0.194 |
| Windowpane Flounder | CRUISEID | RES-1-11 | 0.835 | 0.177 | 652 | 4.715 | 0.000 | 0.05 | 0.487 | 1.183 |
| Windowpane Flounder | CRUISEID | VEN-1-12 | 0.733 | 0.099 | 652 | 7.383 | 0.000 | 0.05 | 0.538 | 0.928 |
| Windowpane Flounder | CRUISEID | WES-1-11 | 0.453 | 0.168 | 652 | 2.695 | 0.007 | 0.05 | 0.123 | 0.783 |
| Windowpane Flounder | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 35:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for Atlantic cod from the model that provided the best fit (intercept and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CruiseID | Estimate | StdErr | DF | tValue | Probt | Alpha | LCI | UCI |
|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic Cod | Intercept | | 1.706 | 1.531 | 41 | 1.115 | 0.271 | 0.05 | -1.385 | 4.798 |
| Atlantic Cod | AREA | CAI | -2.481 | 2.019 | 41 | -1.229 | 0.226 | 0.05 | -6.558 | 1.596 |
| Atlantic Cod | AREA | CAII | 0.000 | | | | | | | |

**Table 36:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for barndoor skate scallops from the model that provided the best fit (intercept, cruiseid and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CRUISEID | AREA | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Barndoor Skate | Intercept | | | 0.066 | 0.239 | 485 | 0.279 | 0.781 | 0.05 | -0.402 | 0.535 |
| Barndoor Skate | AREA | | CAI | -0.325 | 0.119 | 485 | -2.740 | 0.006 | 0.05 | -0.559 | -0.092 |
| Barndoor Skate | AREA | | CAII | 0.000 | | | | | | | |
| Barndoor Skate | CRUISEID | ARC-1-11 | | 0.687 | 0.627 | 485 | 1.095 | 0.274 | 0.05 | -0.545 | 1.919 |
| Barndoor Skate | CRUISEID | CEL-1-11 | | -0.484 | 0.554 | 485 | -0.874 | 0.382 | 0.05 | -1.572 | 0.604 |
| Barndoor Skate | CRUISEID | CEL-2-10 | | 0.335 | 0.316 | 485 | 1.063 | 0.288 | 0.05 | -0.285 | 0.956 |
| Barndoor Skate | CRUISEID | END-1-11 | | 0.228 | 0.274 | 485 | 0.833 | 0.405 | 0.05 | -0.310 | 0.767 |
| Barndoor Skate | CRUISEID | END-2-12 | | -0.437 | 1.294 | 485 | -0.338 | 0.736 | 0.05 | -2.979 | 2.105 |
| Barndoor Skate | CRUISEID | HOR-1-11 | | 0.343 | 0.304 | 485 | 1.126 | 0.261 | 0.05 | -0.255 | 0.941 |
| Barndoor Skate | CRUISEID | LIB-1-11 | | 0.126 | 0.296 | 485 | 0.427 | 0.670 | 0.05 | -0.455 | 0.708 |
| Barndoor Skate | CRUISEID | RAN-1-11 | | 0.611 | 0.283 | 485 | 2.160 | 0.031 | 0.05 | 0.055 | 1.166 |
| Barndoor Skate | CRUISEID | REG-1-11 | | 0.370 | 0.277 | 485 | 1.338 | 0.182 | 0.05 | -0.174 | 0.914 |
| Barndoor Skate | CRUISEID | REG-2-12 | | 0.305 | 0.414 | 485 | 0.737 | 0.461 | 0.05 | -0.508 | 1.119 |
| Barndoor Skate | CRUISEID | RES-1-11 | | 0.077 | 0.282 | 485 | 0.275 | 0.783 | 0.05 | -0.476 | 0.631 |
| Barndoor Skate | CRUISEID | VEN-1-12 | | 1.823 | 0.816 | 485 | 2.234 | 0.026 | 0.05 | 0.219 | 3.426 |
| Barndoor Skate | CRUISEID | WES-1-11 | | -0.621 | 0.328 | 485 | -1.894 | 0.059 | 0.05 | -1.265 | 0.023 |
| Barndoor Skate | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

**Table 37:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for winter skate from the model that provided the best fit (intercept, cruiseid and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CRUISEID | AREA | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter Skate | Intercept | | | -0.043 | 0.117 | 732 | -0.368 | 0.713 | 0.05 | -0.272 | 0.186 |
| Winter Skate | AREA | | CAI | -0.213 | 0.073 | 732 | -2.913 | 0.004 | 0.05 | -0.357 | -0.069 |
| Winter Skate | AREA | | CAII | 0.000 | | | | | | | |
| Winter Skate | CRUISEID | ARC-1-11 | | 0.033 | 0.165 | 732 | 0.201 | 0.841 | 0.05 | -0.291 | 0.357 |
| Winter Skate | CRUISEID | CEL-1-11 | | 0.262 | 0.156 | 732 | 1.678 | 0.094 | 0.05 | -0.045 | 0.568 |
| Winter Skate | CRUISEID | CEL-2-10 | | 0.117 | 0.176 | 732 | 0.663 | 0.508 | 0.05 | -0.229 | 0.462 |
| Winter Skate | CRUISEID | END-2-12 | | 0.036 | 0.156 | 732 | 0.229 | 0.819 | 0.05 | -0.271 | 0.343 |
| Winter Skate | CRUISEID | HOR-1-11 | | 0.247 | 0.152 | 732 | 1.626 | 0.104 | 0.05 | -0.051 | 0.545 |
| Winter Skate | CRUISEID | LIB-1-11 | | 0.454 | 0.161 | 732 | 2.825 | 0.005 | 0.05 | 0.138 | 0.769 |
| Winter Skate | CRUISEID | RAN-1-11 | | 0.616 | 0.153 | 732 | 4.040 | 0.000 | 0.05 | 0.317 | 0.916 |
| Winter Skate | CRUISEID | REG-1-11 | | 0.542 | 0.153 | 732 | 3.538 | 0.000 | 0.05 | 0.241 | 0.844 |
| Winter Skate | CRUISEID | REG-2-12 | | -0.338 | 0.161 | 732 | -2.099 | 0.036 | 0.05 | -0.654 | -0.022 |
| Winter Skate | CRUISEID | RES-1-11 | | 0.059 | 0.155 | 732 | 0.380 | 0.704 | 0.05 | -0.245 | 0.363 |
| Winter Skate | CRUISEID | VEN-1-12 | | 1.167 | 0.196 | 732 | 5.958 | 0.000 | 0.05 | 0.782 | 1.552 |
| Winter Skate | CRUISEID | WES-1-11 | | 0.282 | 0.164 | 732 | 1.723 | 0.085 | 0.05 | -0.039 | 0.603 |
| Winter Skate | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

**Table 38:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for little skate from the model that provided the best fit (intercept, cruiseid and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CRUISEID | AREA | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Skate | Intercept | | | -0.259 | 0.061 | 803 | -4.209 | 0.000 | 0.05 | -0.379 | -0.138 |
| Little Skate | AREA | | CAI | -0.071 | 0.036 | 803 | -1.980 | 0.048 | 0.05 | -0.142 | -0.001 |
| Little Skate | AREA | | CAII | 0.000 | | | | | | | |
| Little Skate | CRUISEID | ARC-1-11 | | -0.080 | 0.086 | 803 | -0.933 | 0.351 | 0.05 | -0.249 | 0.089 |
| Little Skate | CRUISEID | CEL-1-11 | | -0.275 | 0.367 | 803 | -0.747 | 0.455 | 0.05 | -0.996 | 0.447 |
| Little Skate | CRUISEID | CEL-2-10 | | 0.527 | 0.096 | 803 | 5.485 | 0.000 | 0.05 | 0.338 | 0.715 |
| Little Skate | CRUISEID | END-2-12 | | 0.115 | 0.082 | 803 | 1.397 | 0.163 | 0.05 | -0.047 | 0.277 |
| Little Skate | CRUISEID | HOR-1-11 | | 0.566 | 0.084 | 803 | 6.740 | 0.000 | 0.05 | 0.401 | 0.731 |
| Little Skate | CRUISEID | LIB-1-11 | | 0.433 | 0.087 | 803 | 4.969 | 0.000 | 0.05 | 0.262 | 0.604 |
| Little Skate | CRUISEID | RAN-1-11 | | 0.811 | 0.085 | 803 | 9.524 | 0.000 | 0.05 | 0.644 | 0.979 |
| Little Skate | CRUISEID | REG-1-11 | | 0.335 | 0.086 | 803 | 3.883 | 0.000 | 0.05 | 0.166 | 0.505 |
| Little Skate | CRUISEID | REG-2-12 | | 0.227 | 0.085 | 803 | 2.678 | 0.008 | 0.05 | 0.061 | 0.394 |
| Little Skate | CRUISEID | RES-1-11 | | 0.462 | 0.085 | 803 | 5.422 | 0.000 | 0.05 | 0.295 | 0.630 |
| Little Skate | CRUISEID | VEN-1-12 | | 0.721 | 0.085 | 803 | 8.516 | 0.000 | 0.05 | 0.555 | 0.887 |
| Little Skate | CRUISEID | WES-1-11 | | 0.291 | 0.089 | 803 | 3.276 | 0.001 | 0.05 | 0.117 | 0.466 |
| Little Skate | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

**Table 39:** Mixed effects model with pooled catch data for all bycatch survey cruises. Results are for fourspot flounder from the model that provided the best fit (intercept, cruiseid and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | CRUISEID | AREA | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fourspot Flounder | Intercept | | | -0.988 | 0.259 | 494 | -3.811 | 0.000 | 0.05 | -1.497 | -0.479 |
| Fourspot Flounder | AREA | | CAI | -0.309 | 0.134 | 494 | -2.309 | 0.021 | 0.05 | -0.571 | -0.046 |
| Fourspot Flounder | AREA | | CAII | 0.000 | | | | | | | |
| Fourspot Flounder | CRUISEID | ARC-1-11 | | -12.822 | 659.875 | 494 | -0.019 | 0.985 | 0.05 | -1309.329 | 1283.685 |
| Fourspot Flounder | CRUISEID | CEL-1-11 | | 0.240 | 0.958 | 494 | 0.251 | 0.802 | 0.05 | -1.642 | 2.123 |
| Fourspot Flounder | CRUISEID | CEL-2-10 | | 1.326 | 0.323 | 494 | 4.109 | 0.000 | 0.05 | 0.692 | 1.960 |
| Fourspot Flounder | CRUISEID | END-1-11 | | 1.005 | 0.292 | 494 | 3.441 | 0.001 | 0.05 | 0.431 | 1.579 |
| Fourspot Flounder | CRUISEID | END-2-12 | | 0.505 | 0.362 | 494 | 1.397 | 0.163 | 0.05 | -0.205 | 1.216 |
| Fourspot Flounder | CRUISEID | HOR-1-11 | | 1.683 | 0.328 | 494 | 5.138 | 0.000 | 0.05 | 1.039 | 2.327 |
| Fourspot Flounder | CRUISEID | LIB-1-11 | | 1.272 | 0.315 | 494 | 4.032 | 0.000 | 0.05 | 0.652 | 1.891 |
| Fourspot Flounder | CRUISEID | RAN-1-11 | | 1.748 | 0.307 | 494 | 5.691 | 0.000 | 0.05 | 1.145 | 2.352 |
| Fourspot Flounder | CRUISEID | REG-1-11 | | 1.025 | 0.294 | 494 | 3.489 | 0.001 | 0.05 | 0.448 | 1.602 |
| Fourspot Flounder | CRUISEID | REG-2-12 | | 1.157 | 0.448 | 494 | 2.585 | 0.010 | 0.05 | 0.278 | 2.037 |
| Fourspot Flounder | CRUISEID | RES-1-11 | | 1.460 | 0.305 | 494 | 4.790 | 0.000 | 0.05 | 0.861 | 2.058 |
| Fourspot Flounder | CRUISEID | VEN-1-12 | | 2.278 | 0.444 | 494 | 5.132 | 0.000 | 0.05 | 1.406 | 3.150 |
| Fourspot Flounder | CRUISEID | WES-1-11 | | 0.952 | 0.346 | 494 | 2.749 | 0.006 | 0.05 | 0.272 | 1.633 |
| Fourspot Flounder | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

**Table 40:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for from the model that provided the best fit (intercept and length) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|
| Spiny Dogfish | Intercept | 3.860 | 2.033 | 61 | 1.898 | 0.062 | 0.05 | -0.206 | 7.925 |
| Spiny Dogfish | Length | -0.027 | 0.028 | 47 | -0.942 | 0.351 | 0.05 | -0.084 | 0.030 |
| | | | | | | | | | |
| Atlantic Cod | Intercept | 3.095 | 2.293 | 42 | 1.350 | 0.184 | 0.05 | -1.532 | 7.723 |
| Atlantic Cod | Length | -0.061 | 0.046 | 7 | -1.347 | 0.220 | 0.05 | -0.169 | 0.046 |
| | | | | | | | | | |
| American Plaice | Intercept | -0.964 | 0.651 | 276 | -1.482 | 0.139 | 0.05 | -2.245 | 0.316 |
| American Plaice | Length | 0.021 | 0.017 | 343 | 1.255 | 0.210 | 0.05 | -0.012 | 0.054 |
| | | | | | | | | | |
| Summer Flounder | Intercept | -0.160 | 0.513 | 252 | -0.312 | 0.756 | 0.05 | -1.171 | 0.851 |
| Summer Flounder | Length | 0.001 | 0.010 | 274 | 0.090 | 0.928 | 0.05 | -0.018 | 0.020 |
| | | | | | | | | | |
| Grey Sole | Intercept | 0.675 | 1.066 | 146 | 0.633 | 0.528 | 0.05 | -1.432 | 2.782 |
| Grey Sole | Length | -0.012 | 0.026 | 151 | -0.452 | 0.652 | 0.05 | -0.063 | 0.039 |
| | | | | | | | | | |
| Monkfish | Intercept | 0.145 | 0.140 | 663 | 1.038 | 0.300 | 0.05 | -0.129 | 0.419 |
| Monkfish | Length | -0.003 | 0.003 | 2466 | -1.074 | 0.283 | 0.05 | -0.008 | 0.002 |

**Table 41:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for scallops from the model that provided the best fit (intercept, length and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|
| Sea Scallops | Intercept | | 0.969 | 0.062 | 942 | 15.563 | 0.000 | 0.05 | 0.847 | 1.091 |
| Sea Scallops | LENGTH | | -0.007 | 0.000 | 11297 | -18.372 | 0.000 | 0.05 | -0.008 | -0.006 |
| Sea Scallops | CRUISEID | ARC-1-11 | -0.150 | 0.057 | 11297 | -2.649 | 0.008 | 0.05 | -0.262 | -0.039 |
| Sea Scallops | CRUISEID | CEL-1-11 | -0.151 | 0.058 | 11297 | -2.622 | 0.009 | 0.05 | -0.264 | -0.038 |
| Sea Scallops | CRUISEID | CEL-2-10 | 0.092 | 0.064 | 11297 | 1.447 | 0.148 | 0.05 | -0.033 | 0.217 |
| Sea Scallops | CRUISEID | END-1-11 | -0.056 | 0.056 | 11297 | -0.987 | 0.324 | 0.05 | -0.166 | 0.055 |
| Sea Scallops | CRUISEID | END-2-12 | -0.115 | 0.056 | 11297 | -2.061 | 0.039 | 0.05 | -0.224 | -0.006 |
| Sea Scallops | CRUISEID | HOR-1-11 | -0.018 | 0.055 | 11297 | -0.317 | 0.751 | 0.05 | -0.126 | 0.091 |
| Sea Scallops | CRUISEID | LIB-1-11 | 0.155 | 0.057 | 11297 | 2.742 | 0.006 | 0.05 | 0.044 | 0.266 |
| Sea Scallops | CRUISEID | RAN-1-11 | 0.130 | 0.056 | 11297 | 2.320 | 0.020 | 0.05 | 0.020 | 0.241 |
| Sea Scallops | CRUISEID | REG-1-11 | 0.053 | 0.057 | 11297 | 0.933 | 0.351 | 0.05 | -0.058 | 0.164 |
| Sea Scallops | CRUISEID | REG-2-12 | -0.096 | 0.056 | 11297 | -1.709 | 0.088 | 0.05 | -0.206 | 0.014 |
| Sea Scallops | CRUISEID | RES-1-11 | 0.002 | 0.056 | 11297 | 0.032 | 0.975 | 0.05 | -0.109 | 0.112 |
| Sea Scallops | CRUISEID | VEN-1-12 | 0.316 | 0.055 | 11297 | 5.713 | 0.000 | 0.05 | 0.208 | 0.424 |
| Sea Scallops | CRUISEID | WES-1-11 | -0.011 | 0.058 | 11297 | -0.194 | 0.846 | 0.05 | -0.126 | 0.103 |
| Sea Scallops | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 42:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for yellowtail flounder from the model that provided the best fit (intercept, length and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|
| Yellowtail Flounder | Intercept | | 0.536 | 0.252 | 708 | 2.124 | 0.034 | 0.05 | 0.041 | 1.031 |
| Yellowtail Flounder | LENGTH | | -0.022 | 0.006 | 3609 | -3.495 | 0.000 | 0.05 | -0.034 | -0.010 |
| Yellowtail Flounder | CRUISEID | ARC-1-11 | -0.295 | 0.147 | 708 | -2.003 | 0.046 | 0.05 | -0.584 | -0.006 |
| Yellowtail Flounder | CRUISEID | CEL-1-11 | 0.020 | 0.151 | 708 | 0.132 | 0.895 | 0.05 | -0.277 | 0.317 |
| Yellowtail Flounder | CRUISEID | CEL-2-10 | 0.455 | 0.150 | 708 | 3.039 | 0.002 | 0.05 | 0.161 | 0.749 |
| Yellowtail Flounder | CRUISEID | END-1-11 | 0.265 | 0.154 | 708 | 1.723 | 0.085 | 0.05 | -0.037 | 0.567 |
| Yellowtail Flounder | CRUISEID | END-2-12 | 0.473 | 0.135 | 708 | 3.498 | 0.000 | 0.05 | 0.208 | 0.739 |
| Yellowtail Flounder | CRUISEID | HOR-1-11 | 0.540 | 0.142 | 708 | 3.803 | 0.000 | 0.05 | 0.261 | 0.819 |
| Yellowtail Flounder | CRUISEID | LIB-1-11 | 0.403 | 0.157 | 708 | 2.567 | 0.010 | 0.05 | 0.095 | 0.711 |
| Yellowtail Flounder | CRUISEID | RAN-1-11 | 1.094 | 0.139 | 708 | 7.892 | 0.000 | 0.05 | 0.821 | 1.366 |
| Yellowtail Flounder | CRUISEID | REG-1-11 | 0.357 | 0.134 | 708 | 2.672 | 0.008 | 0.05 | 0.095 | 0.620 |
| Yellowtail Flounder | CRUISEID | REG-2-12 | 0.136 | 0.146 | 708 | 0.931 | 0.352 | 0.05 | -0.151 | 0.423 |
| Yellowtail Flounder | CRUISEID | RES-1-11 | 0.876 | 0.137 | 708 | 6.398 | 0.000 | 0.05 | 0.607 | 1.145 |
| Yellowtail Flounder | CRUISEID | VEN-1-12 | 0.810 | 0.157 | 708 | 5.146 | 0.000 | 0.05 | 0.501 | 1.118 |
| Yellowtail Flounder | CRUISEID | WES-1-11 | -0.068 | 0.152 | 708 | -0.448 | 0.654 | 0.05 | -0.366 | 0.230 |
| Yellowtail Flounder | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 43:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for windowpane flounder from the model that provided the best fit (intercept, length and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|
| Windowpane Flounder | Intercept | | -0.451 | 0.214 | 644 | -2.109 | 0.035 | 0.05 | -0.871 | -0.031 |
| Windowpane Flounder | LENGTH | | -0.001 | 0.007 | 3345 | -0.121 | 0.904 | 0.05 | -0.015 | 0.013 |
| Windowpane Flounder | CRUISEID | ARC-1-11 | -0.323 | 0.121 | 644 | -2.679 | 0.008 | 0.05 | -0.560 | -0.086 |
| Windowpane Flounder | CRUISEID | CEL-1-11 | 0.307 | 0.128 | 644 | 2.399 | 0.017 | 0.05 | 0.056 | 0.558 |
| Windowpane Flounder | CRUISEID | CEL-2-10 | 0.531 | 0.172 | 644 | 3.083 | 0.002 | 0.05 | 0.193 | 0.869 |
| Windowpane Flounder | CRUISEID | END-1-11 | -0.171 | 0.190 | 644 | -0.902 | 0.368 | 0.05 | -0.543 | 0.201 |
| Windowpane Flounder | CRUISEID | END-2-12 | 0.340 | 0.112 | 644 | 3.042 | 0.002 | 0.05 | 0.120 | 0.559 |
| Windowpane Flounder | CRUISEID | HOR-1-11 | 0.139 | 0.126 | 644 | 1.107 | 0.269 | 0.05 | -0.108 | 0.386 |
| Windowpane Flounder | CRUISEID | LIB-1-11 | 0.493 | 0.310 | 644 | 1.589 | 0.112 | 0.05 | -0.116 | 1.103 |
| Windowpane Flounder | CRUISEID | RAN-1-11 | 0.965 | 0.163 | 644 | 5.939 | 0.000 | 0.05 | 0.646 | 1.284 |
| Windowpane Flounder | CRUISEID | REG-1-11 | 0.101 | 0.193 | 644 | 0.523 | 0.601 | 0.05 | -0.278 | 0.480 |
| Windowpane Flounder | CRUISEID | REG-2-12 | 0.137 | 0.115 | 644 | 1.186 | 0.236 | 0.05 | -0.090 | 0.364 |
| Windowpane Flounder | CRUISEID | RES-1-11 | 0.866 | 0.202 | 644 | 4.297 | 0.000 | 0.05 | 0.470 | 1.262 |
| Windowpane Flounder | CRUISEID | VEN-1-12 | 0.598 | 0.118 | 644 | 5.060 | 0.000 | 0.05 | 0.366 | 0.830 |
| Windowpane Flounder | CRUISEID | WES-1-11 | 0.515 | 0.185 | 644 | 2.786 | 0.005 | 0.05 | 0.152 | 0.878 |
| Windowpane Flounder | CRUISEID | WIS-1-12 | 0.000 | | | | | | | |

**Table 44:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for haddock from the model that provided the best fit (intercept, length and area) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|
| Haddock | Intercept | | 0.188 | 0.533 | 79 | 0.352 | 0.726 | 0.05 | -0.874 | 1.249 |
| Haddock | LENGTH | | 0.014 | 0.014 | 44 | 0.989 | 0.328 | 0.05 | -0.015 | 0.043 |
| Haddock | AREA | CAI | -0.696 | 0.417 | 79 | -1.669 | 0.099 | 0.05 | -1.527 | 0.134 |
| Haddock | AREA | CAII | 0.000 | | | | | | | |

**Table 45:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for barndoor skate from the model that provided the best fit (intercept, length, area and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Area | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Barndoor Skate | Intercept | | | 0.006 | 0.265 | 512 | 0.023 | 0.981 | 0.05 | -0.514 | 0.527 |
| Barndoor Skate | LENGTH | | | 0.001 | 0.002 | 1095 | 0.510 | 0.610 | 0.05 | -0.003 | 0.005 |
| Barndoor Skate | AREA | | CAI | -0.322 | 0.121 | 512 | -2.664 | 0.008 | 0.05 | -0.559 | -0.084 |
| Barndoor Skate | AREA | | CAII | 0.000 | | | | | | | |
| Barndoor Skate | CRUISEID | ARC-1-11 | | 0.707 | 0.625 | 512 | 1.130 | 0.259 | 0.05 | -0.522 | 1.935 |
| Barndoor Skate | CRUISEID | CEL-1-11 | | -0.361 | 0.561 | 512 | -0.644 | 0.520 | 0.05 | -1.463 | 0.741 |
| Barndoor Skate | CRUISEID | CEL-2-10 | | 0.483 | 0.315 | 512 | 1.534 | 0.126 | 0.05 | -0.136 | 1.102 |
| Barndoor Skate | CRUISEID | END-1-11 | | 0.218 | 0.274 | 512 | 0.793 | 0.428 | 0.05 | -0.321 | 0.756 |
| Barndoor Skate | CRUISEID | END-2-12 | | 0.295 | 0.327 | 512 | 0.901 | 0.368 | 0.05 | -0.348 | 0.938 |
| Barndoor Skate | CRUISEID | HOR-1-11 | | 0.415 | 0.304 | 512 | 1.363 | 0.173 | 0.05 | -0.183 | 1.012 |
| Barndoor Skate | CRUISEID | LIB-1-11 | | 0.107 | 0.295 | 512 | 0.363 | 0.717 | 0.05 | -0.473 | 0.687 |
| Barndoor Skate | CRUISEID | RAN-1-11 | | 0.512 | 0.282 | 512 | 1.812 | 0.071 | 0.05 | -0.043 | 1.066 |
| Barndoor Skate | CRUISEID | REG-1-11 | | 0.464 | 0.278 | 512 | 1.667 | 0.096 | 0.05 | -0.083 | 1.011 |
| Barndoor Skate | CRUISEID | REG-2-12 | | 0.329 | 0.413 | 512 | 0.797 | 0.426 | 0.05 | -0.483 | 1.141 |
| Barndoor Skate | CRUISEID | RES-1-11 | | 0.150 | 0.279 | 512 | 0.537 | 0.591 | 0.05 | -0.399 | 0.699 |
| Barndoor Skate | CRUISEID | VEN-1-12 | | 1.834 | 0.814 | 512 | 2.252 | 0.025 | 0.05 | 0.234 | 3.433 |
| Barndoor Skate | CRUISEID | WES-1-11 | | -0.652 | 0.327 | 512 | -1.992 | 0.047 | 0.05 | -1.295 | -0.009 |
| Barndoor Skate | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

**Table 46:** Mixed effects model with the unpooled catch data for all bycatch survey cruises. Results are for fourspot flounder from the model that provided the best fit (intercept, length, area and cruiseid) to the data as supported by model comparison (minimum AIC value). Confidence limits are Wald type confidence intervals. Parameter estimates are on the logit scale.

| Species | Effect | Cruiseid | Area | Estimate | StdErr | DF | tValue | Probt | Alpha | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fourspot Flounder | Intercept | | | -1.011 | 0.310 | 493 | -3.260 | 0.001 | 0.05 | -1.620 | -0.402 |
| Fourspot Flounder | LENGTH | | | 0.001 | 0.000 | 1171 | | 0.000 | | | |
| Fourspot Flounder | AREA | | CAI | -0.364 | 0.129 | 493 | -2.811 | 0.005 | 0.05 | -0.618 | -0.110 |
| Fourspot Flounder | AREA | | CAII | 0.000 | | | | | | | |
| Fourspot Flounder | CRUISEID | ARC-1-11 | | -11.809 | 402.003 | 493 | -0.029 | 0.977 | 0.05 | -801.659 | 778.040 |
| Fourspot Flounder | CRUISEID | CEL-1-11 | | 0.235 | 0.940 | 493 | 0.250 | 0.803 | 0.05 | -1.612 | 2.083 |
| Fourspot Flounder | CRUISEID | CEL-2-10 | | 1.367 | 0.312 | 493 | 4.379 | 0.000 | 0.05 | 0.754 | 1.981 |
| Fourspot Flounder | CRUISEID | END-1-11 | | 0.999 | 0.282 | 493 | 3.542 | 0.000 | 0.05 | 0.445 | 1.553 |
| Fourspot Flounder | CRUISEID | END-2-12 | | 0.480 | 0.350 | 493 | 1.371 | 0.171 | 0.05 | -0.208 | 1.167 |
| Fourspot Flounder | CRUISEID | HOR-1-11 | | 1.741 | 0.319 | 493 | 5.459 | 0.000 | 0.05 | 1.114 | 2.367 |
| Fourspot Flounder | CRUISEID | LIB-1-11 | | 1.256 | 0.305 | 493 | 4.119 | 0.000 | 0.05 | 0.657 | 1.855 |
| Fourspot Flounder | CRUISEID | RAN-1-11 | | 1.699 | 0.299 | 493 | 5.681 | 0.000 | 0.05 | 1.111 | 2.286 |
| Fourspot Flounder | CRUISEID | REG-1-11 | | 1.038 | 0.285 | 493 | 3.638 | 0.000 | 0.05 | 0.477 | 1.598 |
| Fourspot Flounder | CRUISEID | REG-2-12 | | 1.136 | 0.436 | 493 | 2.608 | 0.009 | 0.05 | 0.280 | 1.992 |
| Fourspot Flounder | CRUISEID | RES-1-11 | | 1.434 | 0.295 | 493 | 4.867 | 0.000 | 0.05 | 0.855 | 2.013 |
| Fourspot Flounder | CRUISEID | VEN-1-12 | | 2.238 | 0.432 | 493 | 5.175 | 0.000 | 0.05 | 1.388 | 3.087 |
| Fourspot Flounder | CRUISEID | WES-1-11 | | 0.947 | 0.331 | 493 | 2.863 | 0.004 | 0.05 | 0.297 | 1.596 |
| Fourspot Flounder | CRUISEID | WIS-1-12 | | 0.000 | | | | | | | |

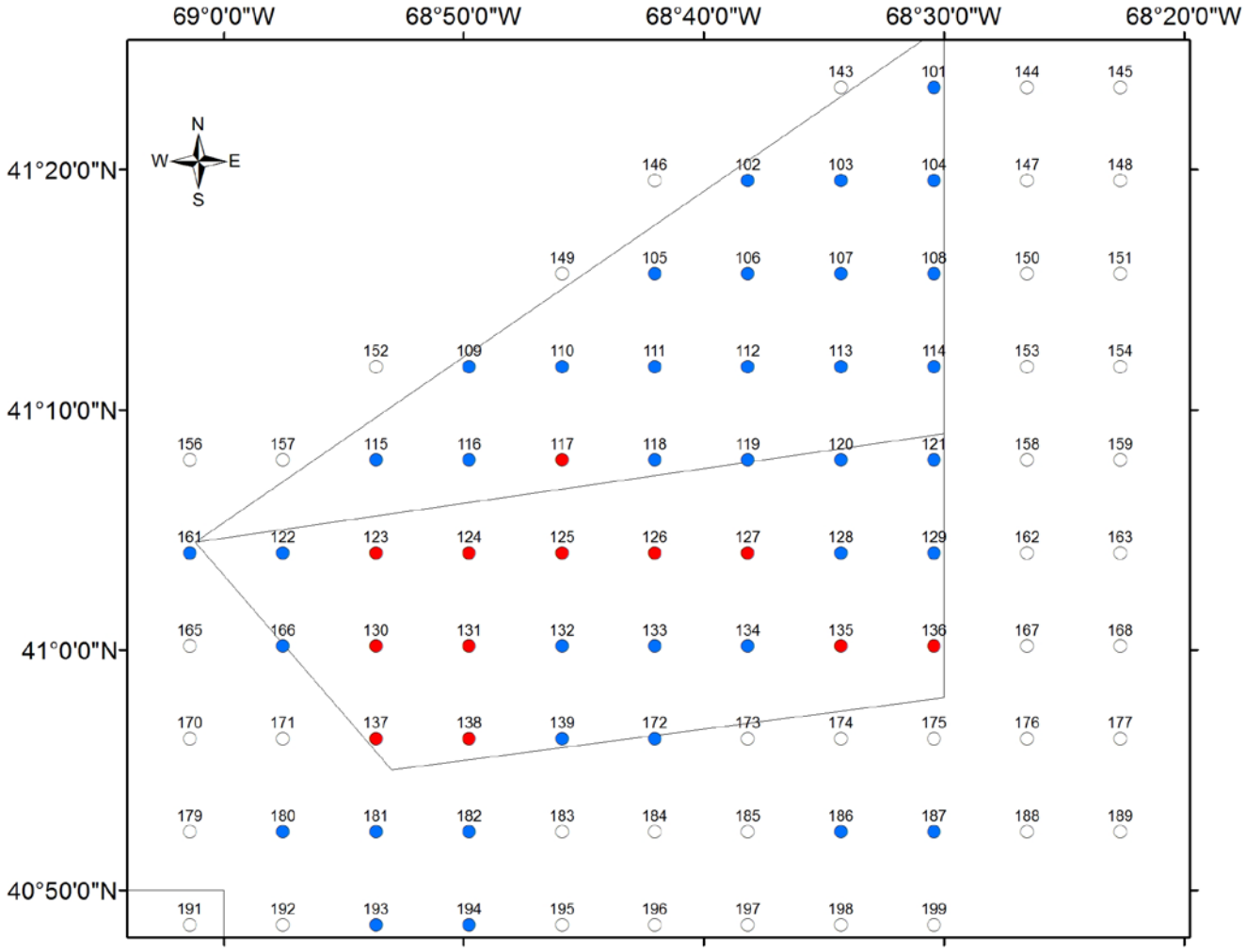



**Figure 1:** Stations in and around Georges Bank CAI scallop access area. Stations occupied successfully inside CAI on all 14 trips were 117, 123, 124, 125, 126, 127, 130, 131, 135, 136, 137, and 138.

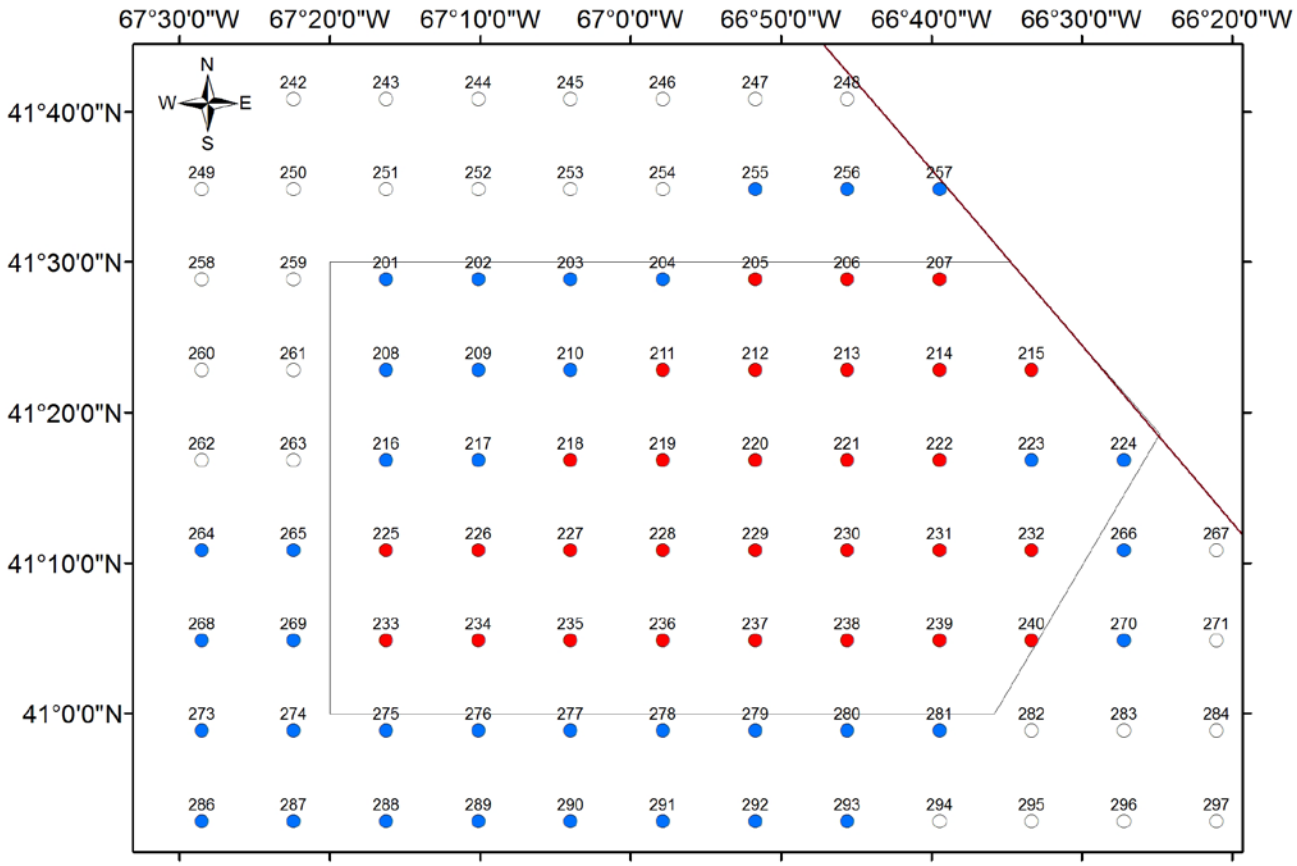



**Figure 2**: Stations in and around Georges Bank CAII scallop access area. Stations occupied successfully inside CAII on all 14 trips were 205-207, 211-215, 218-222, and 225-240. As the project progressed more stations were occupied south of CAII.

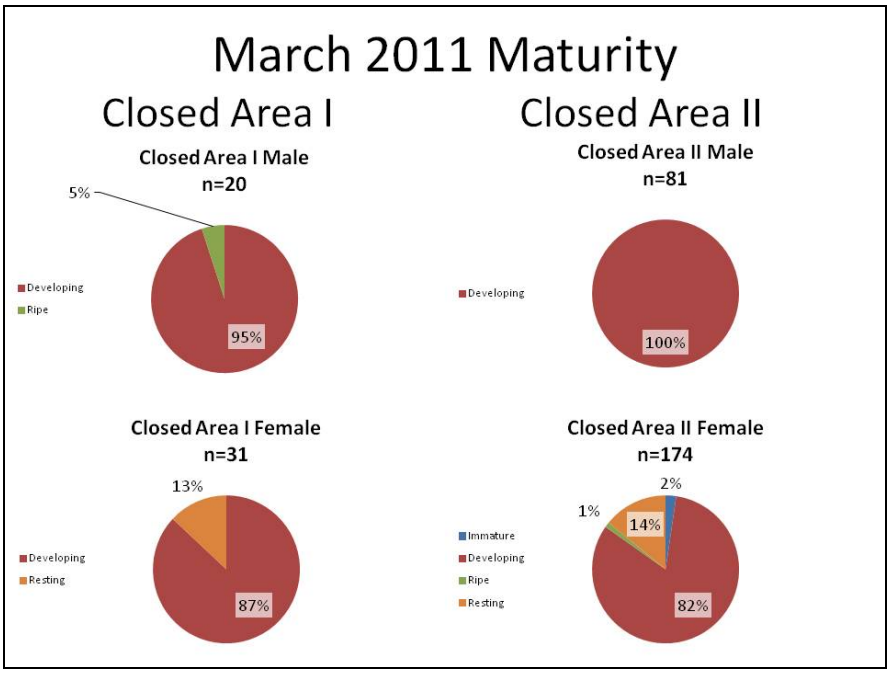



**Figure 3:** March 2011 Yellowtail flounder Maturity.

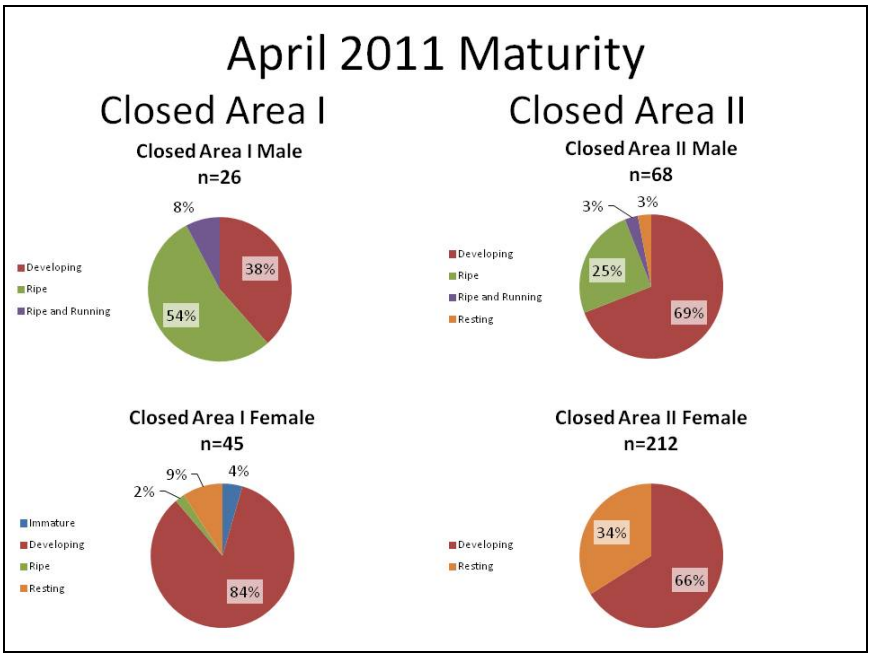



**Figure 4:** April 2011 Yellowtail Flounder Maturity.

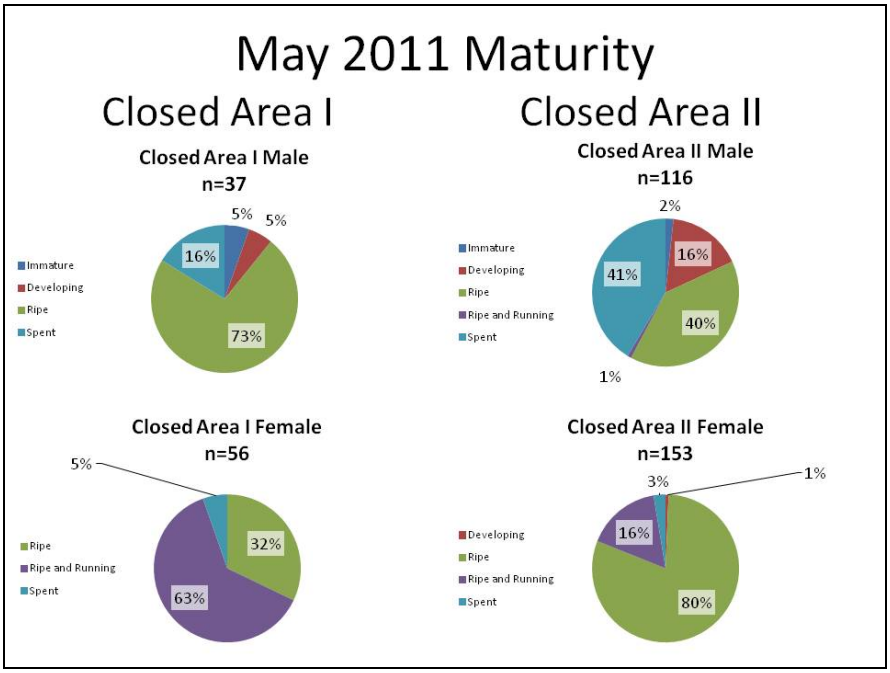



**Figure 5:** May 2011 Yellowtail Flounder Maturity**.**

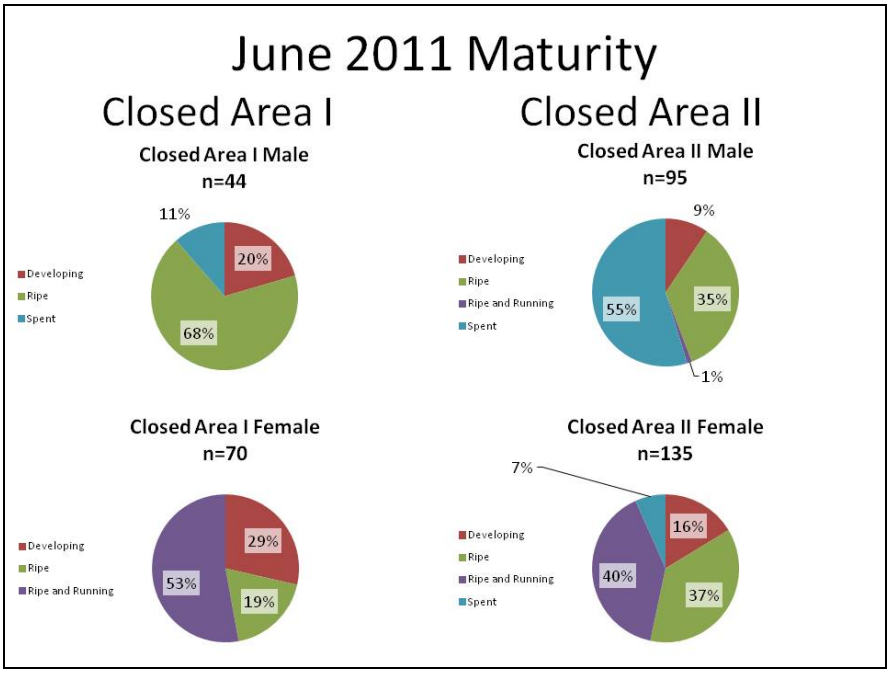



**Figure 6:** June 2011 Yellowtail Flounder Maturity.

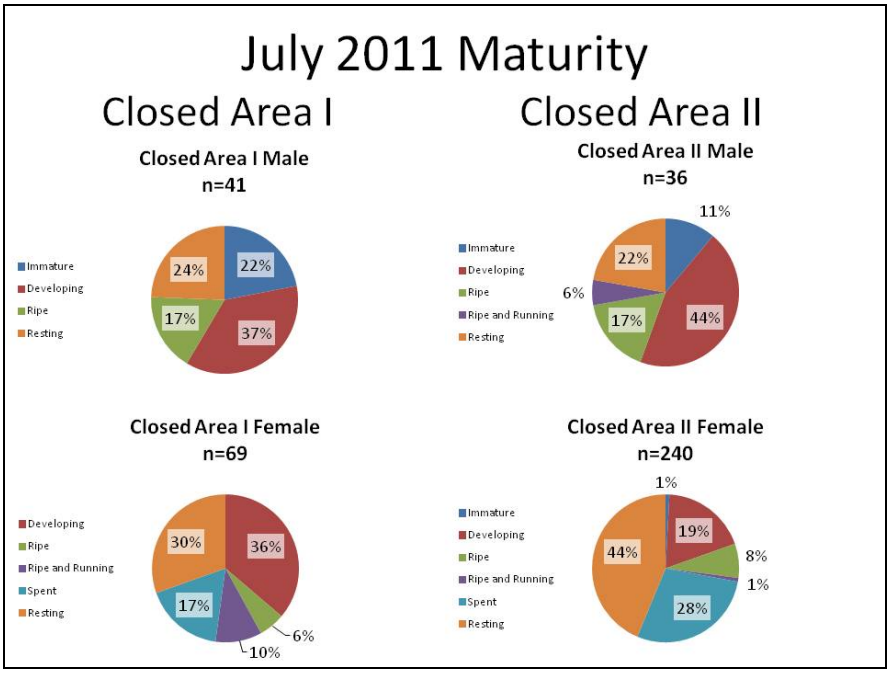



**Figure 7.** July 2011 Yellowtail Flounder Maturity.

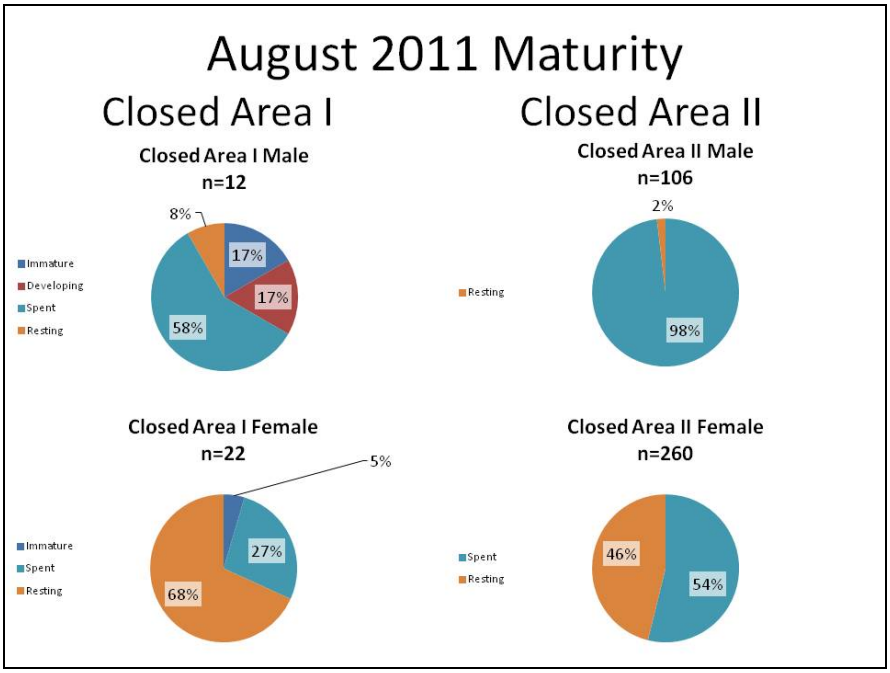



**Figure 8.** August 2011 Yellowtail Flounder Maturity.

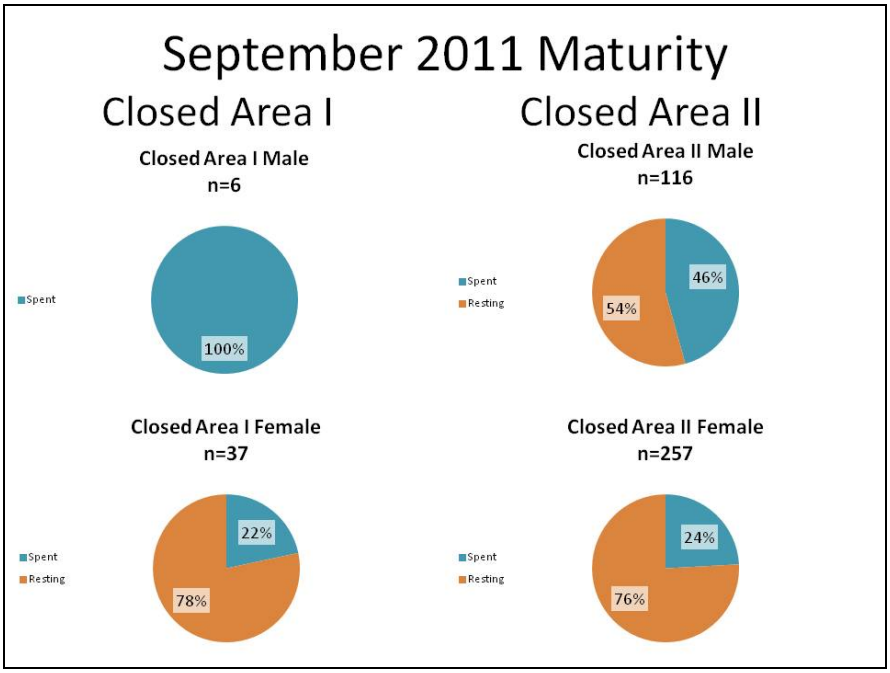



**Figure 9:** September 2011 Yellowtail Flounder Maturity.

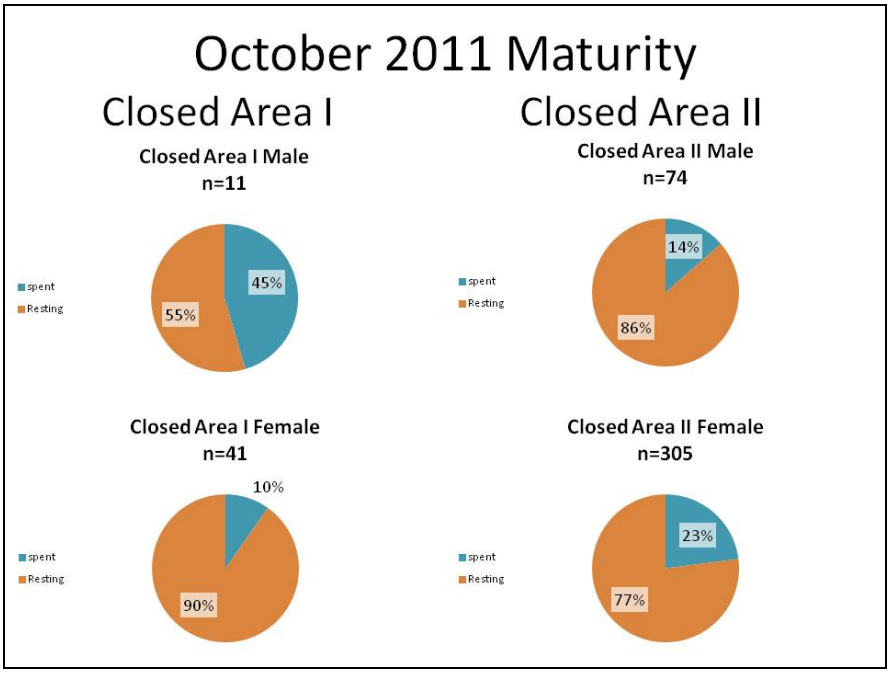



**Figure 10:** October 2011 Yellowtail Flounder Maturity.

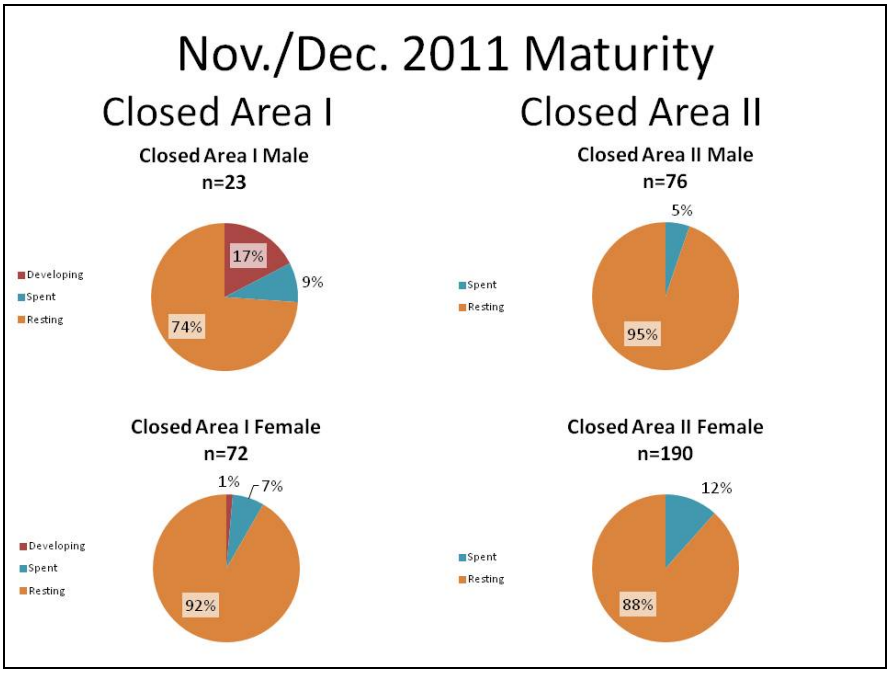



**Figure 11:** November-December 2011 Yellowtail Flounder Maturity.

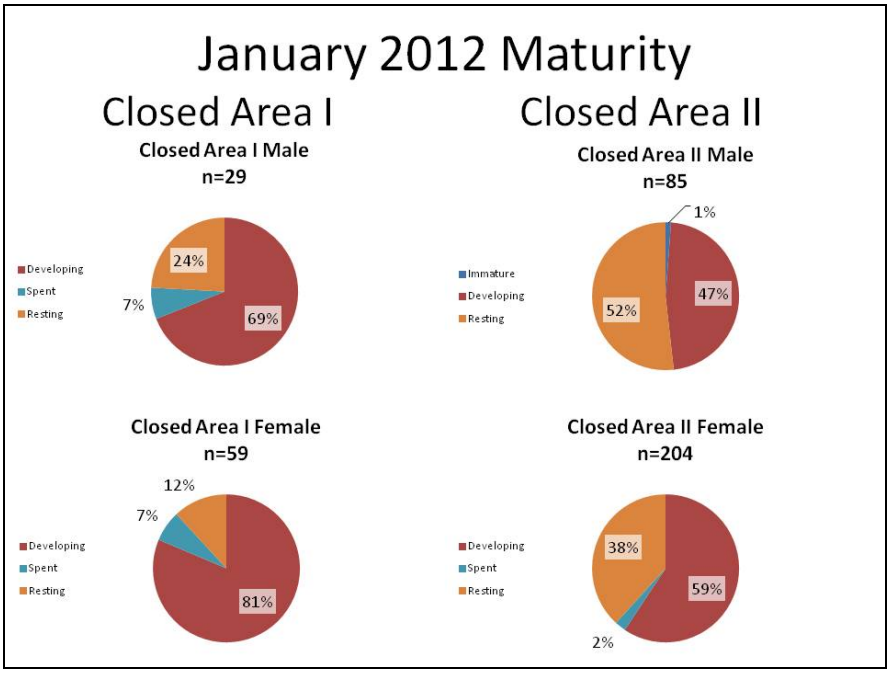



**Figure 12:** January 2012 Yellowtail Flounder Maturity.

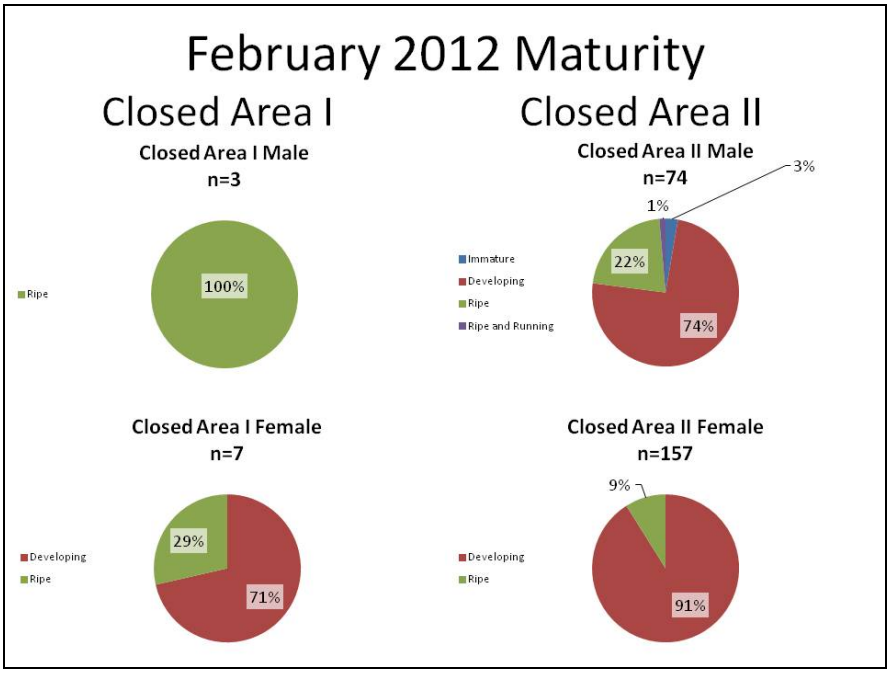



**Figure 13:** February 2012 Yellowtail Flounder Maturity.

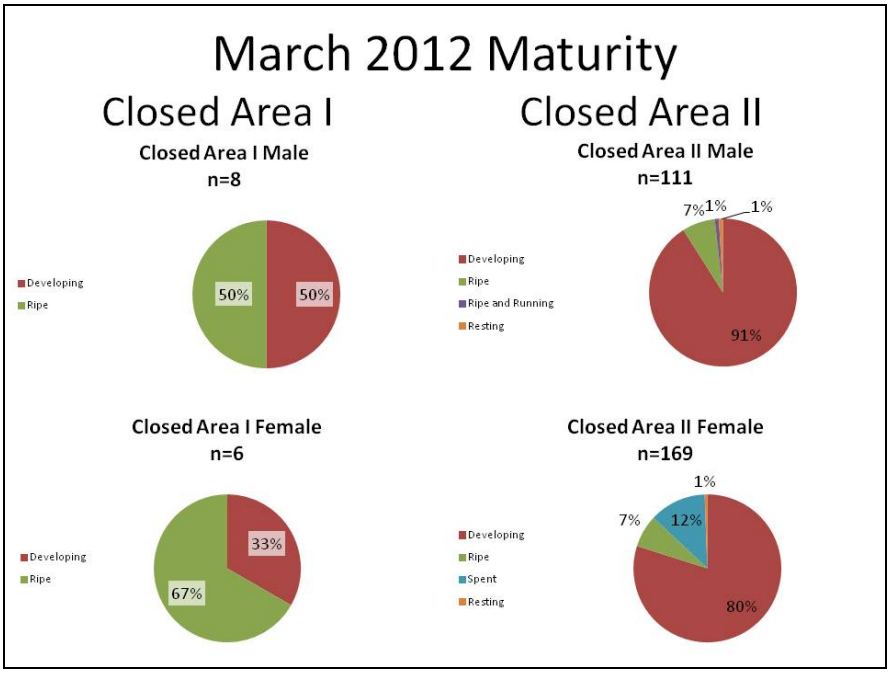



**Figure 14:** March 2012 Yellowtail Flounder Maturity.

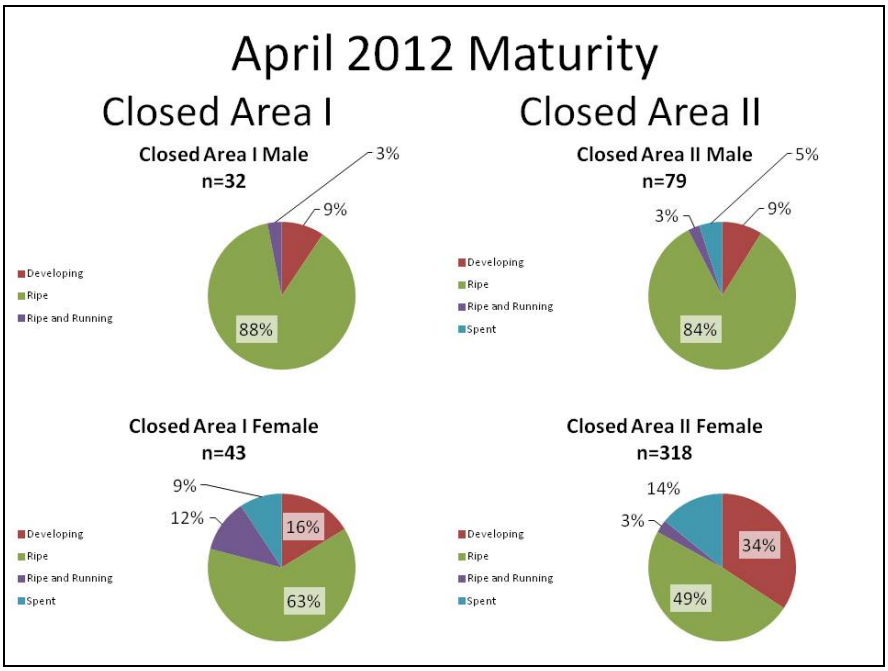



**Figure 15:** April 2012 Yellowtail Flounder Maturity.

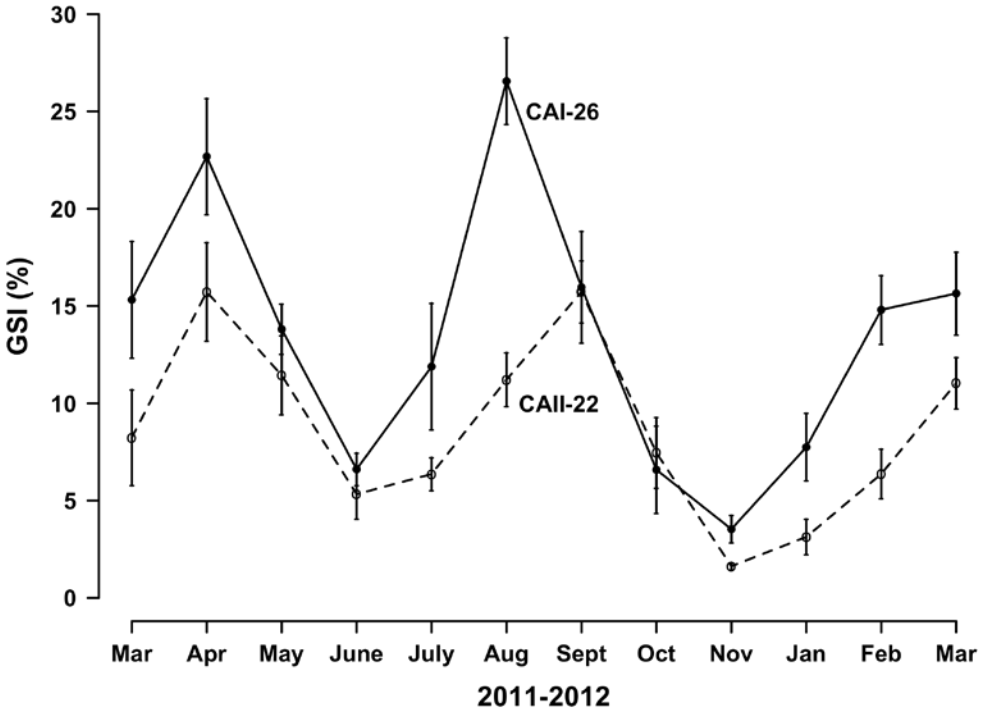



**Figure 16:** Mean gonosomatic index (GSI) at Station 126 and Station 222 from March 2011-March 2012 with 95% confidence intervals.

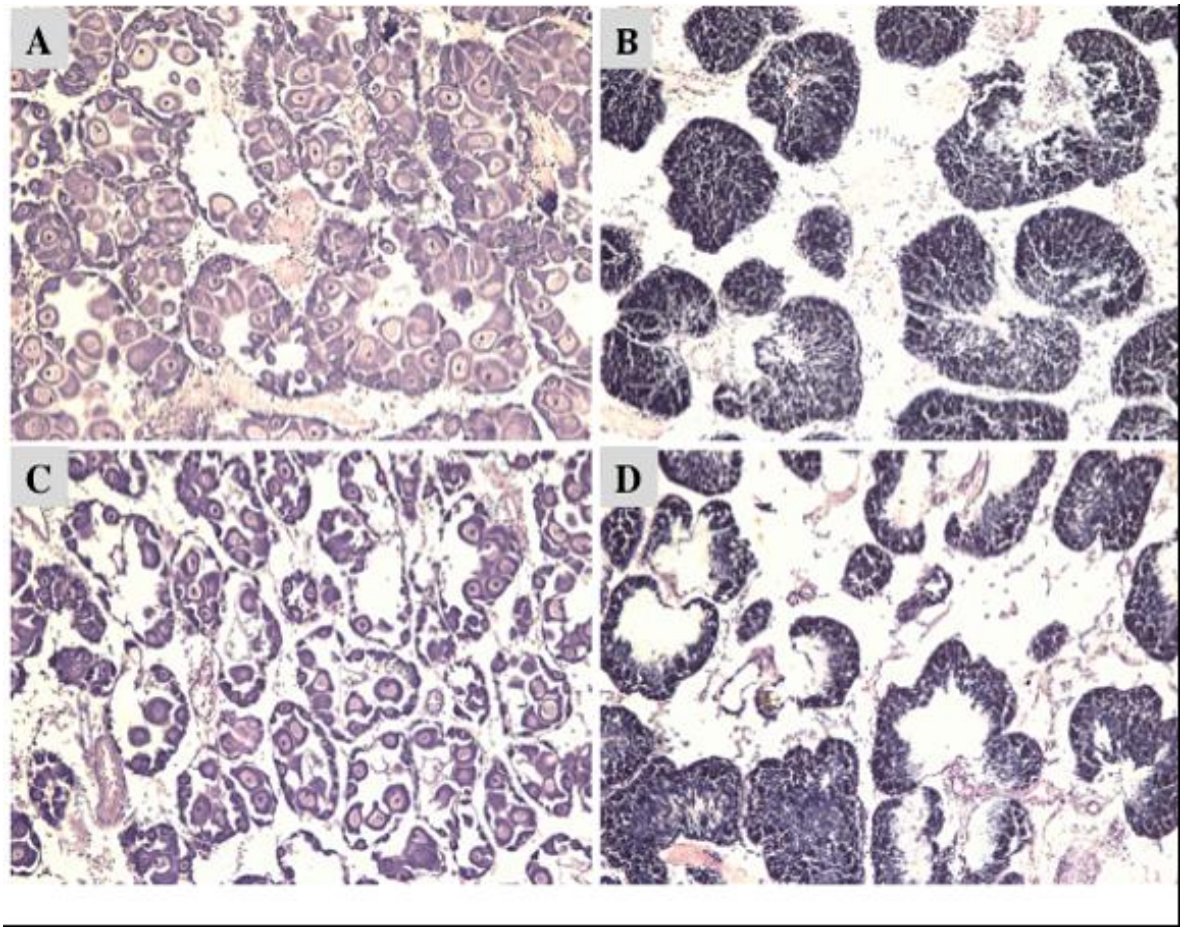



**Figure 17:** Histological evidence of spring spawning. Station 126: A. 120 mm female (June), B. 125 mm male (June); Station 222: C. 136 mm female (July), D. 155 mm male (June).

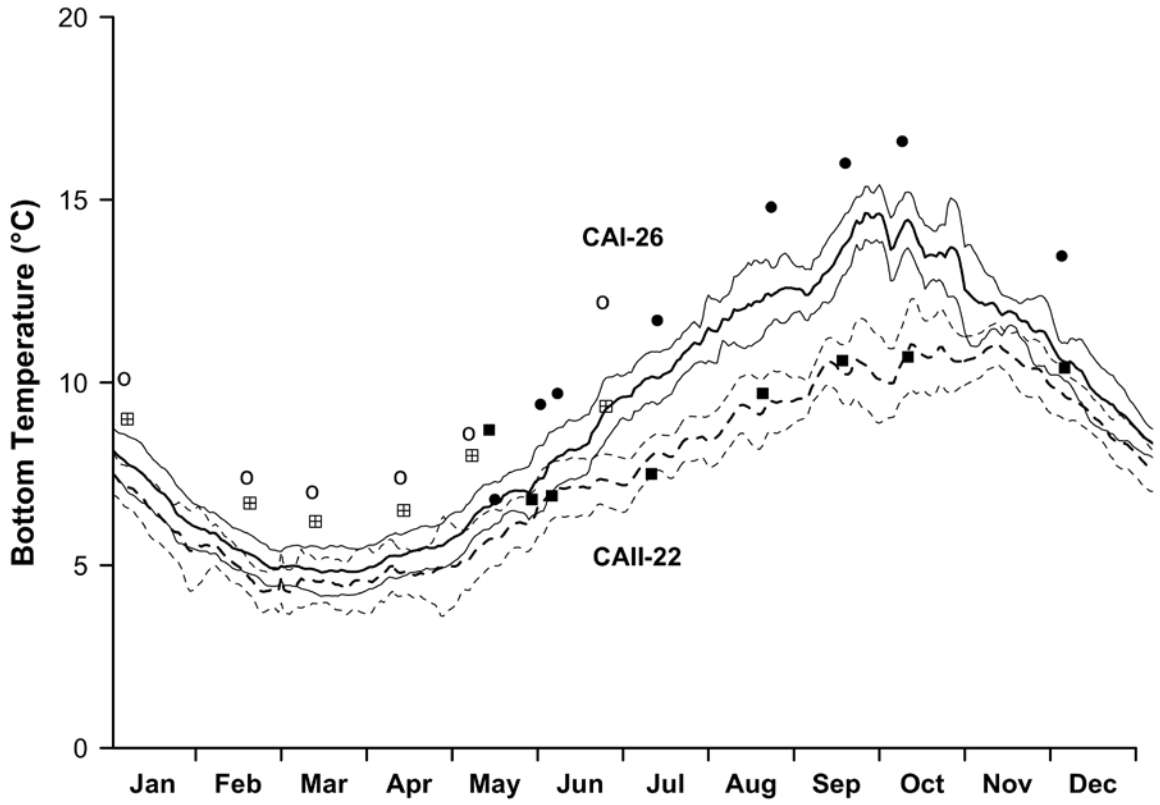
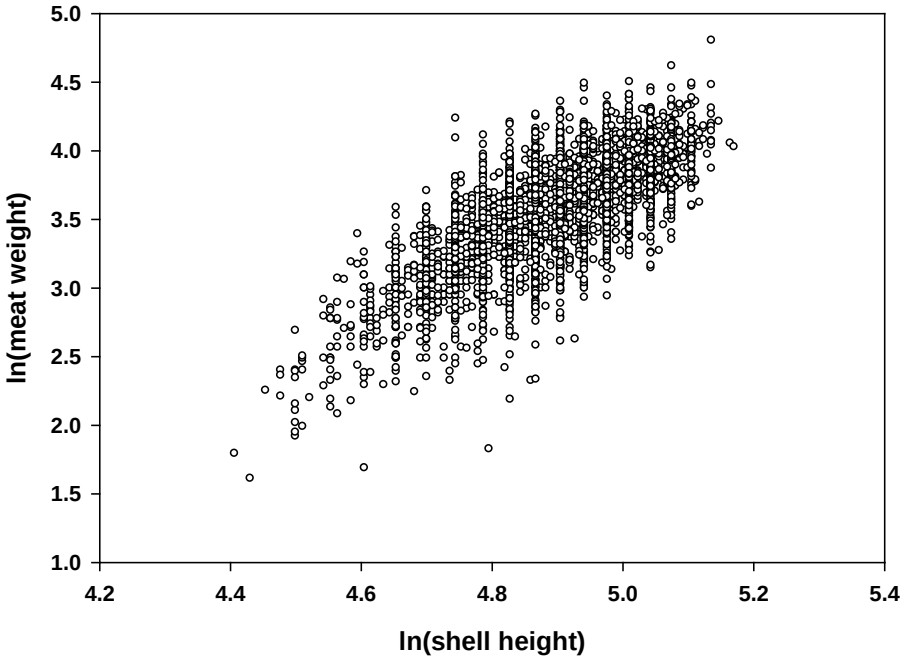



**Figure 18:** Bottom temperature at Station 126 (solid lines, circles) and Station 222 (hashed lines, squares): FVCOM mean daily estimates 2000-2009 (± 95% CI), measured bottom temperature from May-Dec 2011 (solid points) and Jan-June 2012 (hollow points).



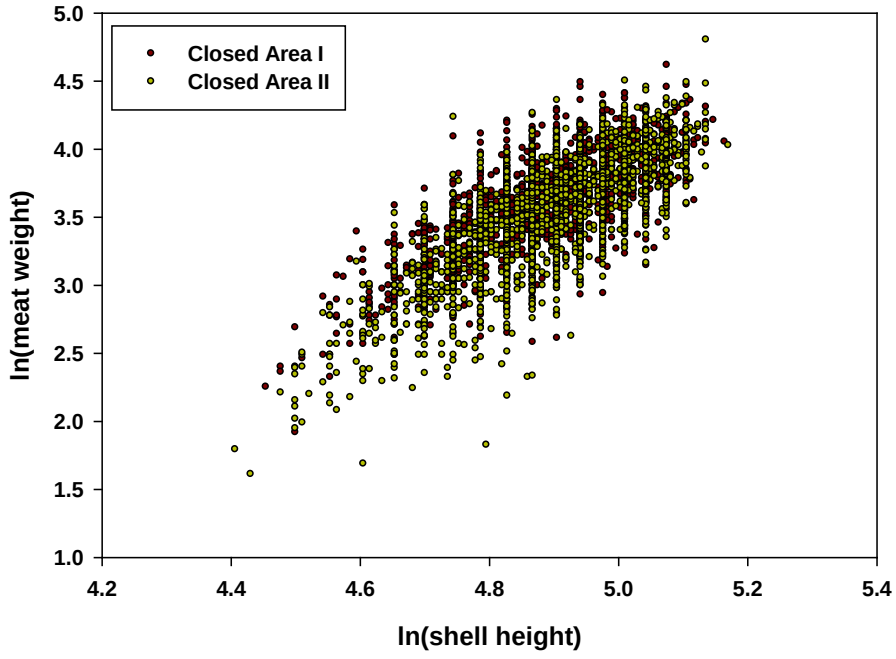




**Figure 19:** Shell Height: Meat Weight data for both areas combined (top panel) and the two areas plotted separately (bottom panel).

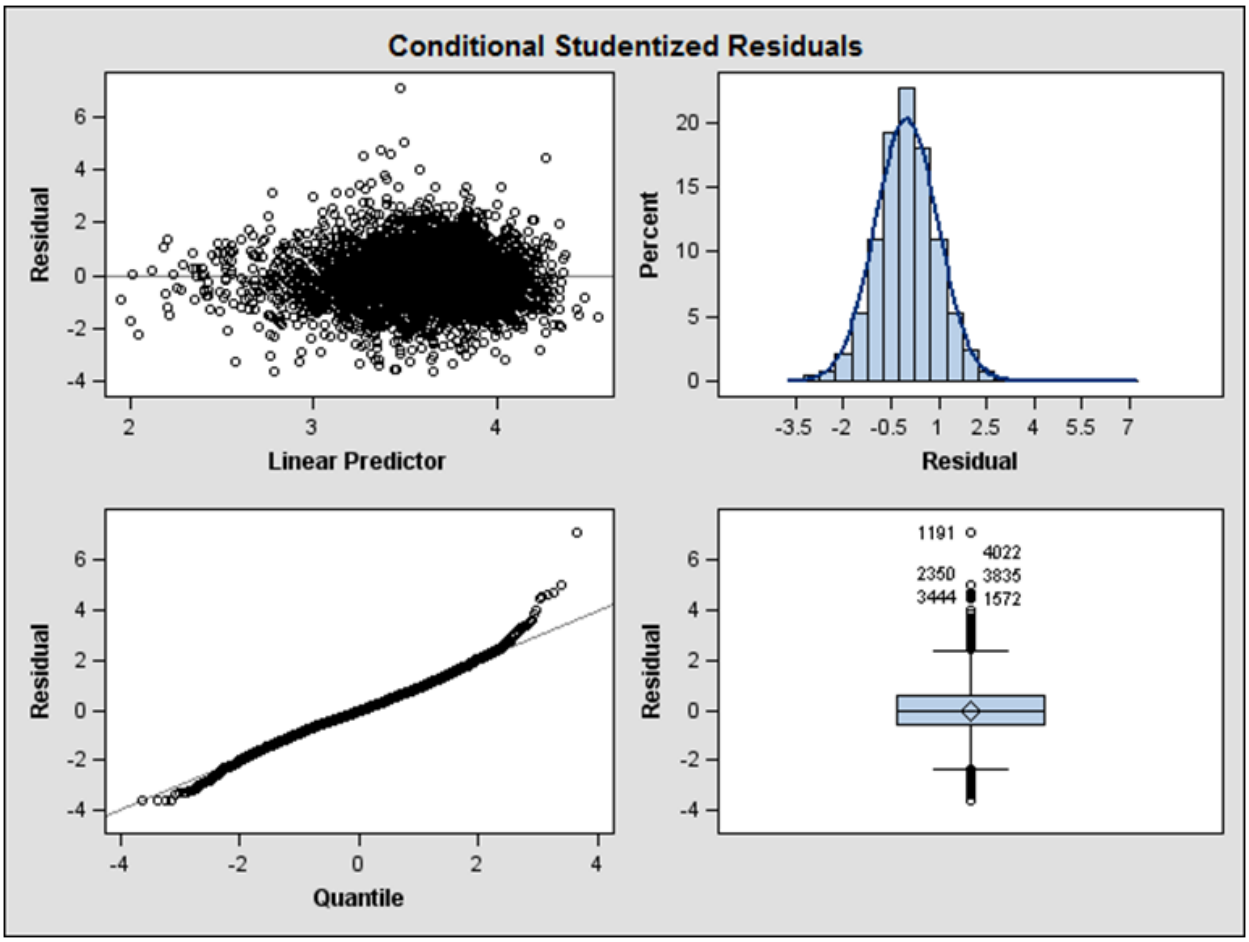



**Figure 20:** Residuals and QQ plot for the best model fit as determined by minimum AIC value. Residuals show no evidence of pattern, however a number of larger than expected meats were observed as evidenced by a small number of large positively valued residuals.

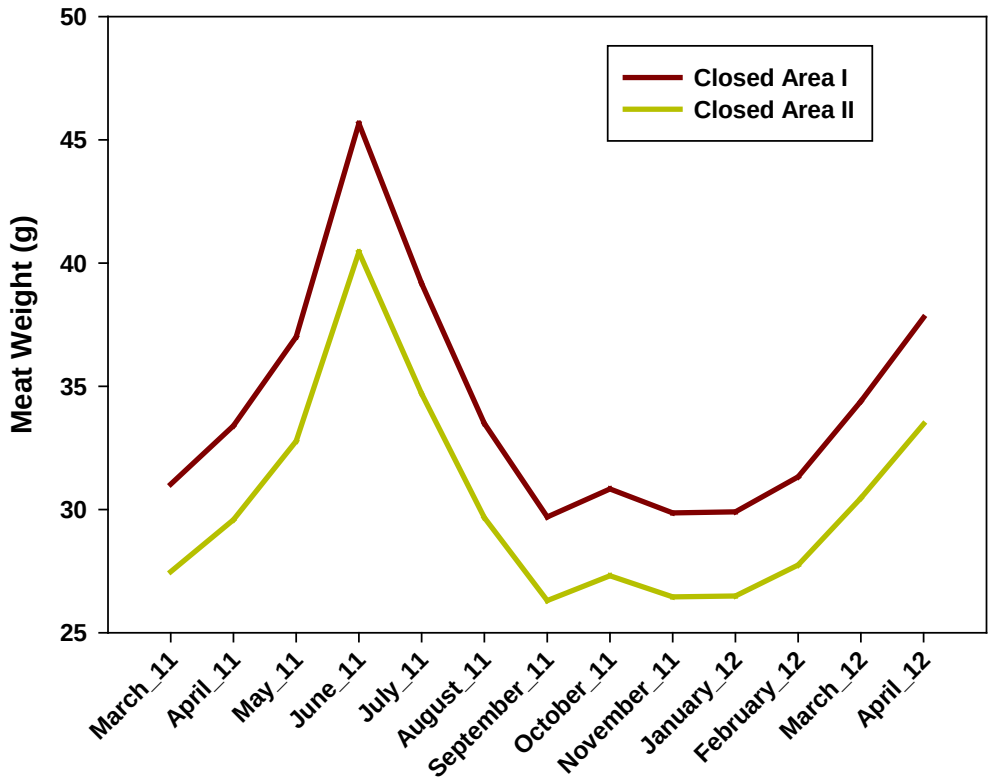



**Figure 21:** Temporal trends for the predicted meat weight of a 125 mm shell height scallop from the two areas. Depth was calculated as the mean depth of each area (CAI=65.06m, CAII=73.02m).

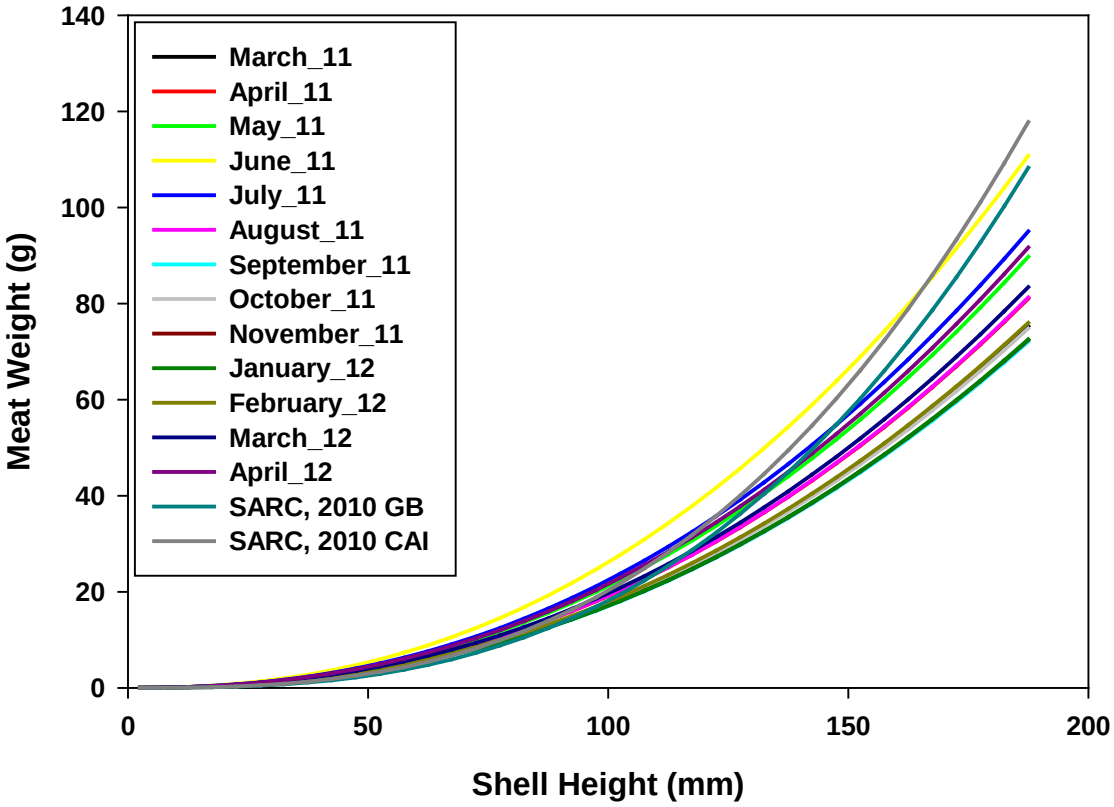



**Figure 22:** Comparison of estimated curves for each month in Closed Area I. Estimates for length:weight relationships for the Georges Bank in general and Closed Area I specifically from NEFSC (2010) are shown for comparison. Depth was calculated as the mean depth of each area (CAI=65.06m).

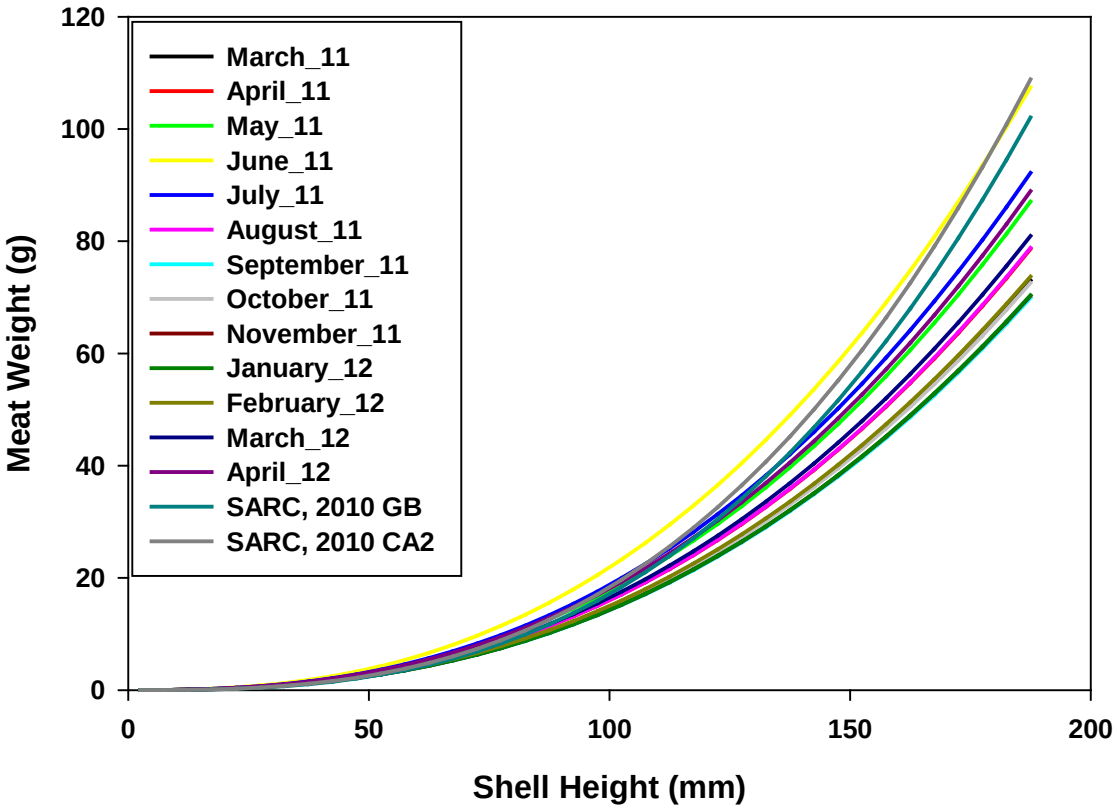
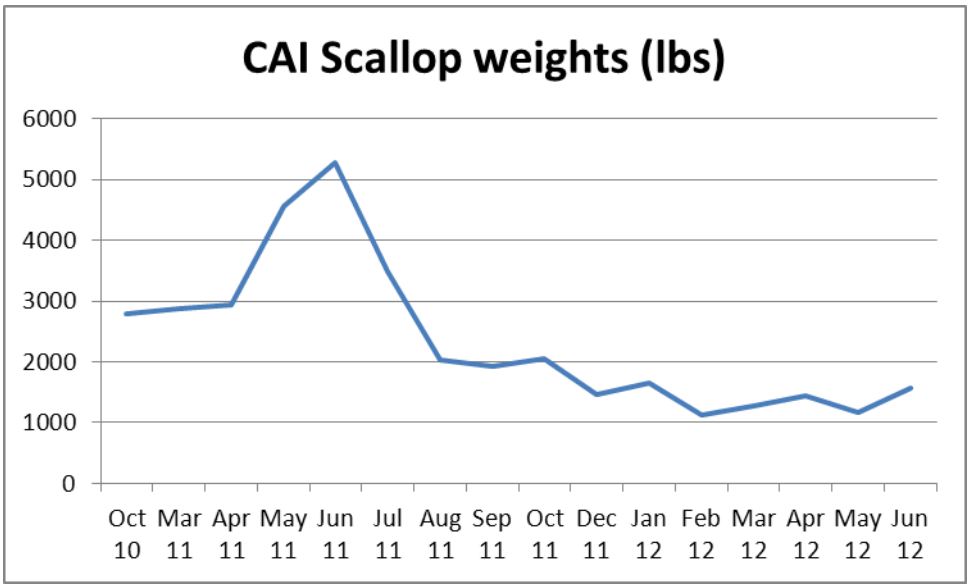



**Figure 23:** Comparison of estimated curves for each month in Closed Area II. Estimates for length:weight relationships for the Georges Bank in general and Closed Area II specifically from NEFSC (2010) are shown for comparison. Depth was calculated as the mean depth of each area (CAII=73.02m).



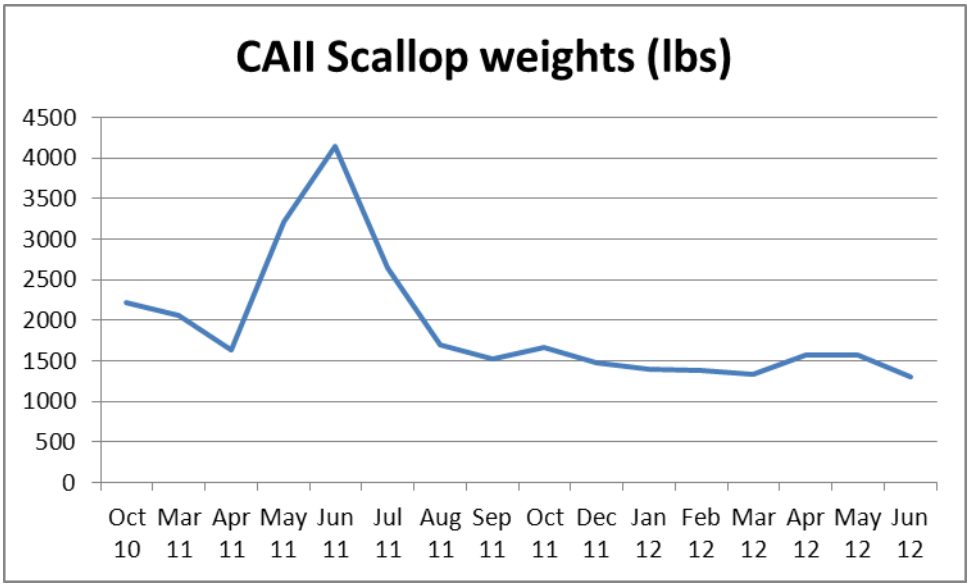
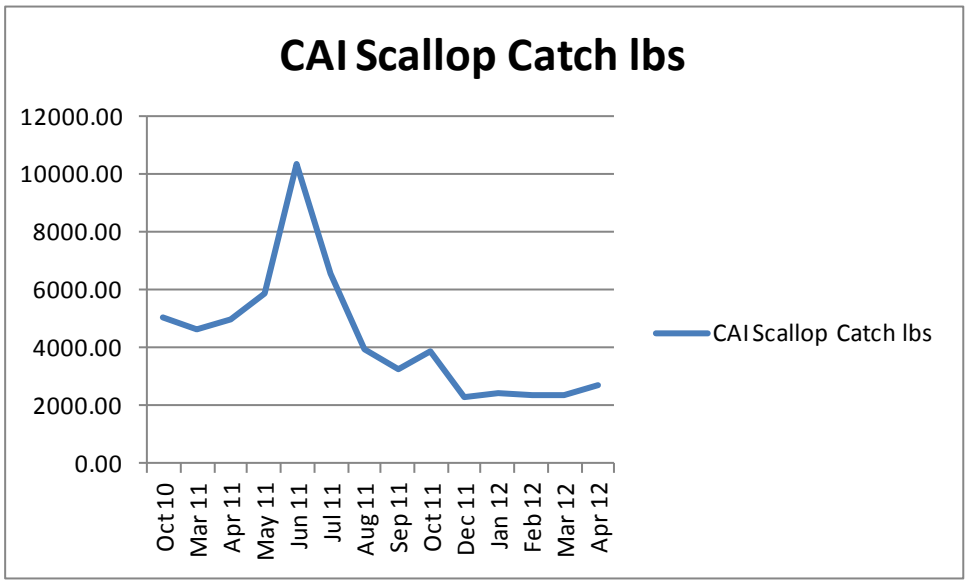




**Figure 24**: The scallop catch by weight in pounds from the 41 selected stations inside and outside of CAI and CAII. (CFTDD only.)



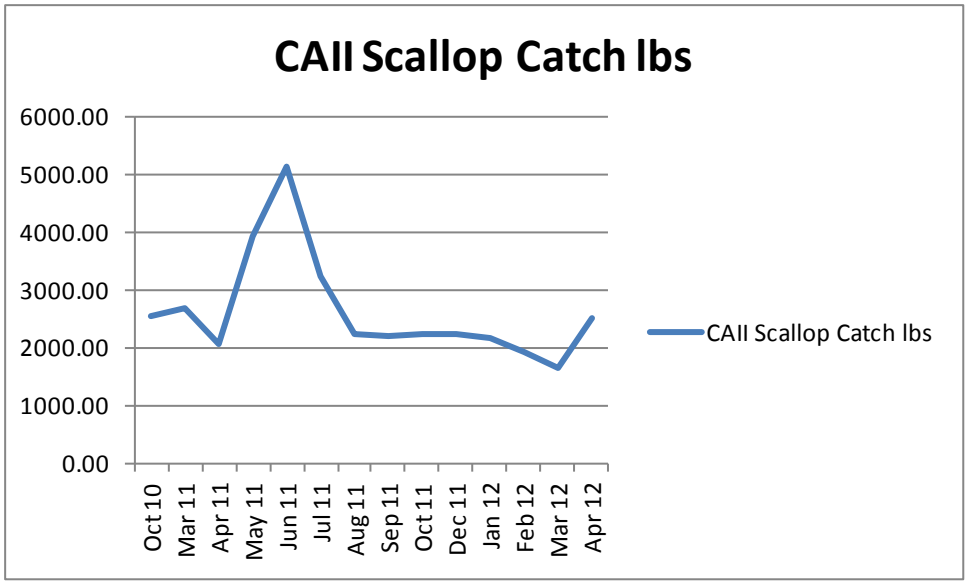
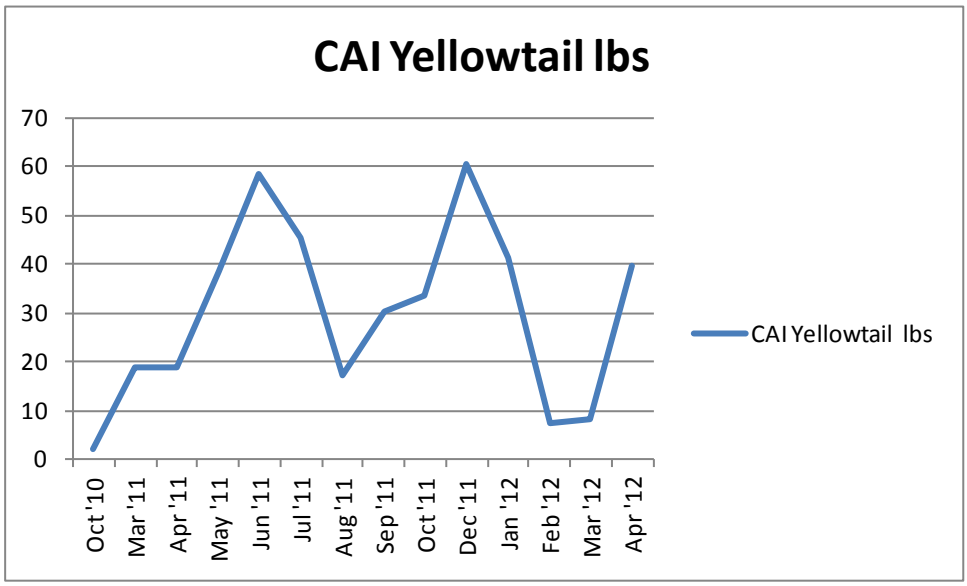




**Figure 25**: The scallop catch by weight in pounds from all surveyed stations inside and outside of CAI and CAII. (CFTDD only.)



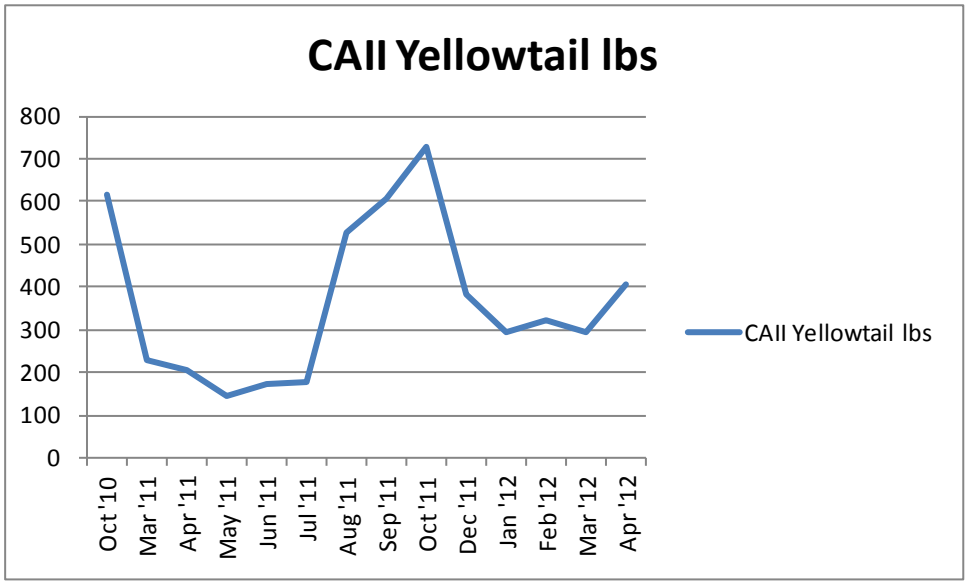
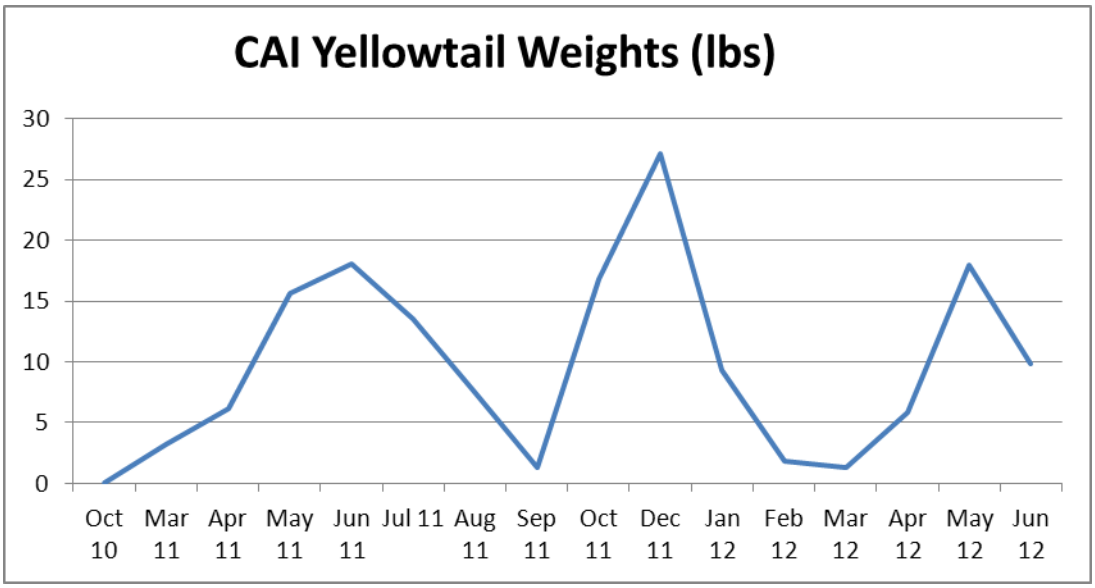




**Figure 26:** Monthly catch distribution in weight of yellowtail flounder from all surveyed stations inside and outside of CAI and CAII. (CFTDD only.)



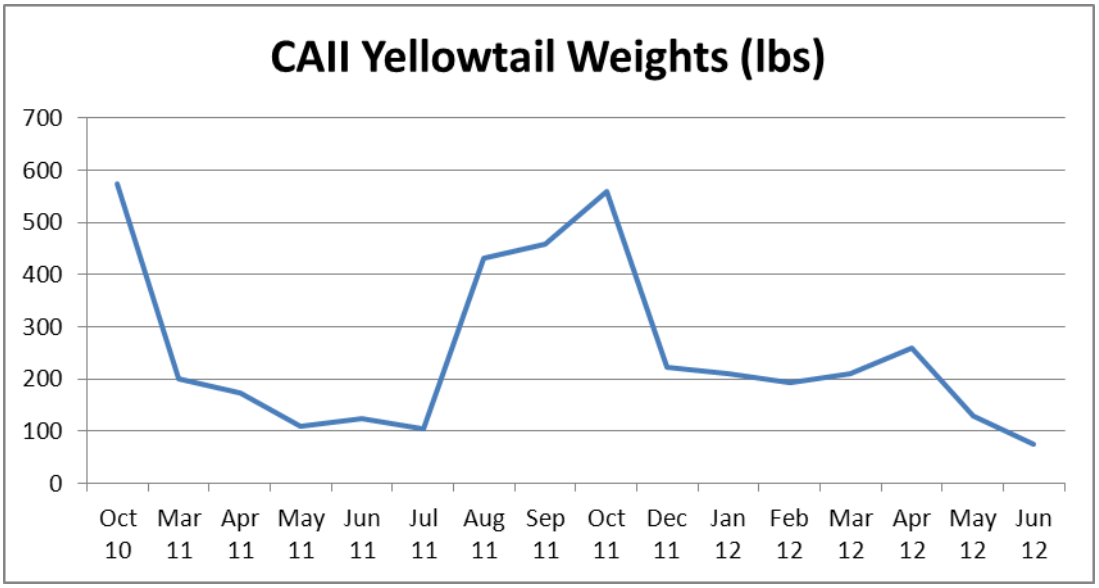




**Figure 27:** Monthly catch distribution in weight of yellowtail flounder from the 41 selected standardized stations inside of CAI and CAII. (CFTDD only.)

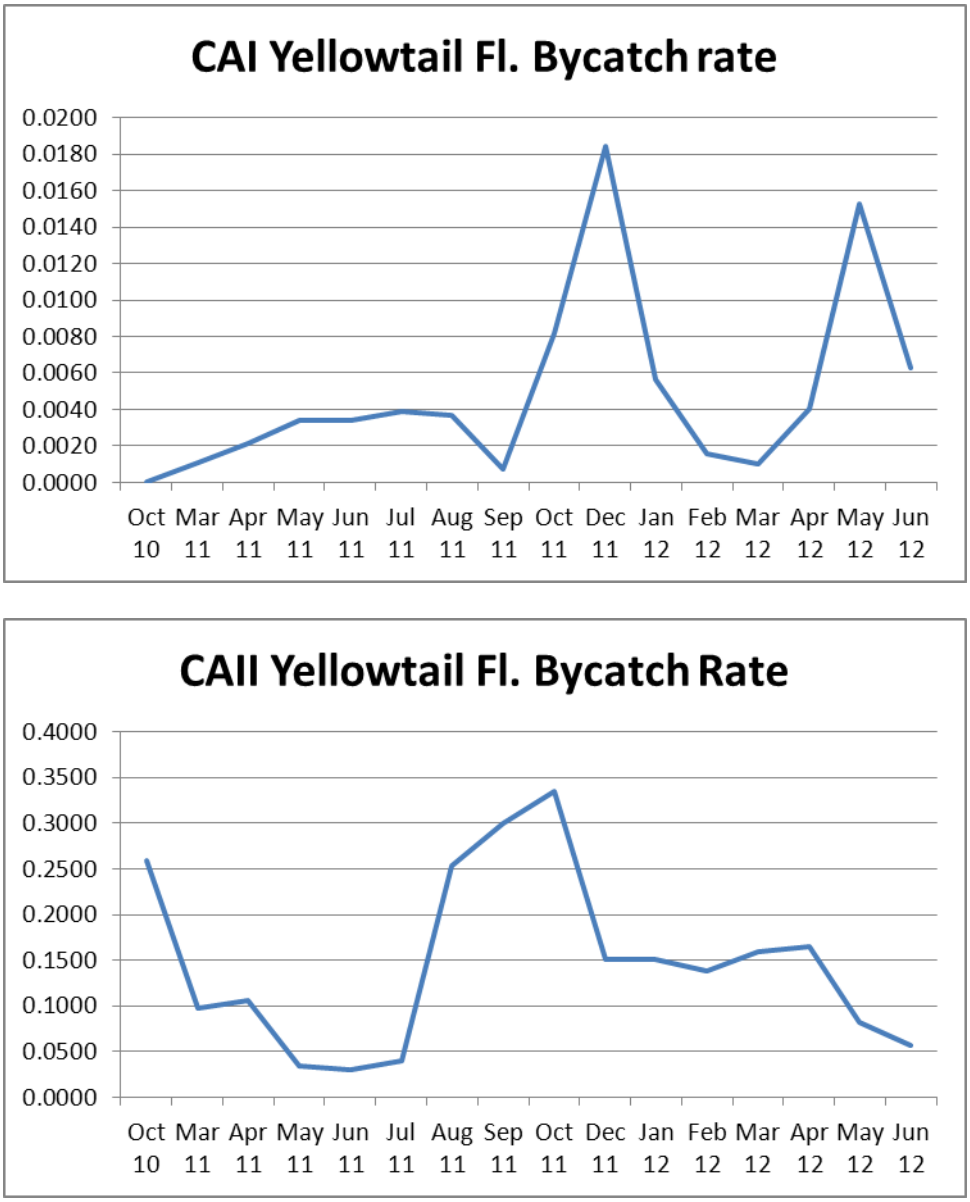
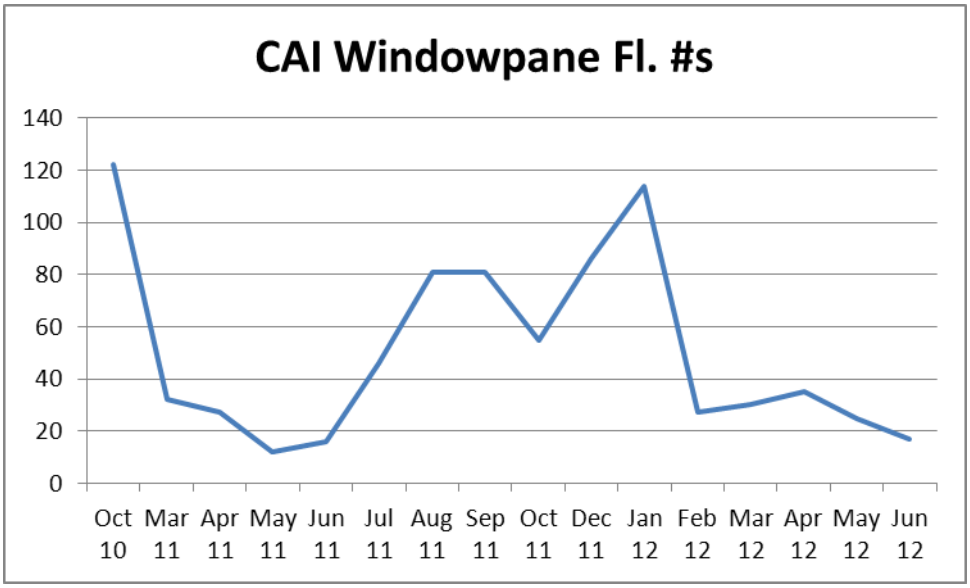






**Figure 28**: Yellowtail bycatch rates for the 41 selected stations inside CAI and CAII. (CFTDD only.)



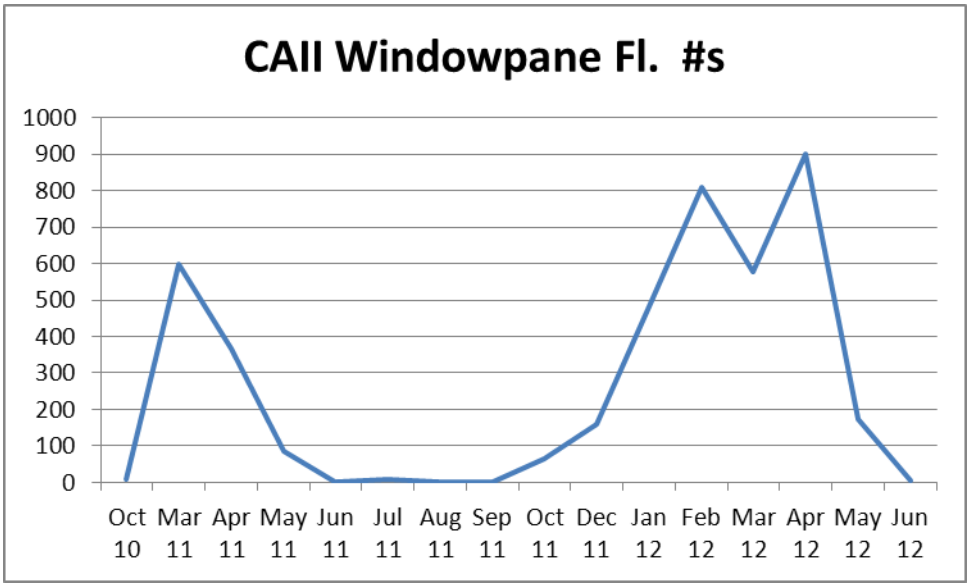




**Figure 29**: Number of windowpane flounder caught at the 41 selected stations inside CAI and CAII. (CFTDD only.)

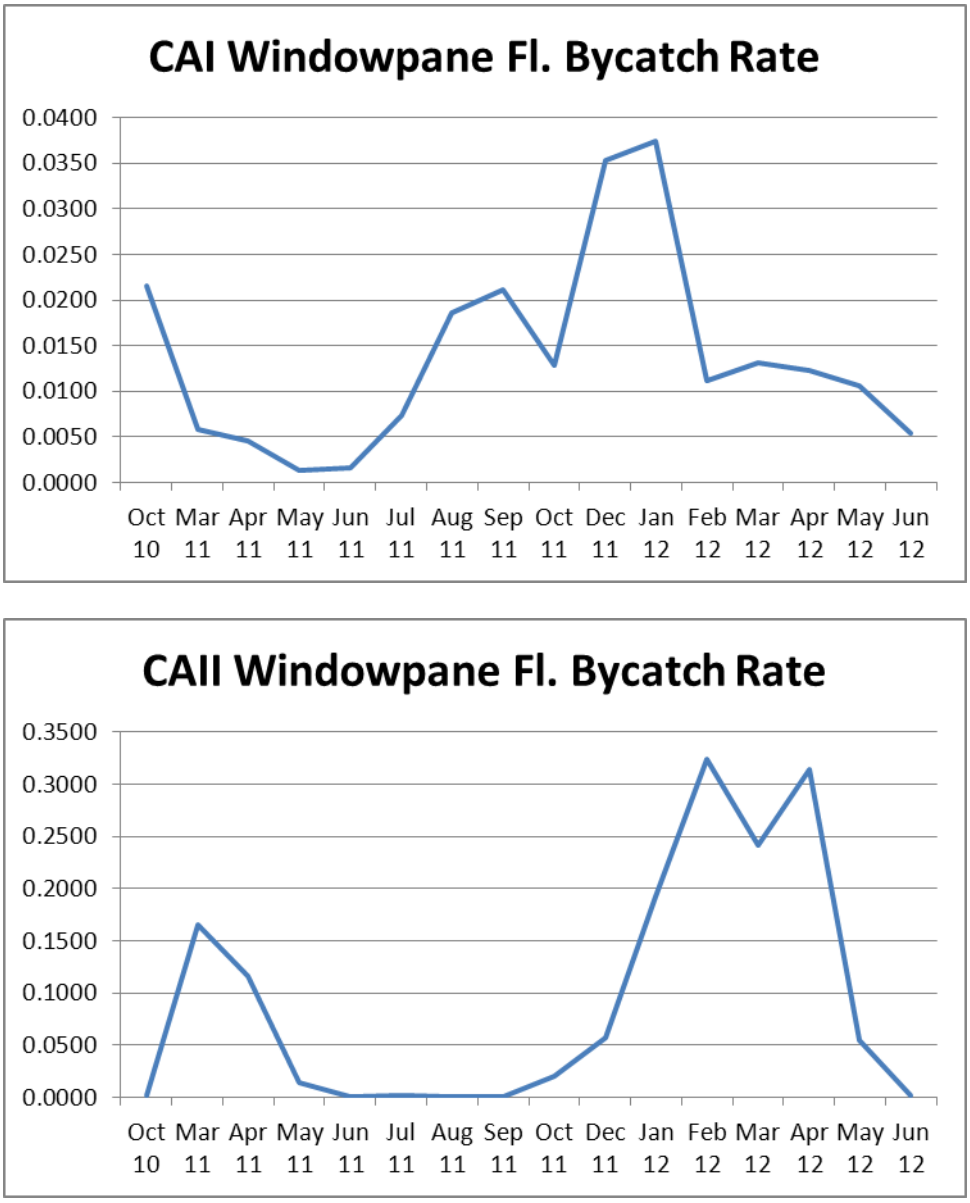
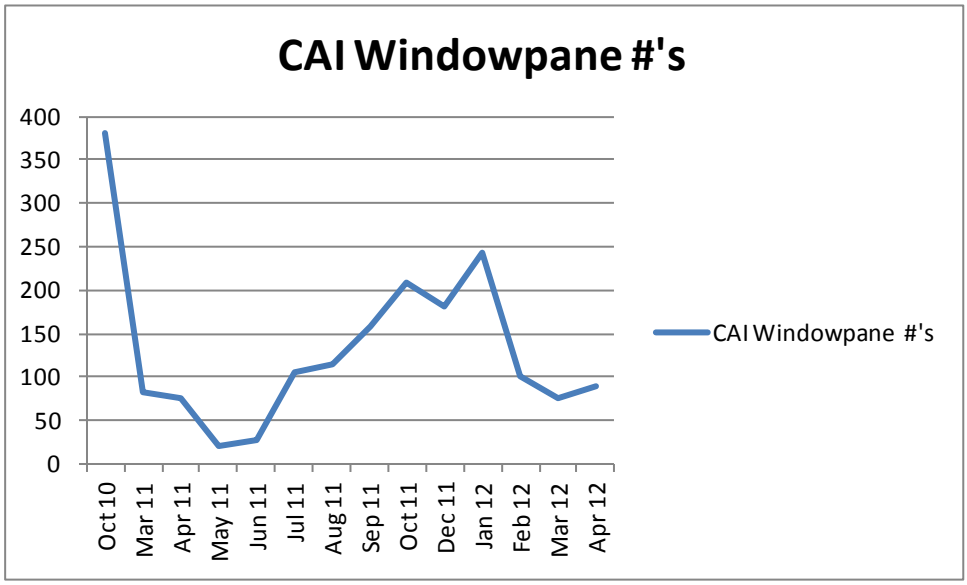






**Figure 30**: Windowpane flounder bycatch rates for the 41 selected stations inside CAI and CAII. (CFTDD only.)



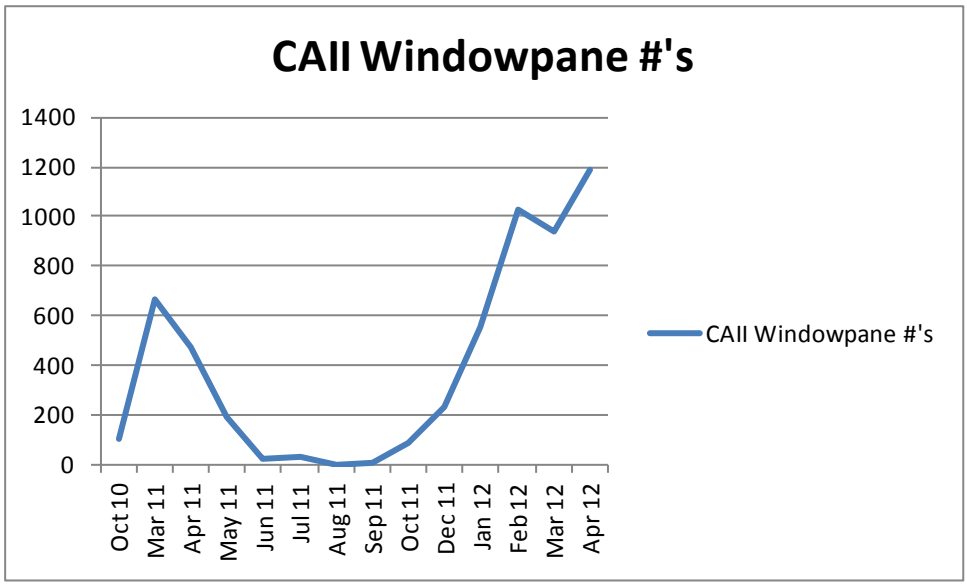
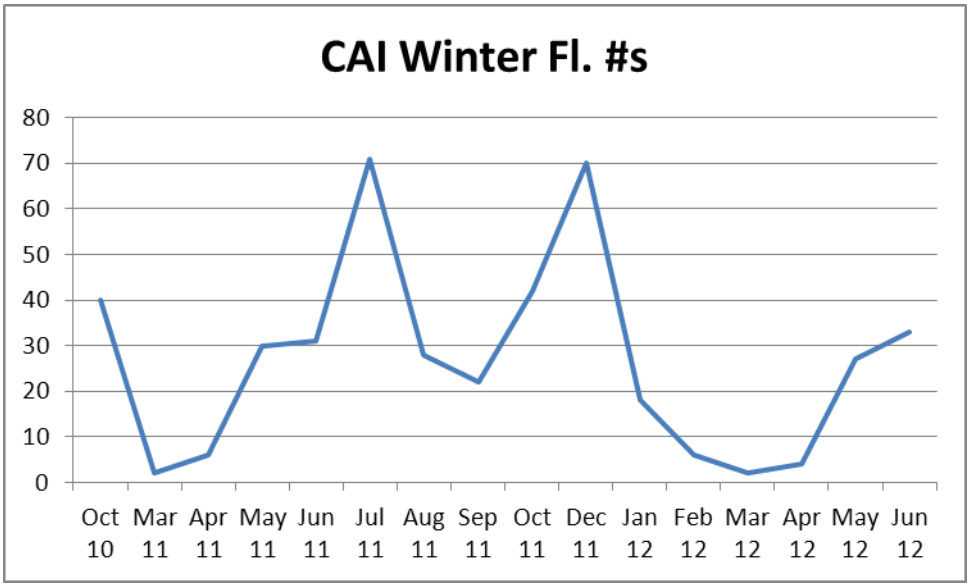




**Figure 31**: Number of windowpane flounder caught at all surveyed stations inside and outside CAI and CAII. (CFTDD only.)



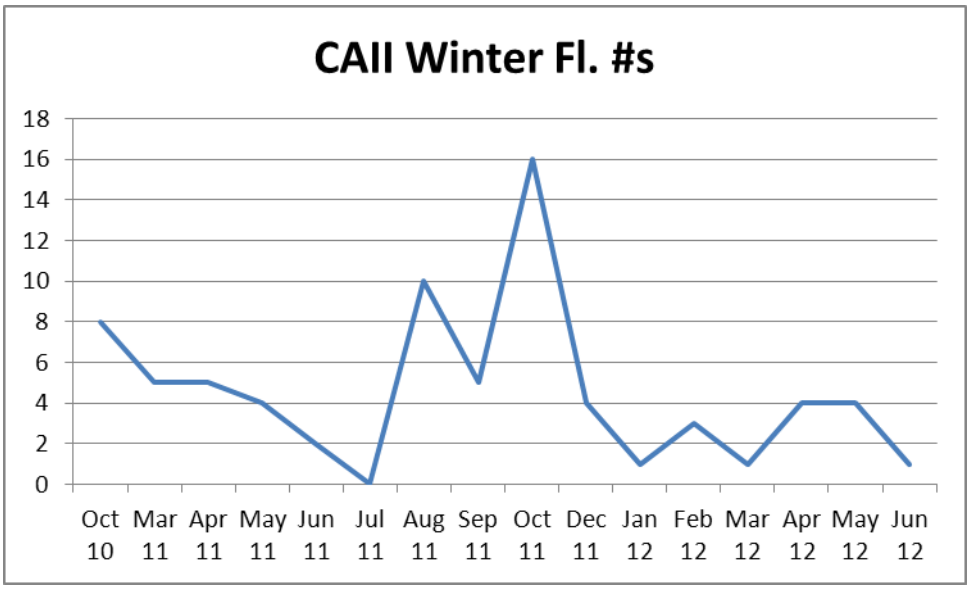
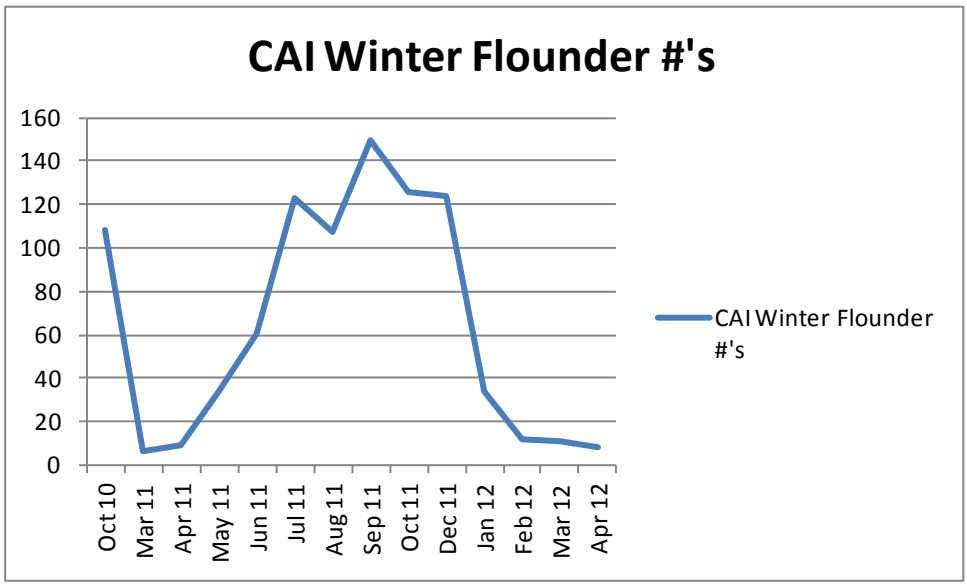




**Figure 32**: Number of winter flounder caught at the 41 selected stations inside CAI and CAII. (CFTDD only.)



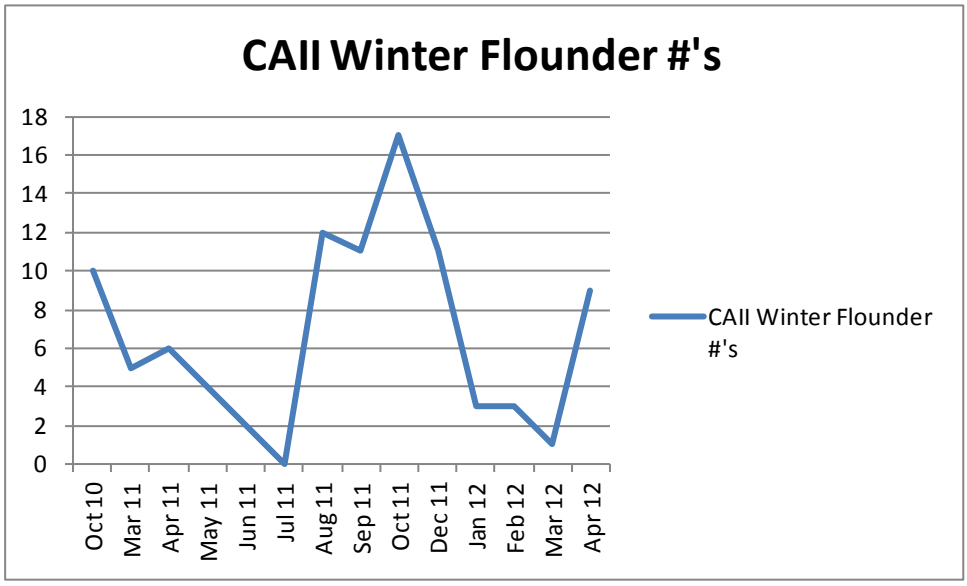
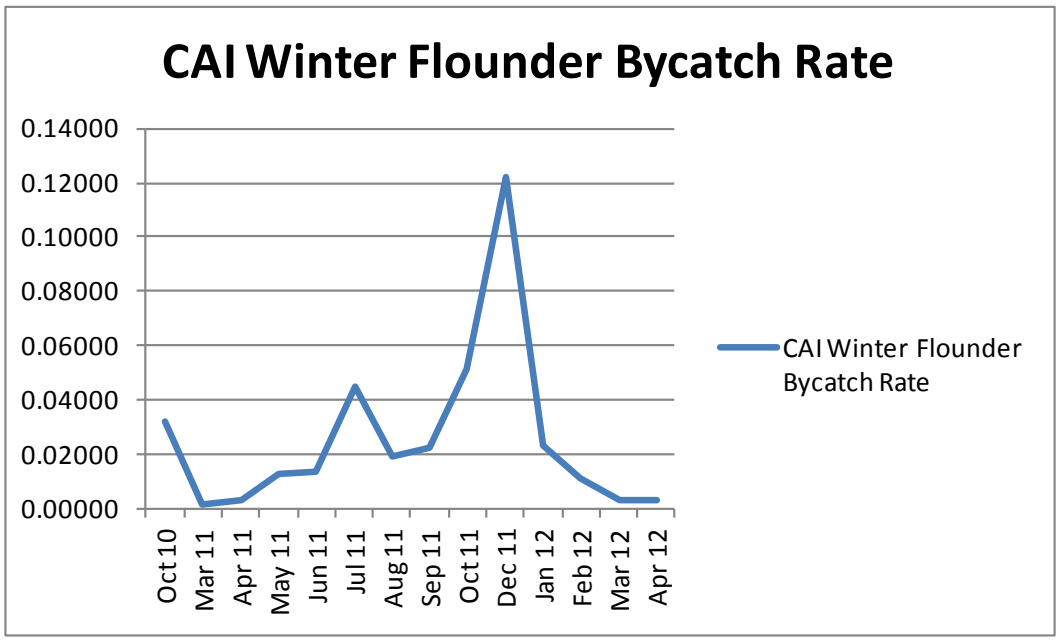




**Figure 33**: Number of winter flounder caught at all surveyed stations inside and outside CAI and CAII. (CFTDD only.)



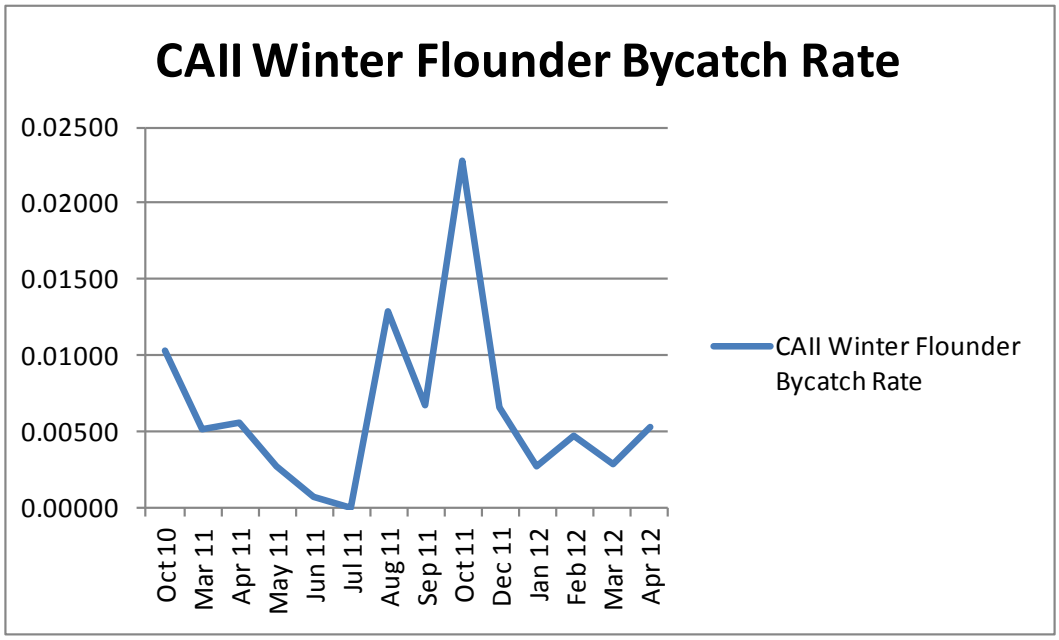
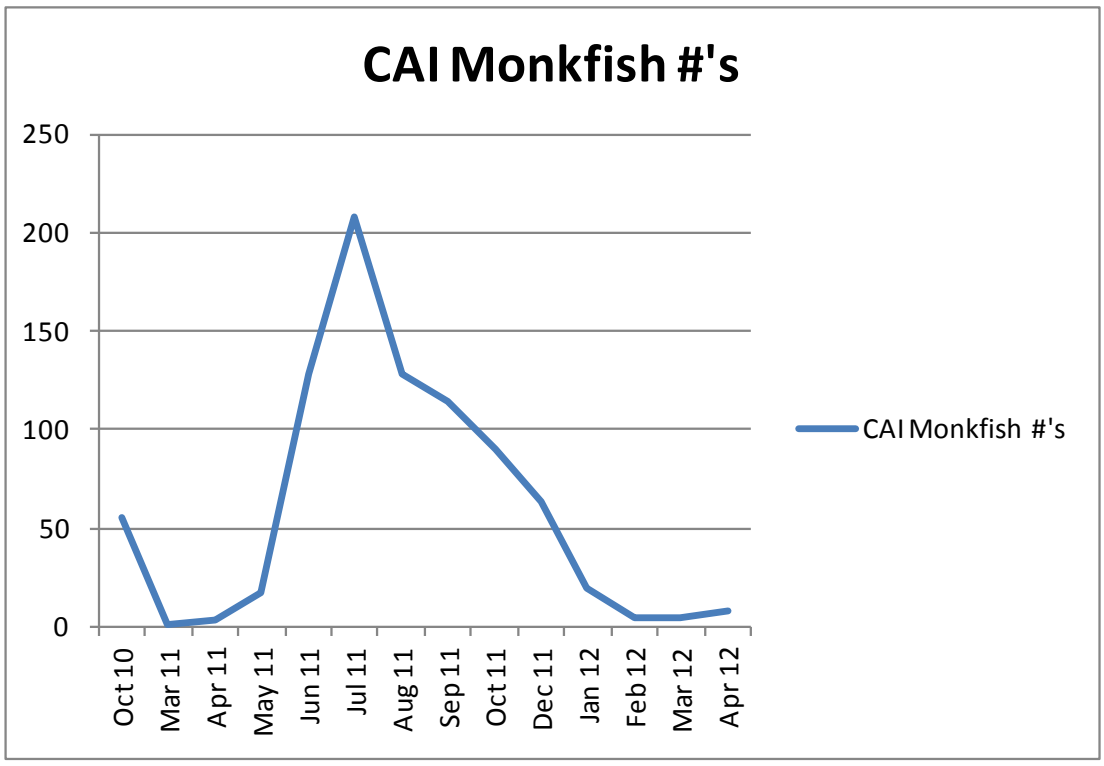




**Figure 34**: Winter flounder bycatch rates for the 41 selected stations inside CAI and CAII. (CFTDD only.)



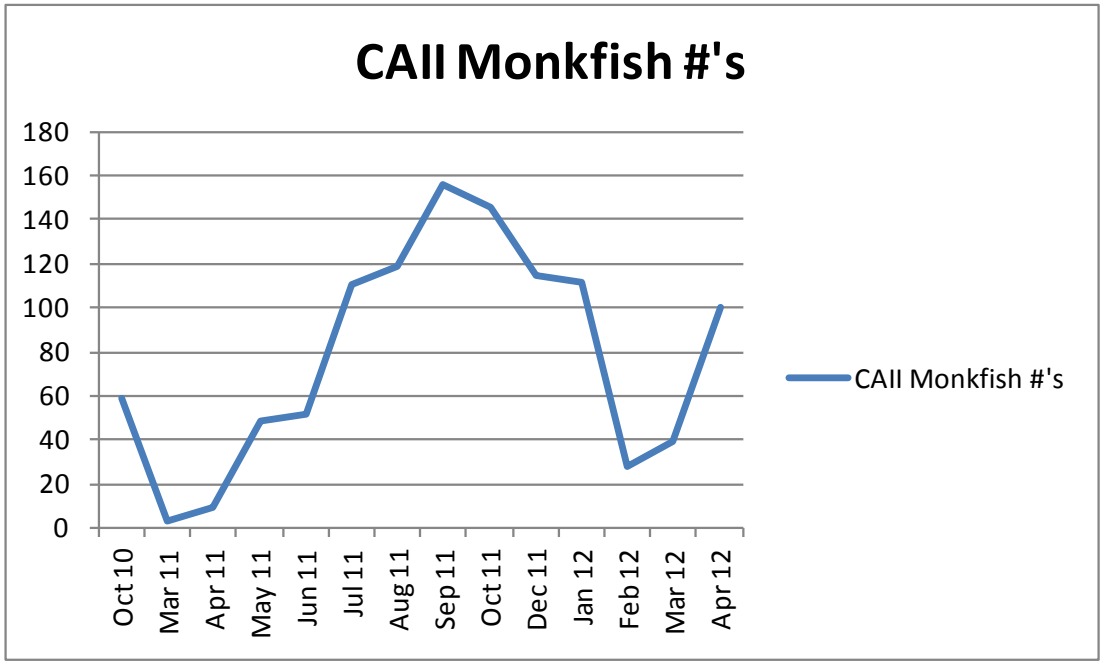
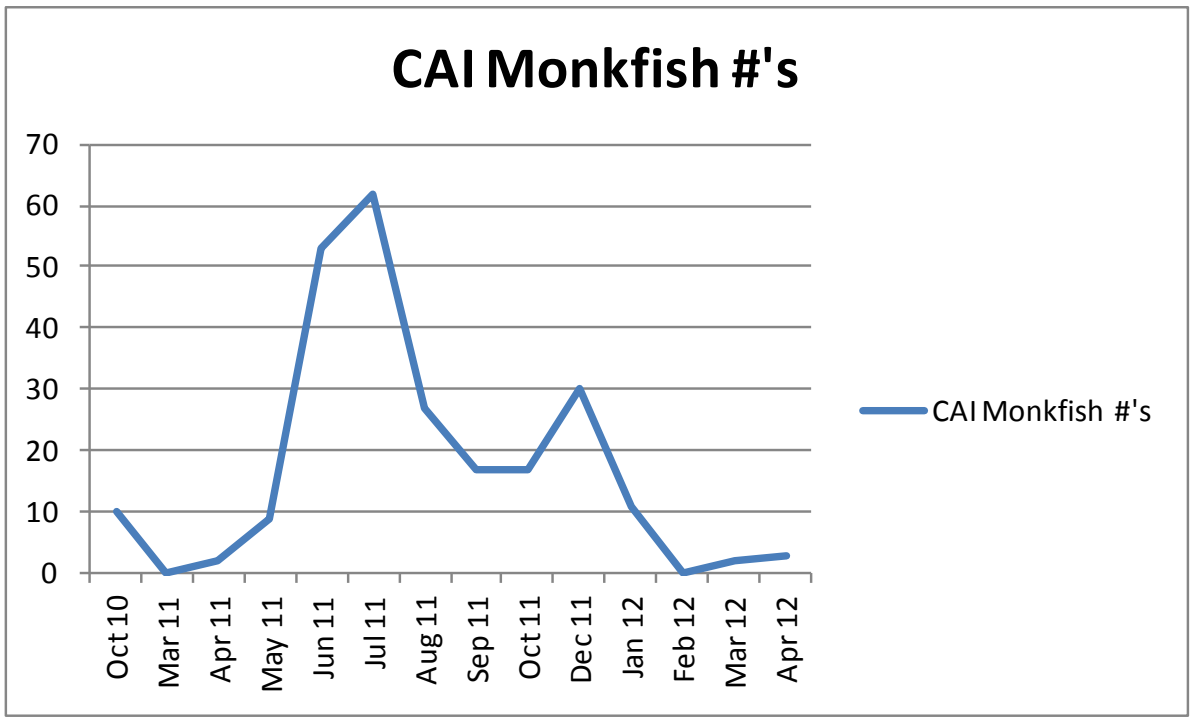




**Figure 35**: Number of monkfish caught for all surveyed stations inside and outside CAI and CAII. (CFTDD only.)



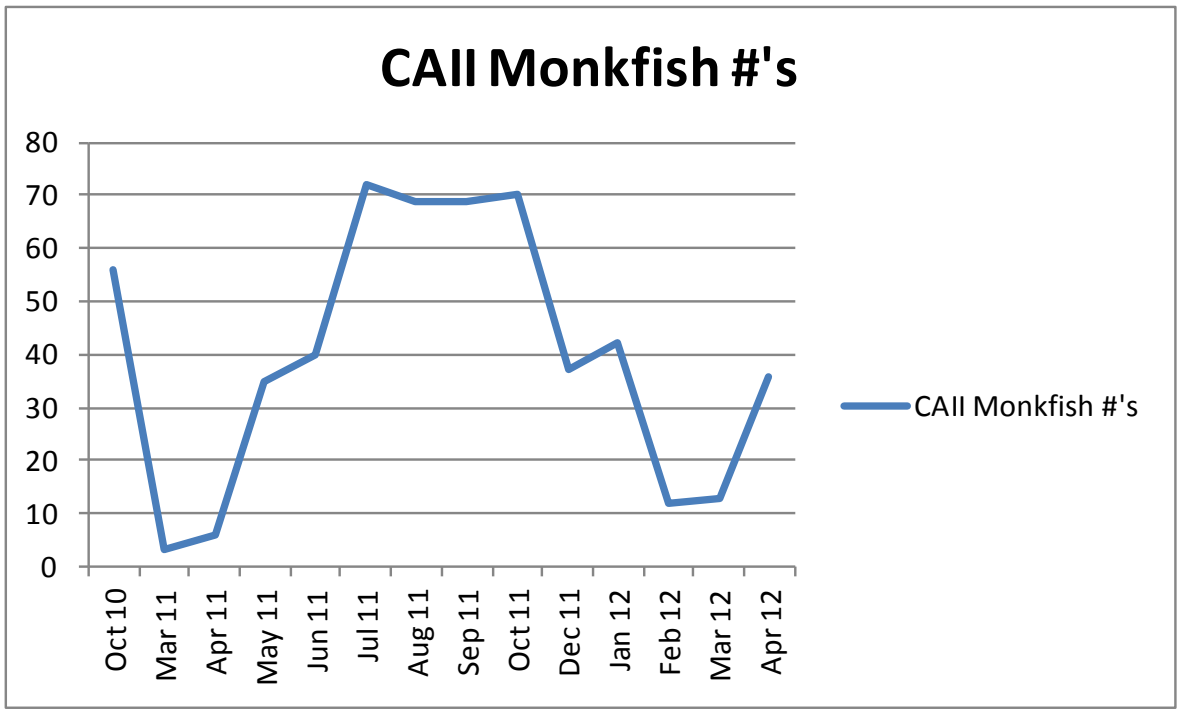
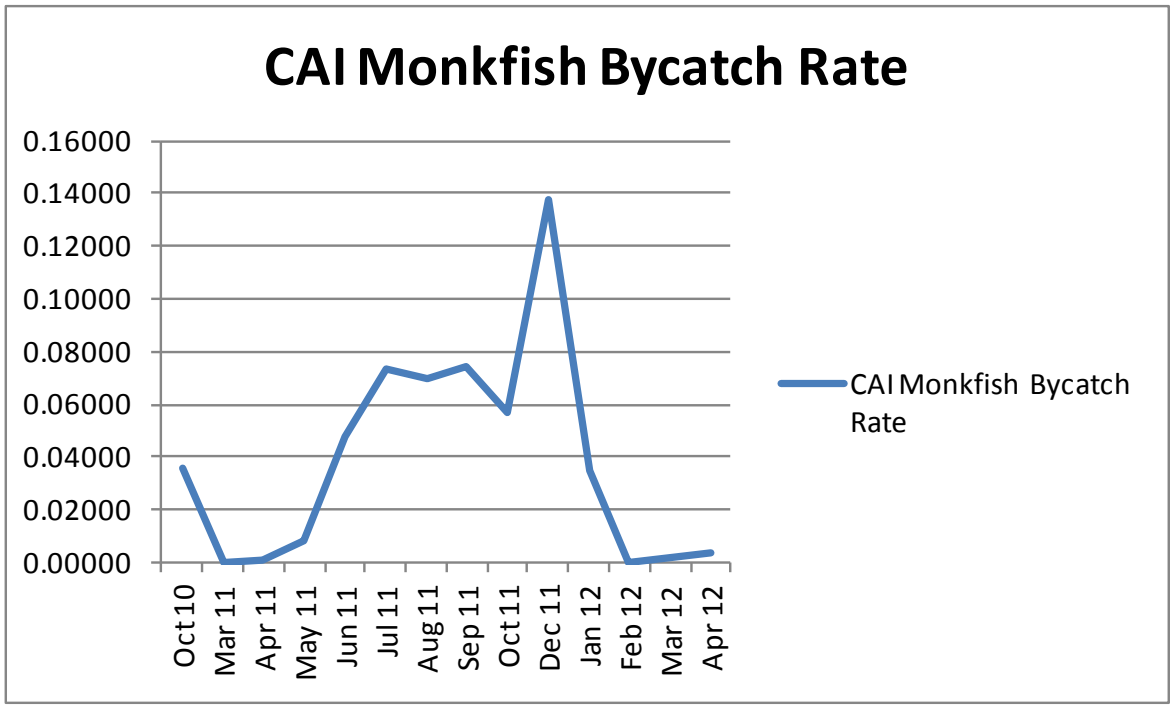




**Figure 36:** Number of monkfish caught at the 41 selected stations inside CAI and CAII. (CFTDD only.)



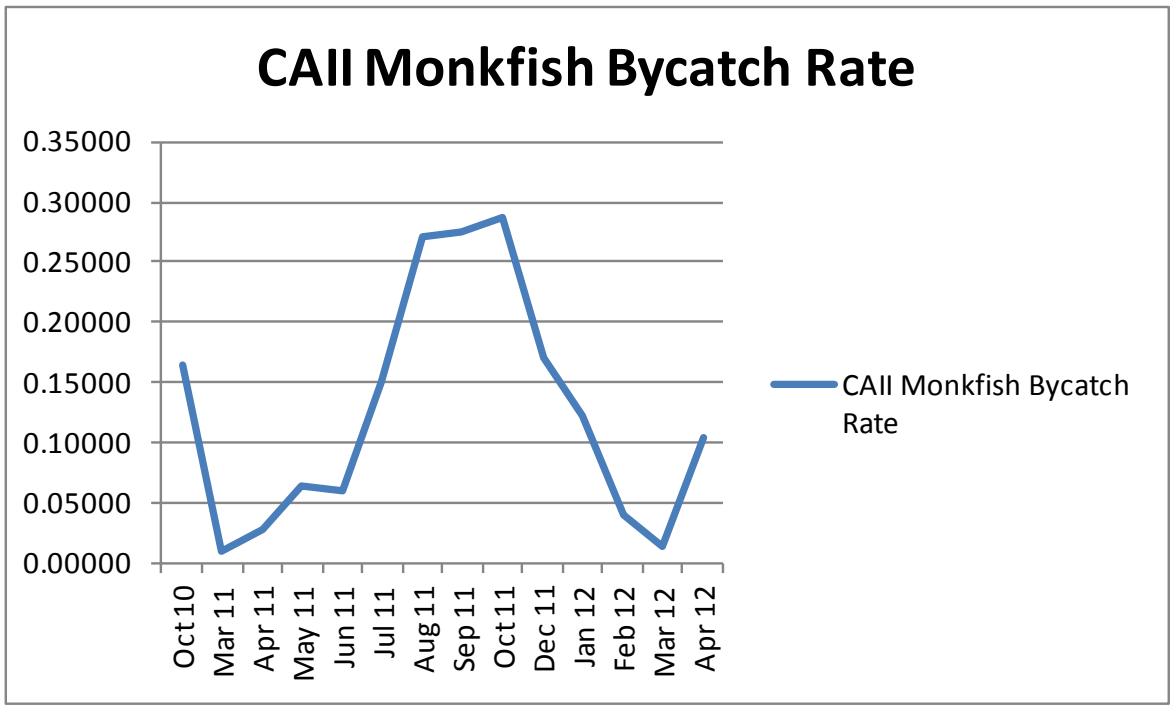




**Figure 37**: Monkfish bycatch rates for the 41 selected stations inside CAI and CAII. (CFTDD only.)

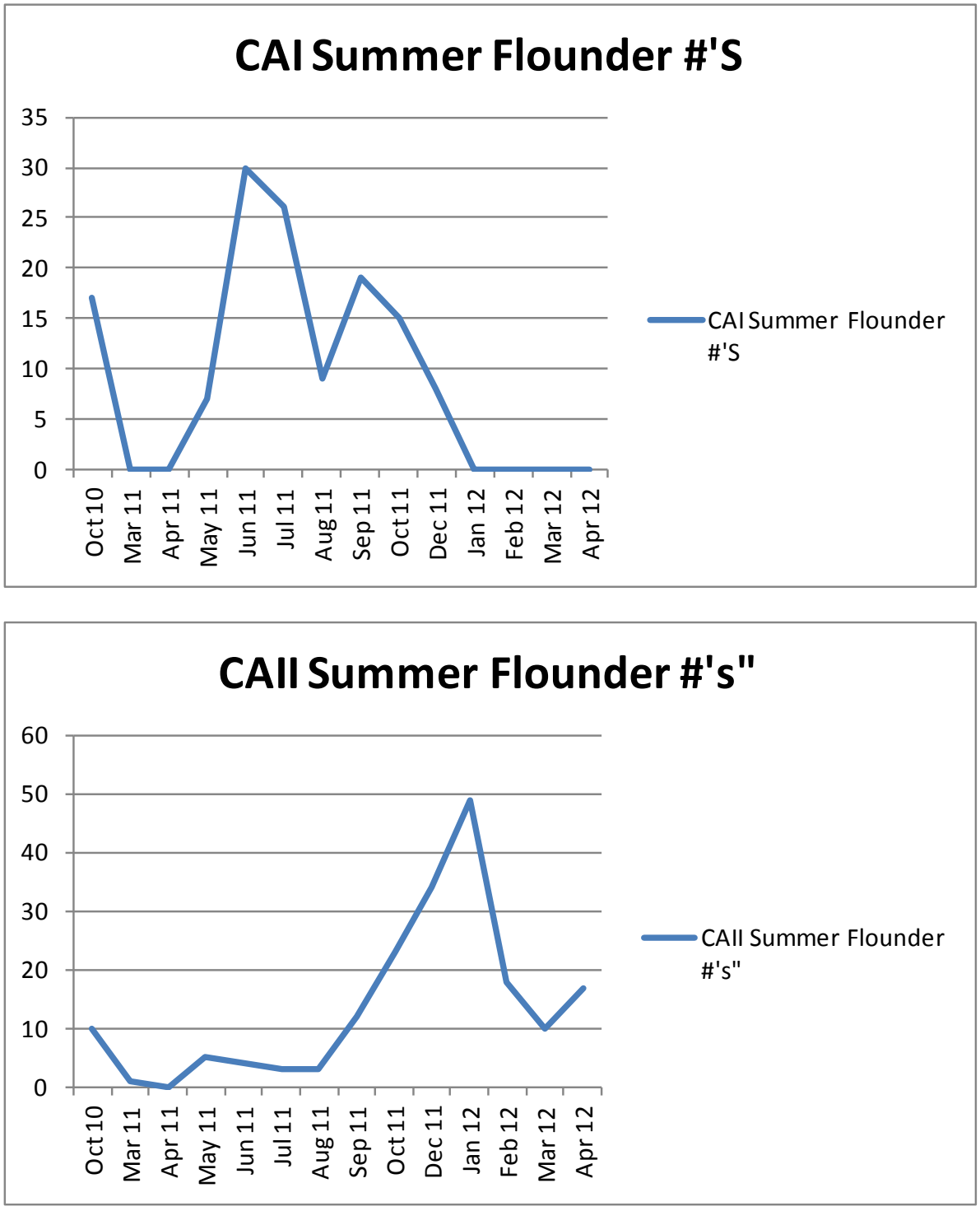
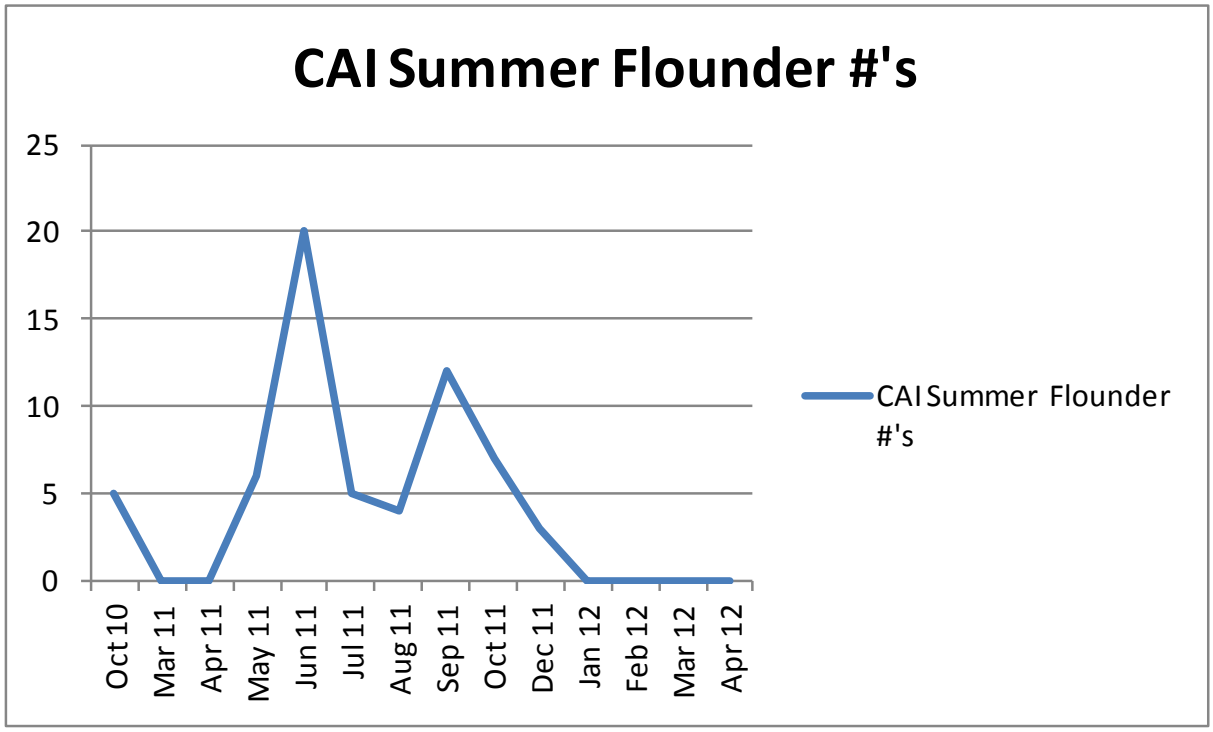



**Figure 38**: Number of summer flounder caught at all surveyed stations inside and outside CAI and CAII. (CFTDD only.)



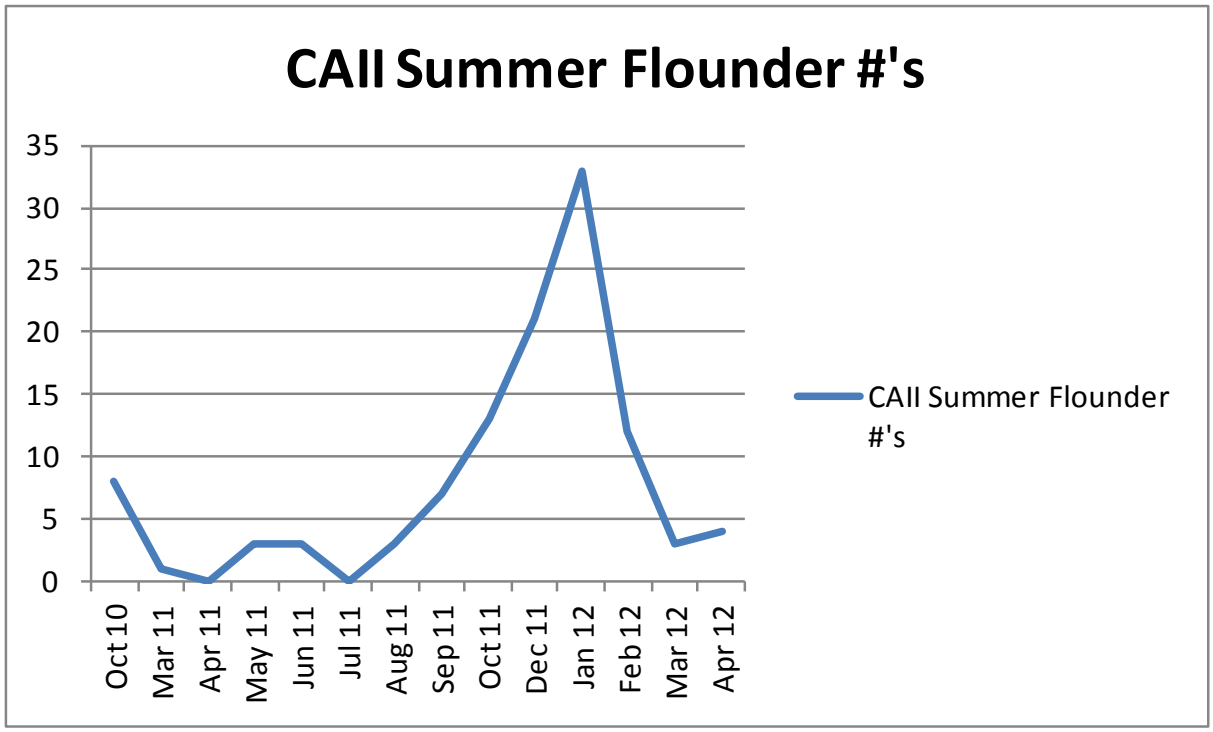




**Figure 39:** Number of summer flounder caught at the 41 selected stations inside CAI and CAII. (CFTDD only.)

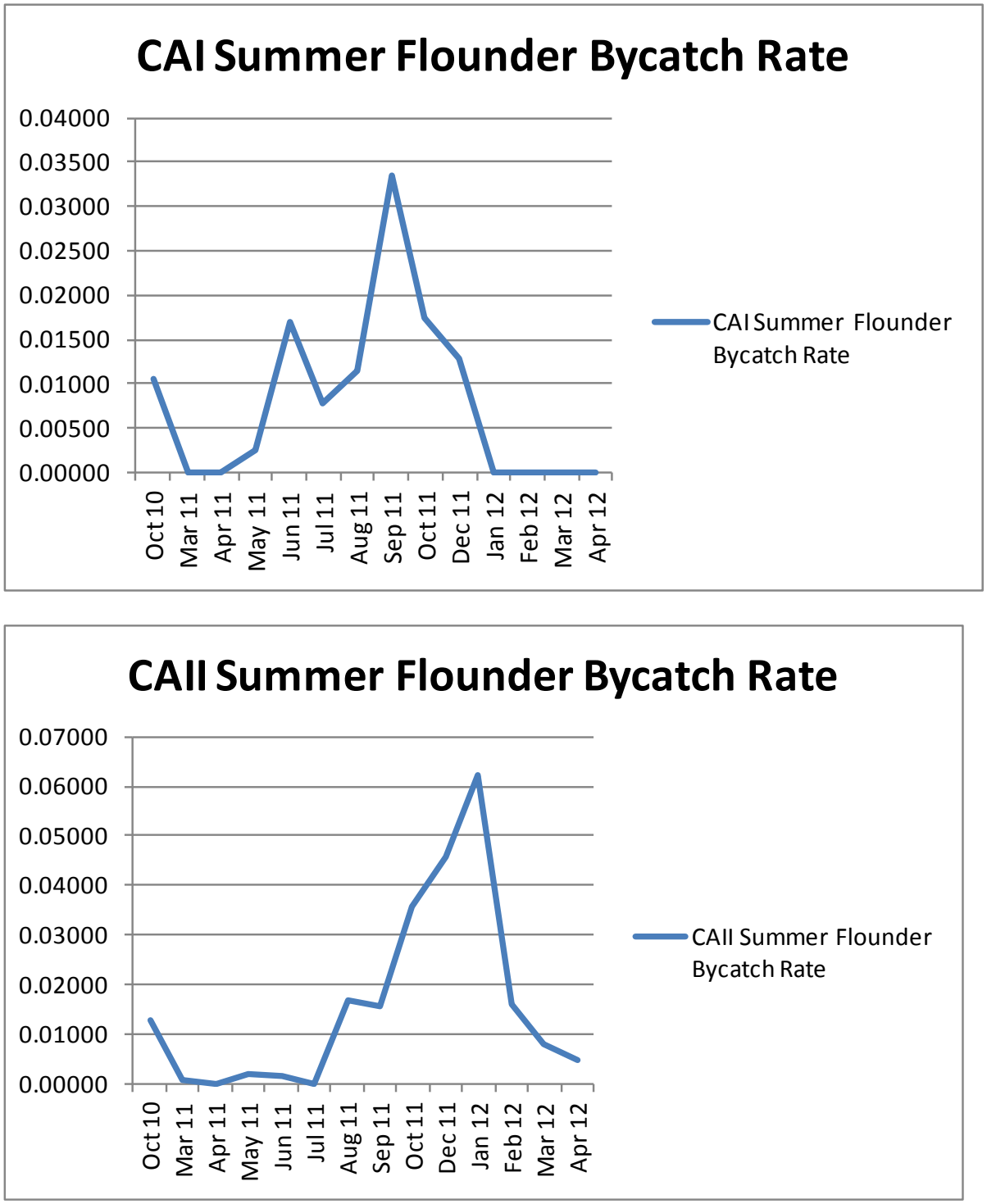



**Figure 40**: Summer flounder bycatch rates for the 41 selected stations inside CAI and CAII. (CFTDD only.)

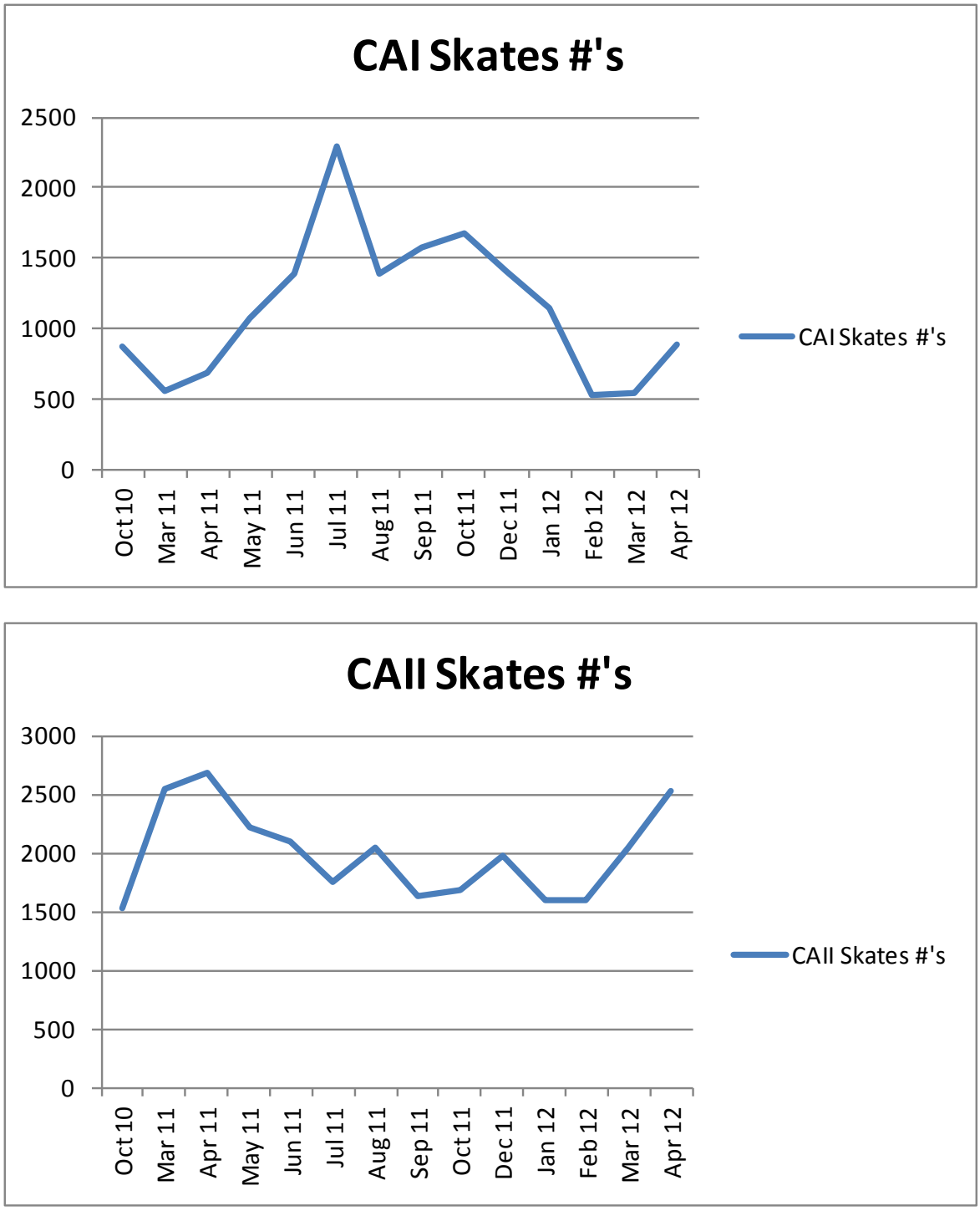
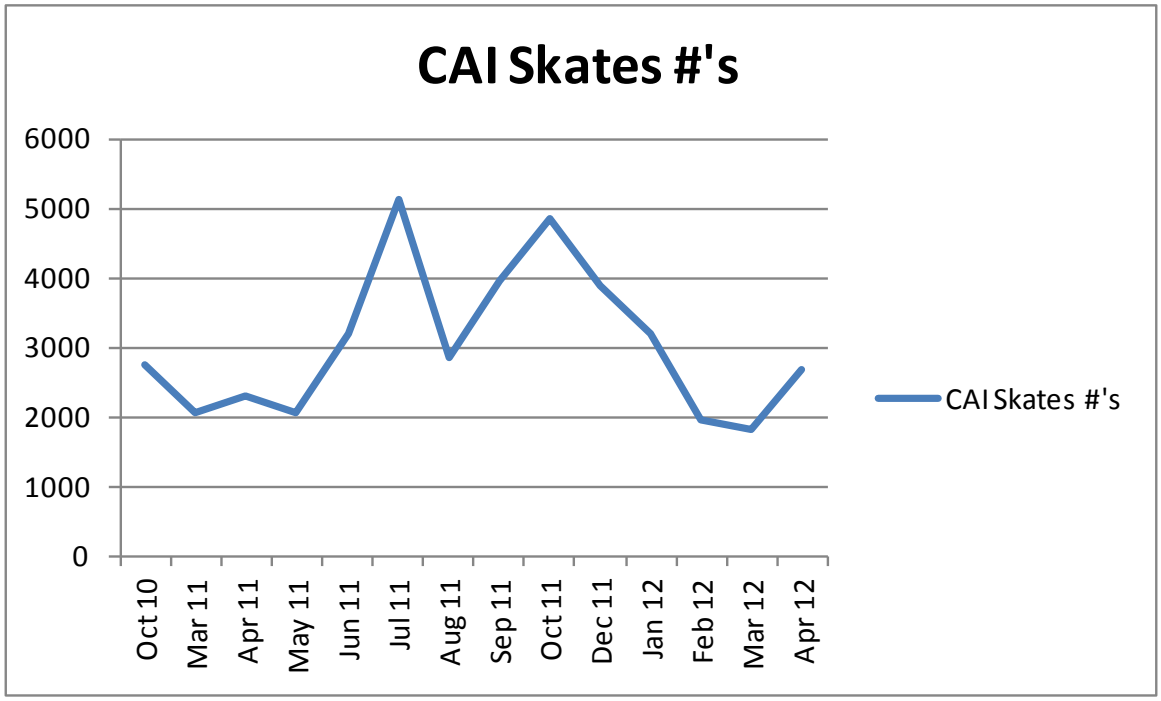



**Figure 41:** Number of little and winter skates caught at the 41 selected stations inside CAI and CAII. (CFTDD only.)



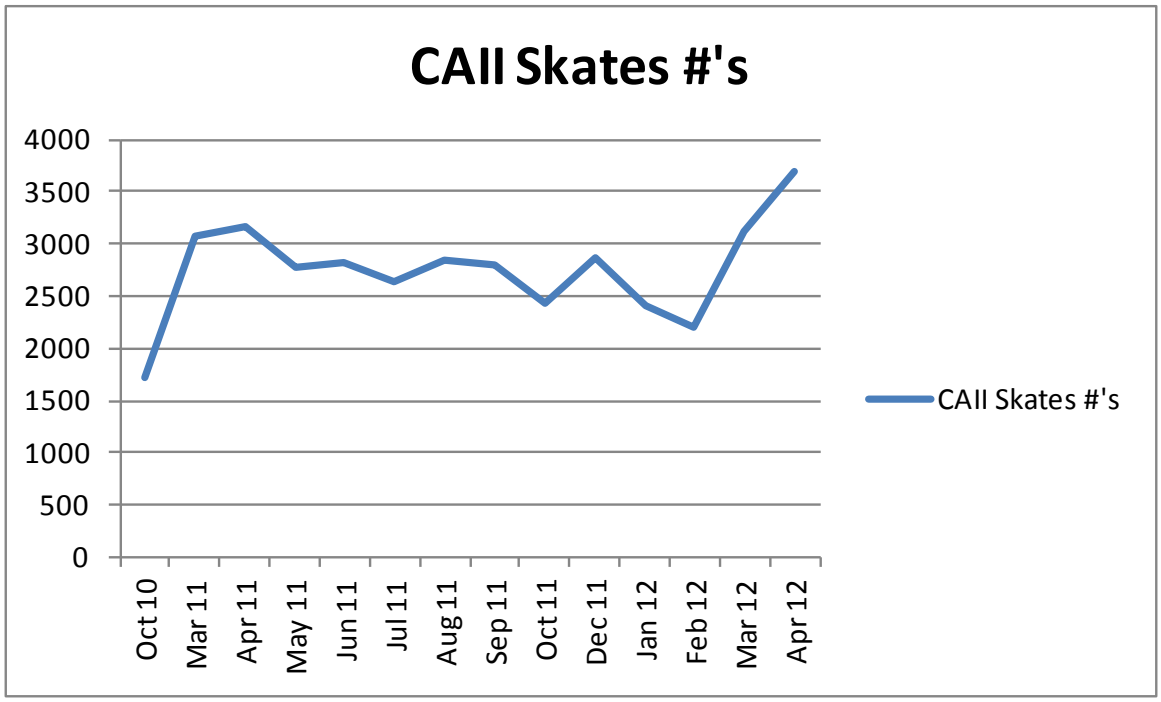




**Figure 42**: Number of little and winter skates caught at all surveyed stations inside and outside CAI and CAII. (CFTDD only.)

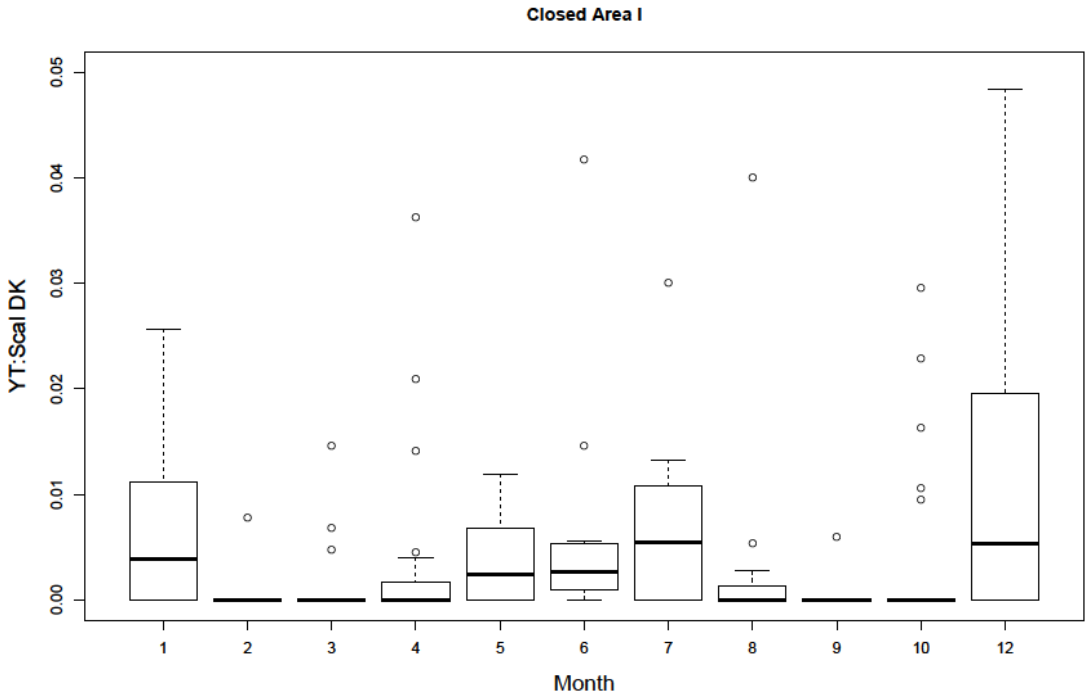



**Figure 43**: Box and whisker plot of the distribution of the bycatch ratio by station of yellowtail in CAI for each month of the survey showing the means, 25 and 75 percentiles (interquartile range), and outliers. Data from multiple years were combined.

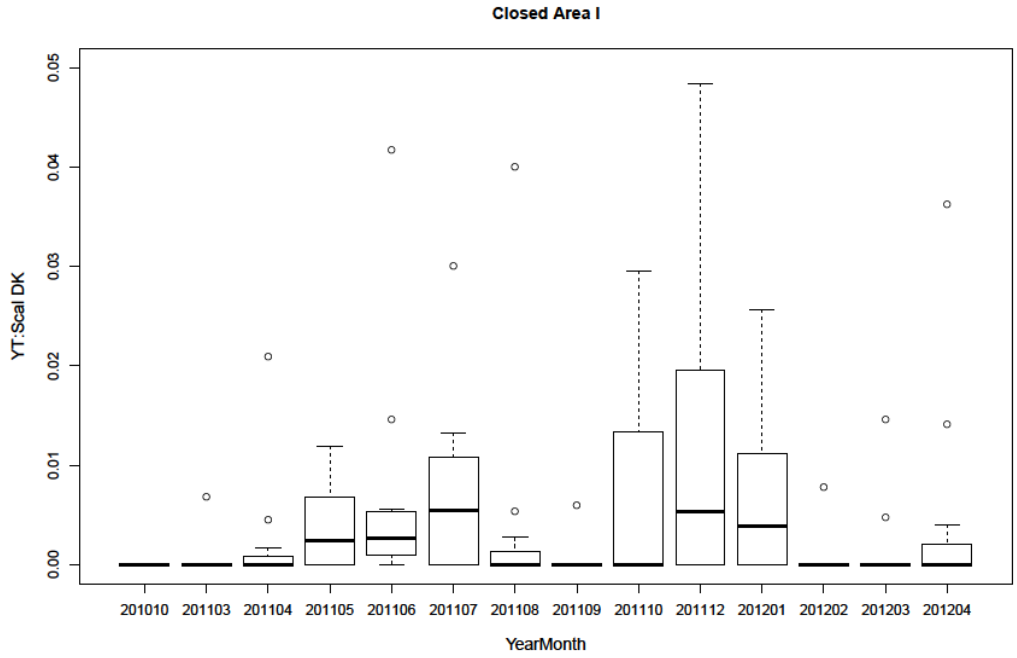



**Figure 44**: Distribution of the bycatch ratio by station of yellowtail in CAI for each of the fourteen survey trips.

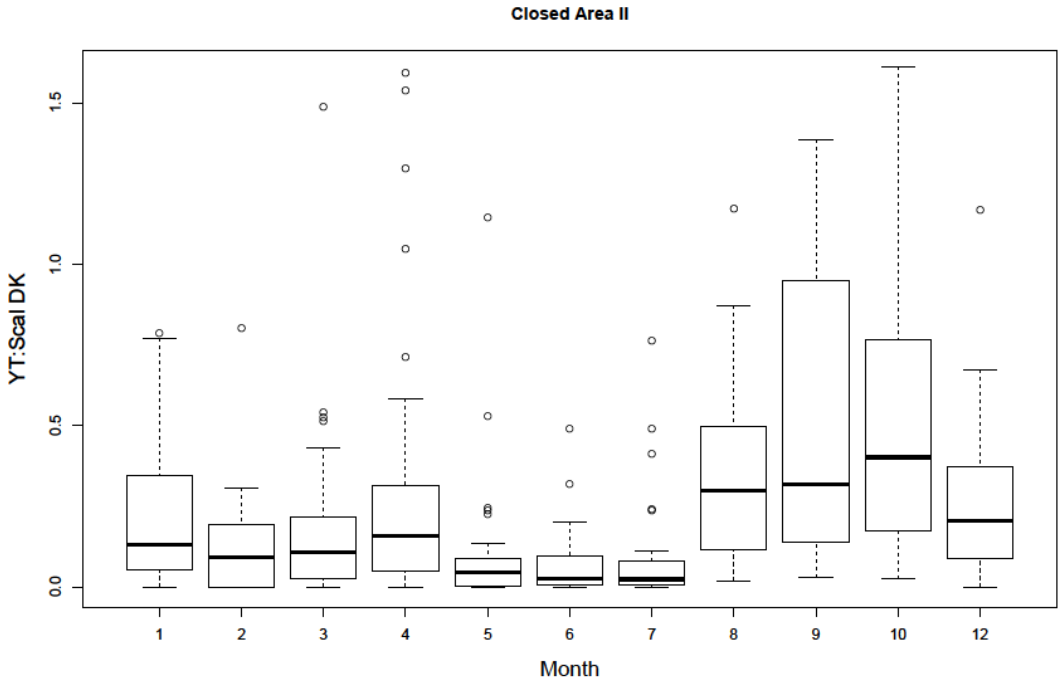



**Figure 45**: Box and whisker plot of the distribution of the bycatch ratio by station of yellowtail in CAII for each month of the survey showing the means, 25 and 75 percentiles (interquartile range), and outliers. Data from multiple years were combined.

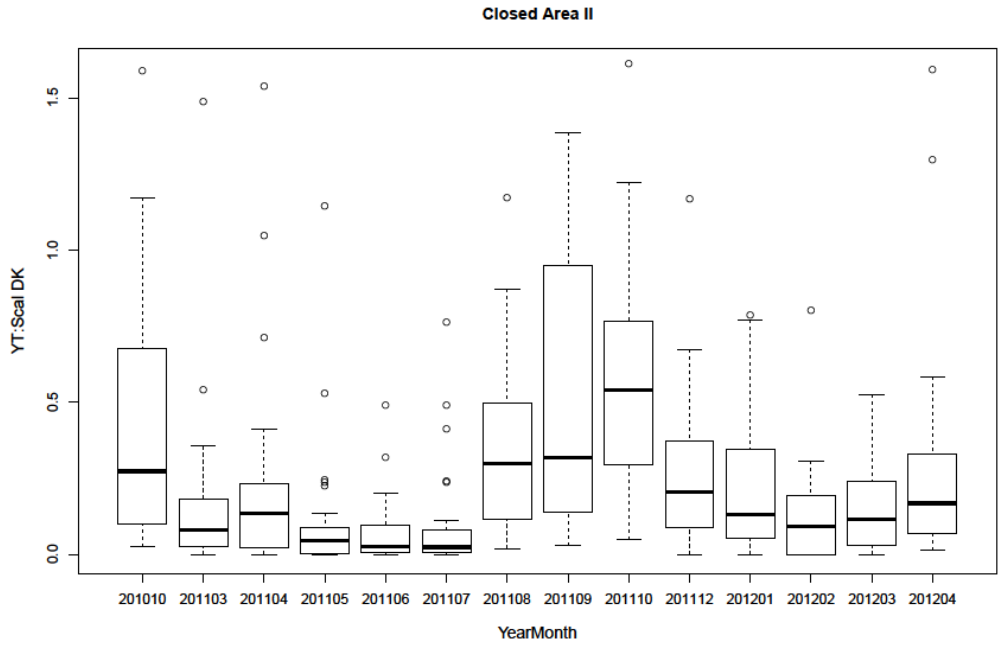



**Figure 46**: Distribution of the bycatch ratio by station of yellowtail in CAI for each of the fourteen survey trips.

**Figure 47:** Total pooled catches for sea scallops for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

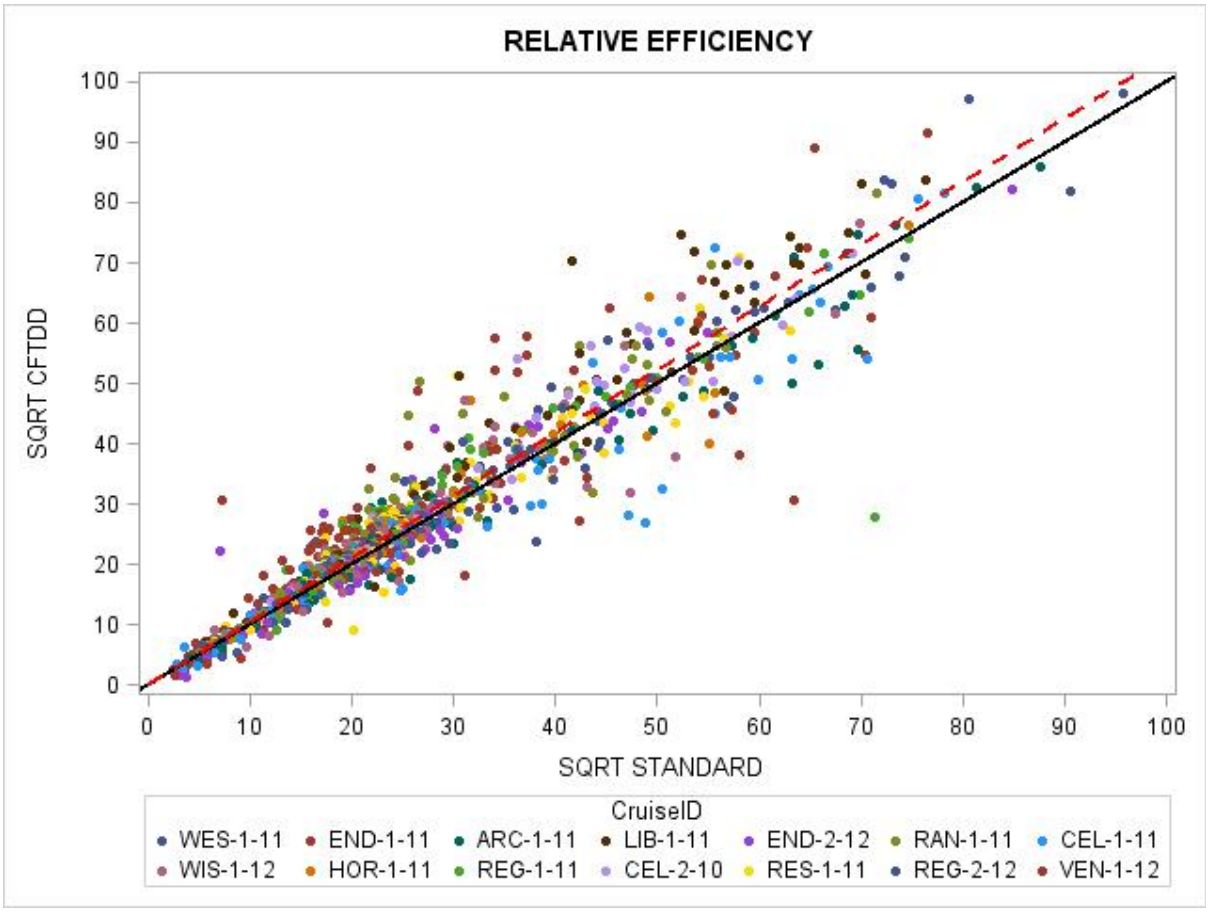


**Figure 48:** Total pooled catches monkfish for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

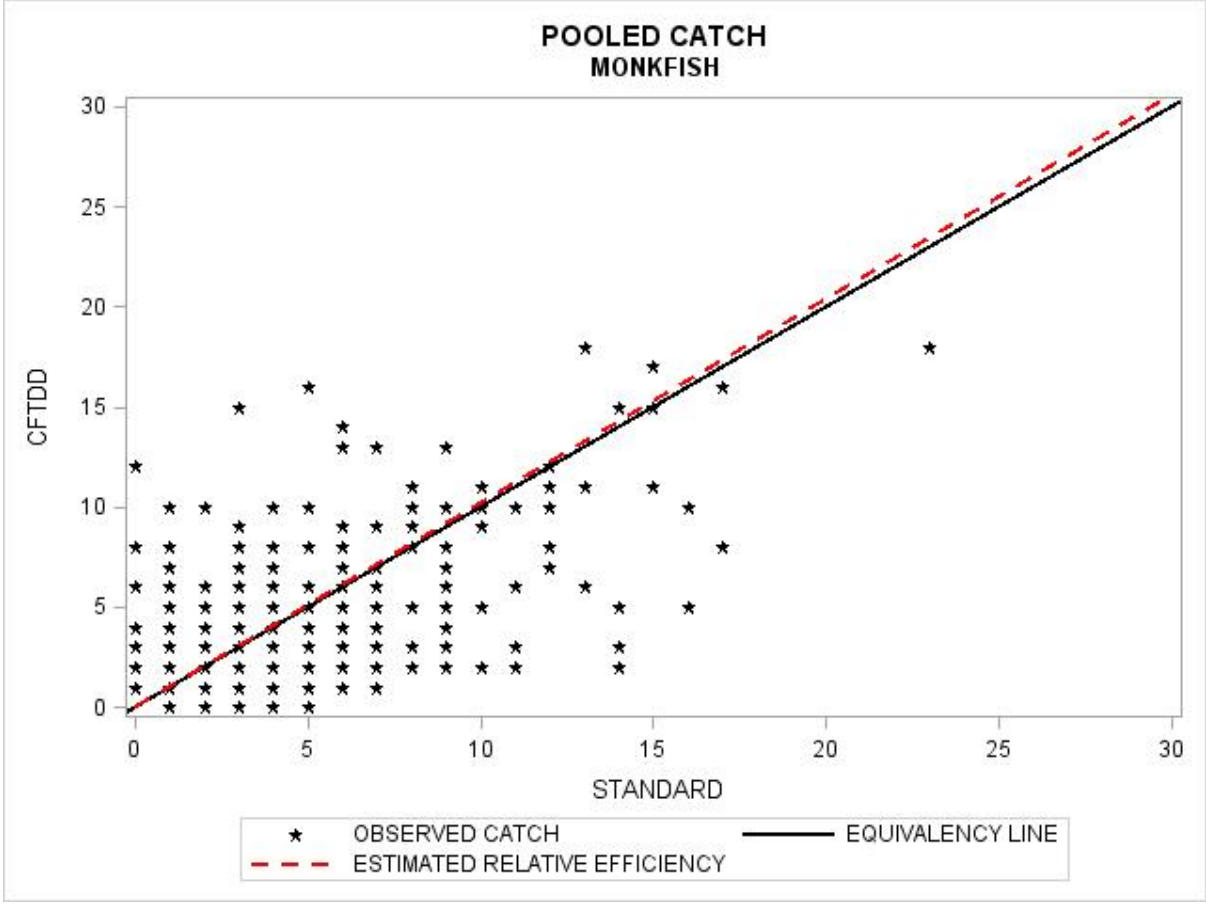


**Figure 49:** Total pooled catches for windowpane flounder for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

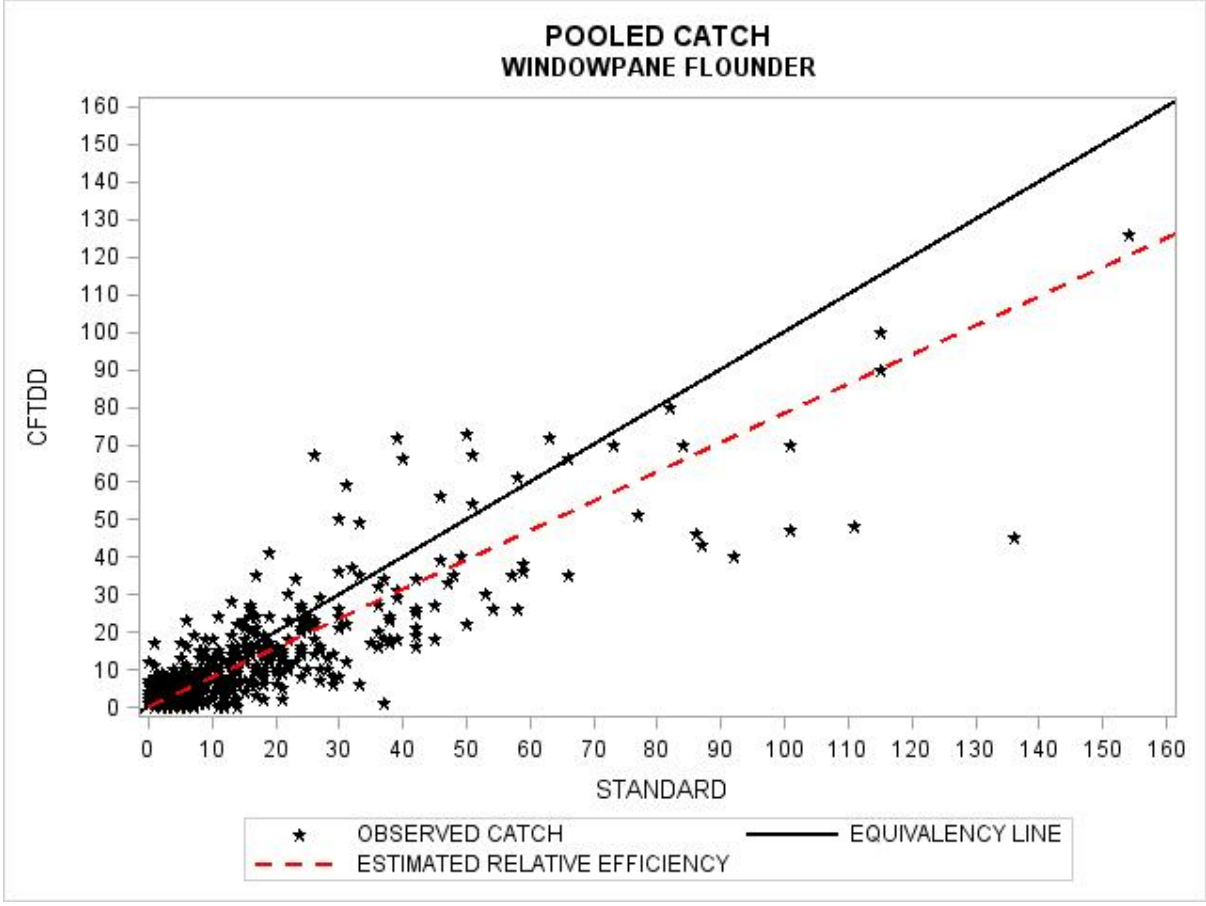


**Figure 50:** Total pooled catches grey sole for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

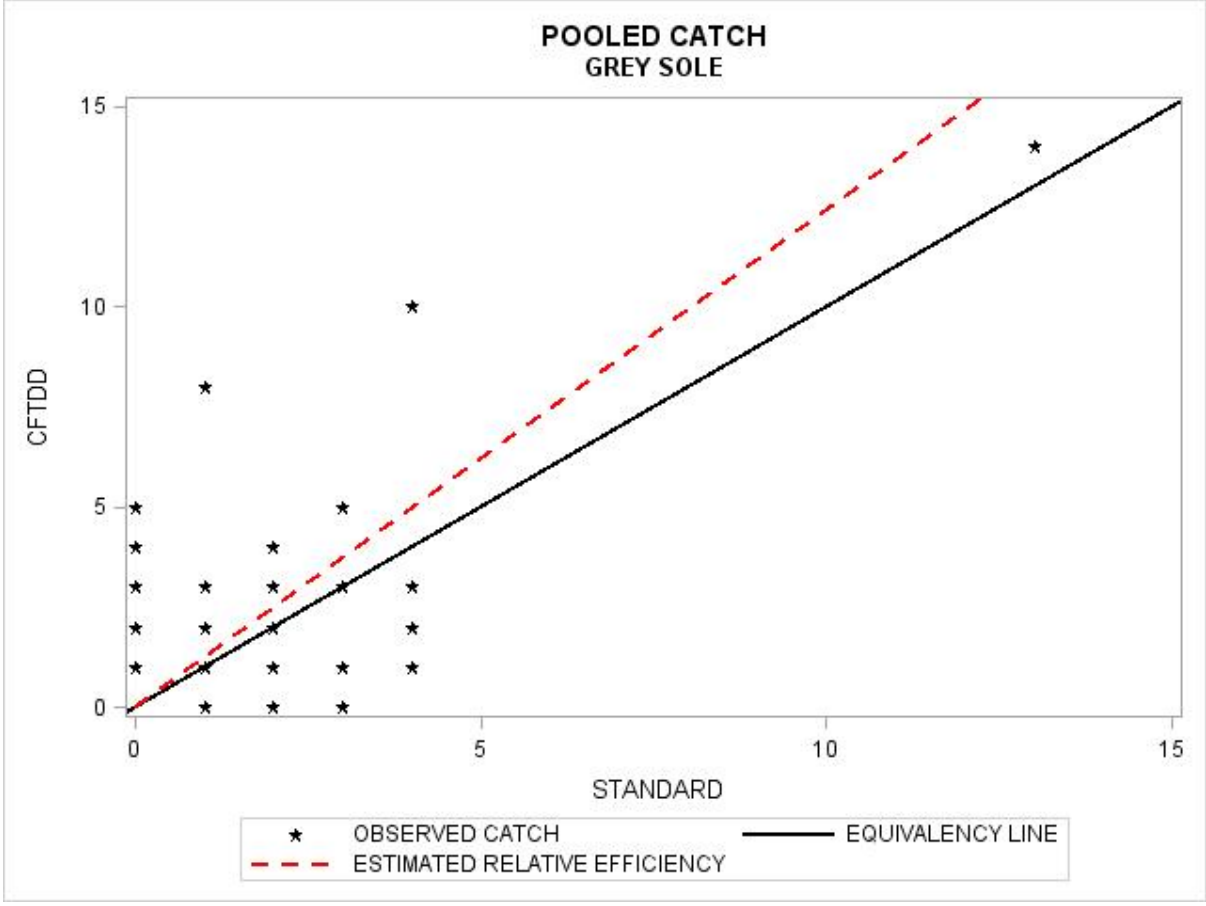


**Figure 51:** Total pooled catches for winter flounder for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

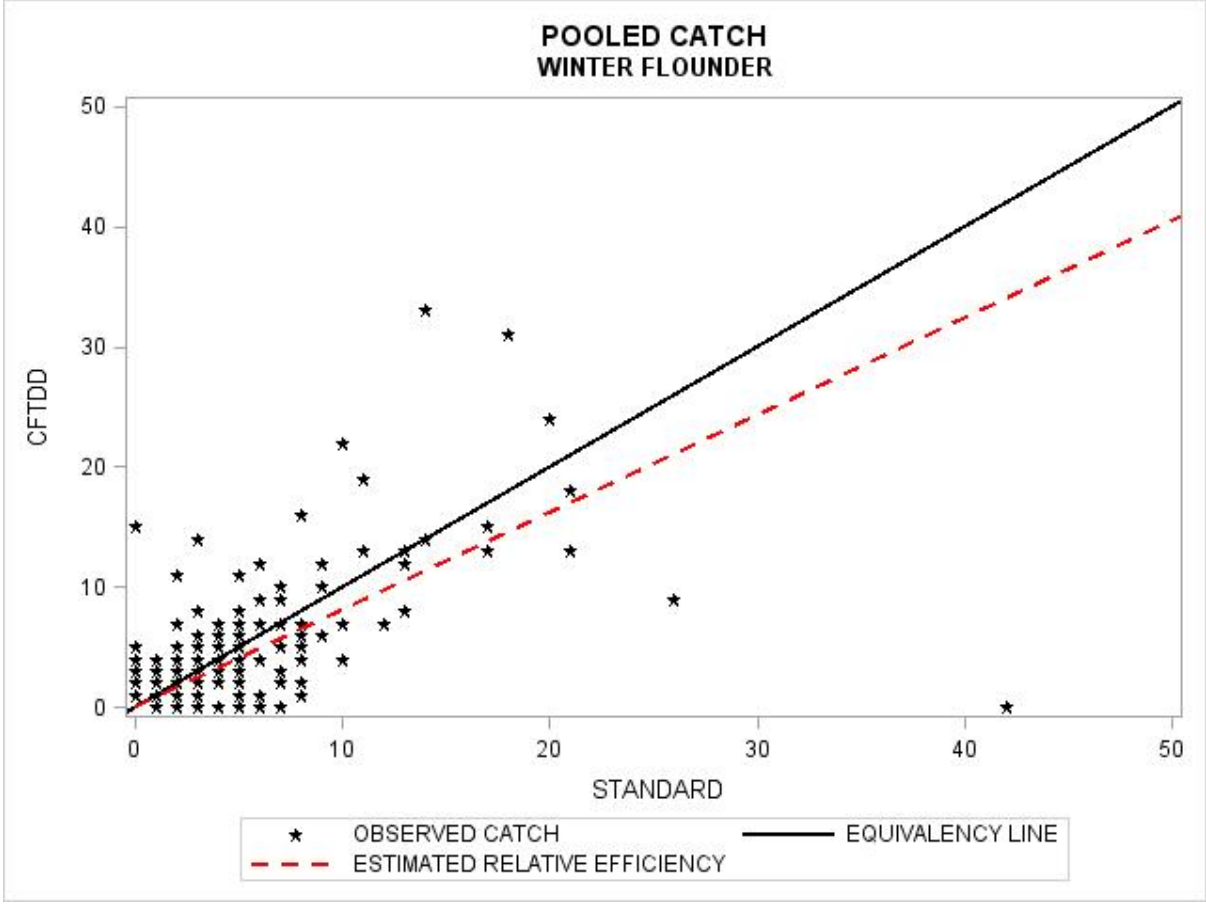


**Figure 52:** Total pooled catches for yellowtail flounder for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

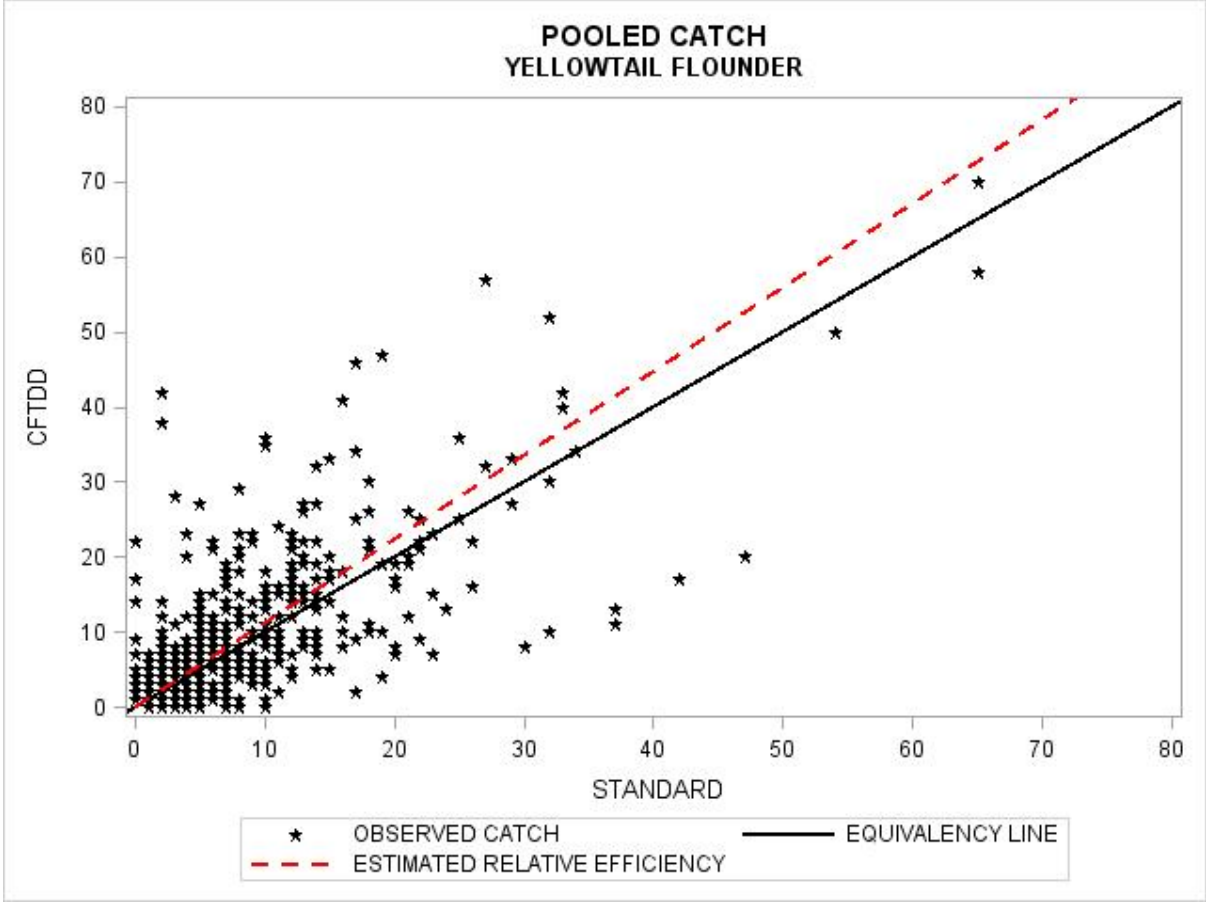


**Figure 53:** Total pooled catches for fourspot flounder for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

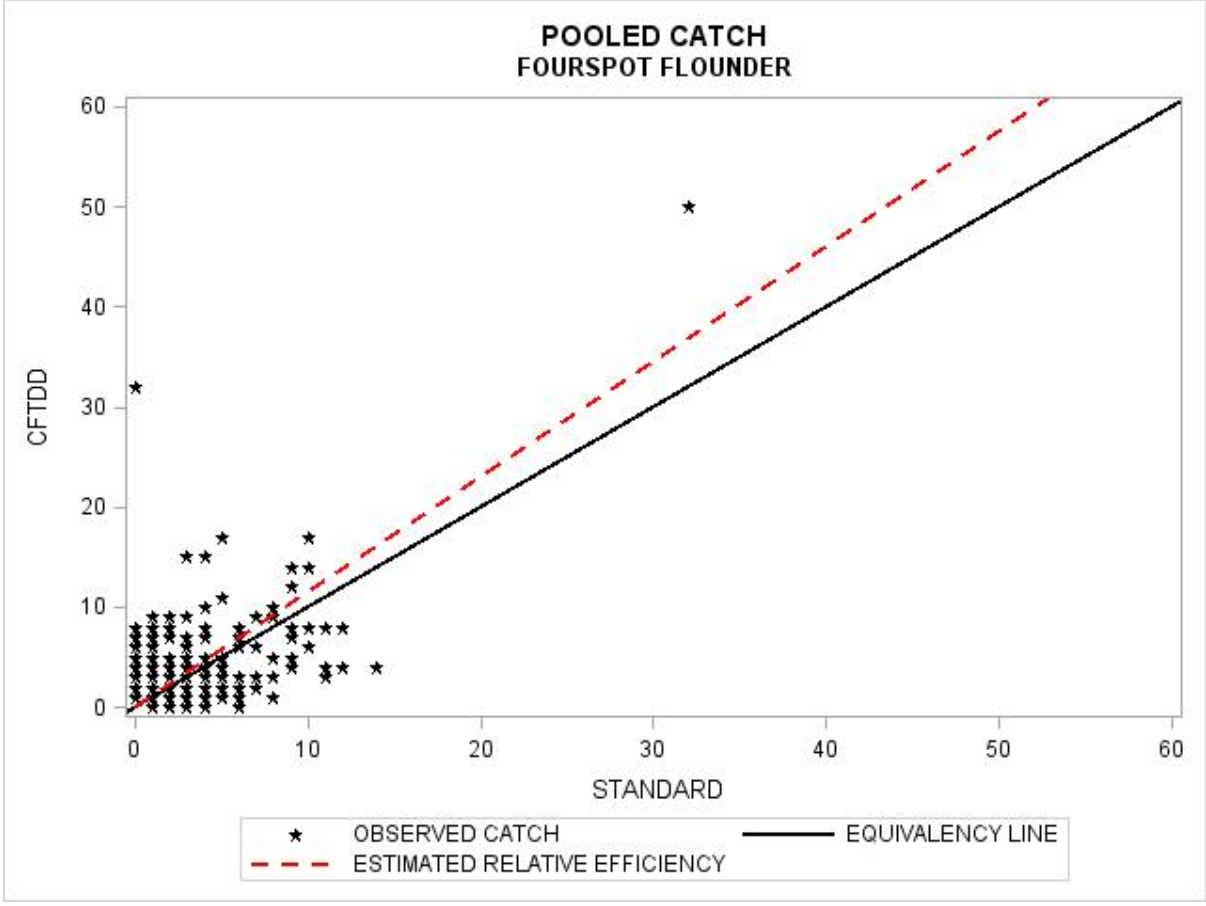


**Figure 54:** Total pooled catches for summer flounder for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

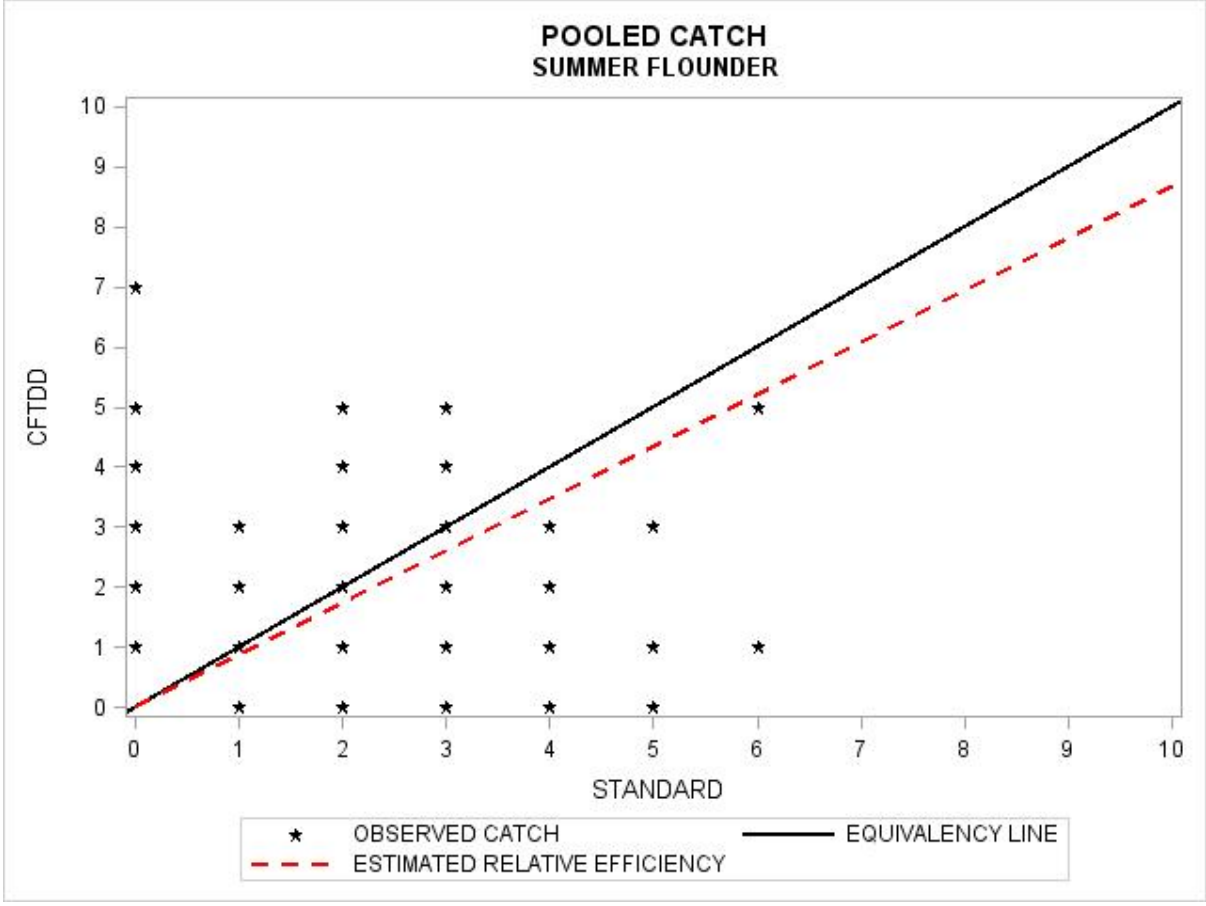


**Figure 55:** Total pooled catches for American plaice for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

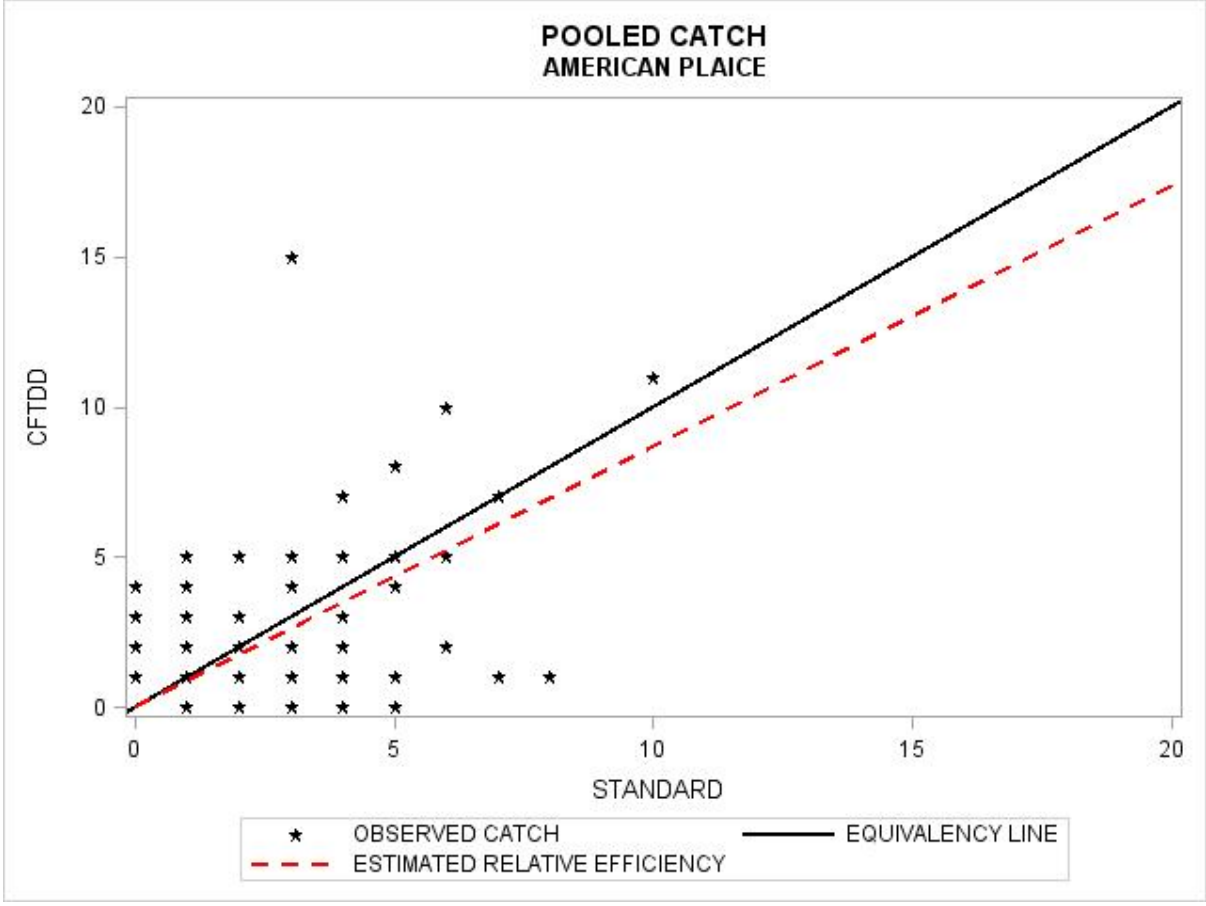


**Figure 56:** Total pooled catches for haddock for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

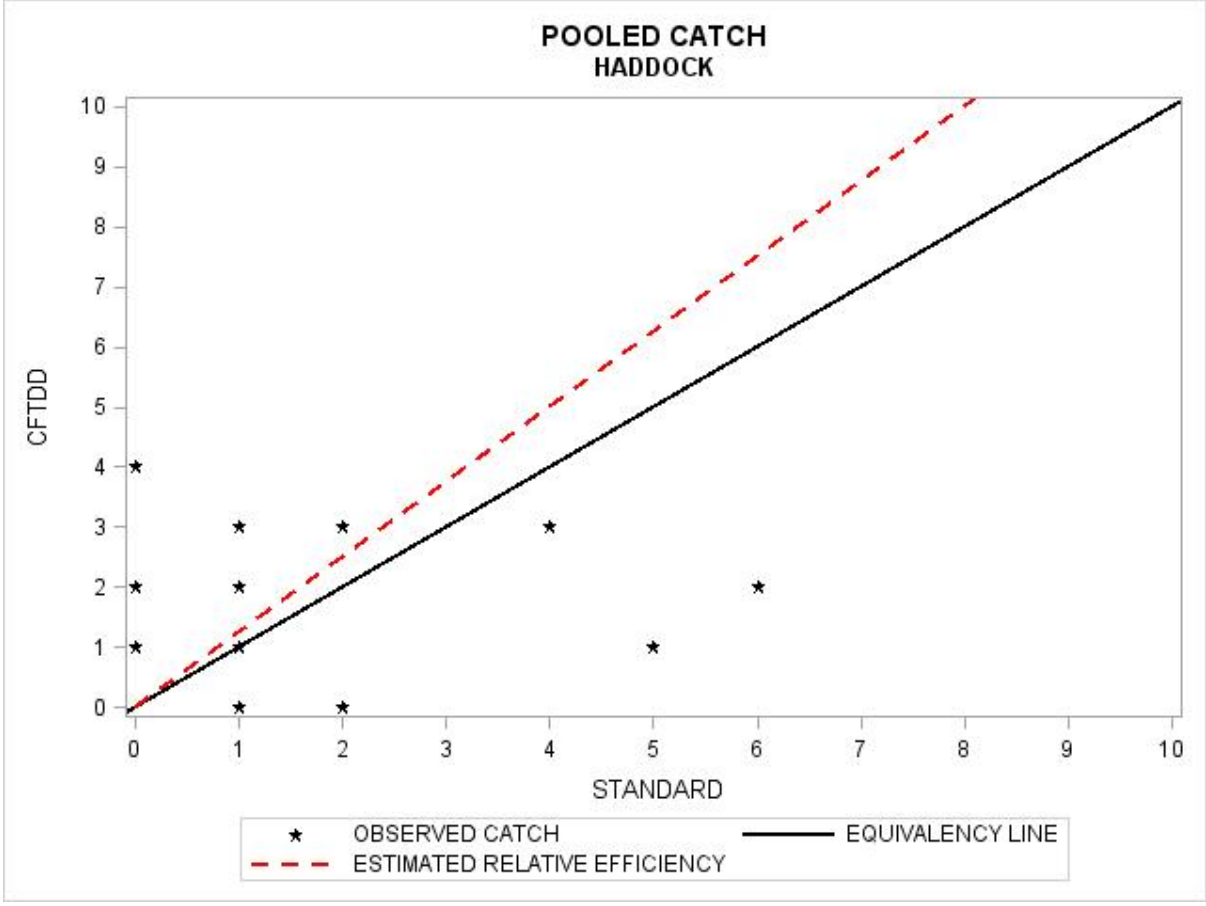


**Figure 57:** Total pooled catches for Atlantic Cod sea scallops for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

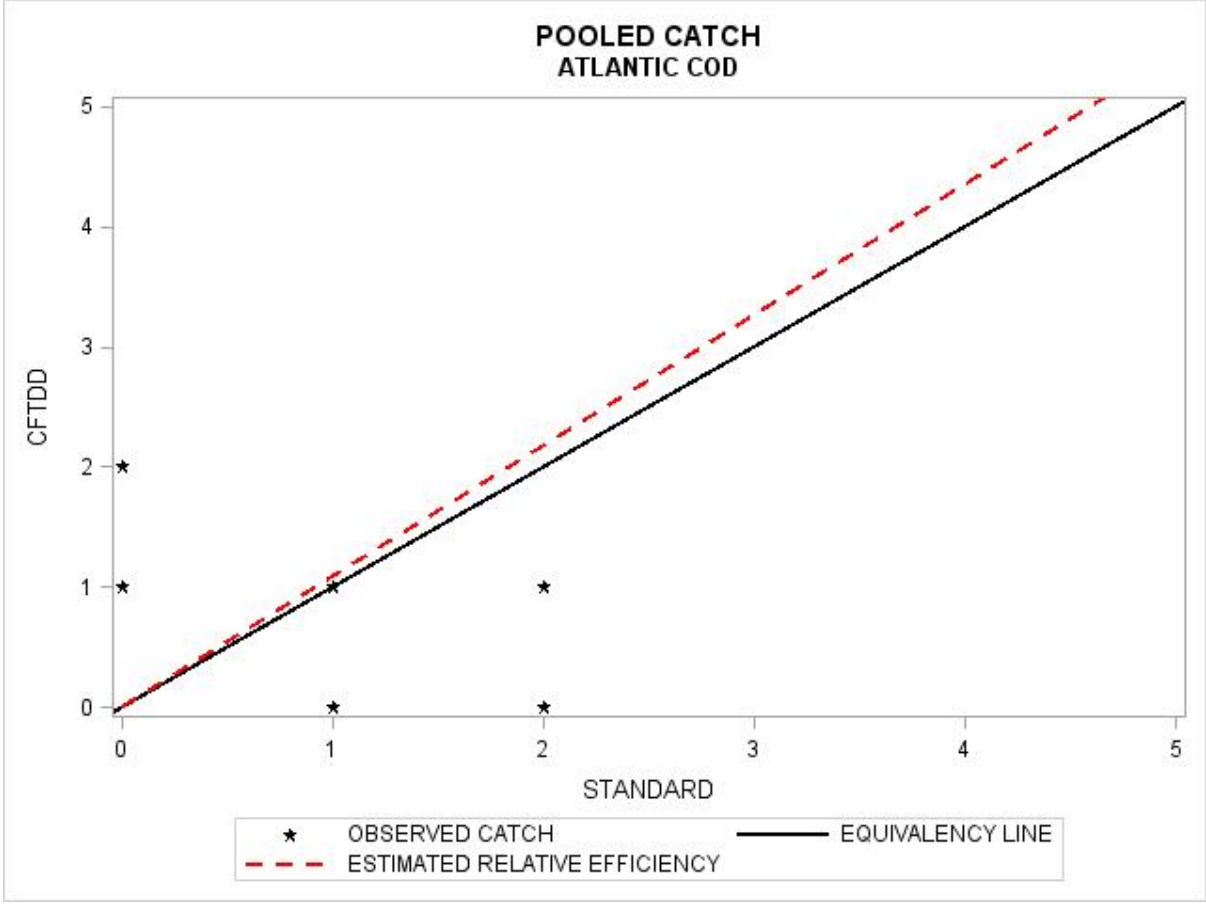


**Figure 58:** Total pooled catches for little skate for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

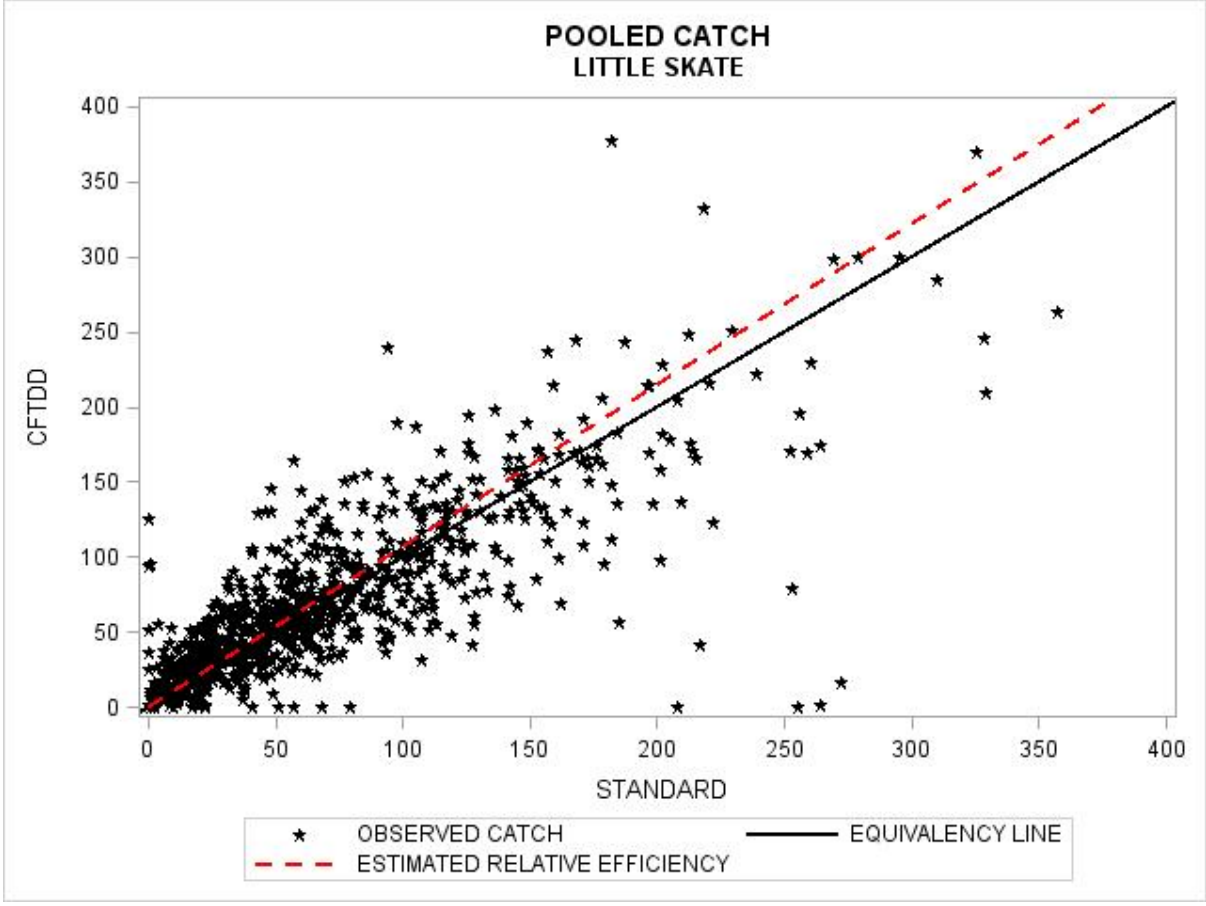


**Figure 59:** Total pooled catches for winter skate for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

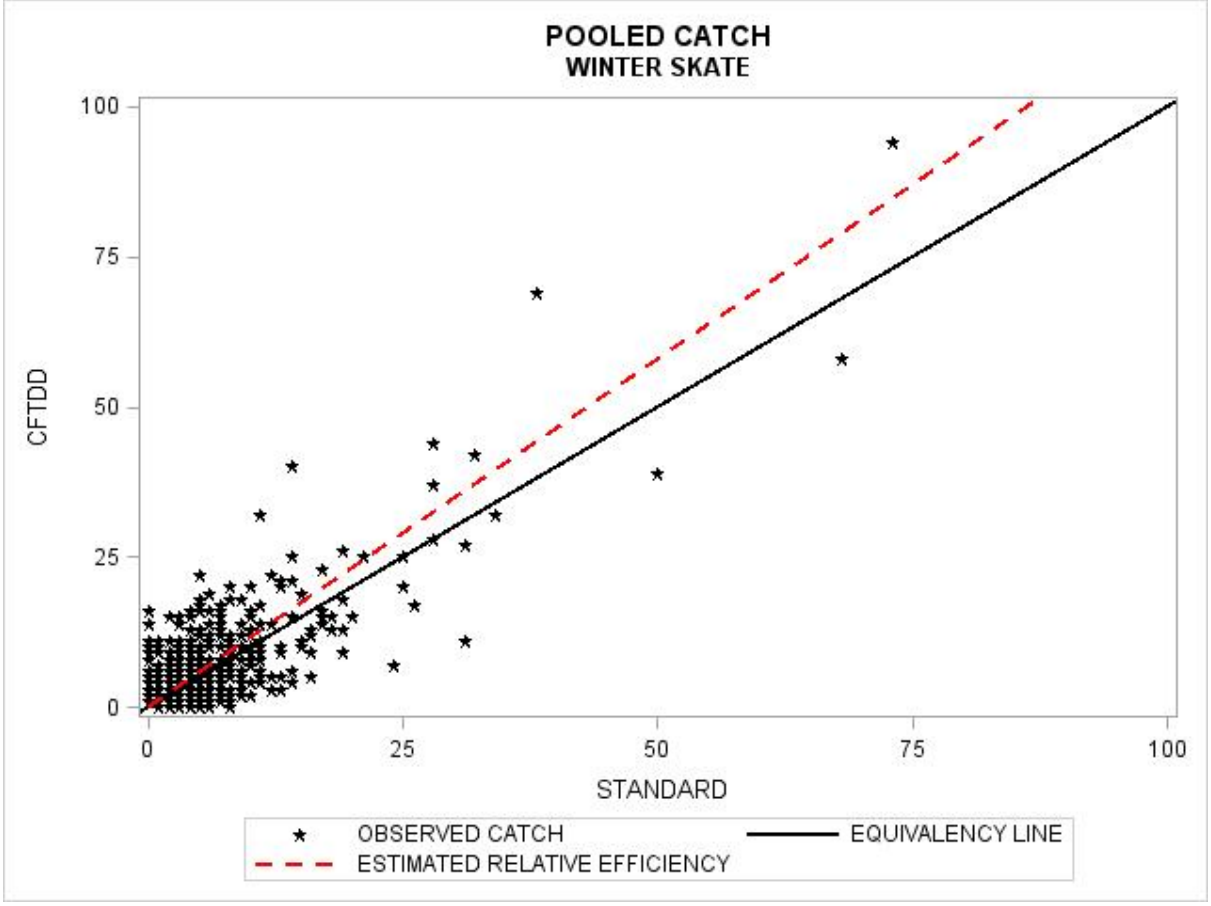


**Figure 60:** Total pooled catches for barndoor skate for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

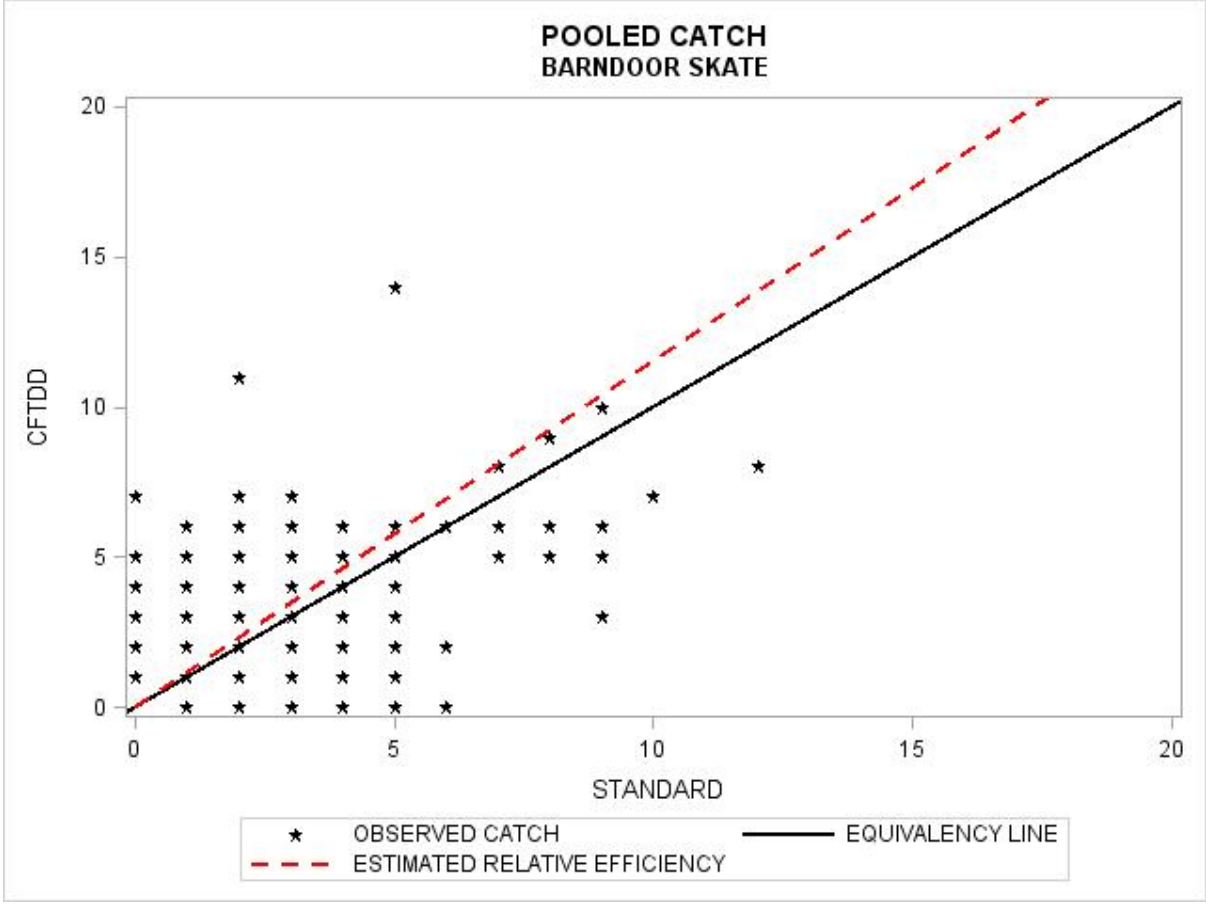


**Figure 61:** Total pooled catches for unclassified skates for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

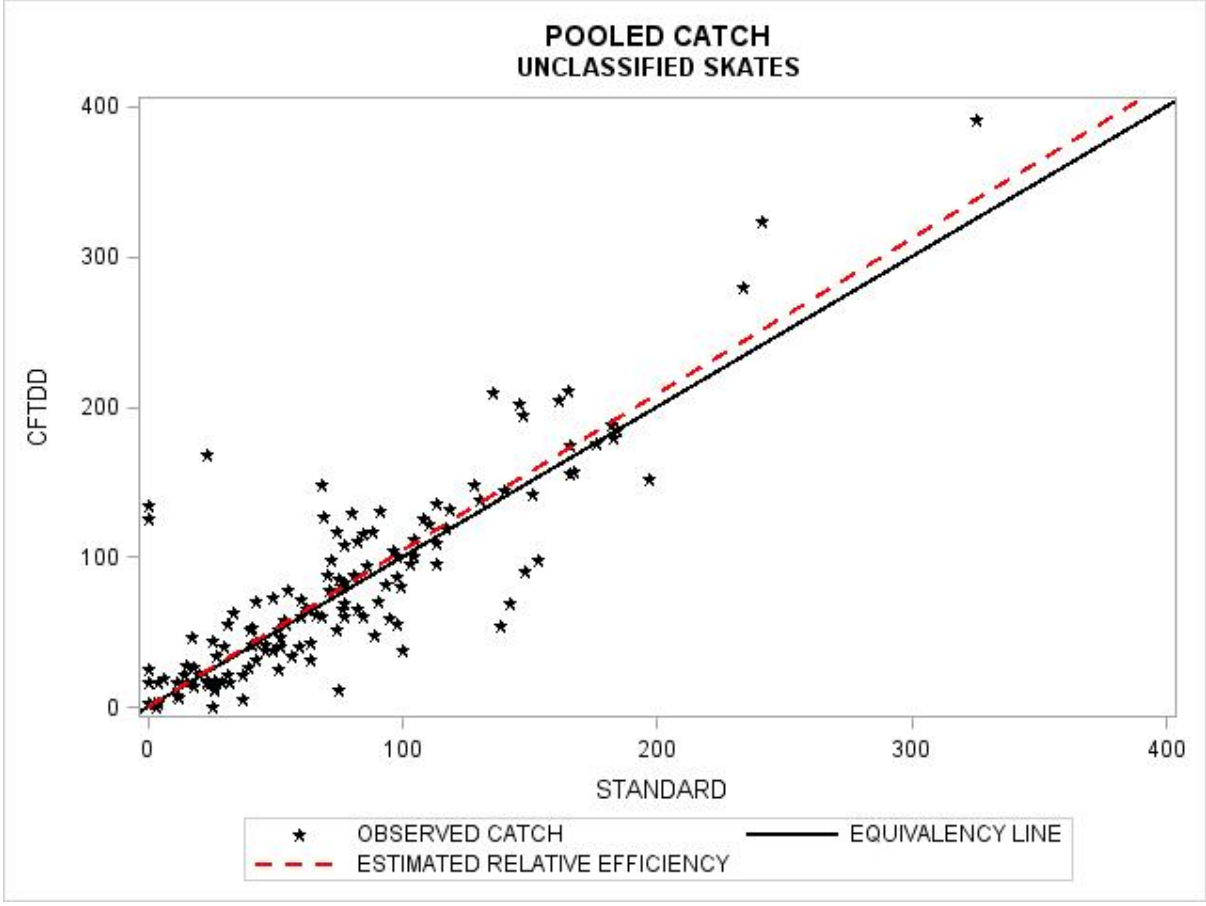


**Figure 62:** Total pooled catches for spiny dogfish for the CFTDD vs. standard new Bedford Style Sea Scallop Dredge encountered during all cruises. The black line has a slope of one. The dashed line has a slope equal to the estimated relative efficiency (from the one parameter mixed effects model).

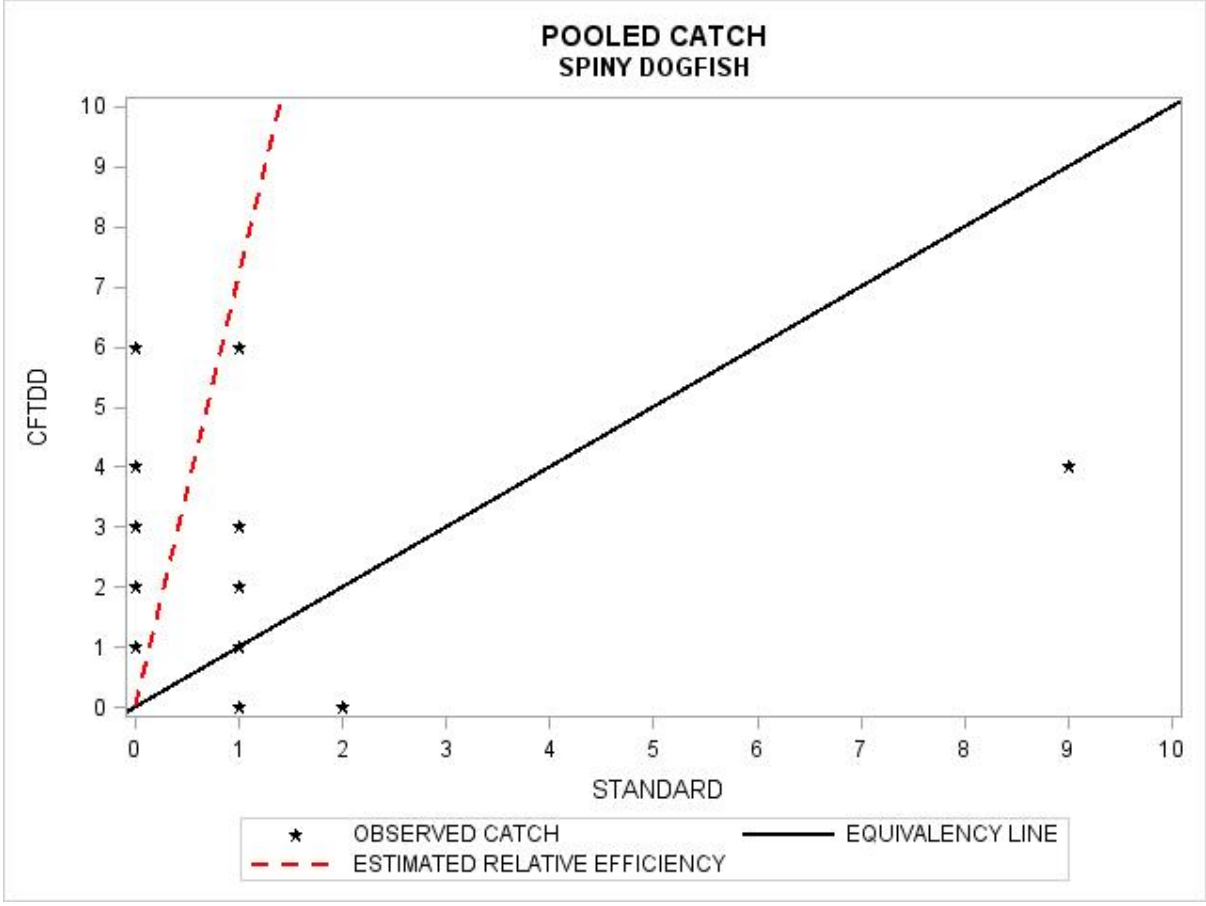


**Figure 63:** The proportion of scallops retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard}$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

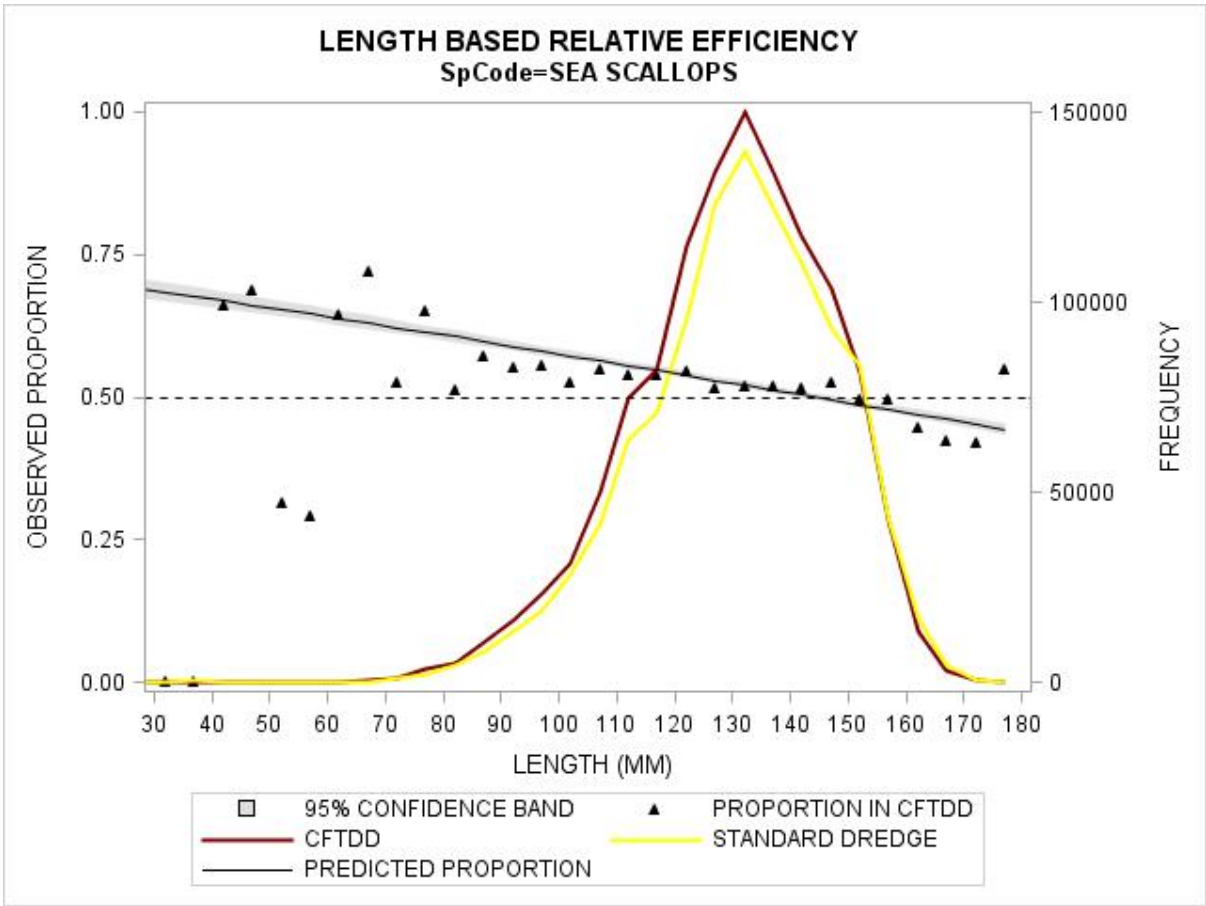


**Figure 64:** The proportion of monkfish retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard}$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

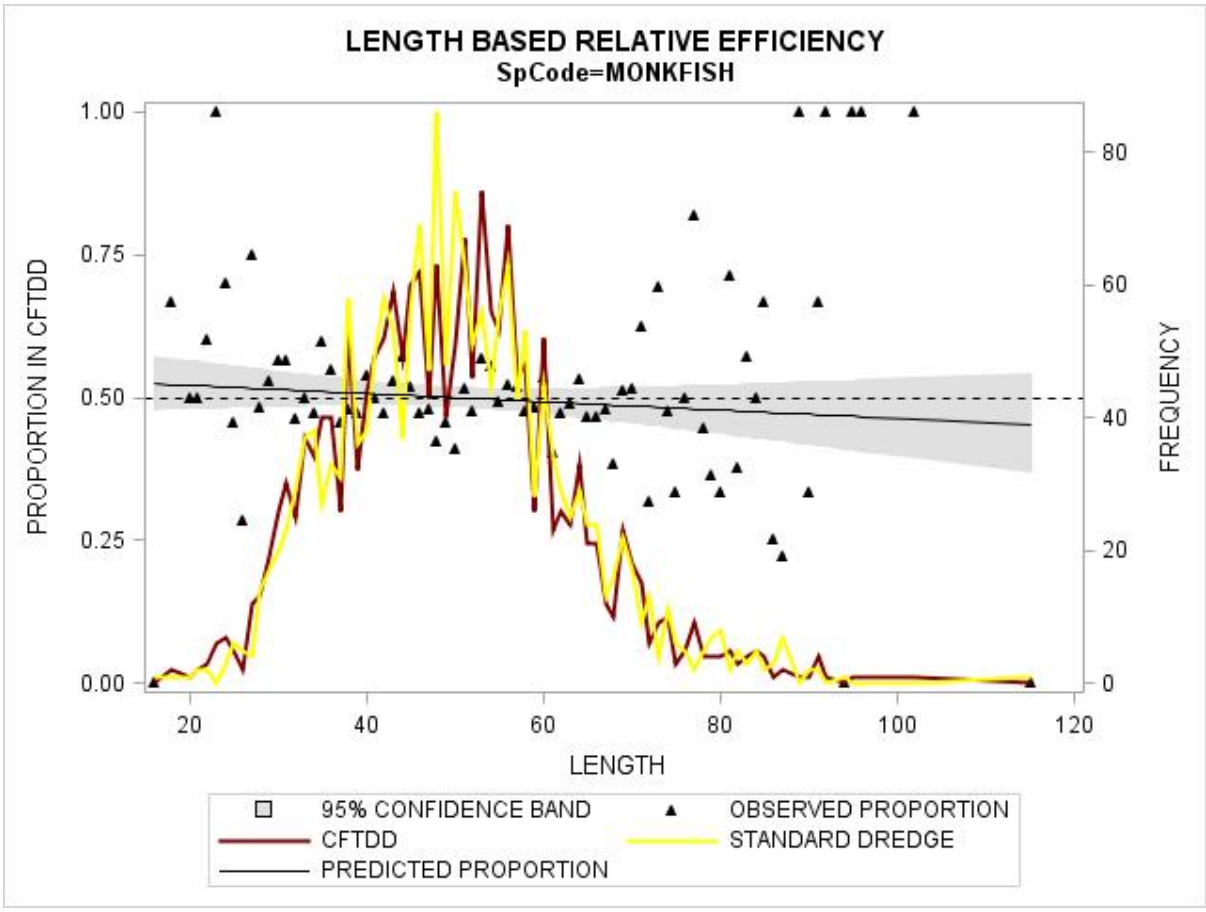


**Figure 65:** The proportion of Atlantic cod retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard}$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

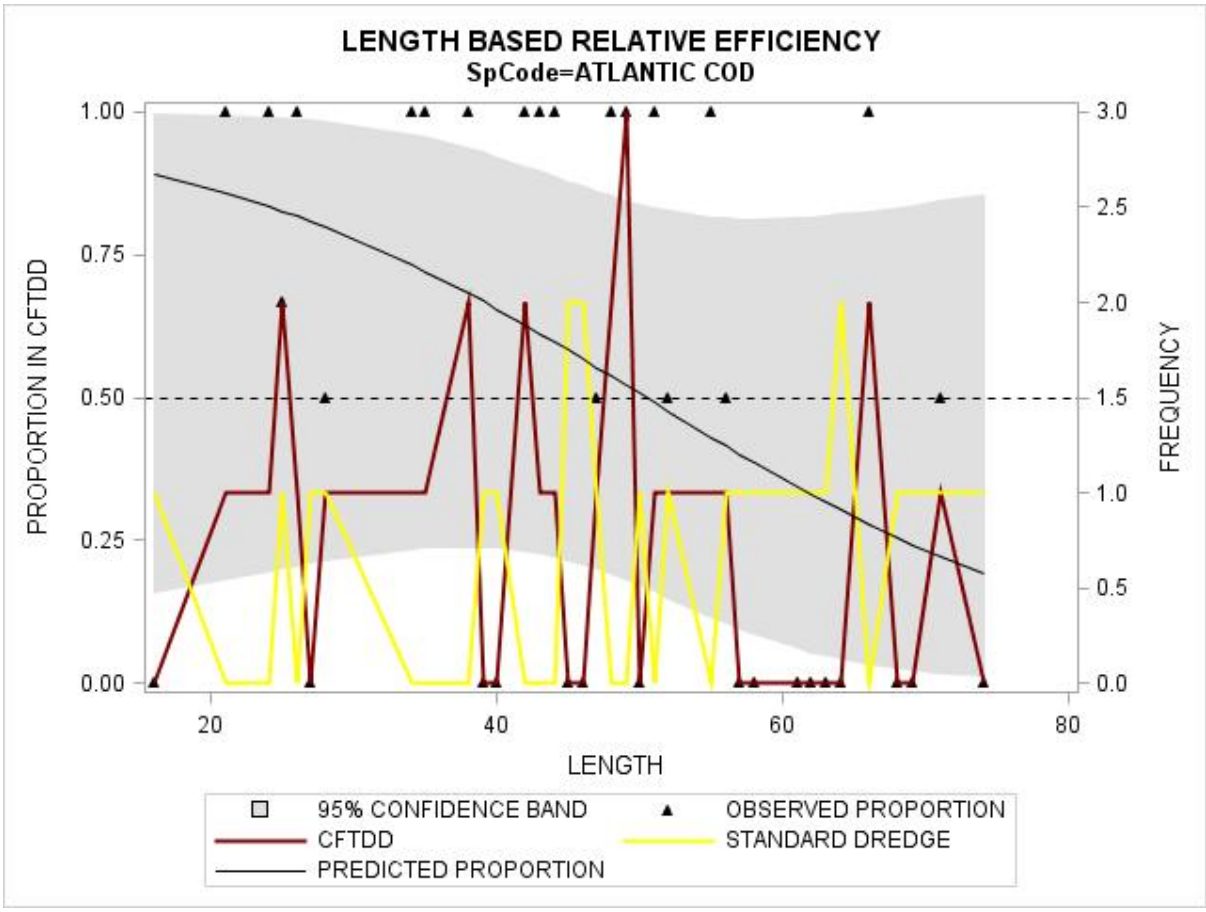


**Figure 66:** The proportion of haddock retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard}$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

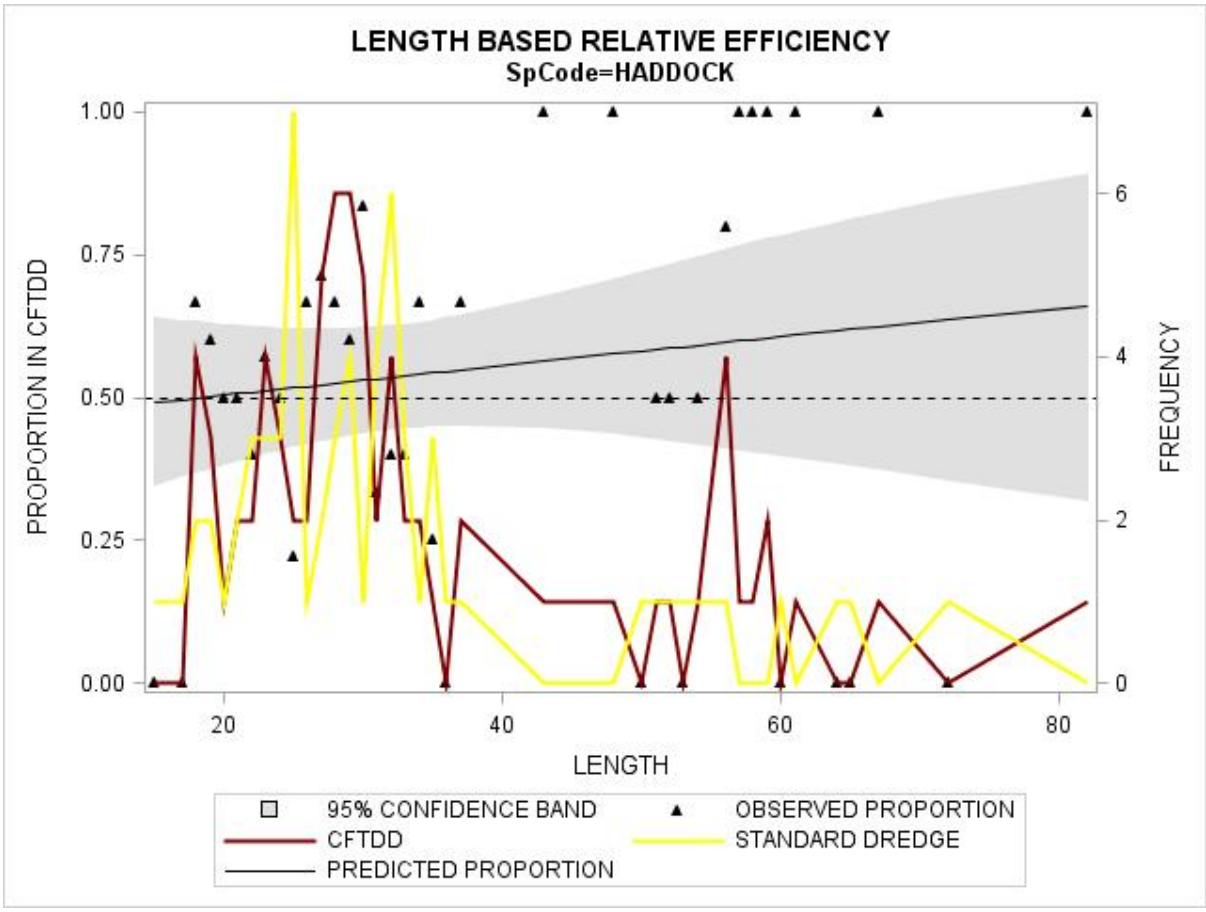


**Figure 67:** The proportion of American plaice retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

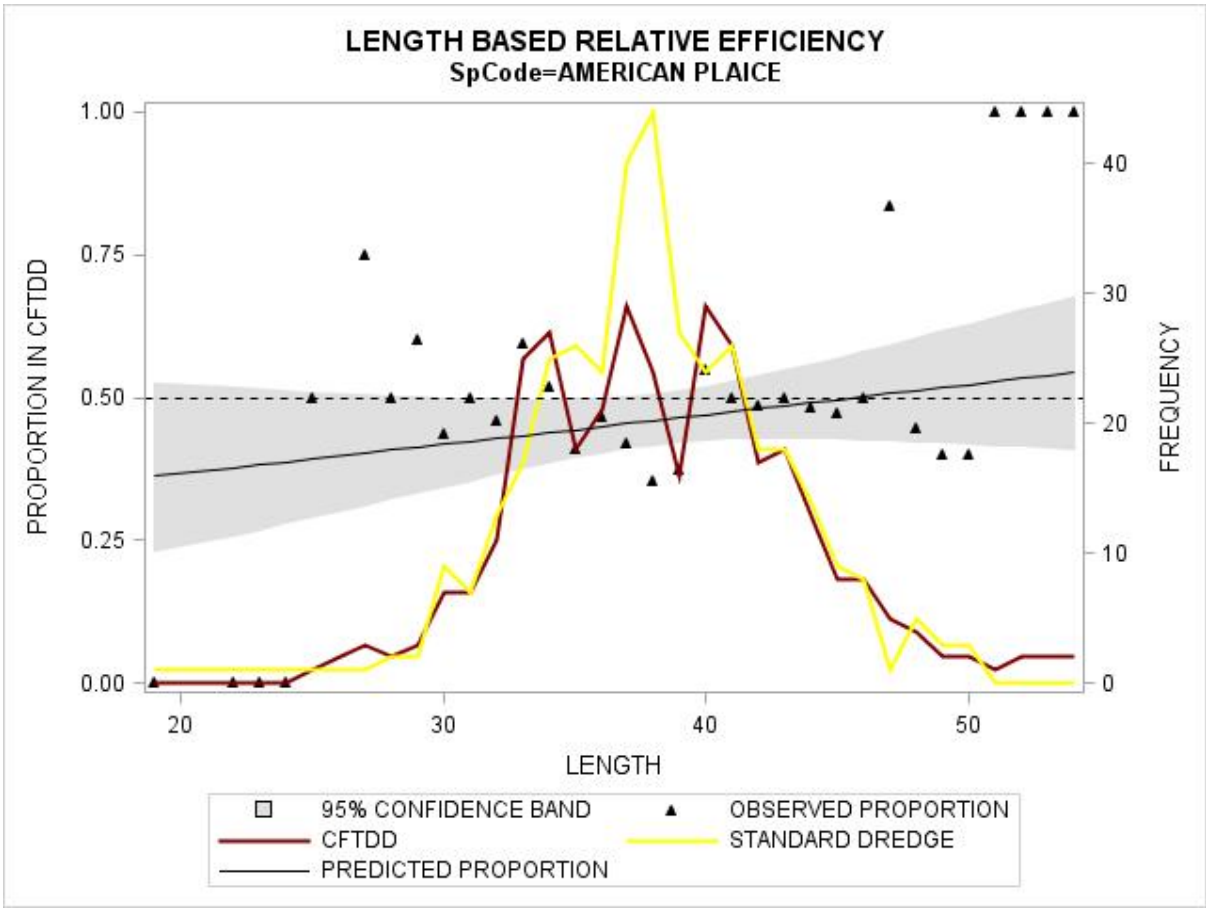


**Figure 68:** The proportion of summer flounder retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$. The grey area represents the 95% confidence band for the modeled proportion (solid black line).

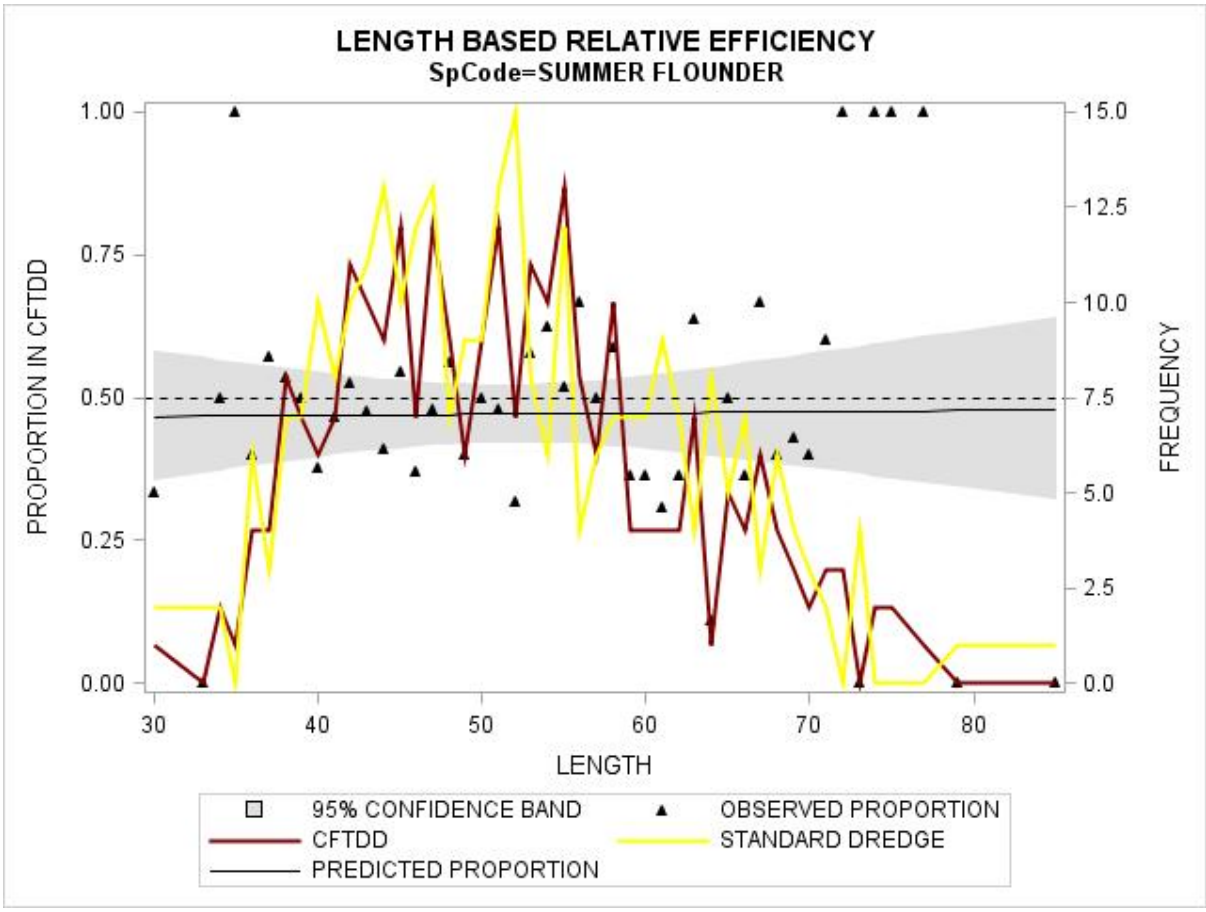


**Figure 69:** The proportion of fourspot flounder retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$. The grey area represents the 95% confidence band for the modeled proportion (solid black line).

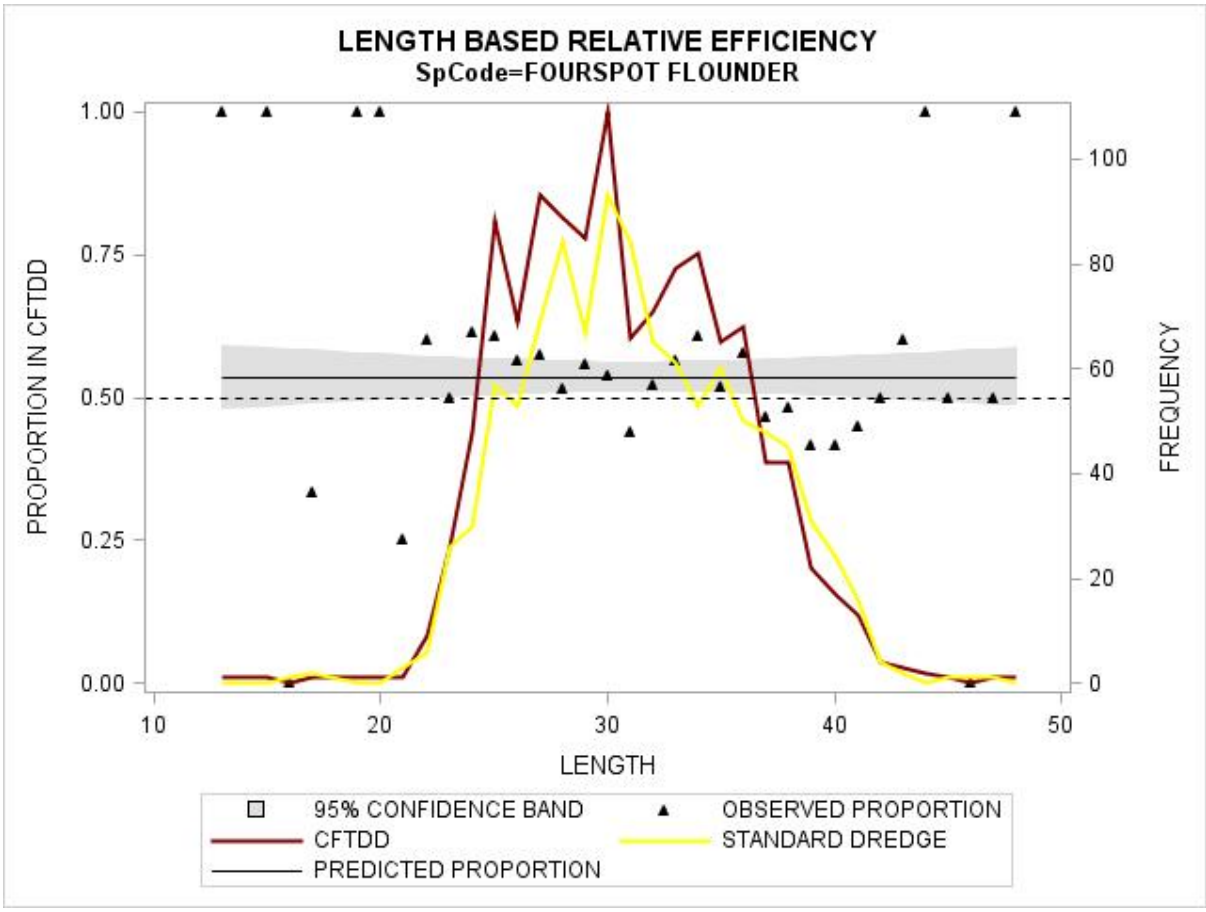


**Figure 70:** The proportion of yellowtail flounder retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$. The grey area represents the 95% confidence band for the modeled proportion (solid black line).

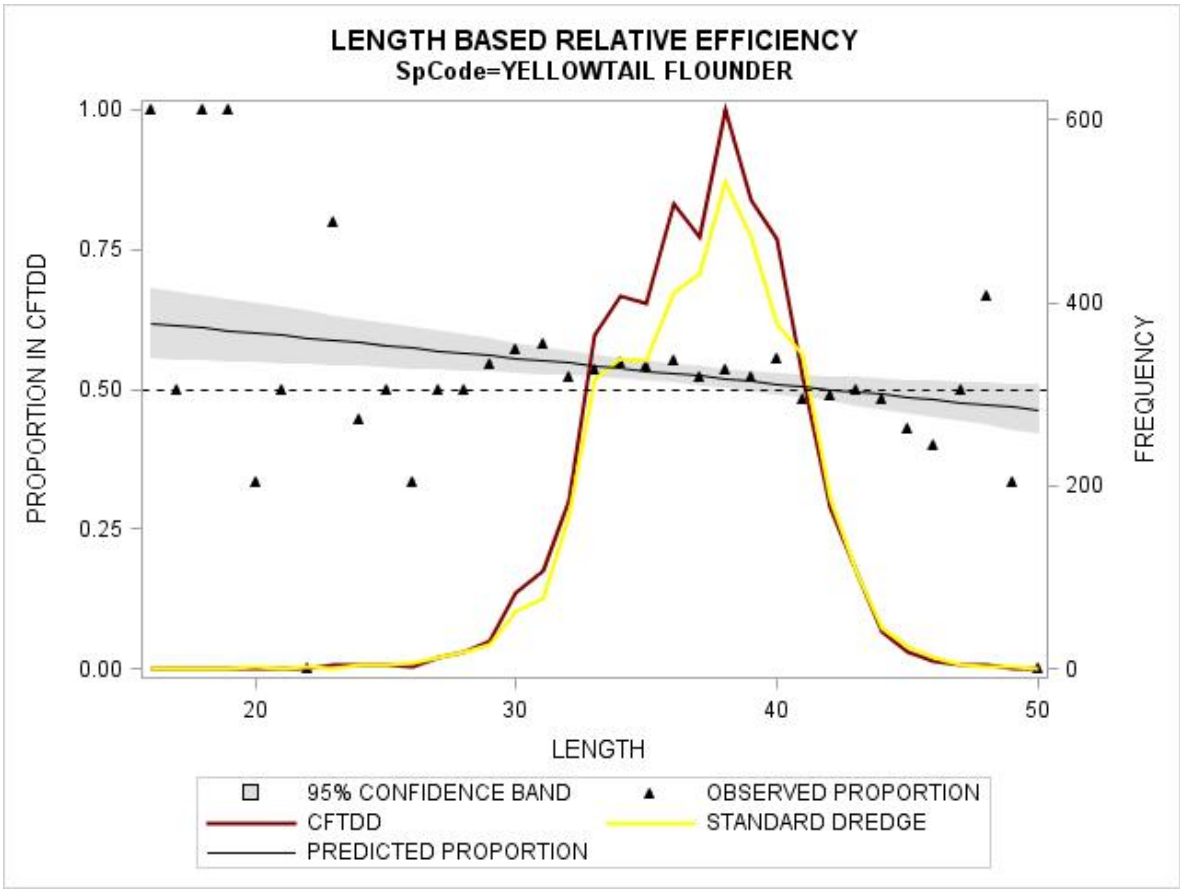


**Figure 71:** The proportion of winter flounder retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$. The grey area represents the 95% confidence band for the modeled proportion (solid black line).

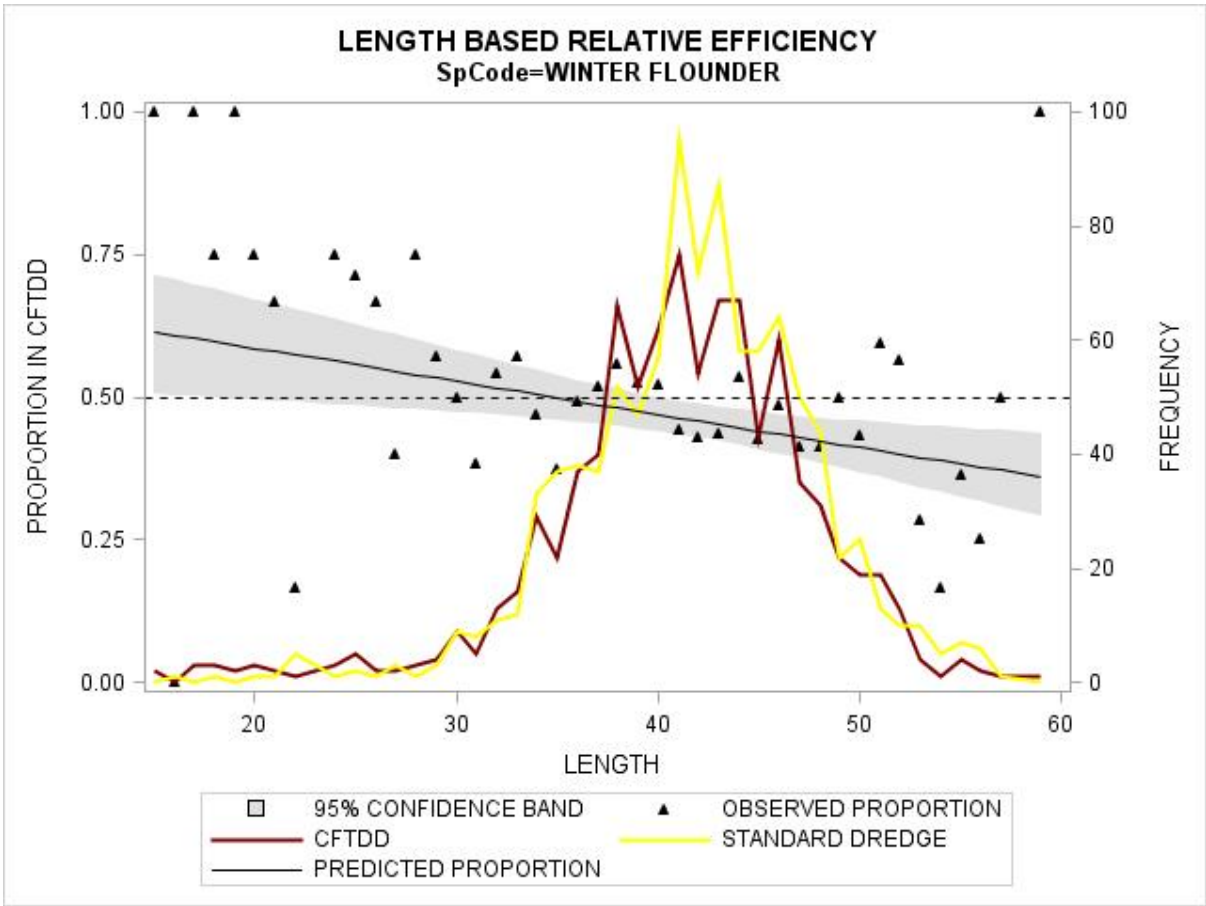


**Figure 72:** The proportion of grey sole retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard}$). The grey area represents the 95% confidence band for the modeled proportion (solid black line).

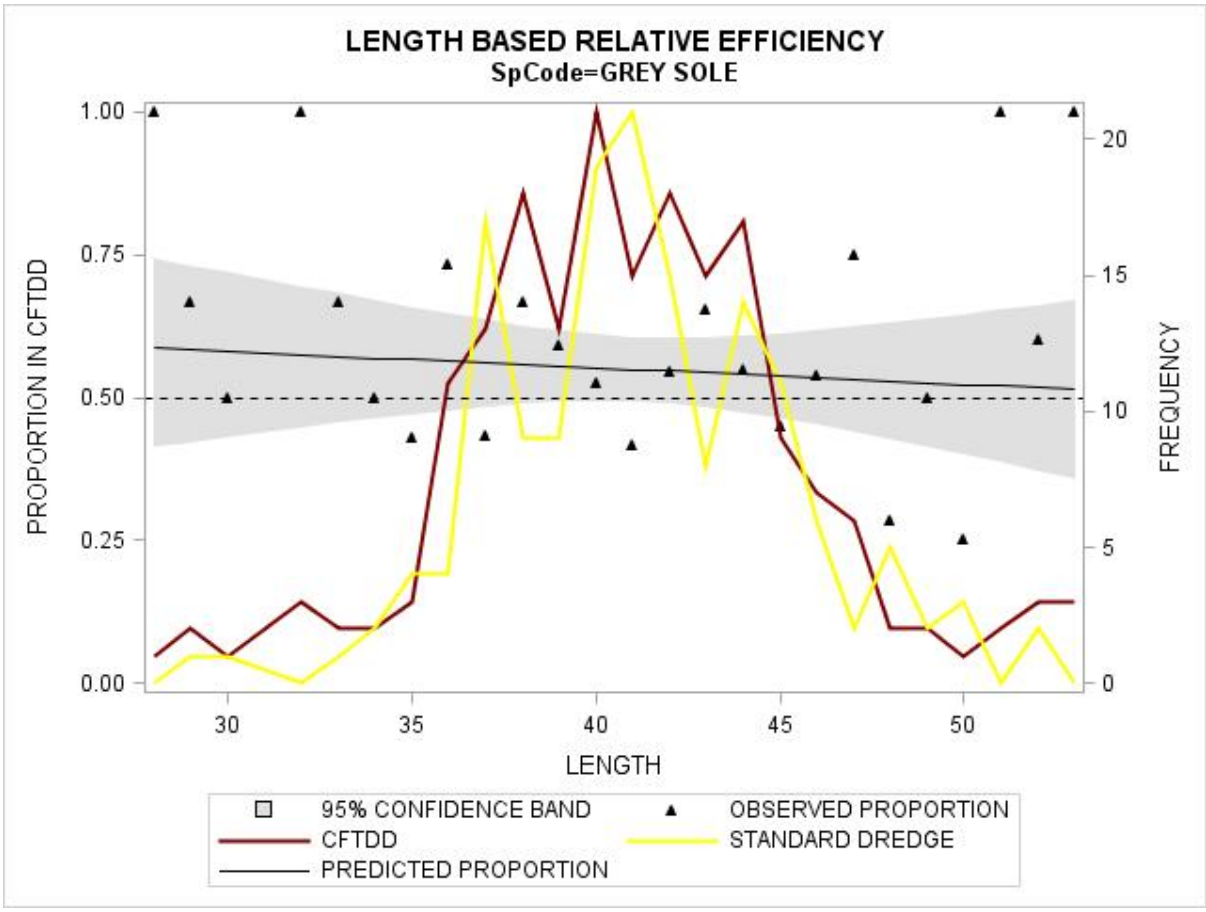
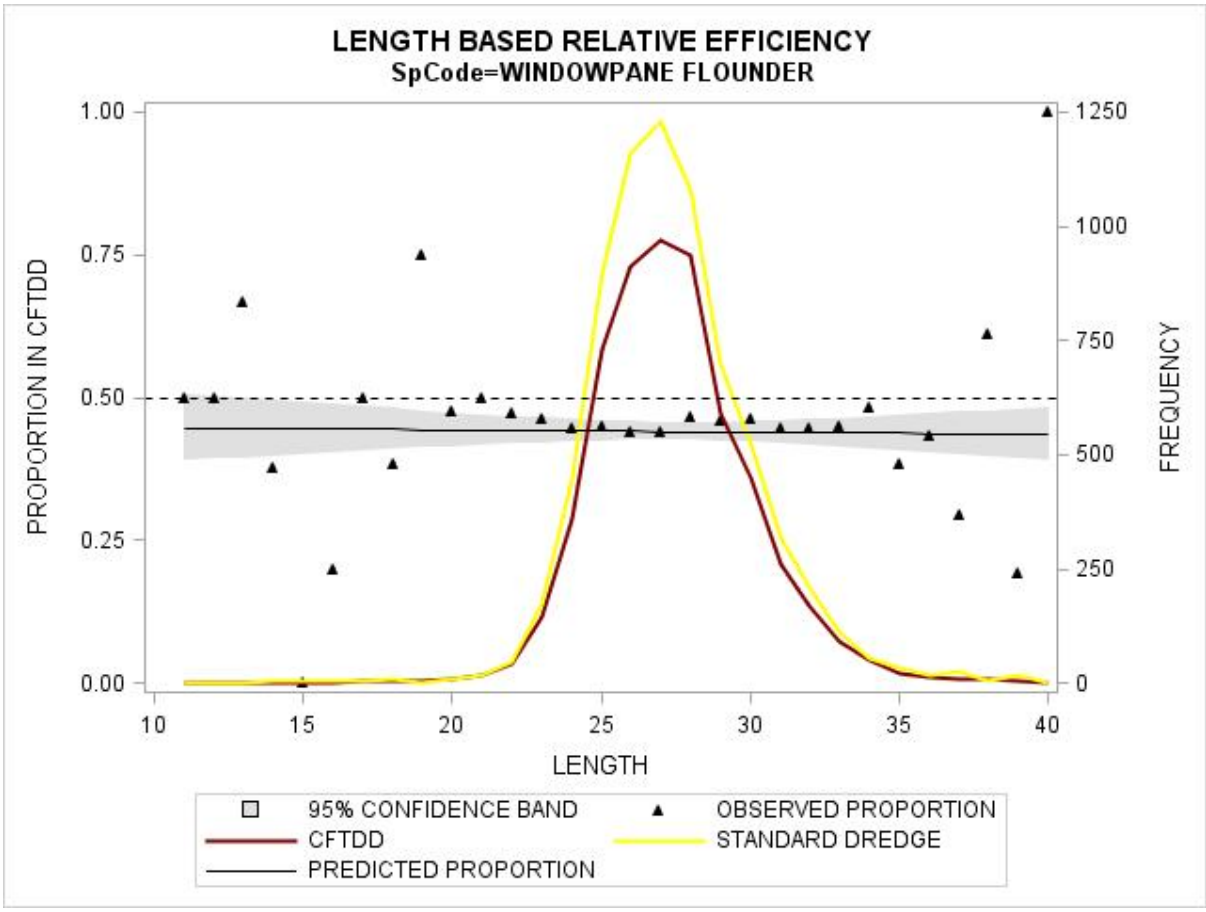
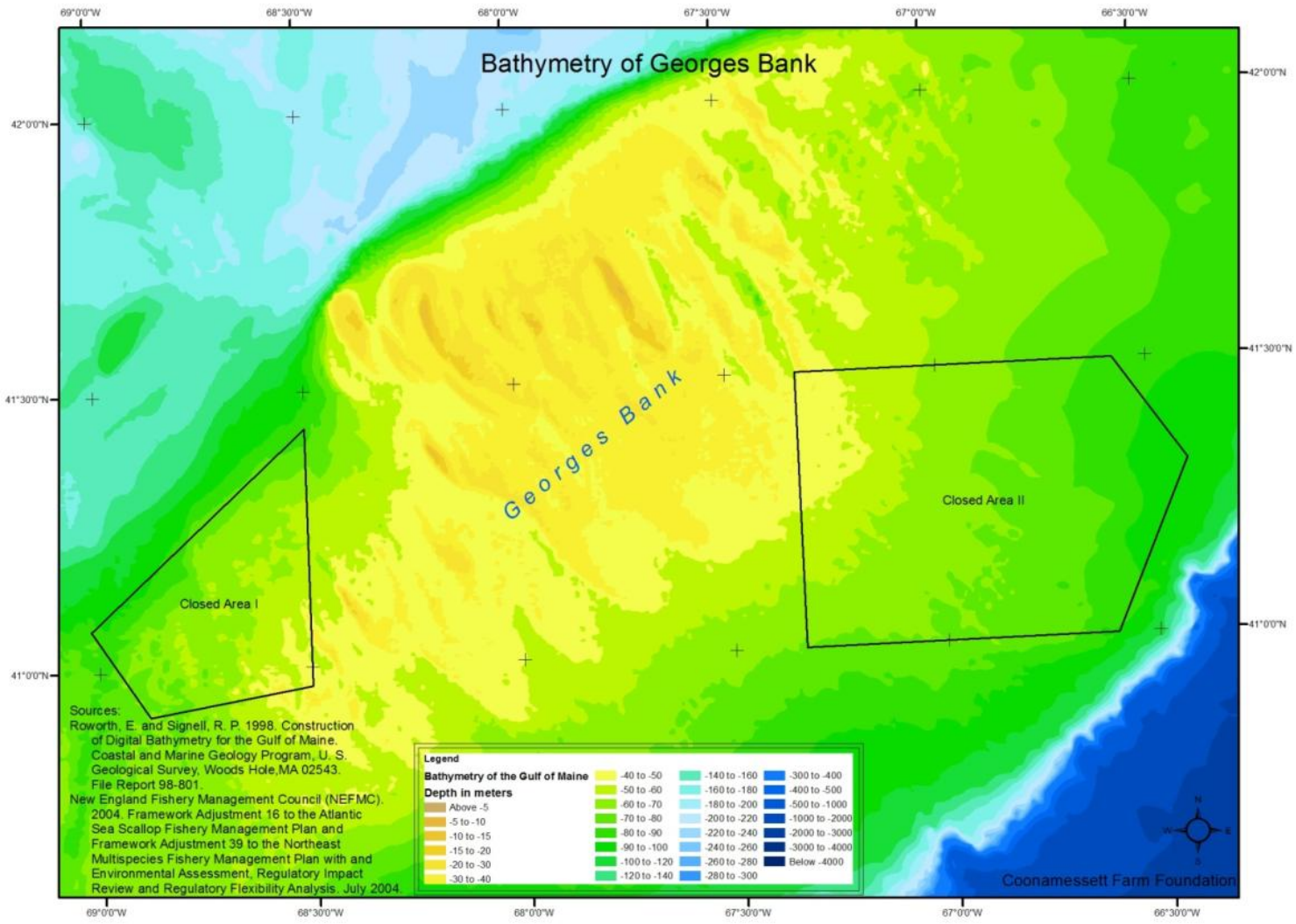


**Figure 73:** The proportion of windowpane flounder retained by the two dredge designs tested during all bycatch survey cruises. A proportion >0.5 represents more animals at length were captured by the CFTDD. The triangles represent the observed proportion at length ($Catch_{CFTDD}/(Catch_{CFTDD} + Catch_{standard})$. The grey area represents the 95% confidence band for the modeled proportion (solid black line).

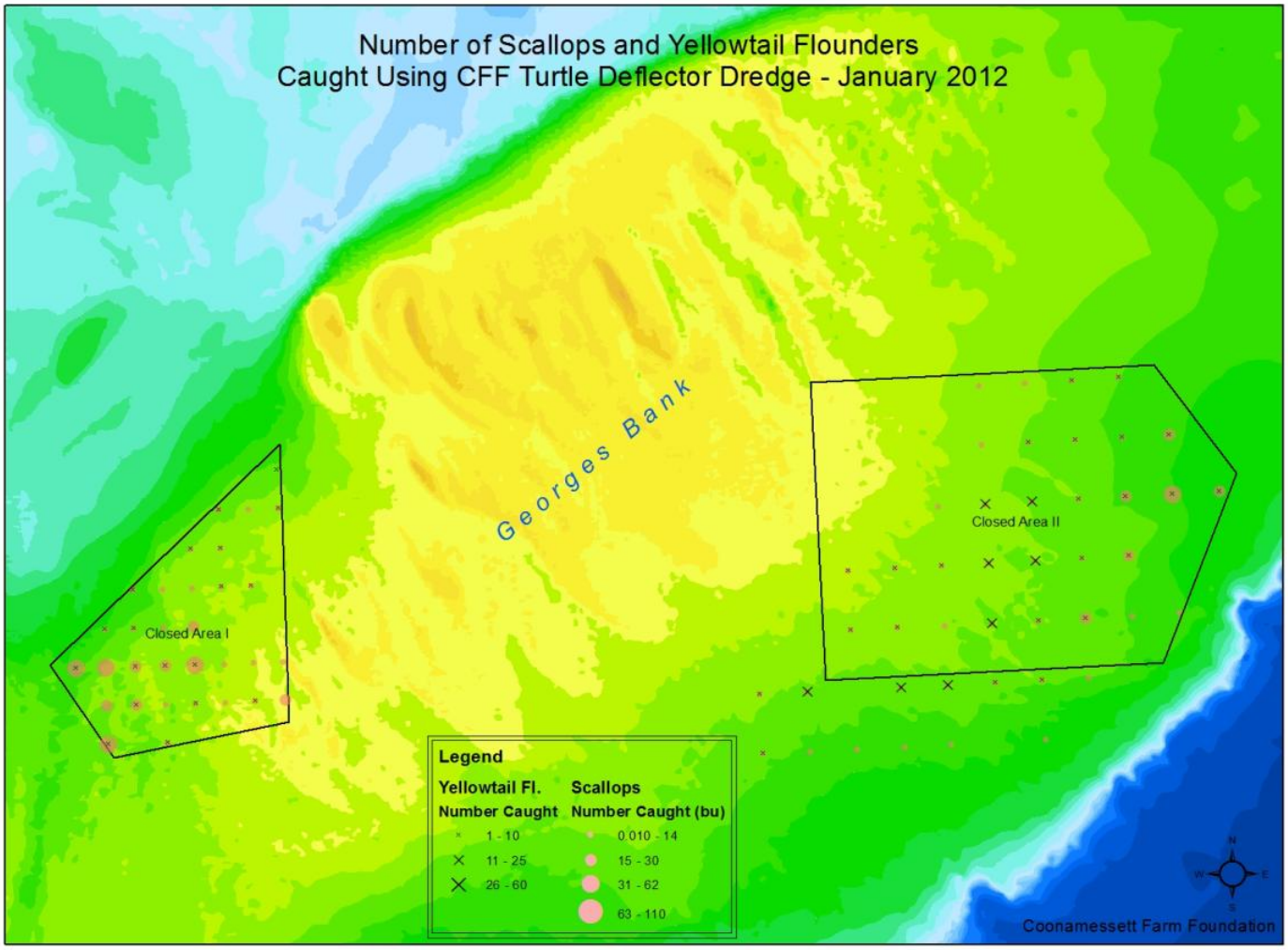


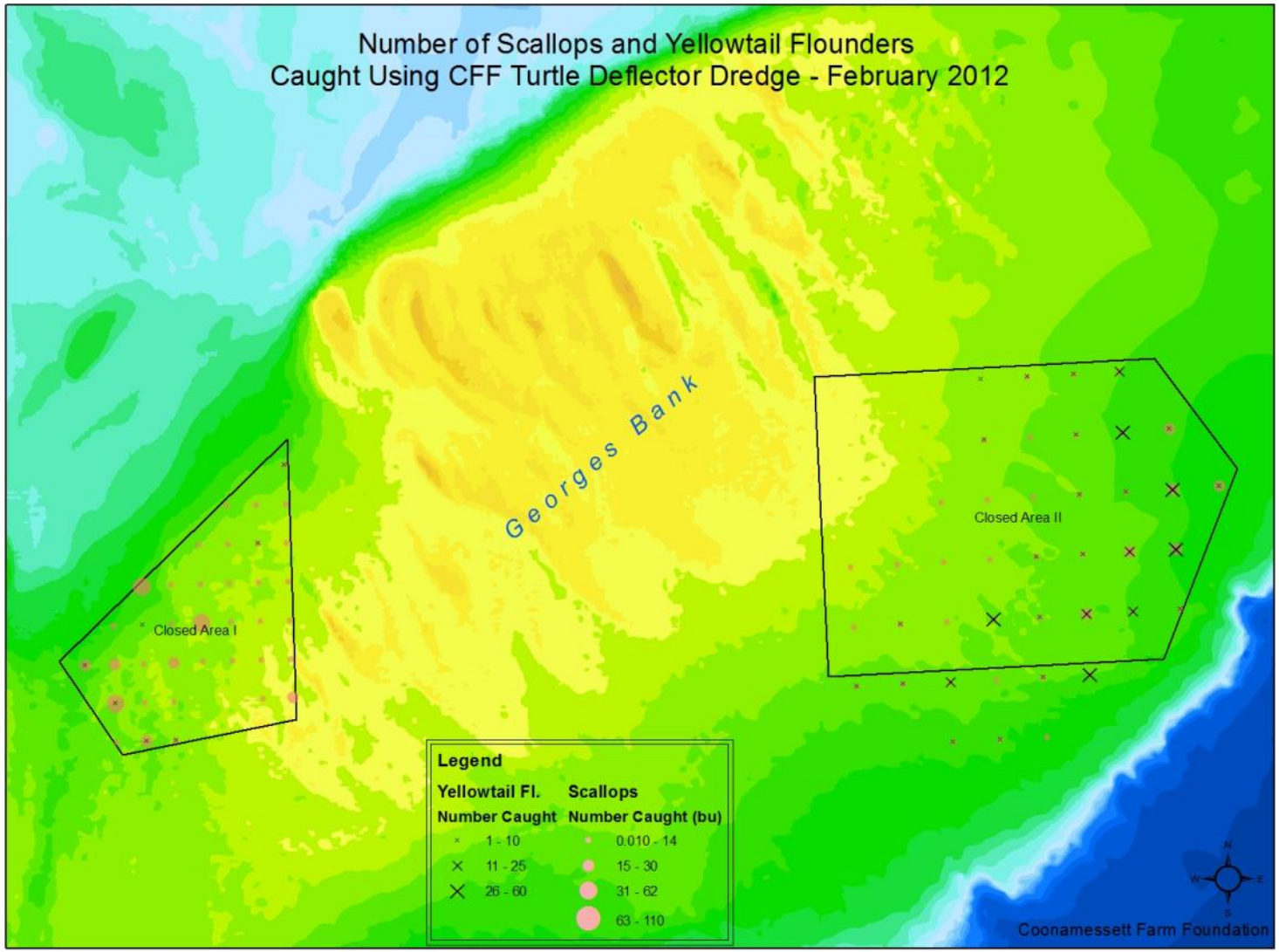
# Appendix A
# Scallop and By Catch Figures
# Caught Using CFTDD
# by Month

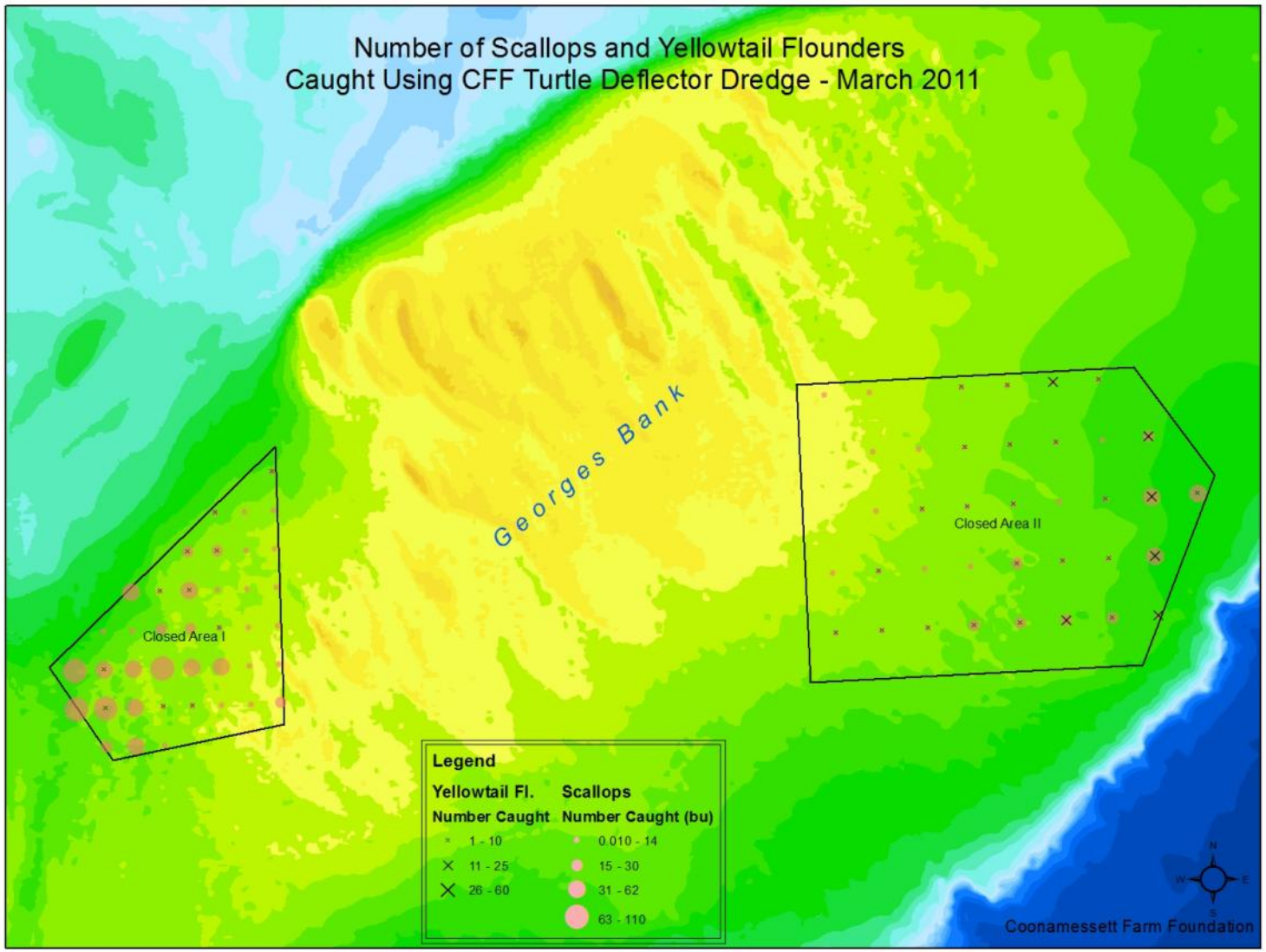


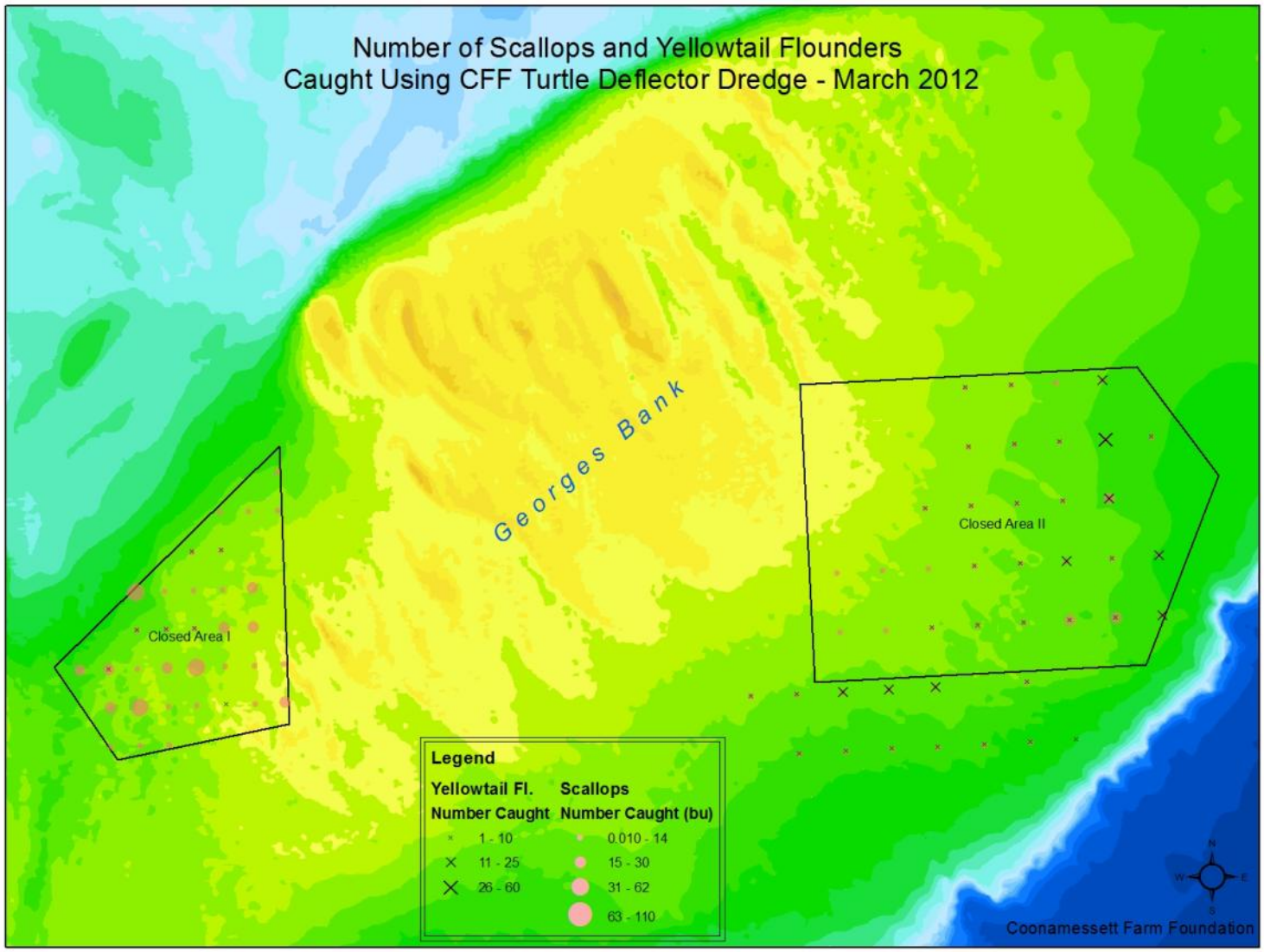

Note: The bathymetry legend, sources, and latitude and longitude information is not repeated on the following figures.

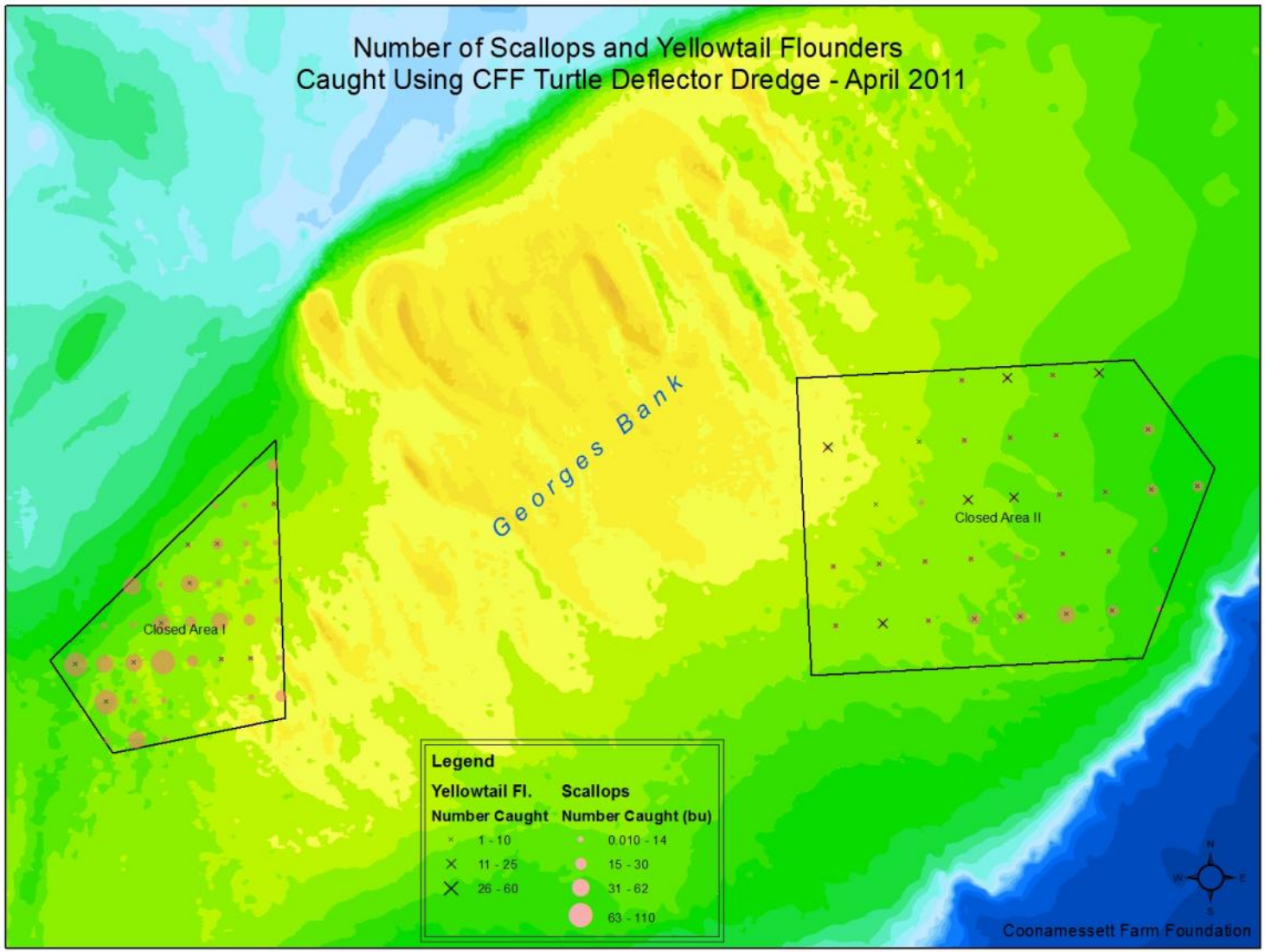
**Scallops and Yellowtail Flounder**

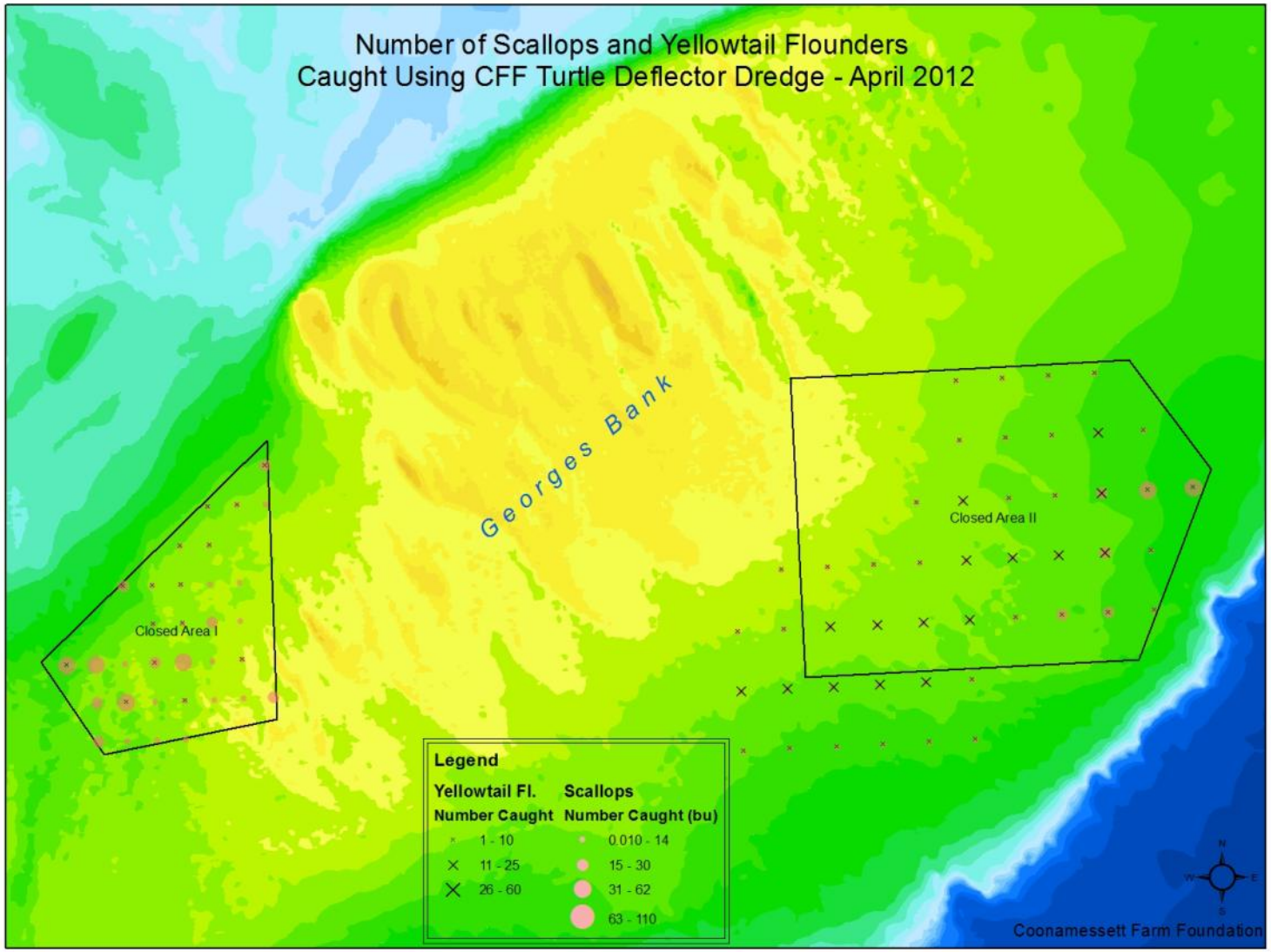


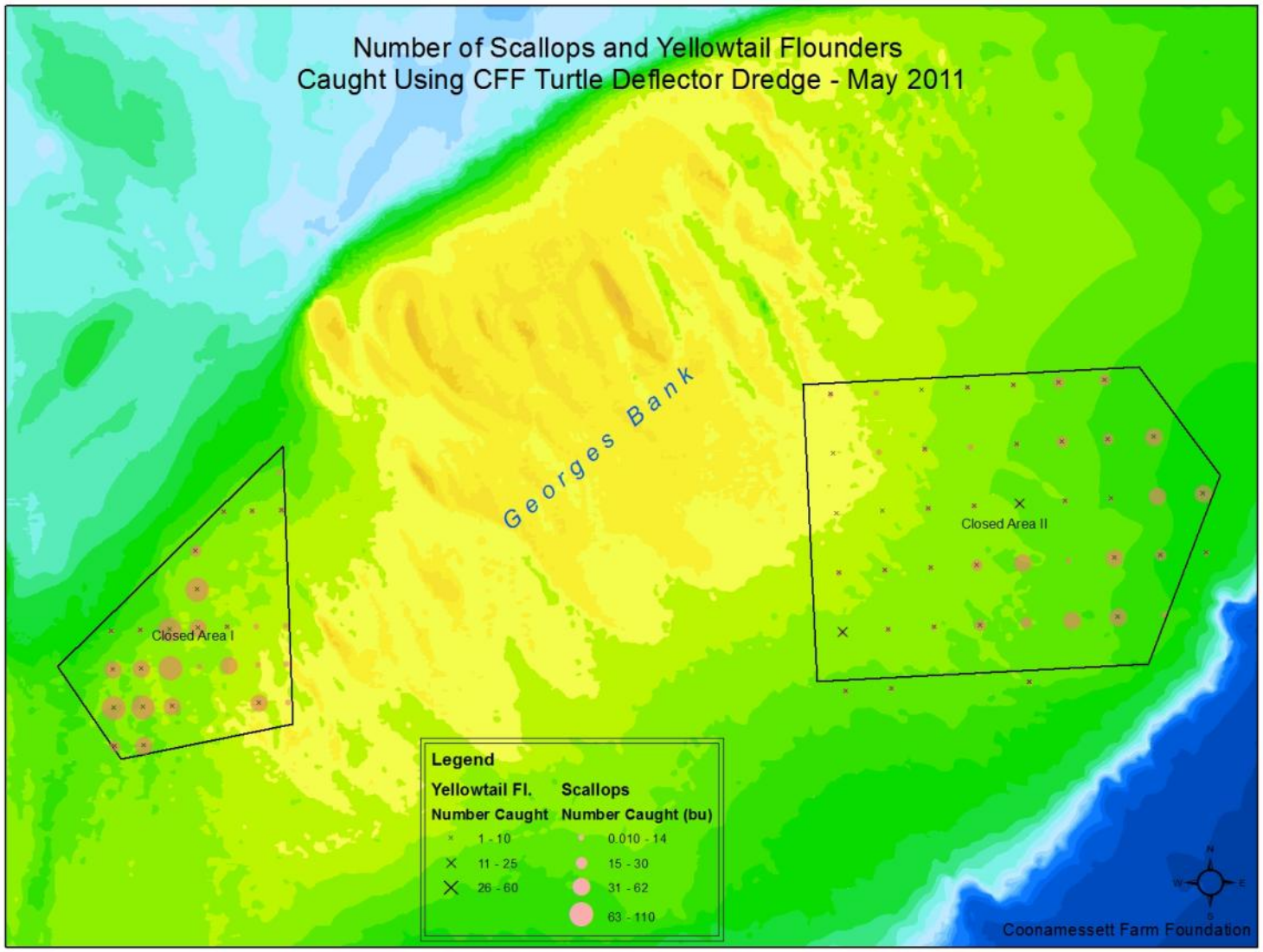

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

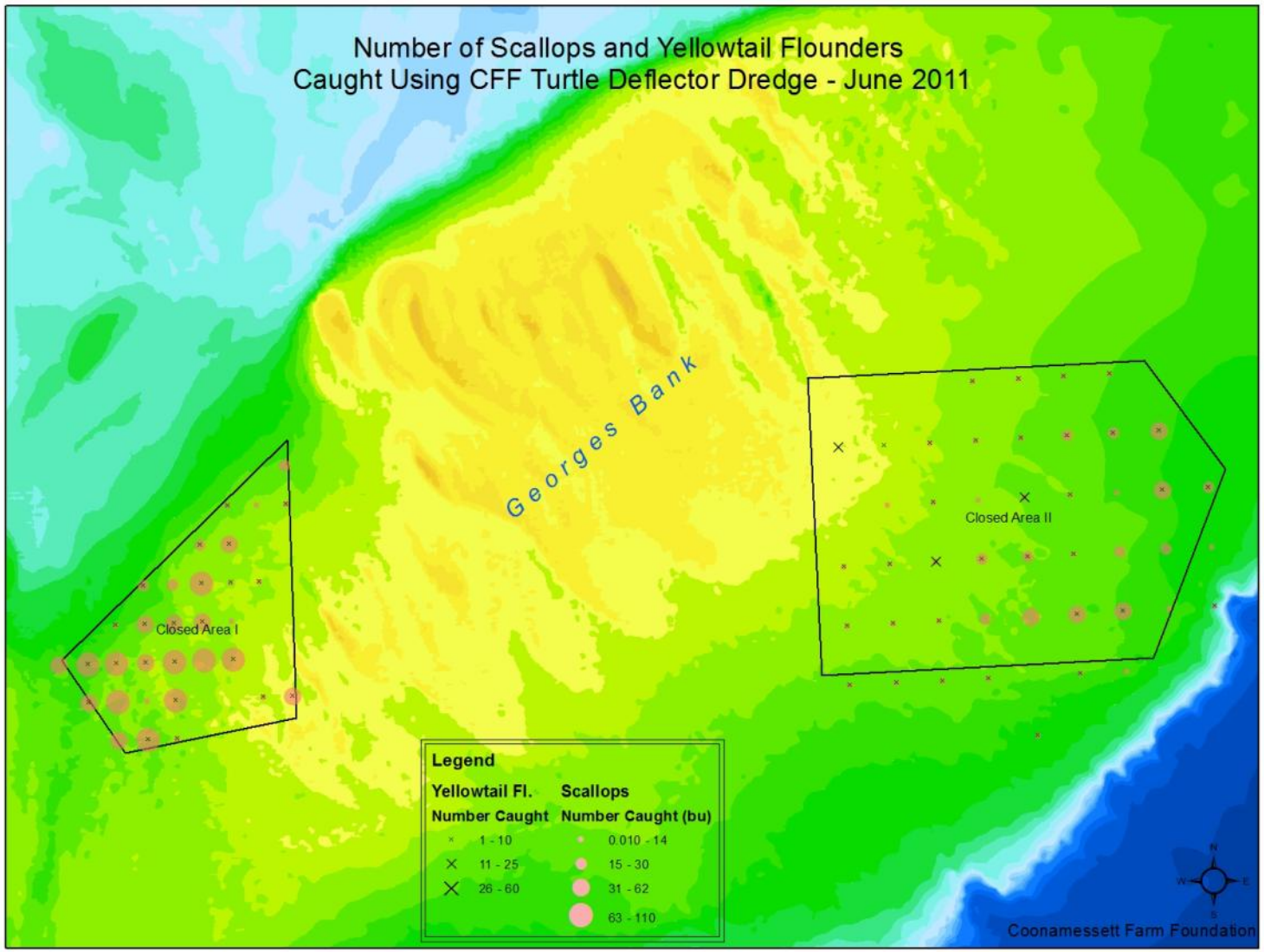

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

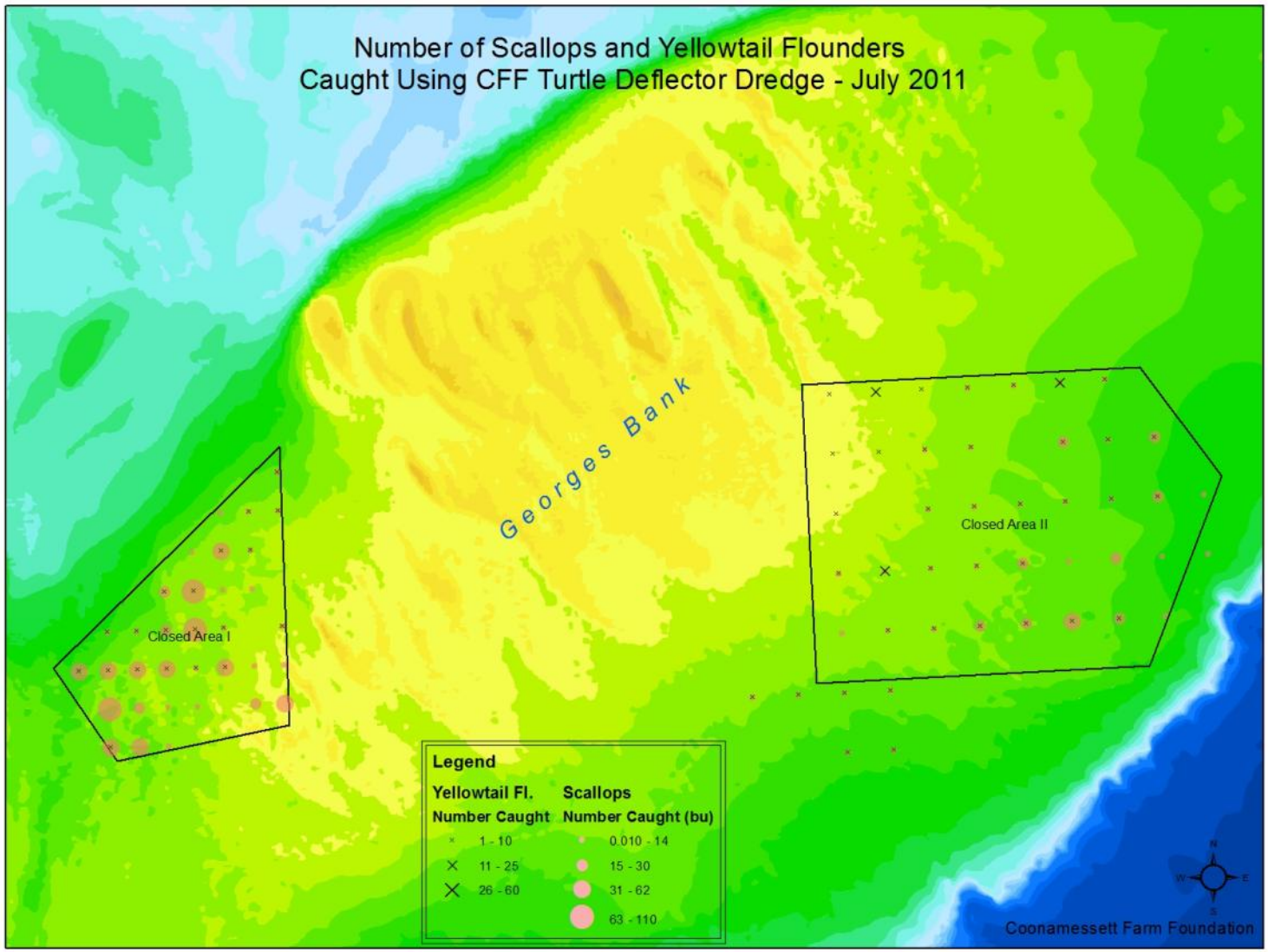

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

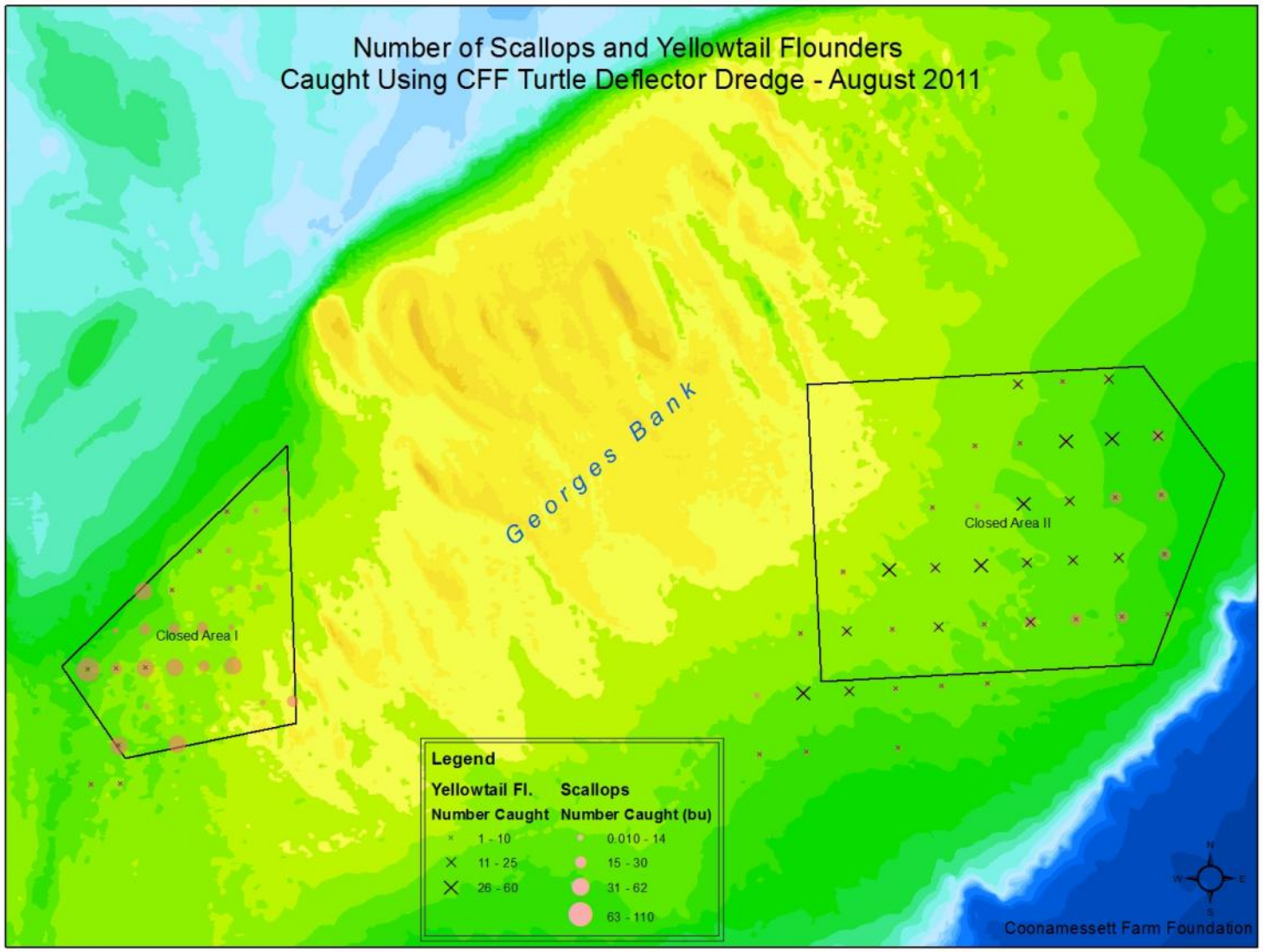

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

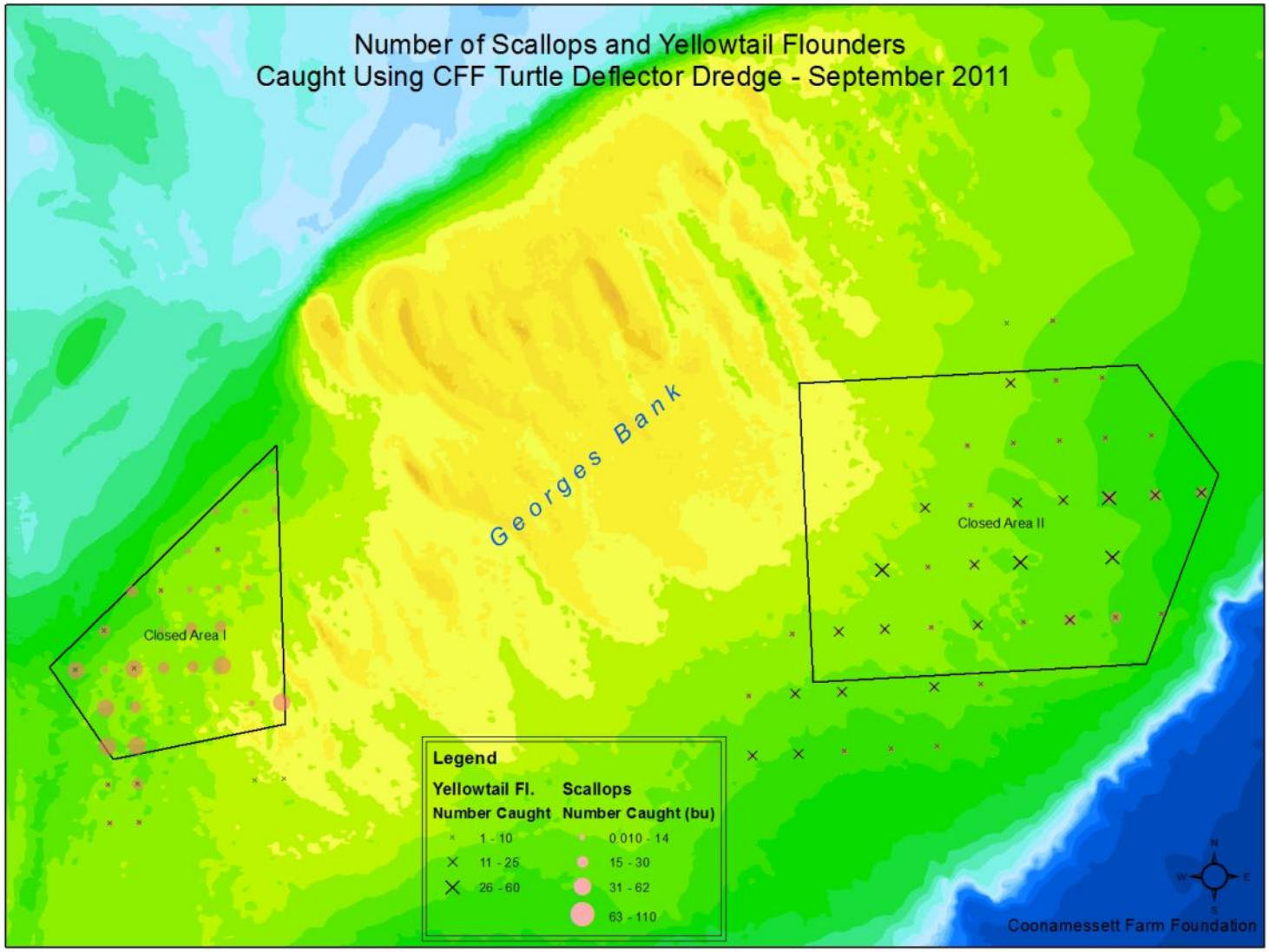

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

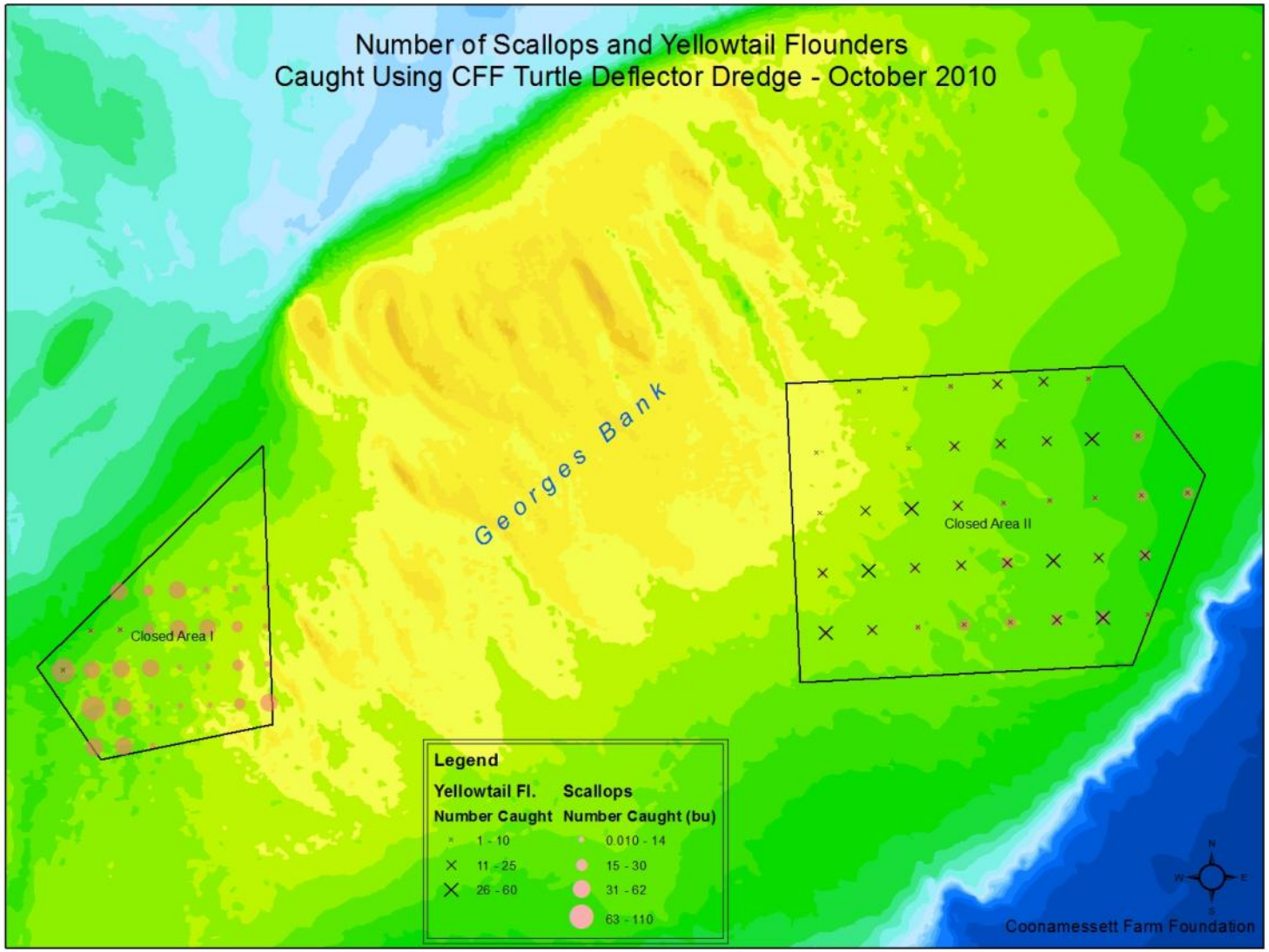

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

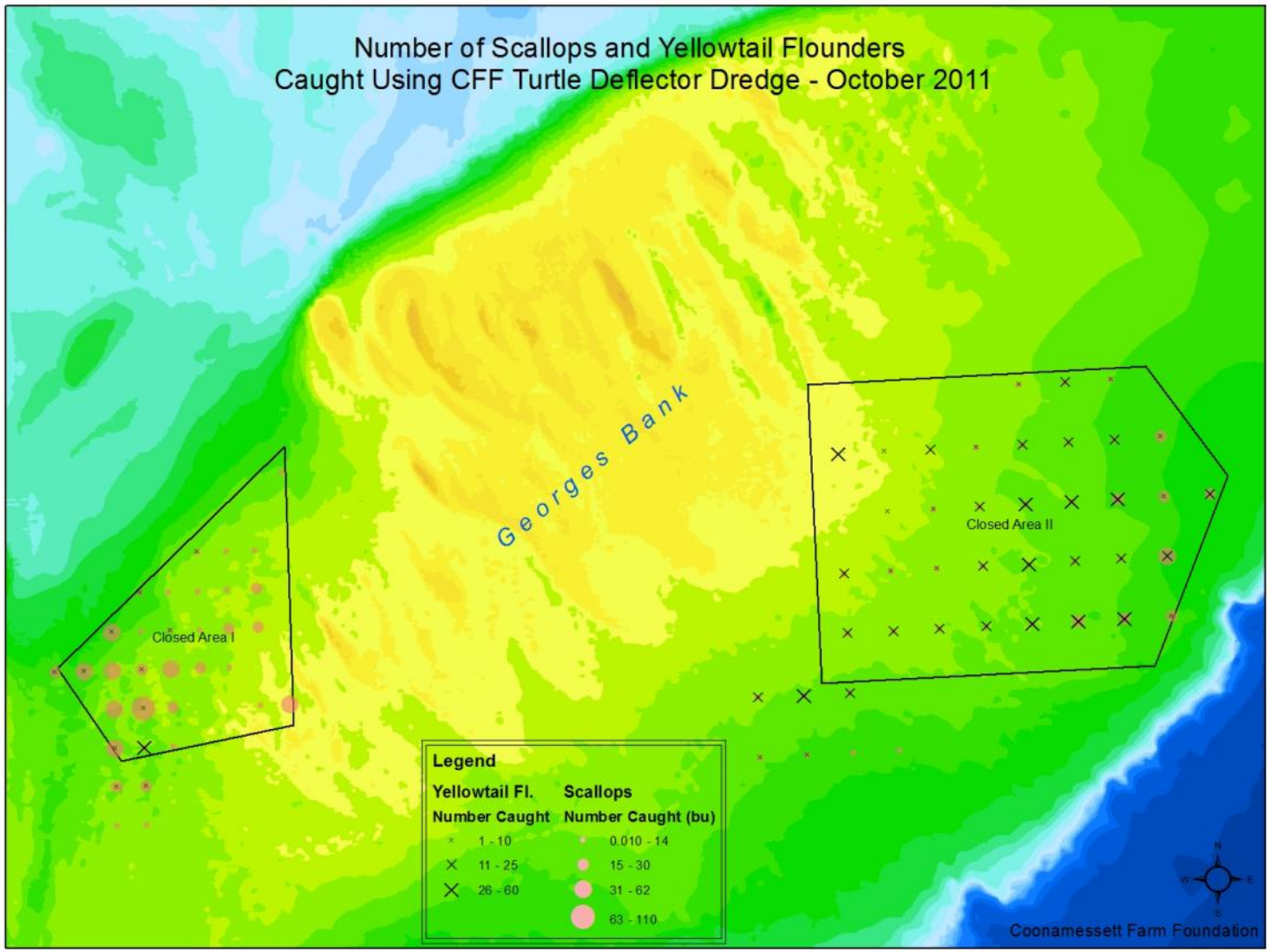

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

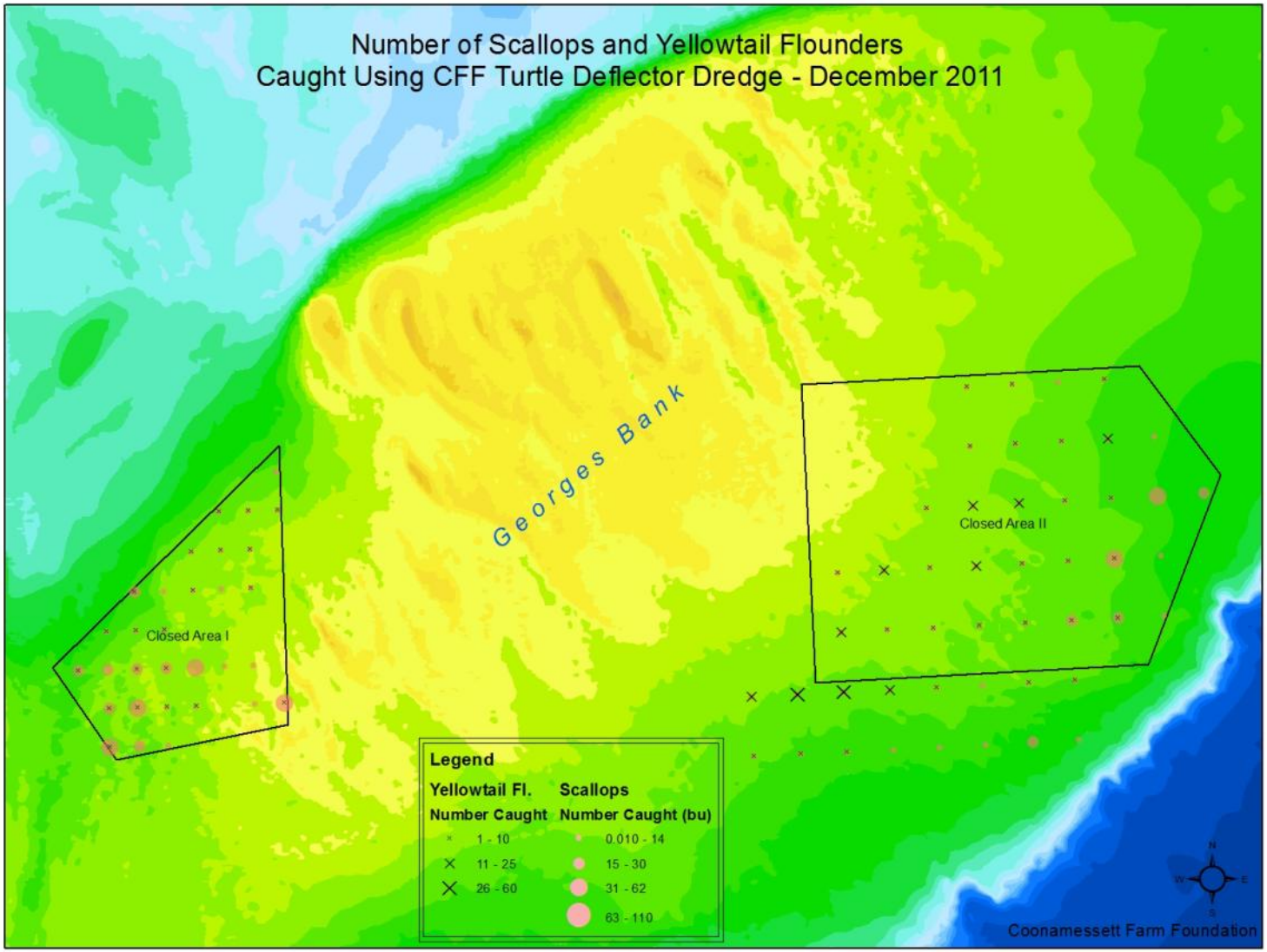

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

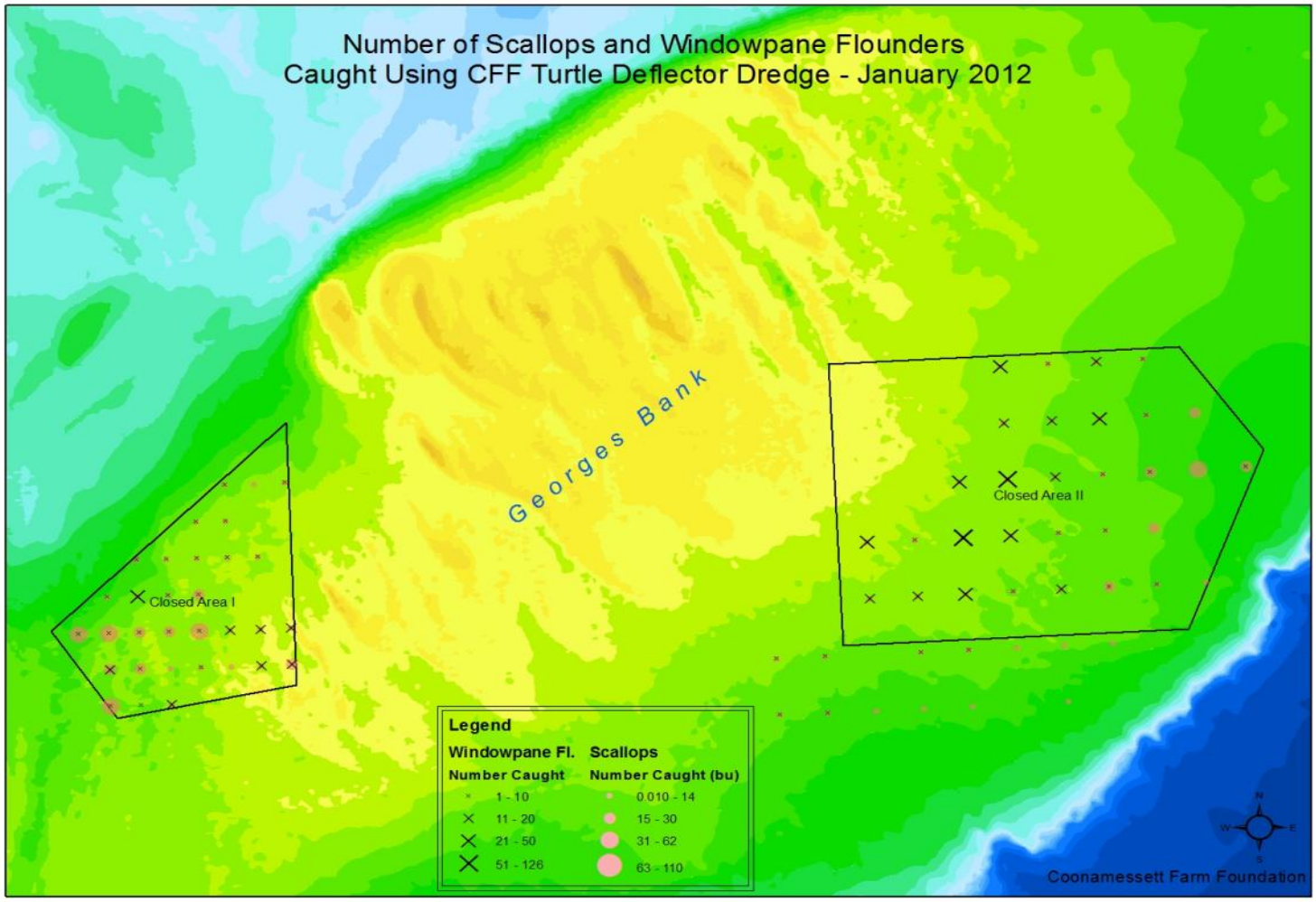

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

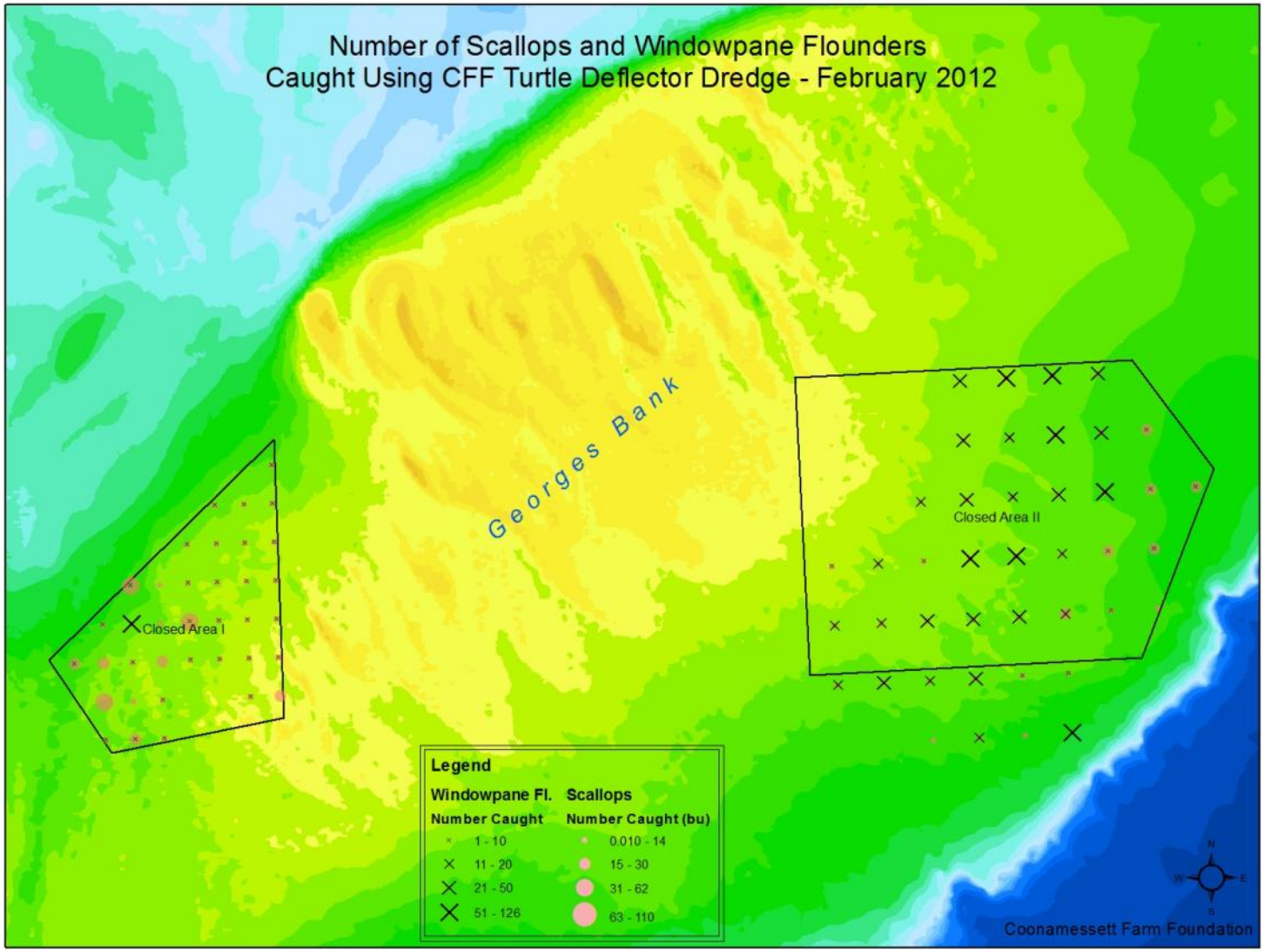

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

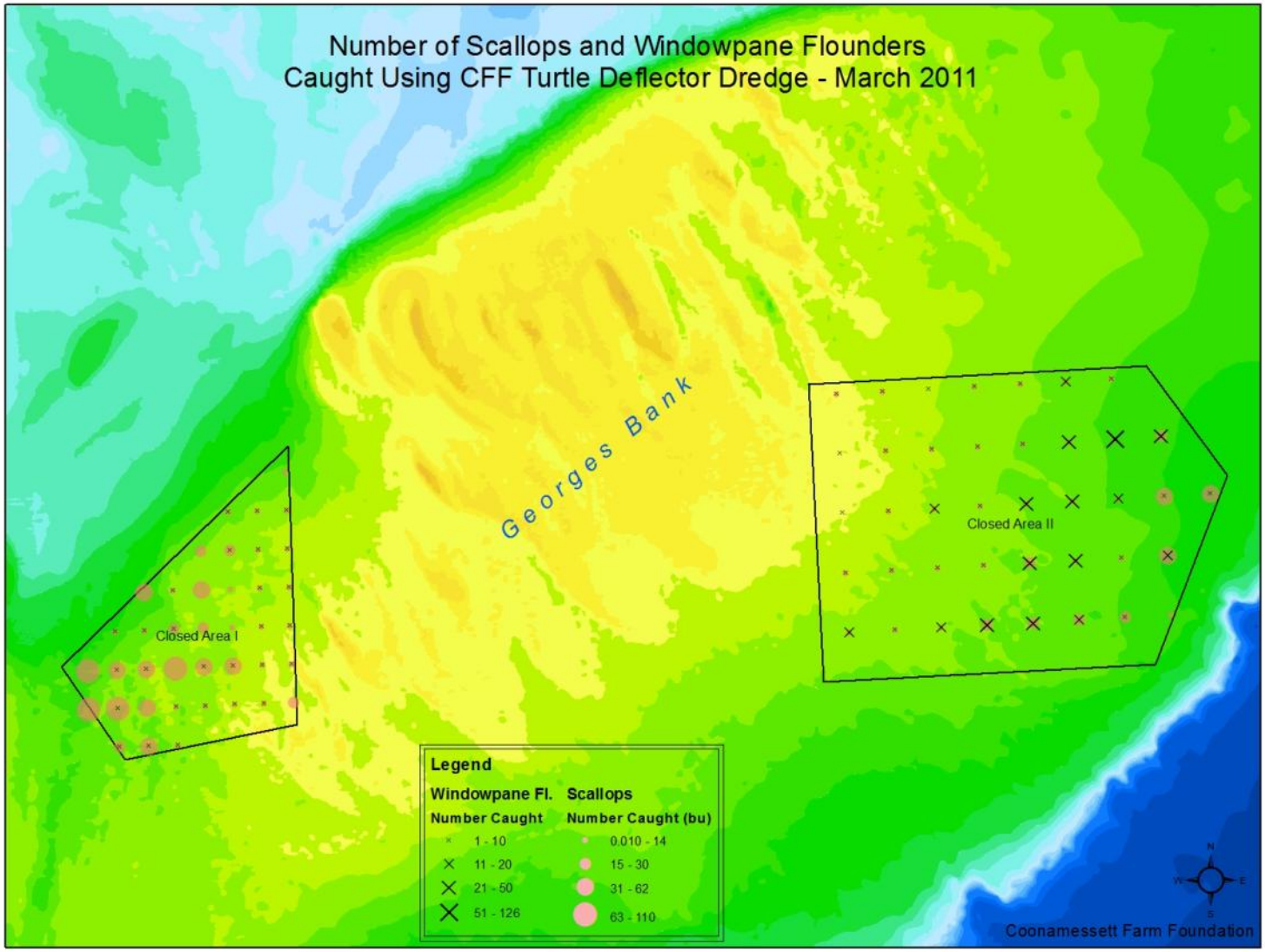

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

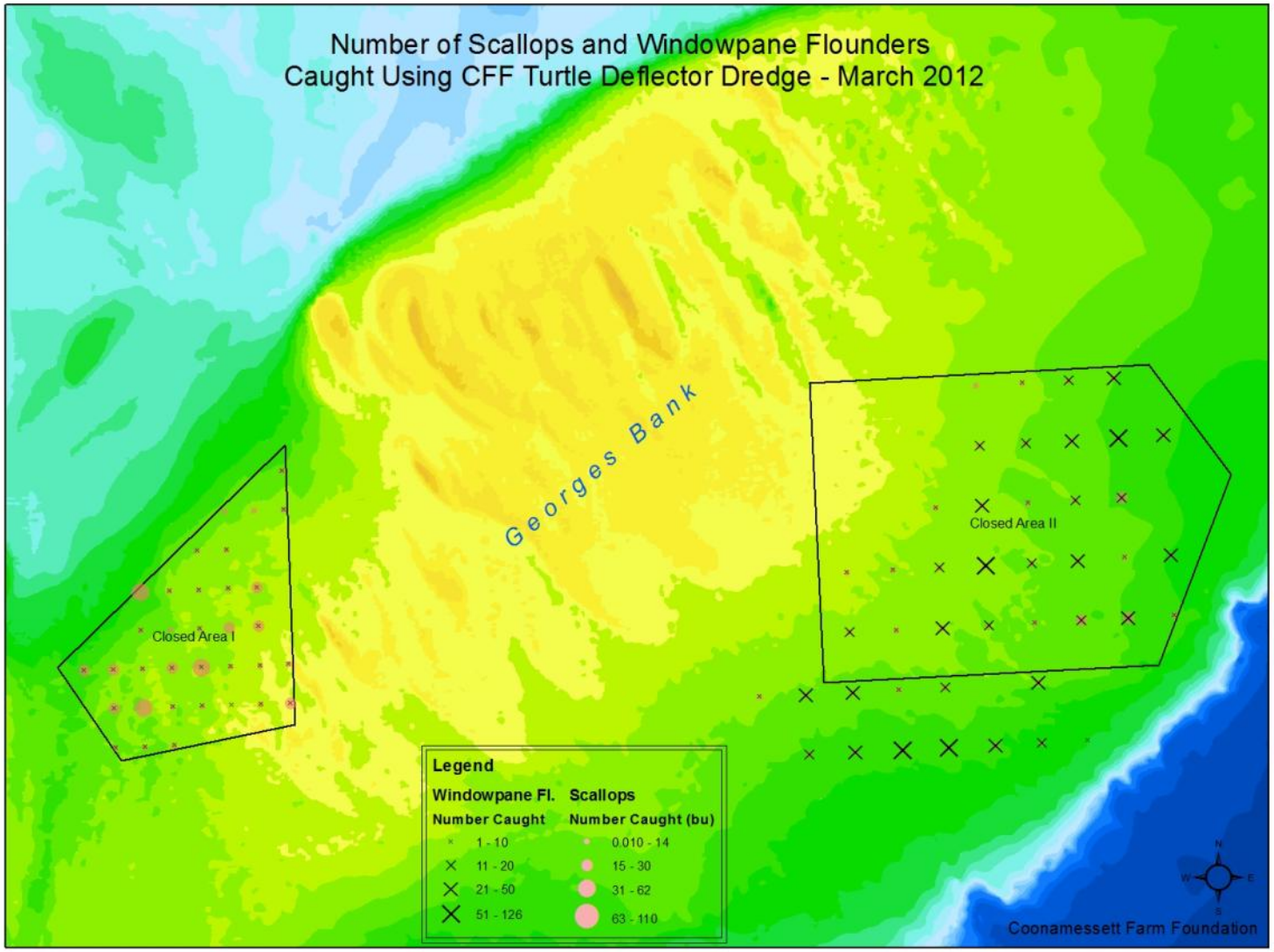

Number of Scallops and Yellowtail Flounders
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Yellowtail Fl.
Number Caught
1 - 10
11 - 25
26 - 60
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

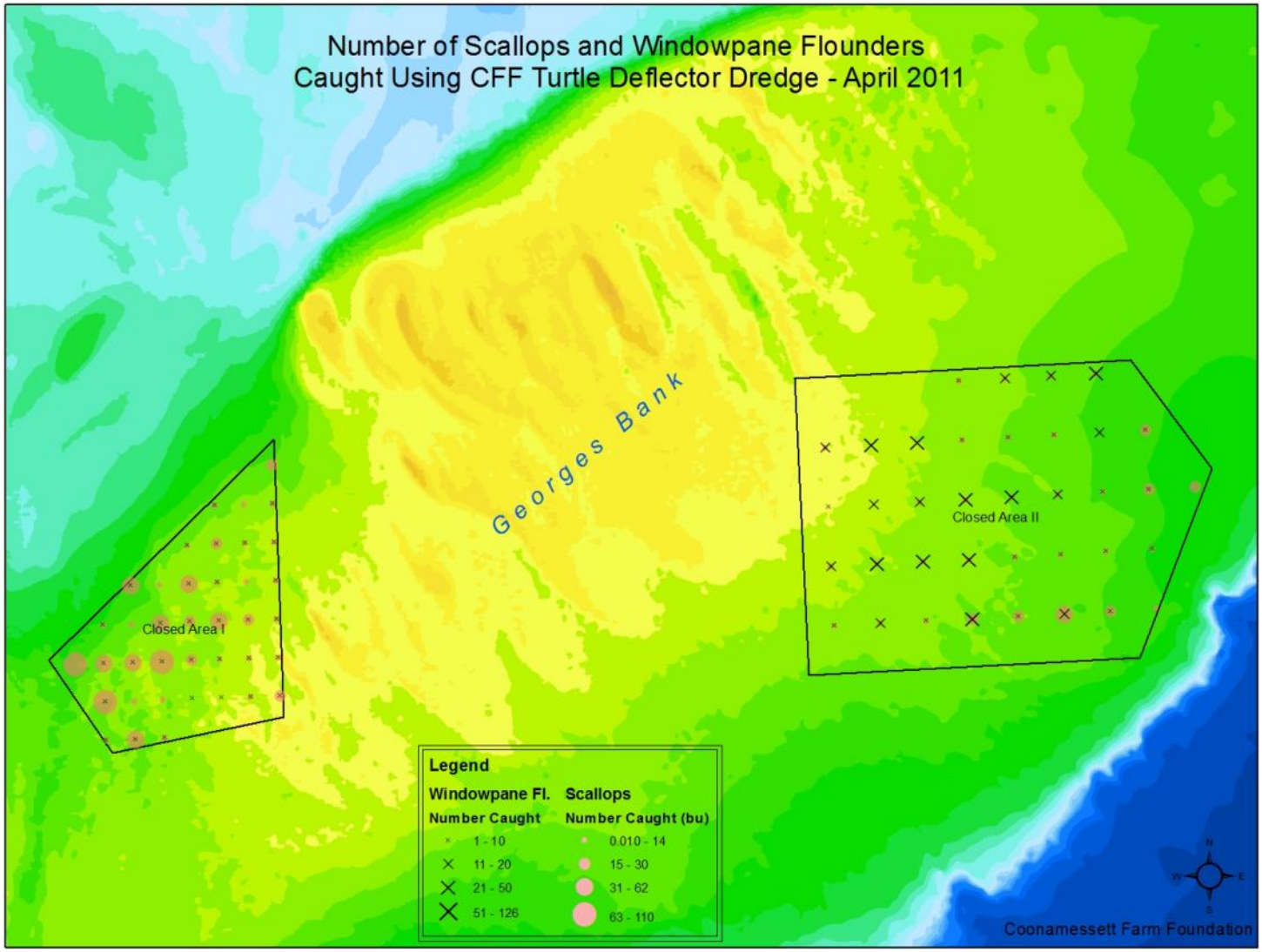
**Scallops and Windowpane Flounder**

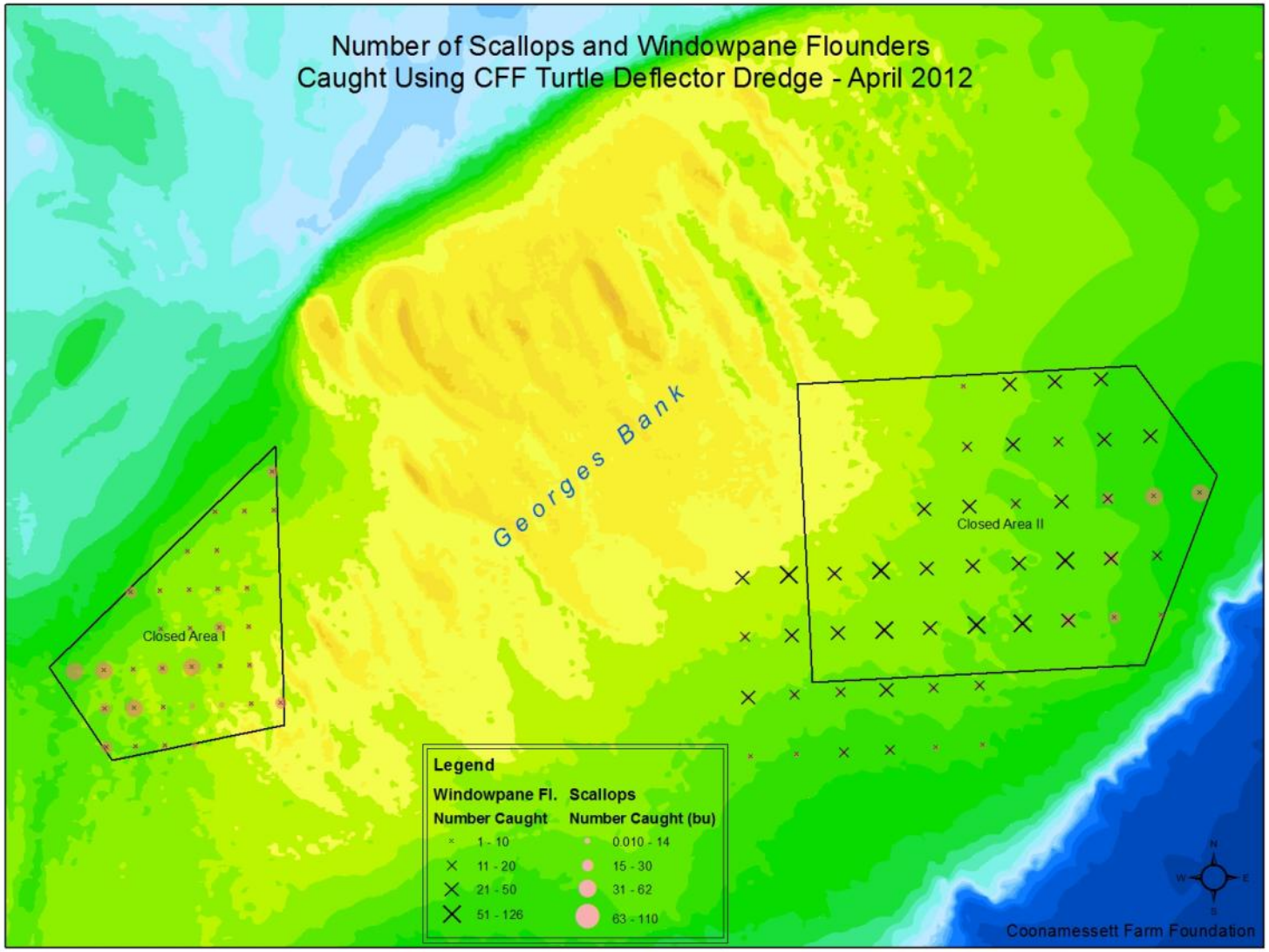


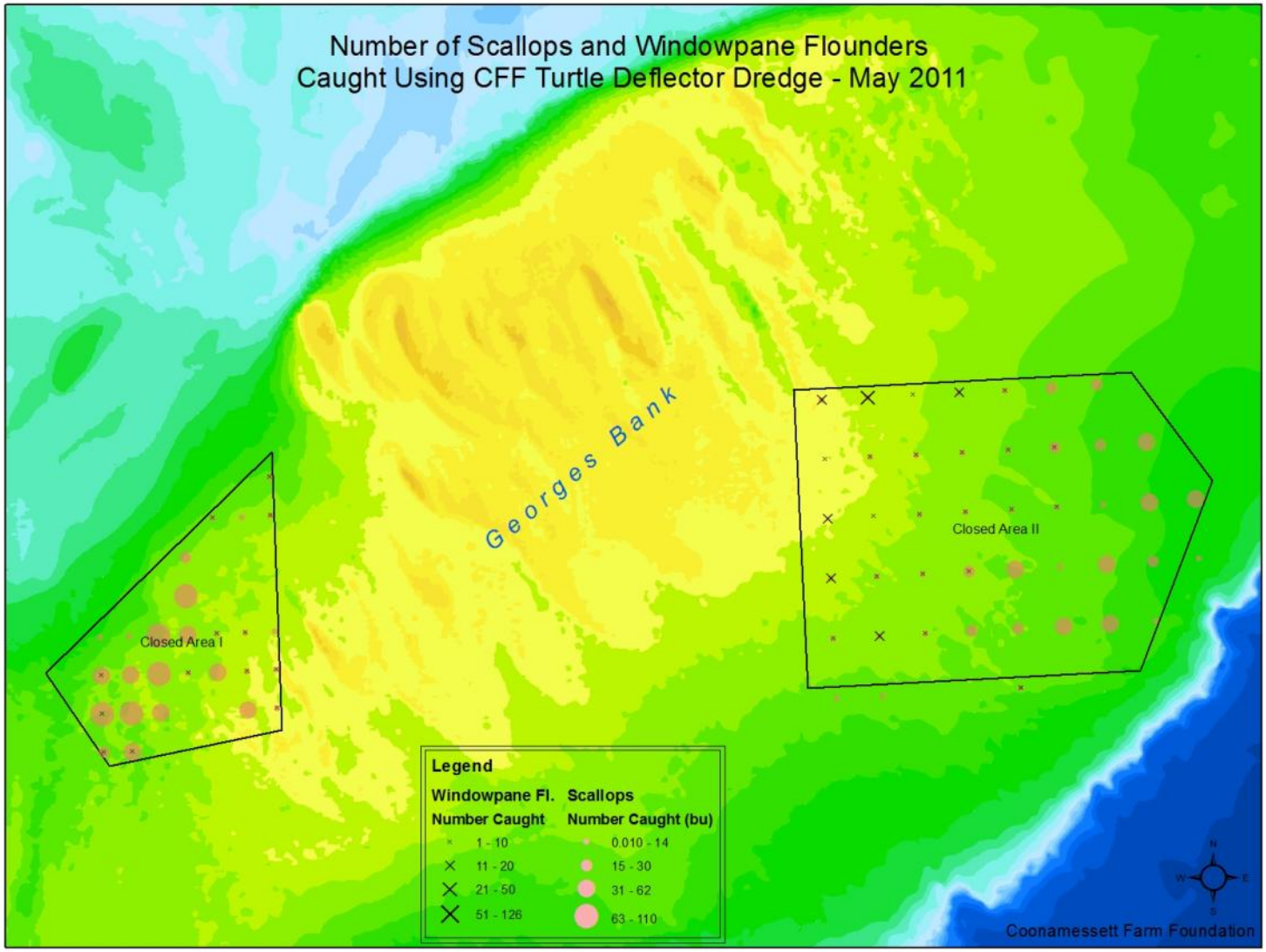

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

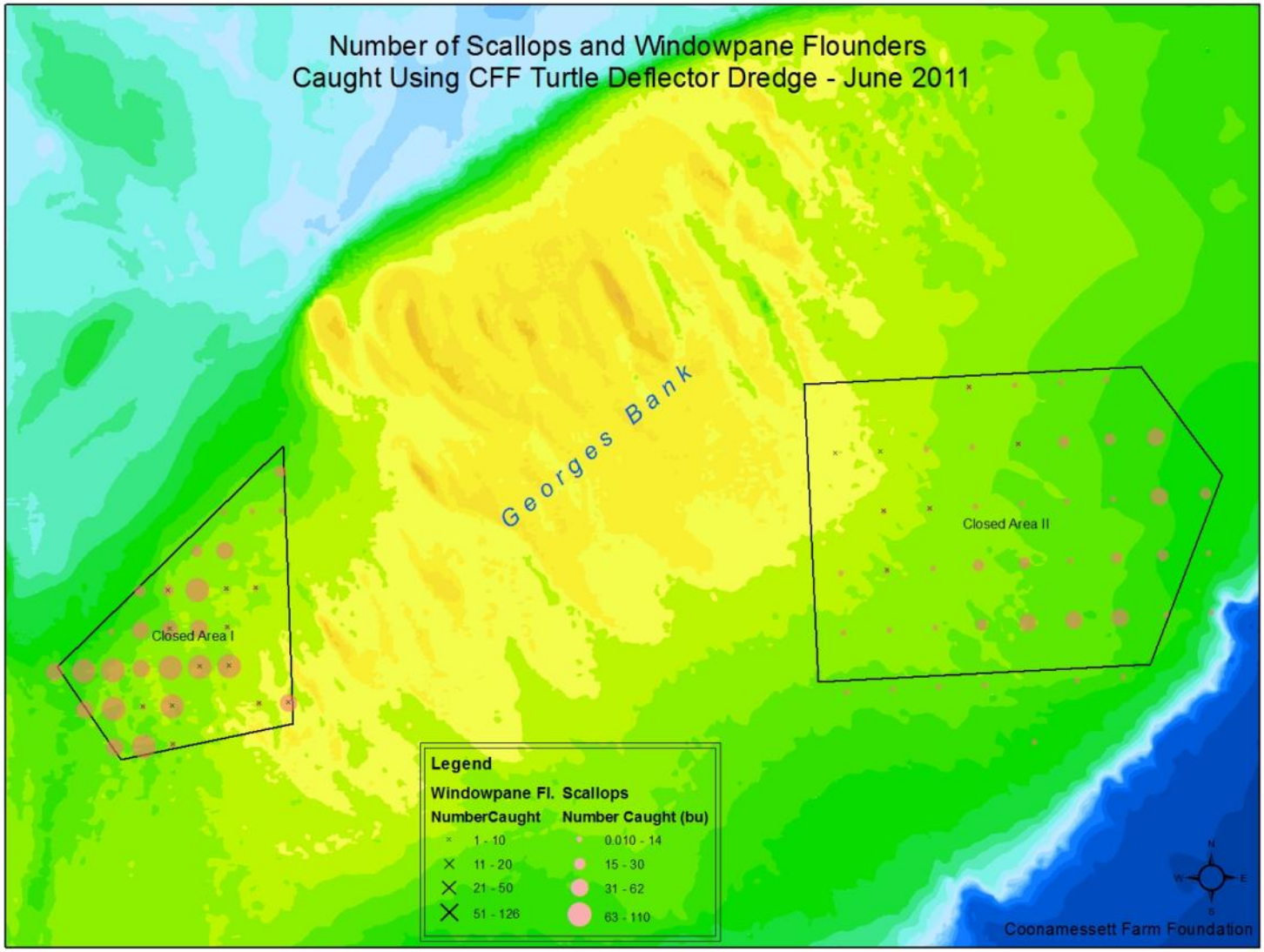

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

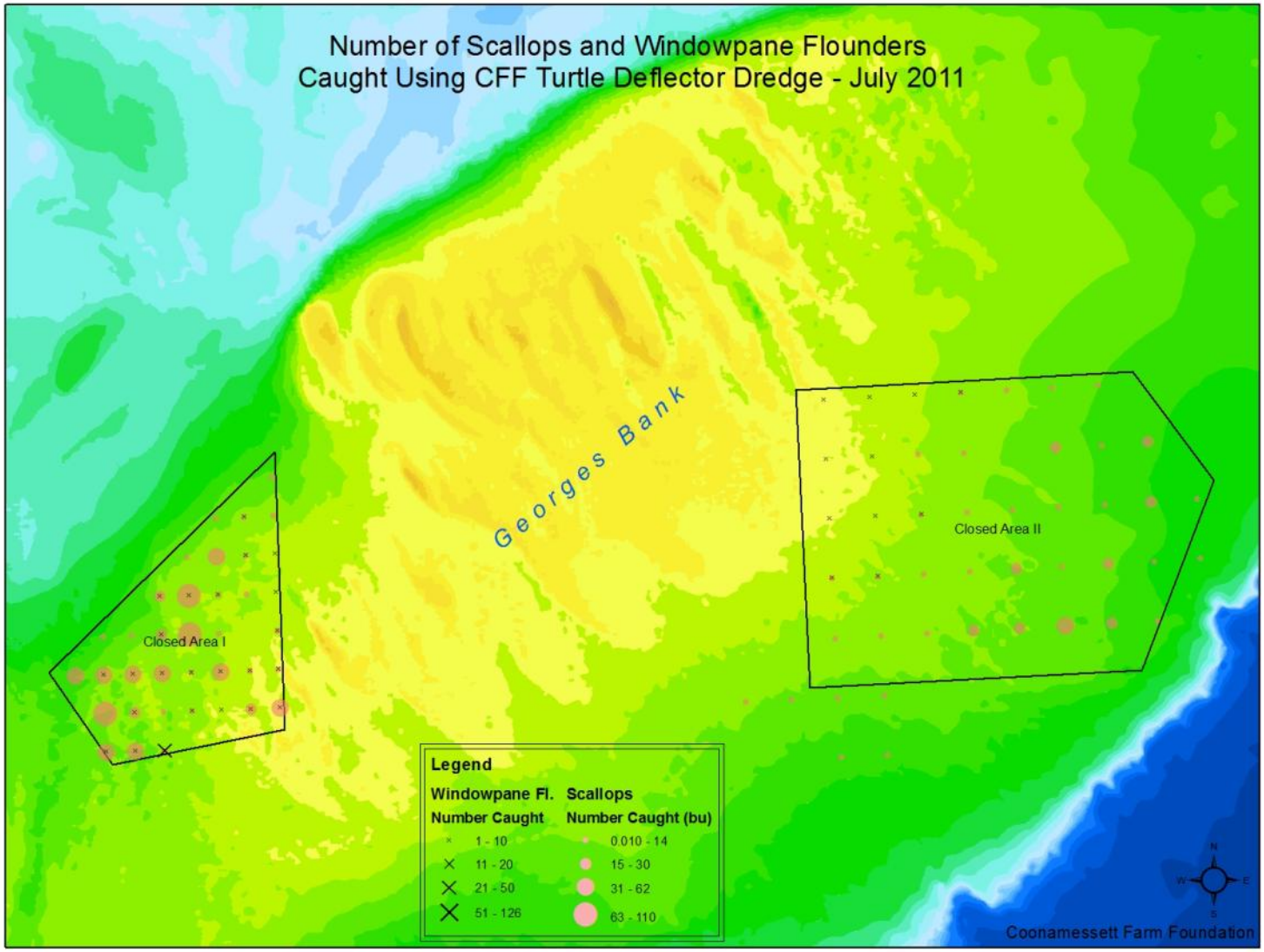

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

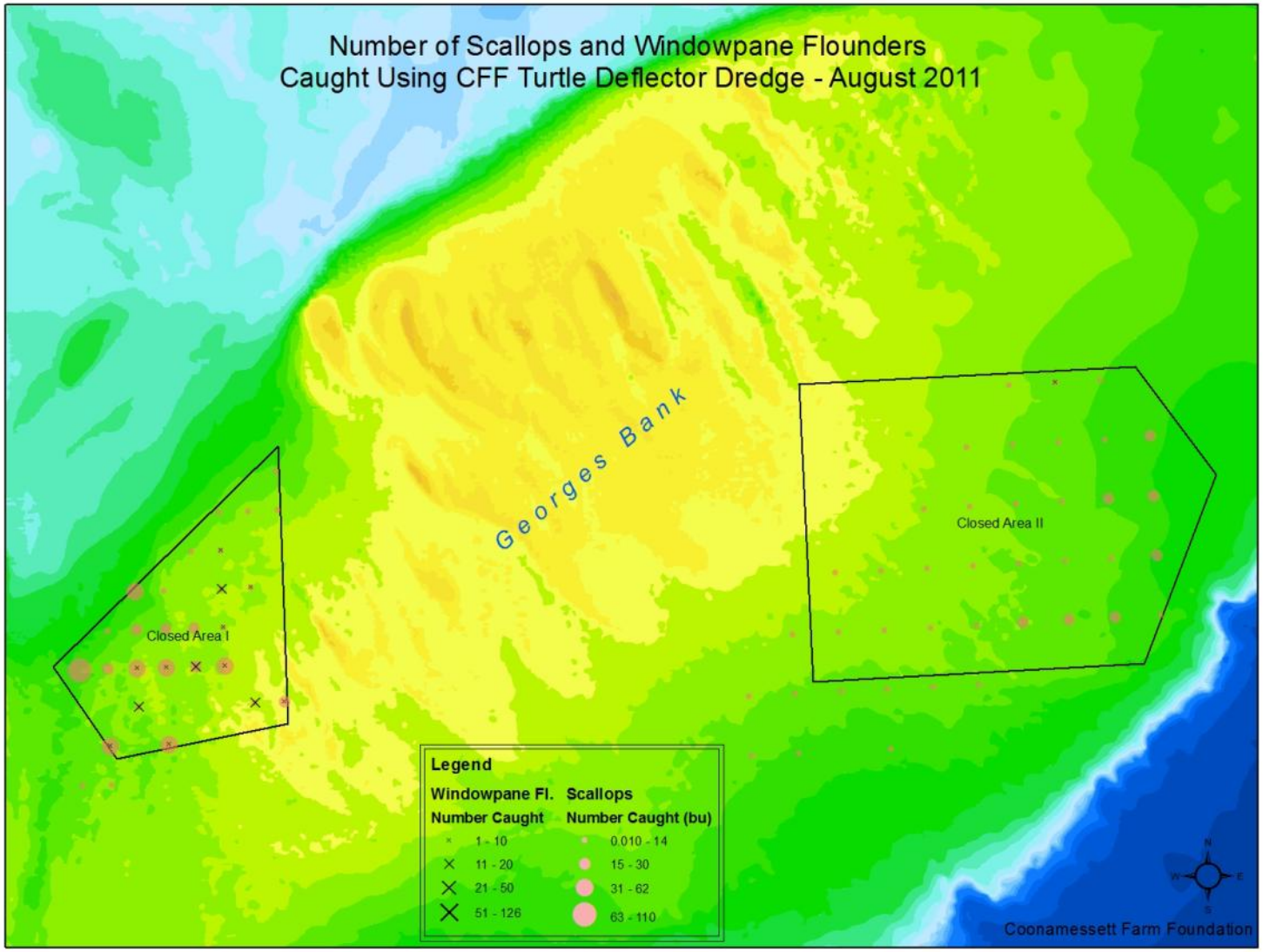

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

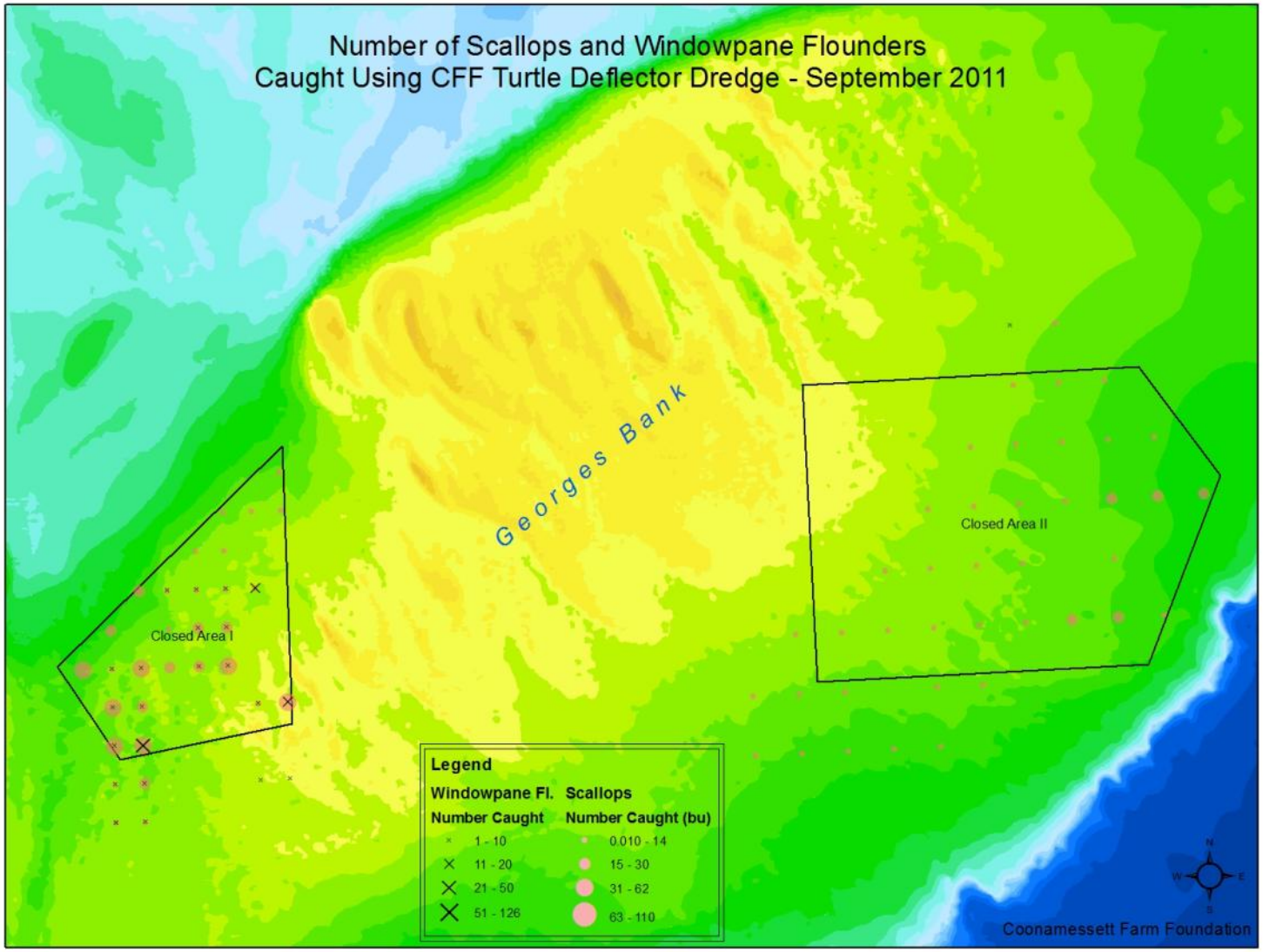

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

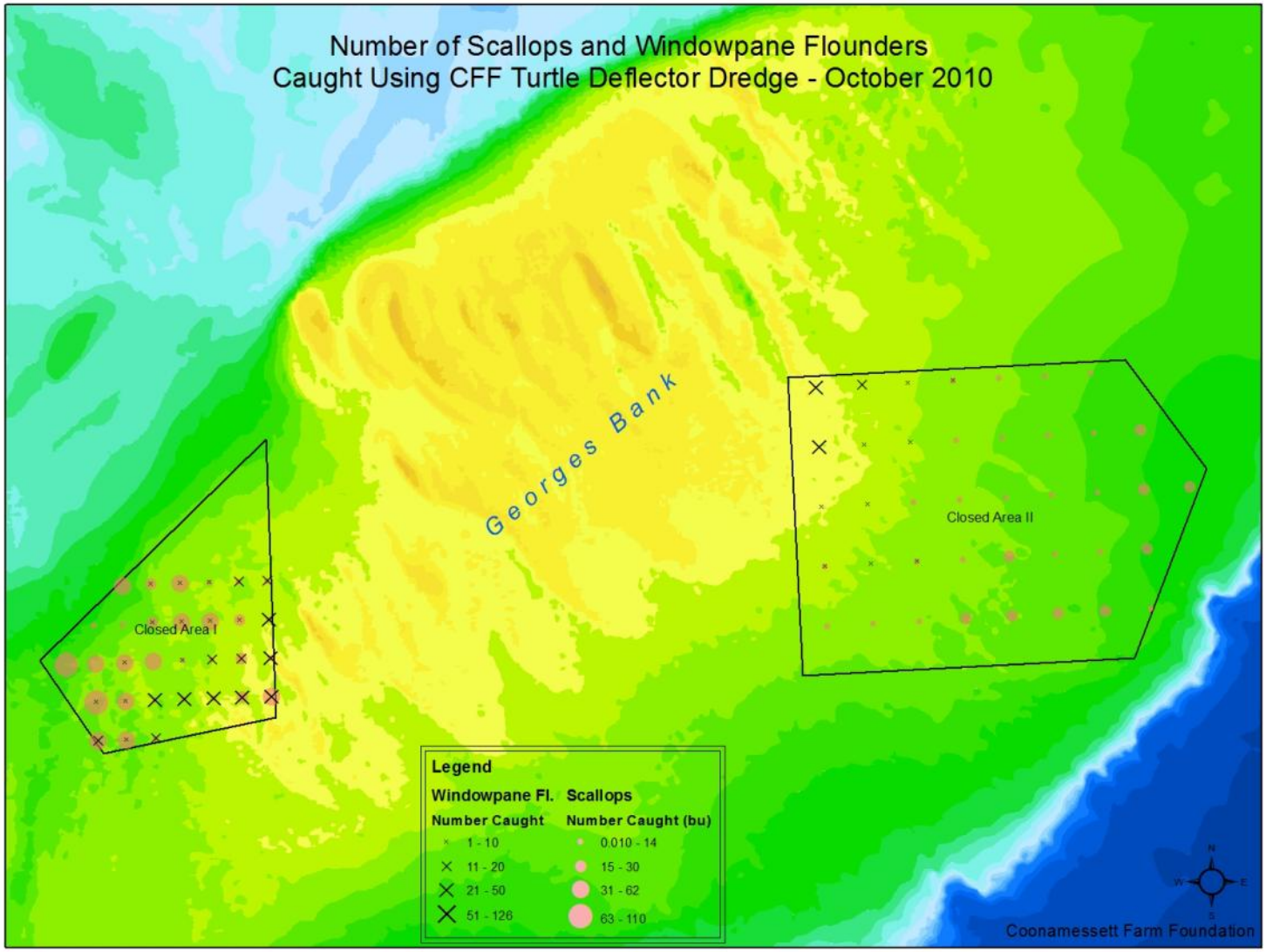

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

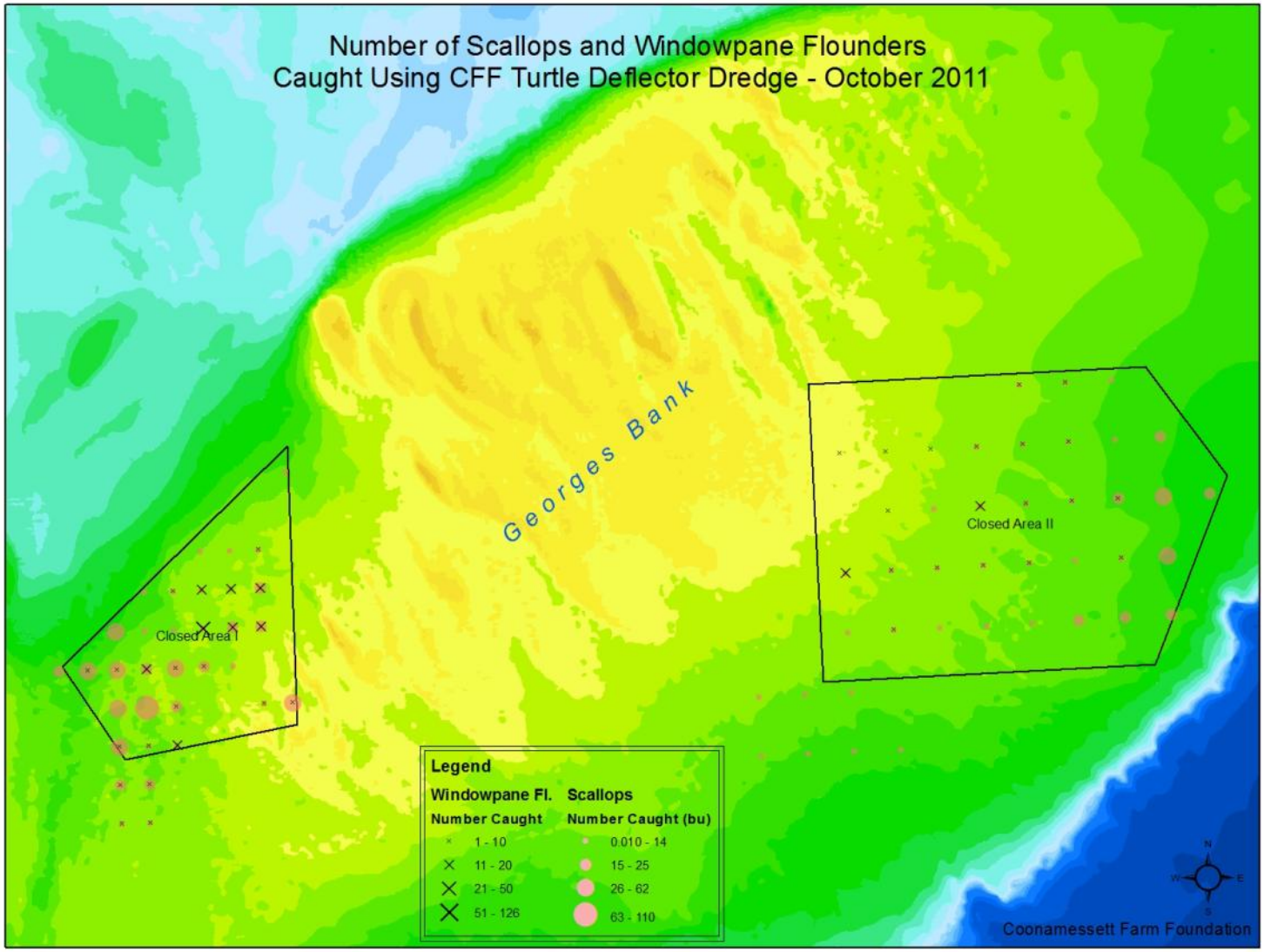

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
NumberCaught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

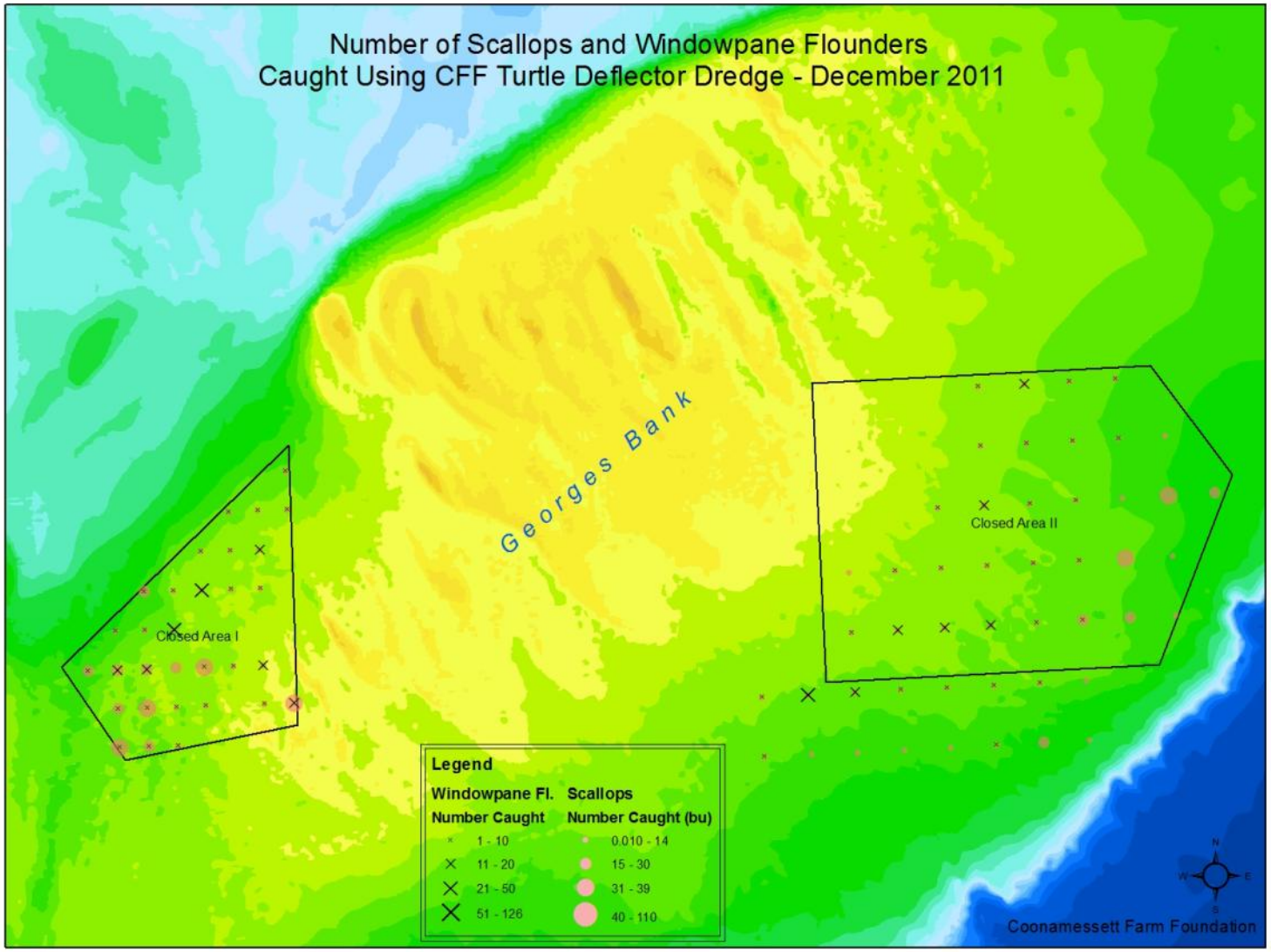

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation


Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

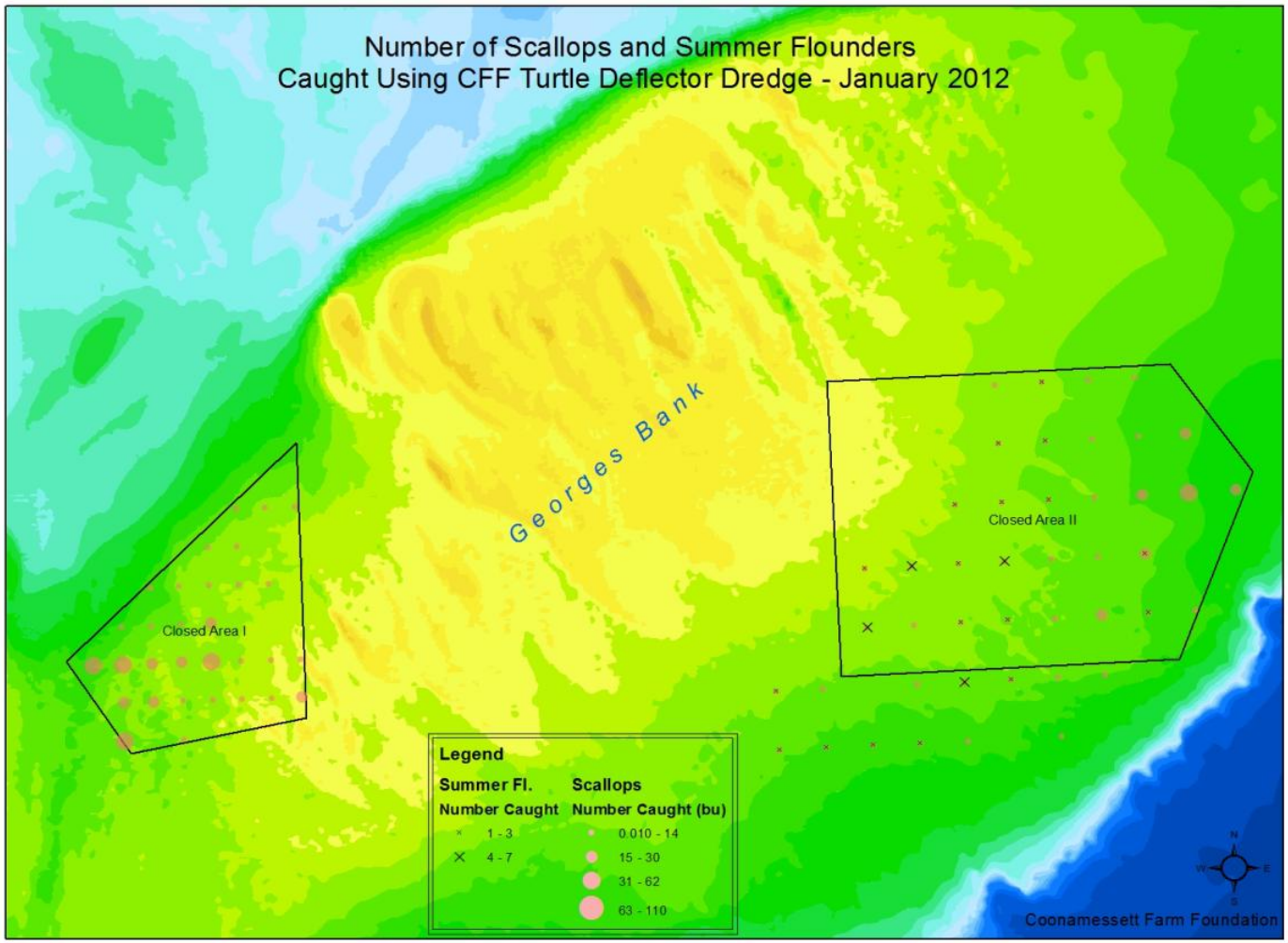

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

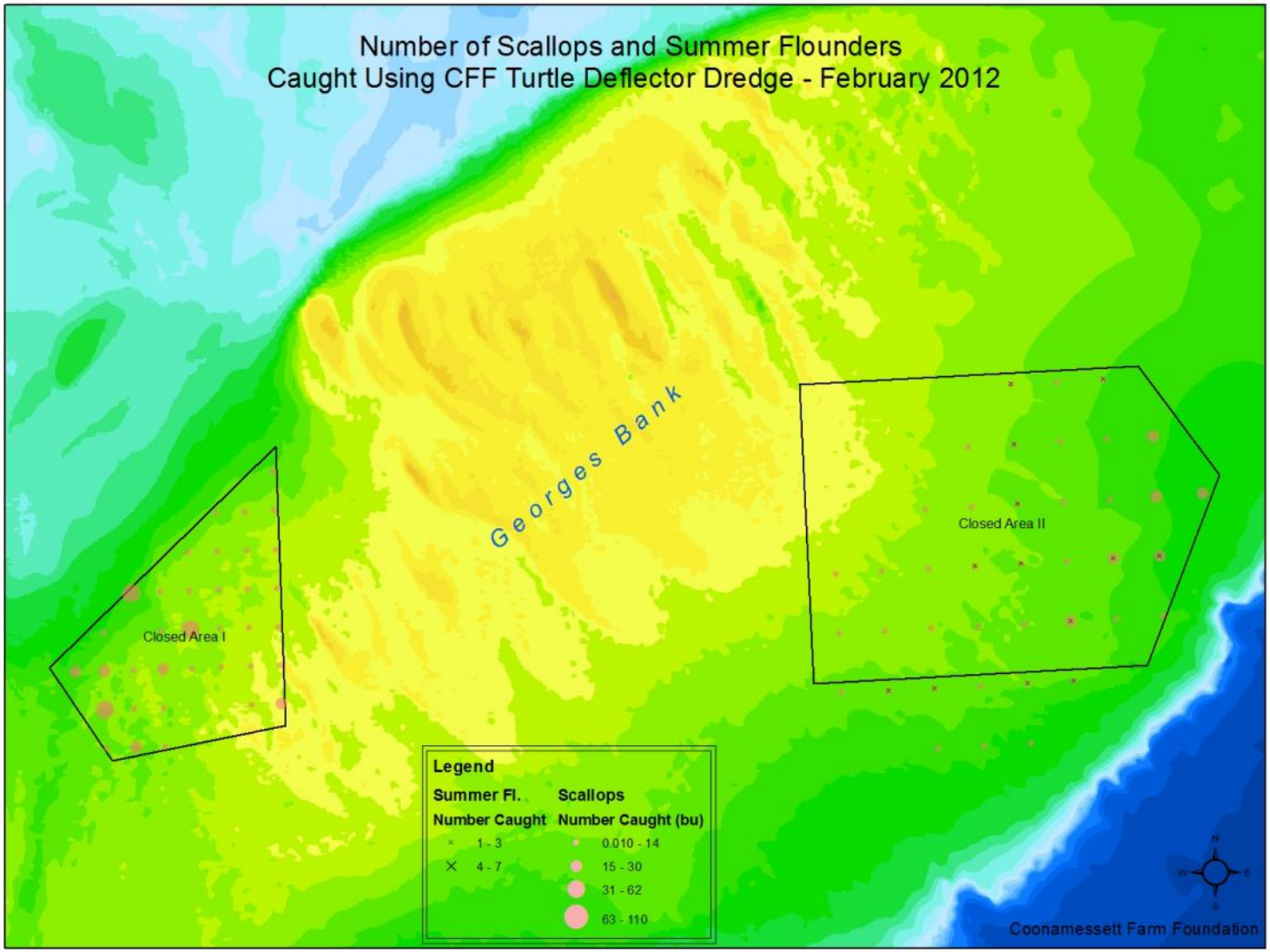

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

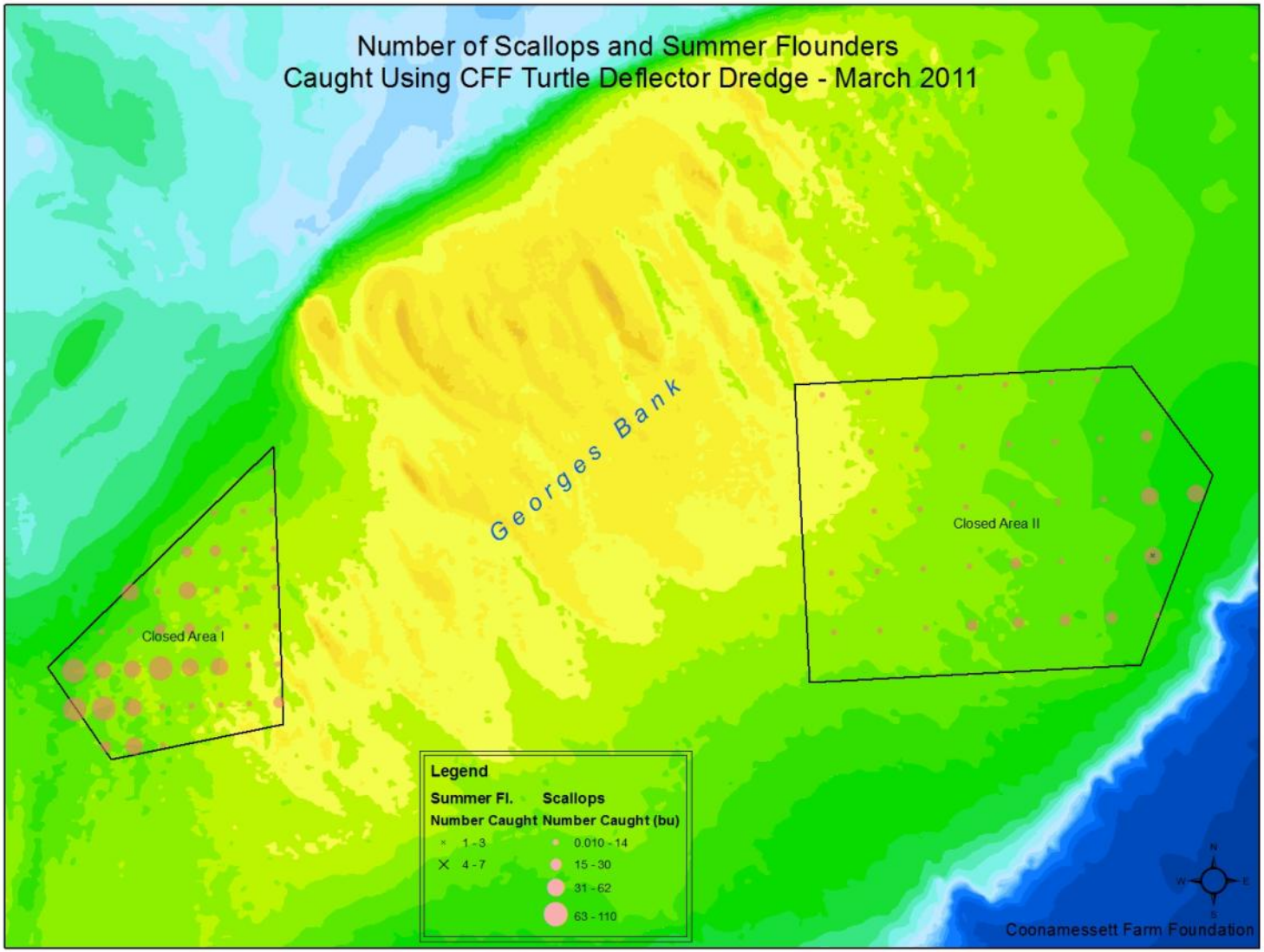

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 25
26 - 62
63 - 110
Coonamessett Farm Foundation

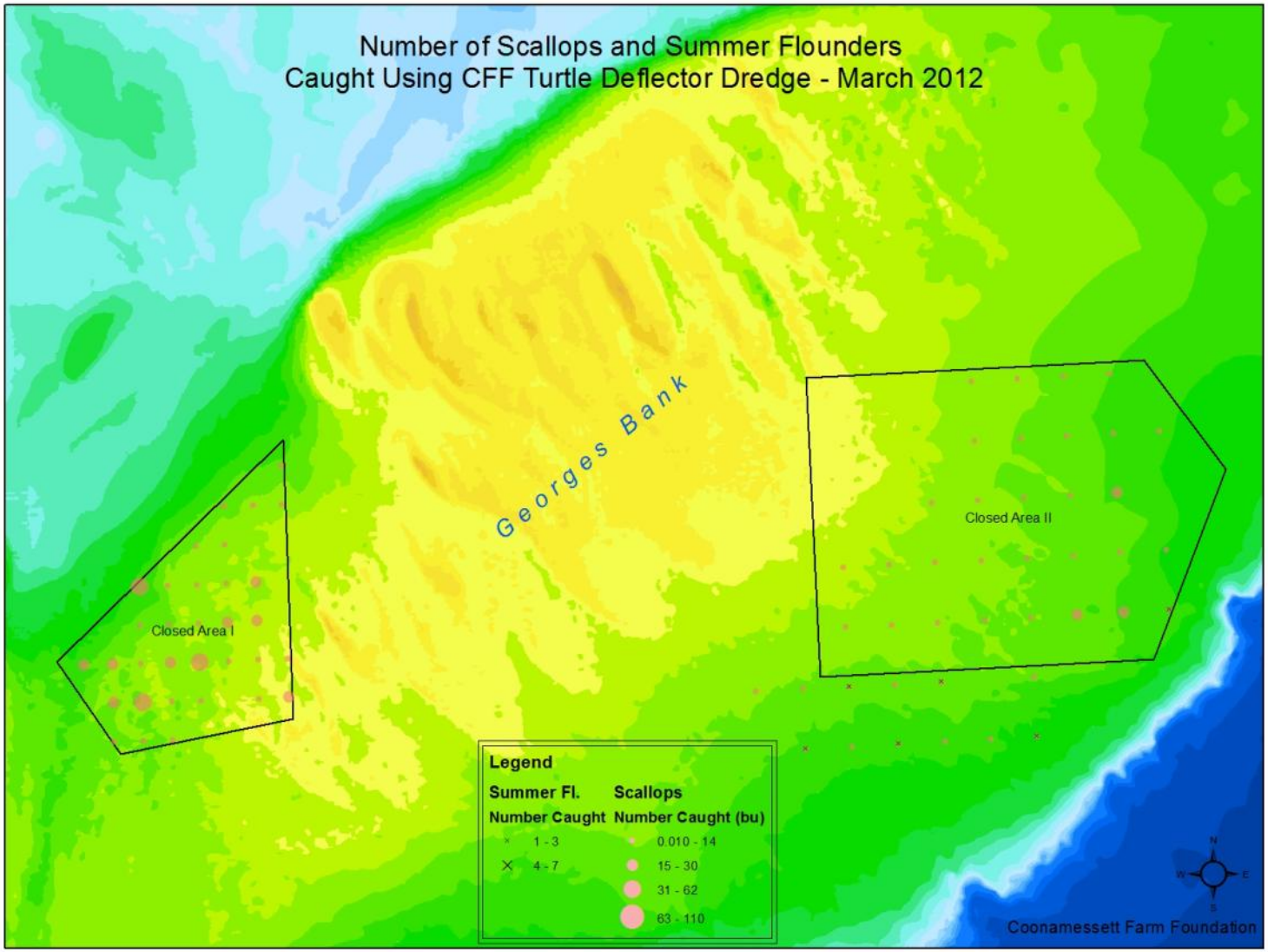

Number of Scallops and Windowpane Flounders
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Windowpane Fl.
Number Caught
1 - 10
11 - 20
21 - 50
51 - 126
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 39
40 - 110
N
W
E
S
Coonamessett Farm Foundation

**Scallops and Summer Flounder**

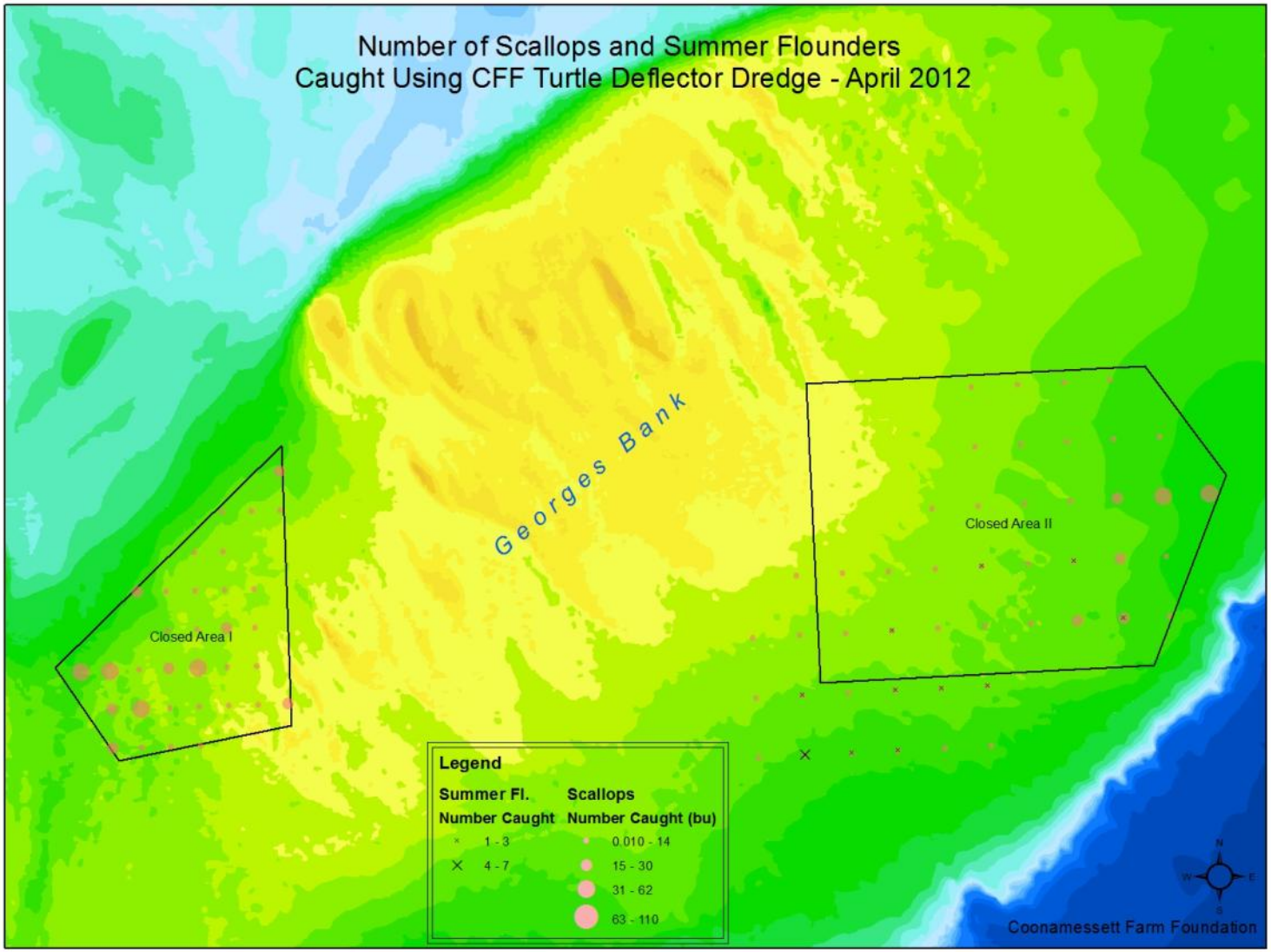


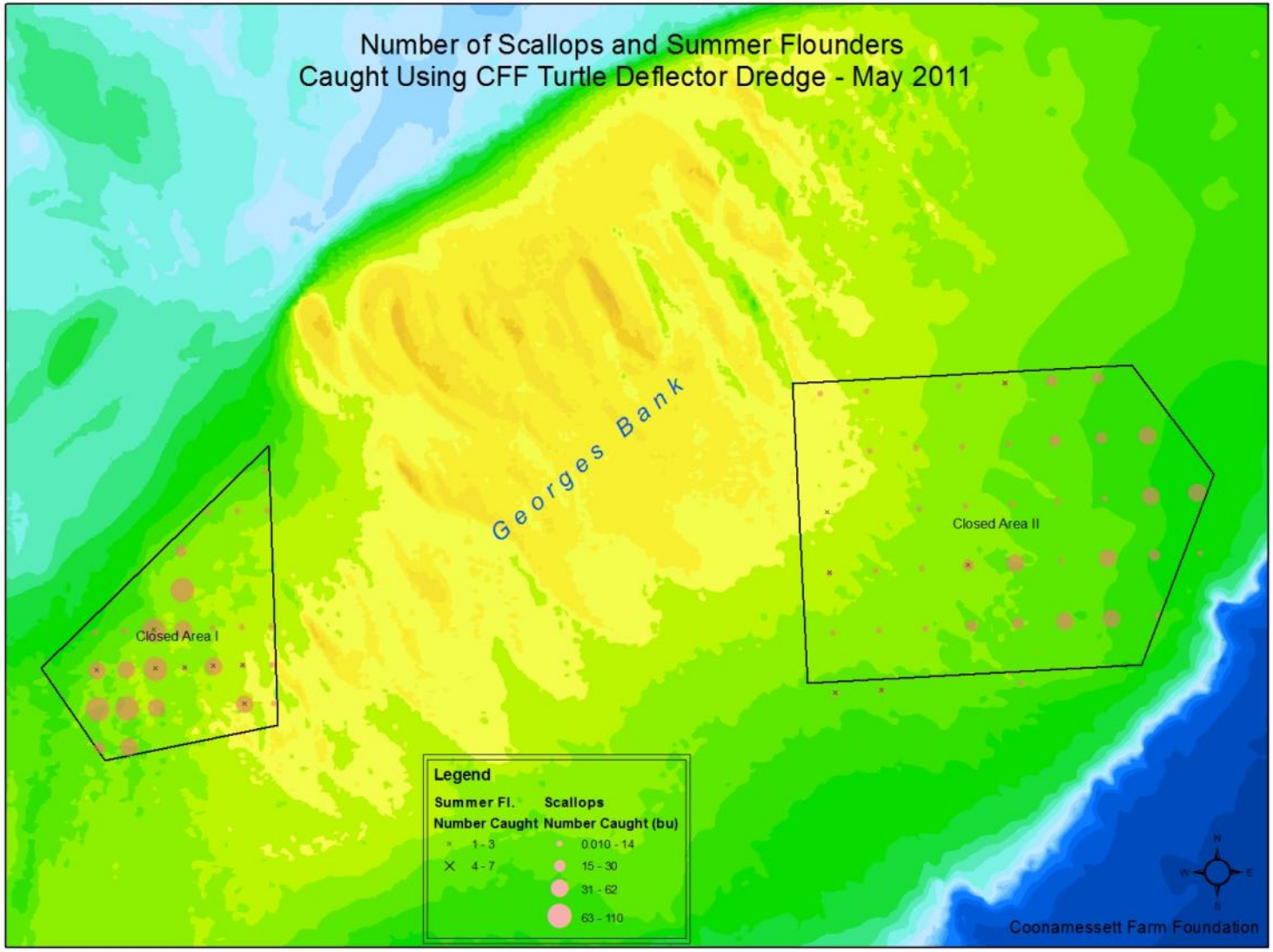

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

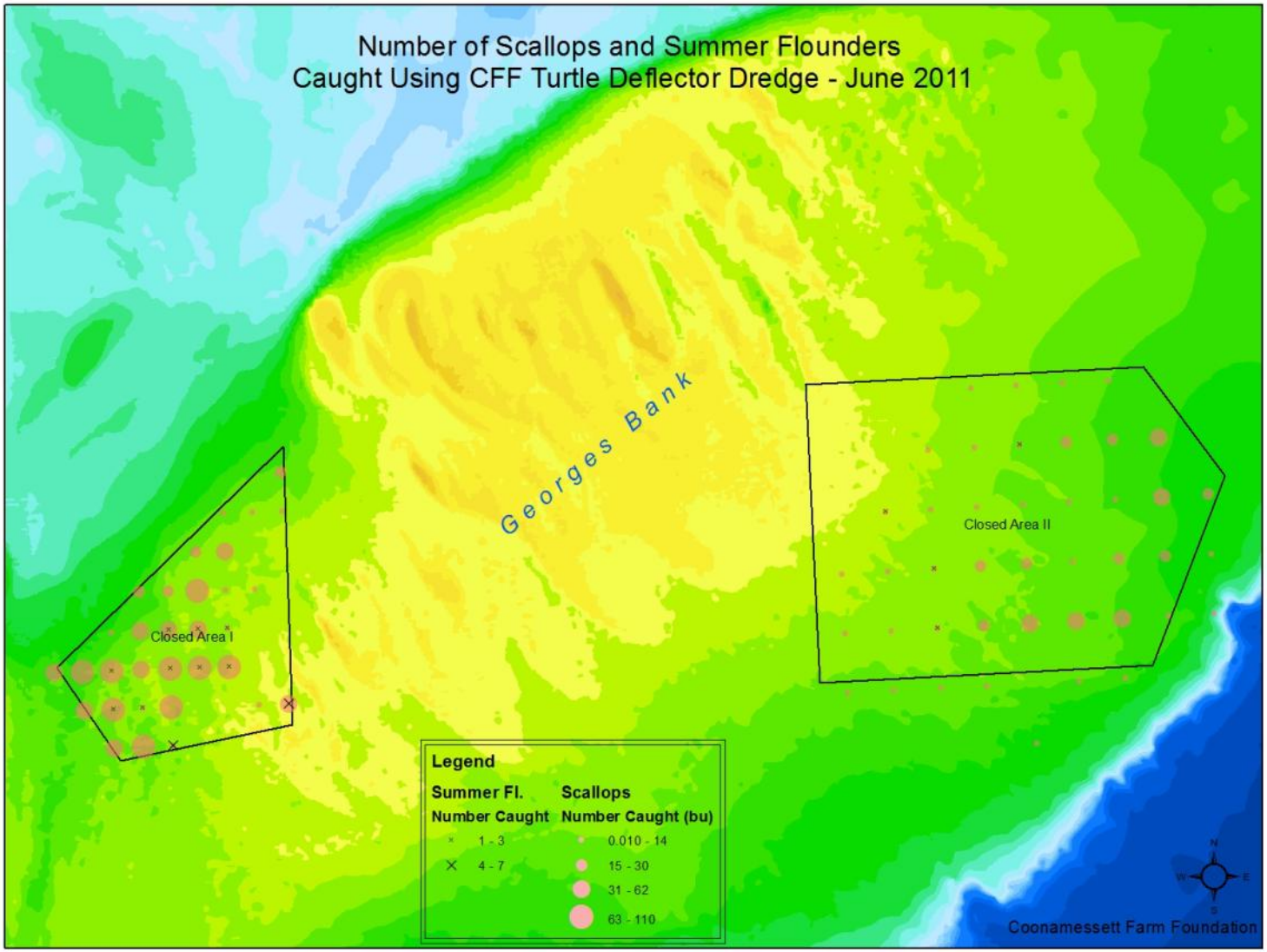

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

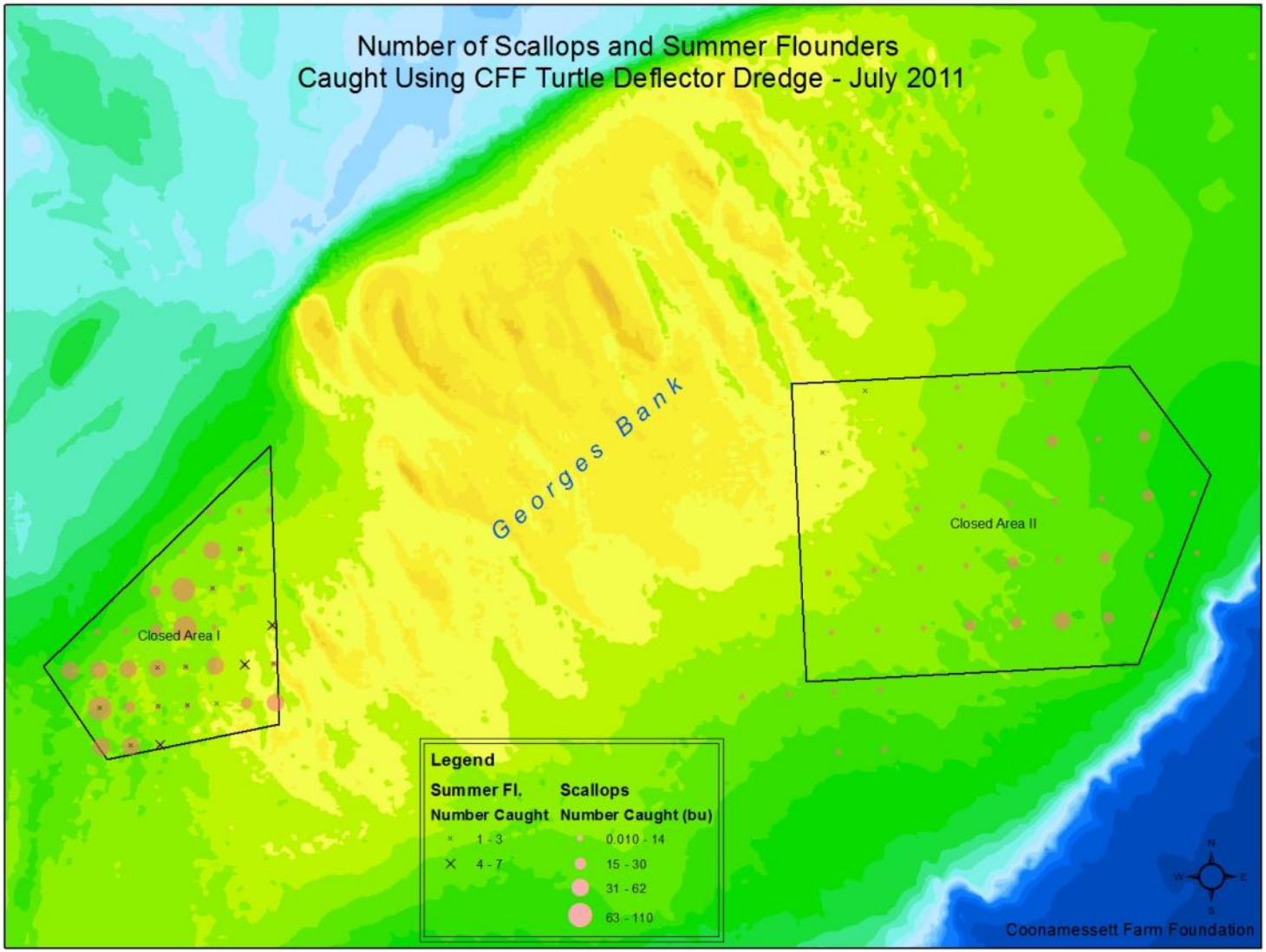

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

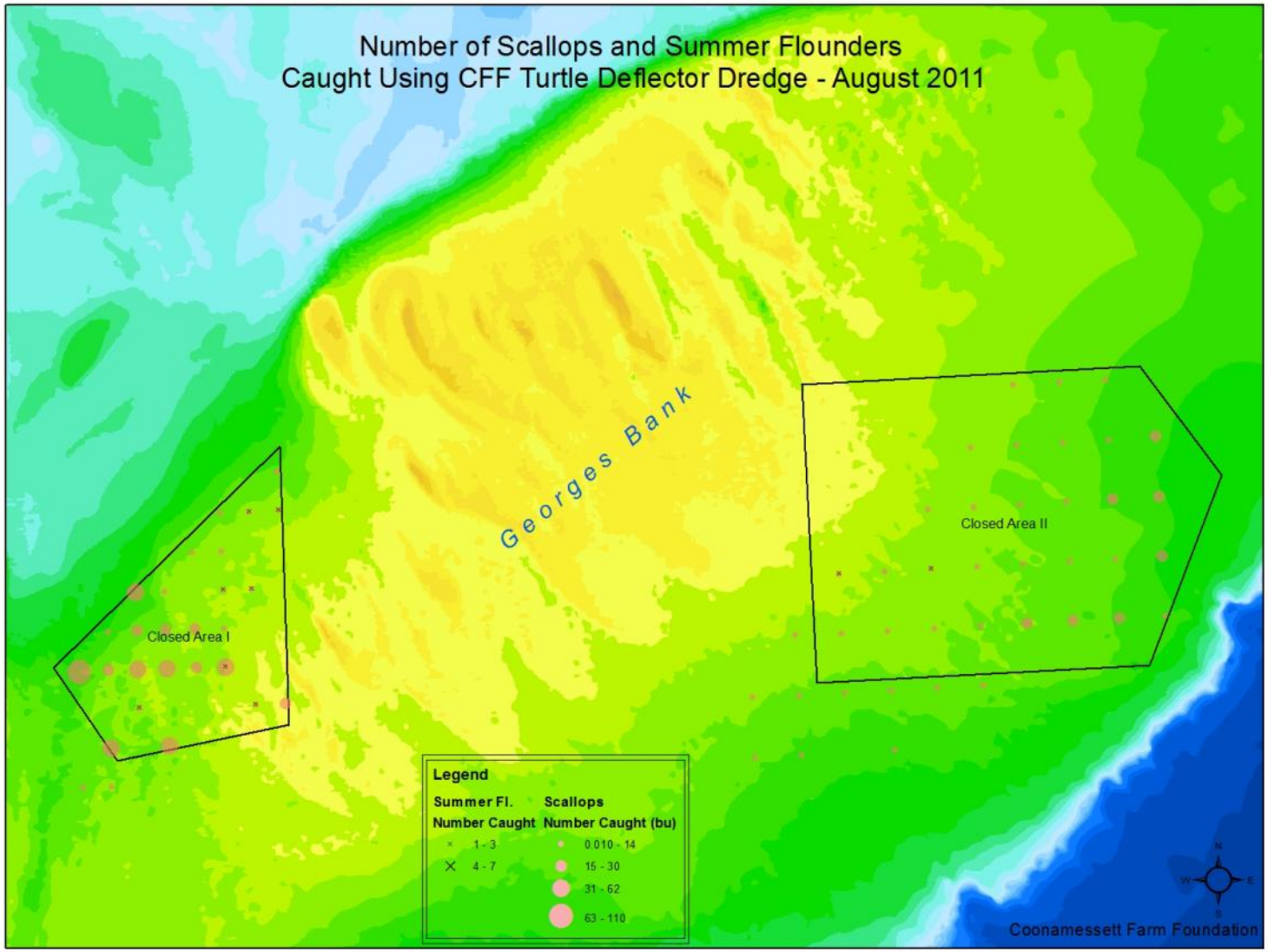
Note:  No summer flounder were caught in April 2011.

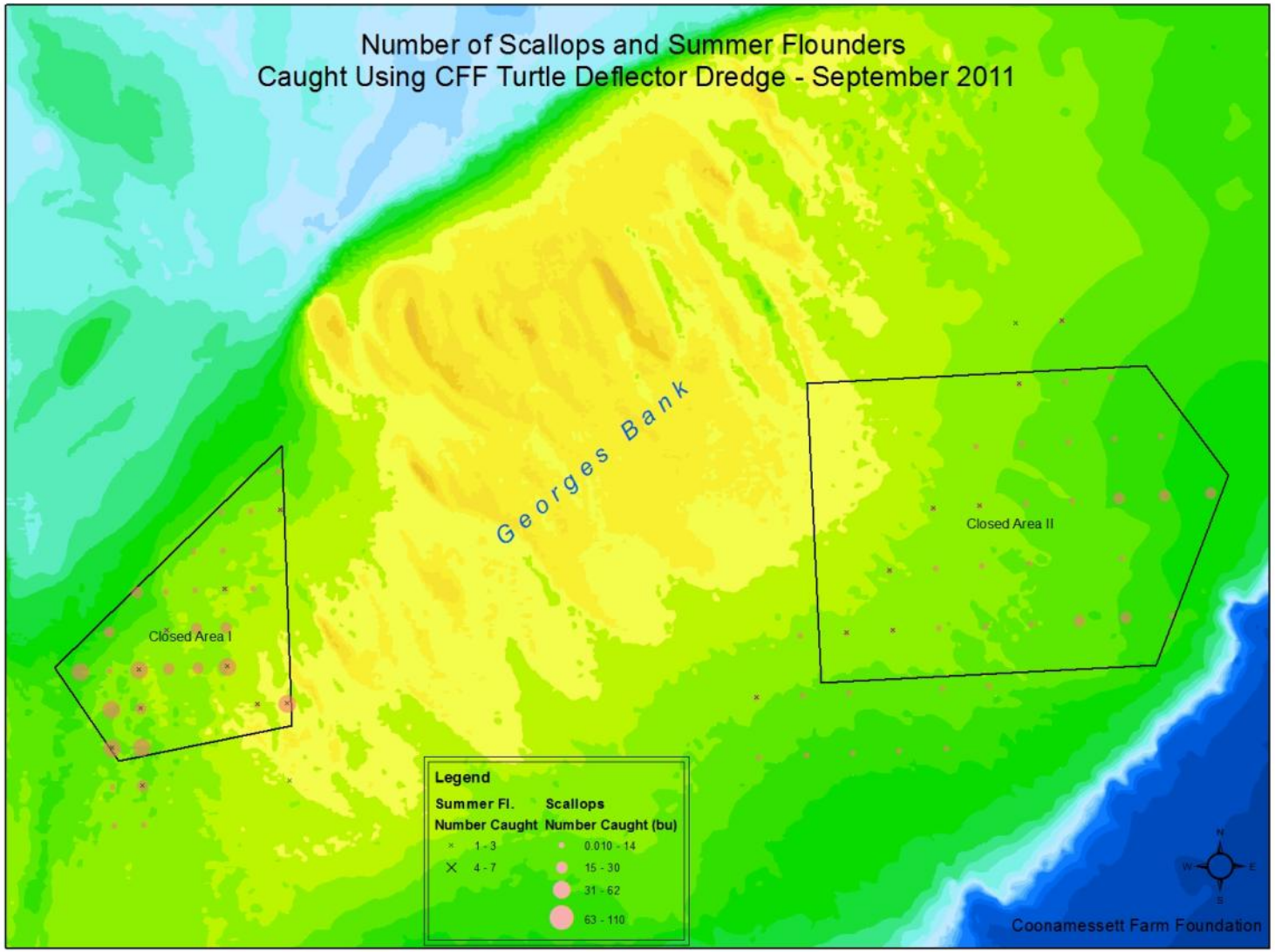

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

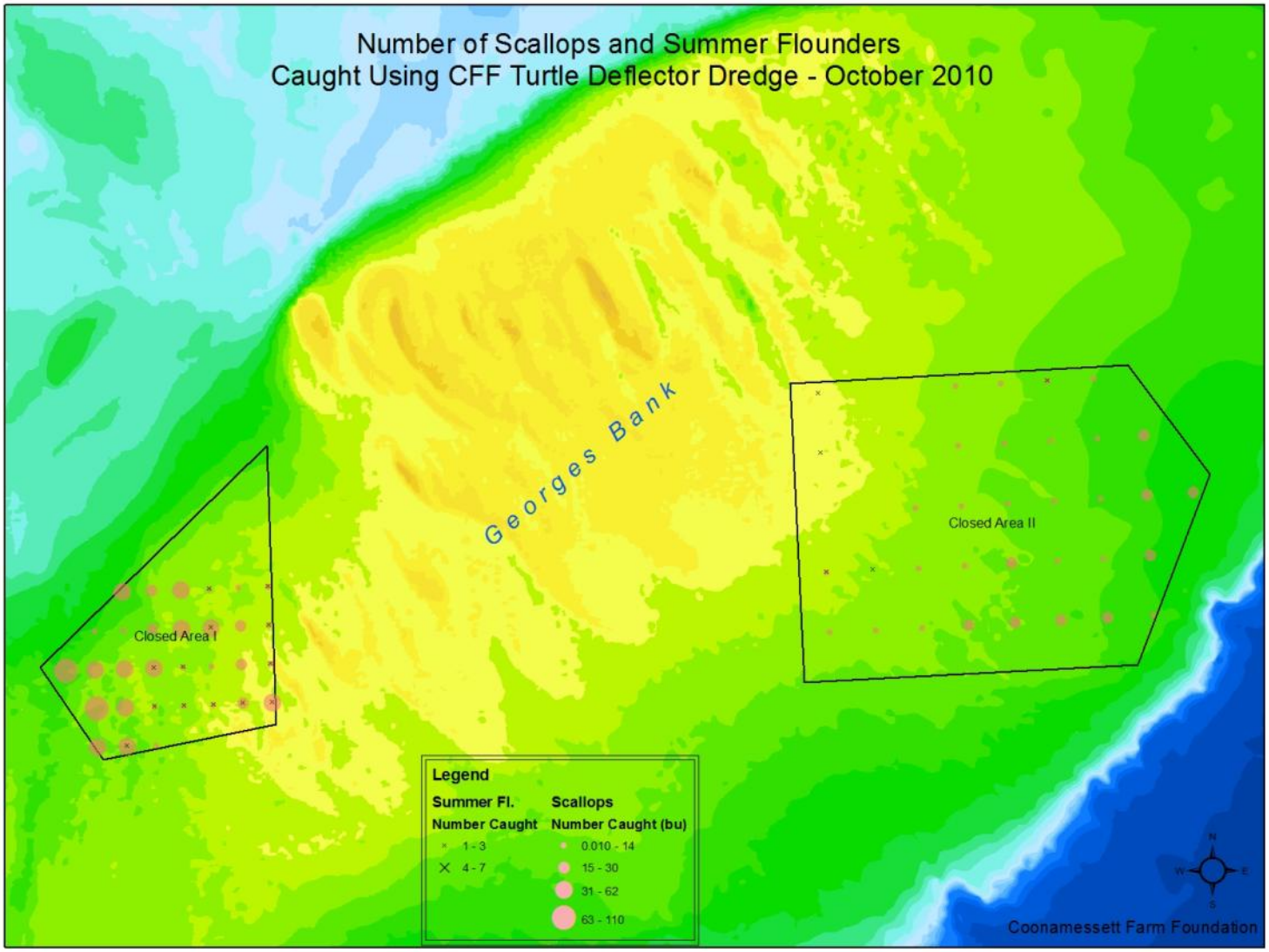

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

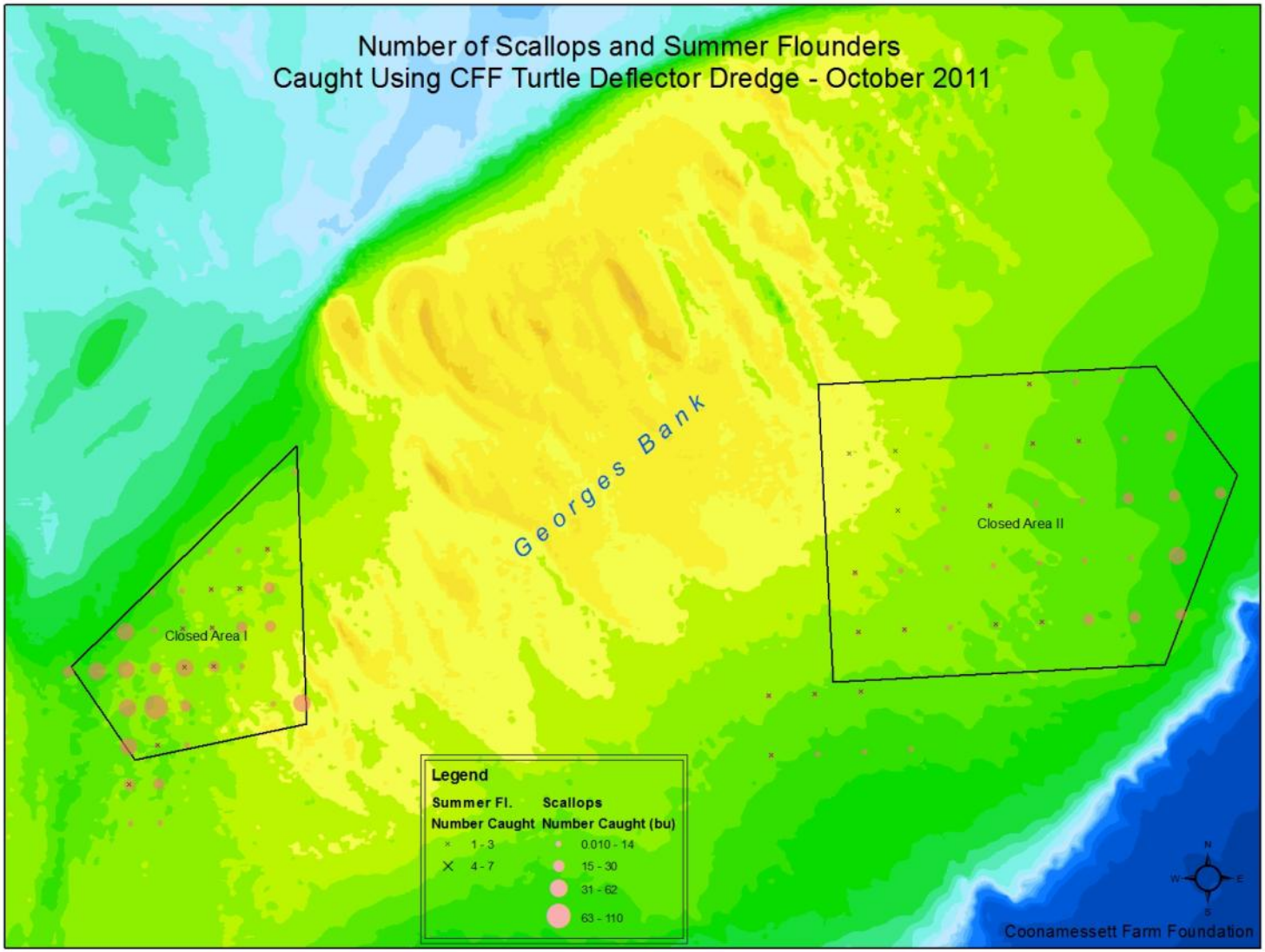

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

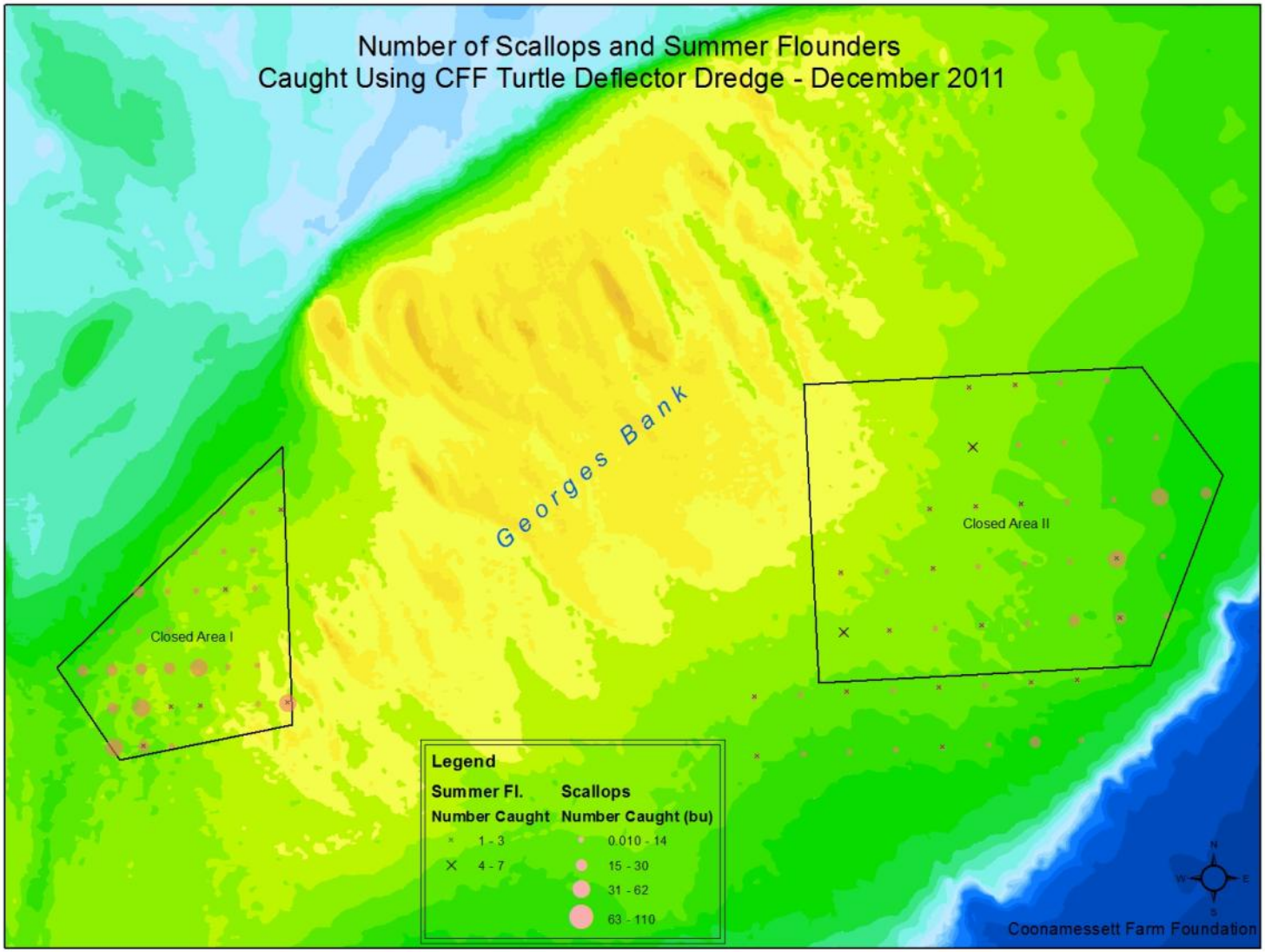

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation


Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

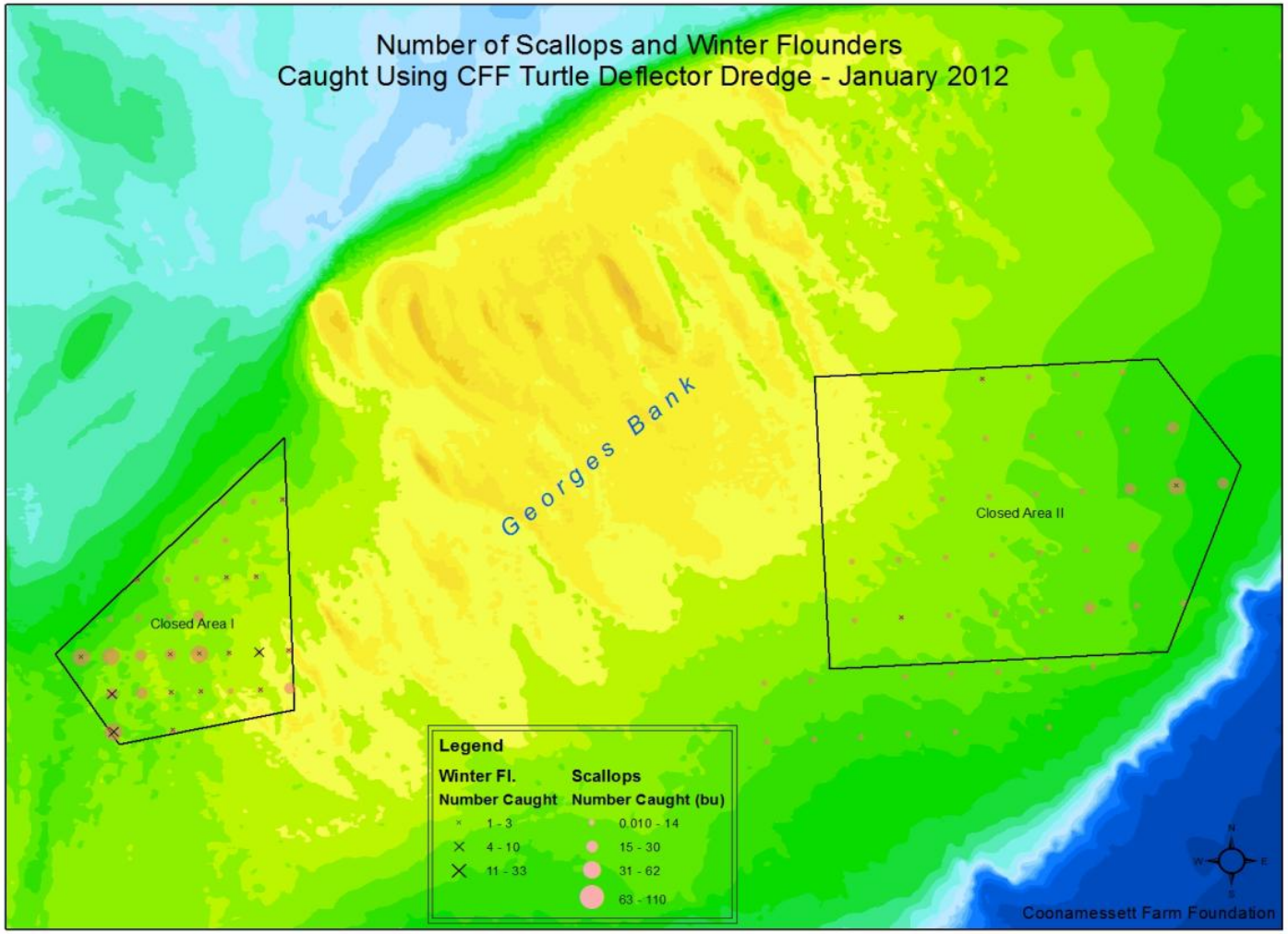

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

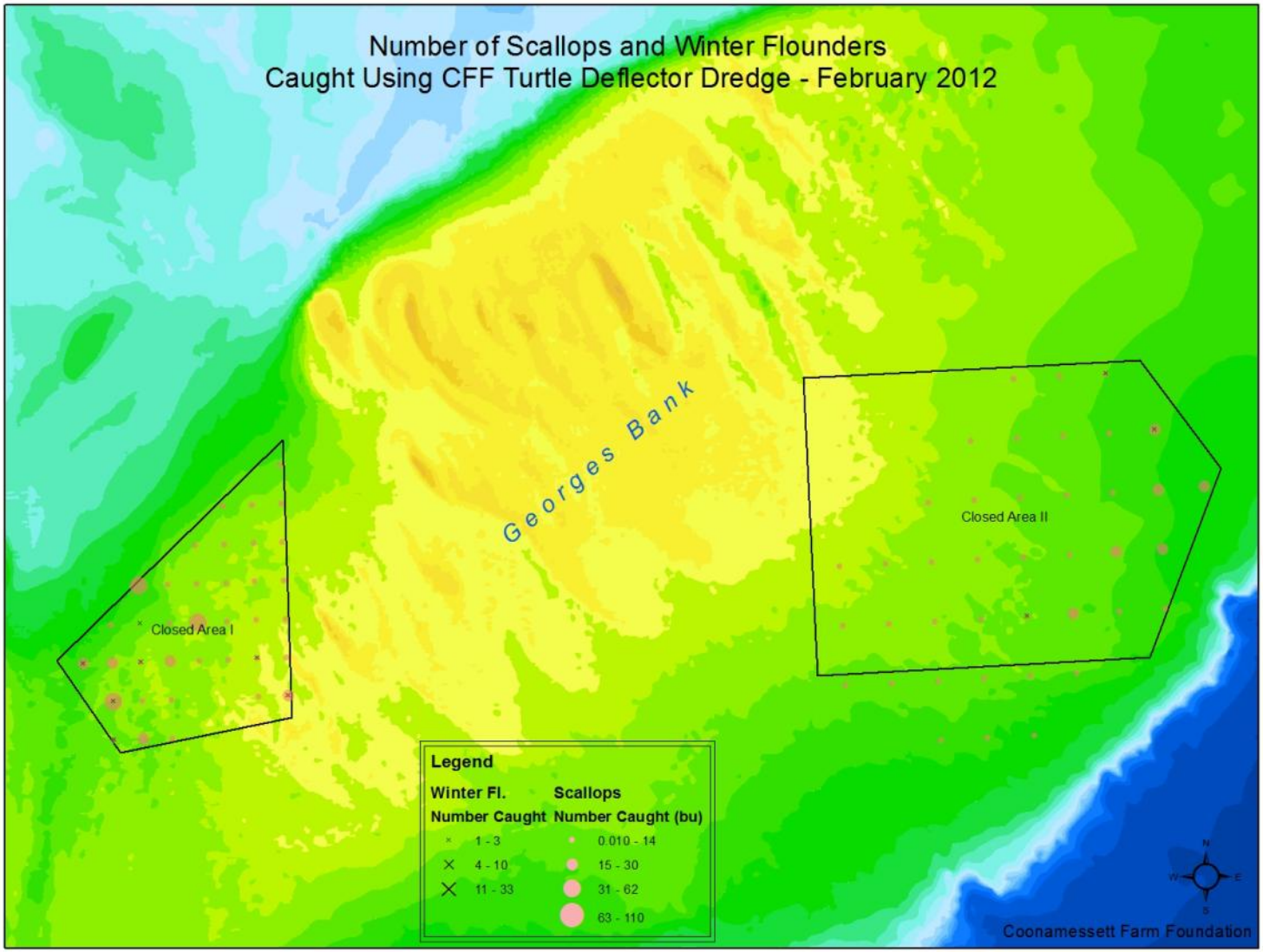

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

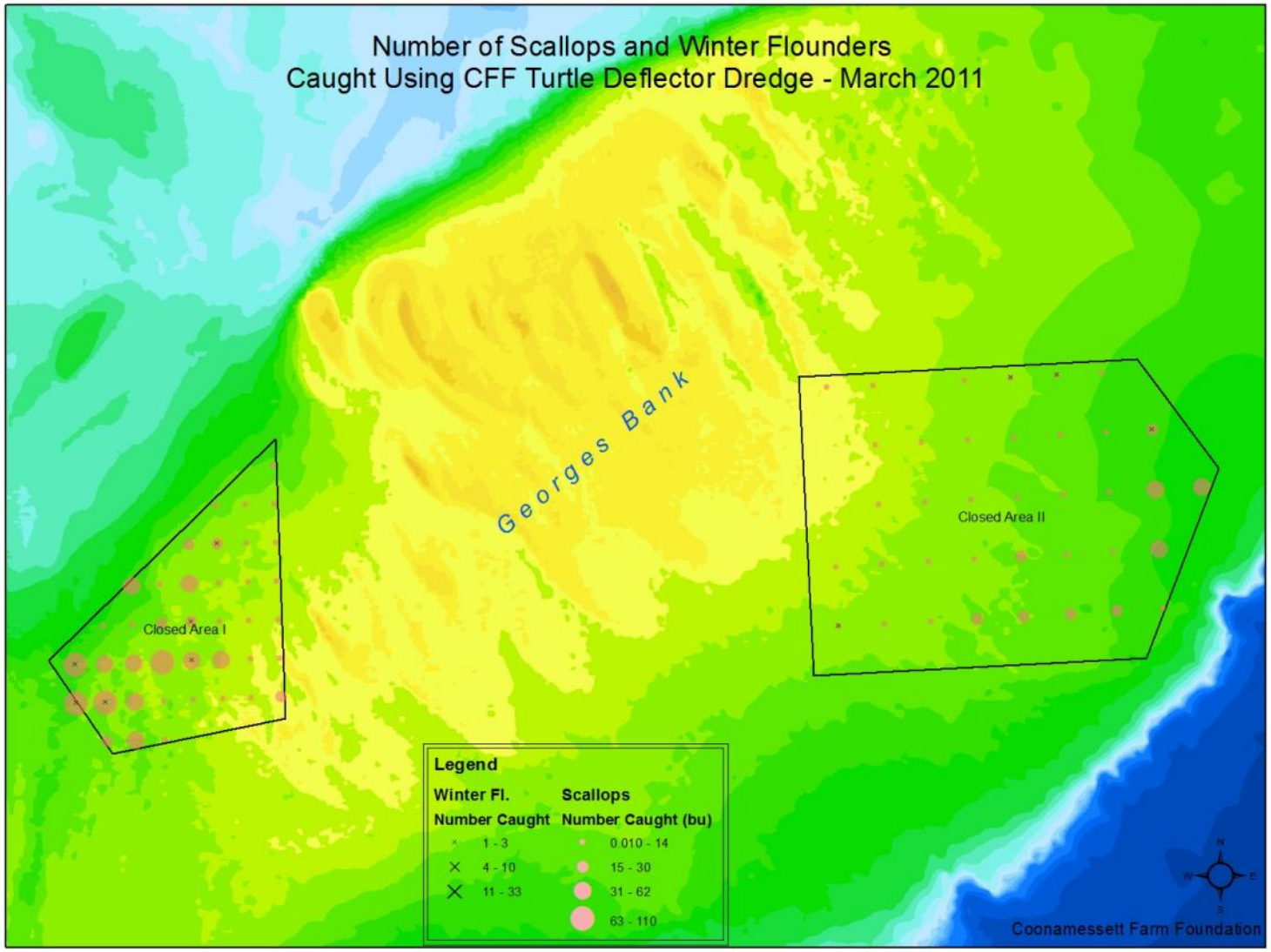

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

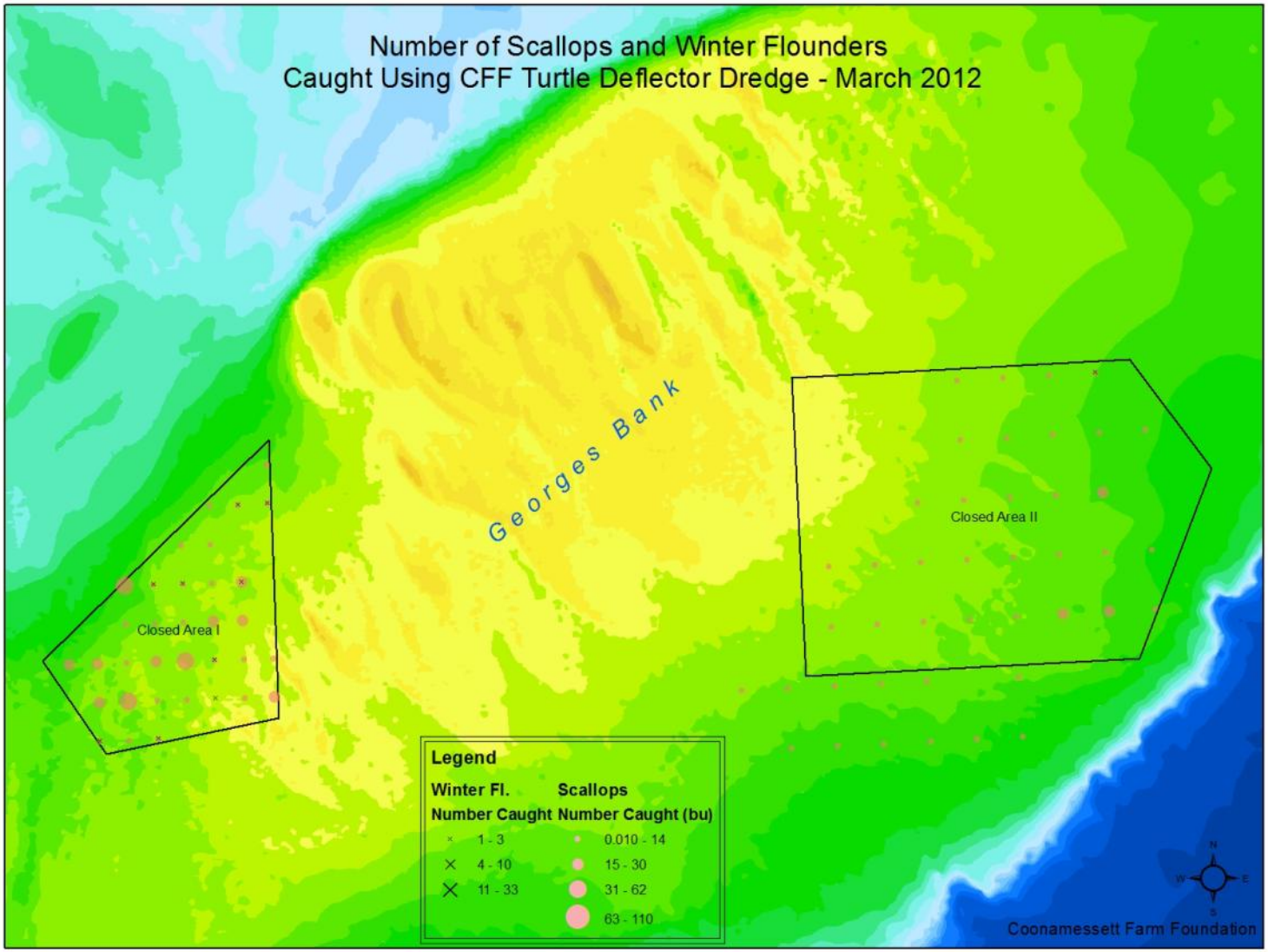

Number of Scallops and Summer Flounders
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Summer Fl.
Number Caught
1 - 3
4 - 7
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

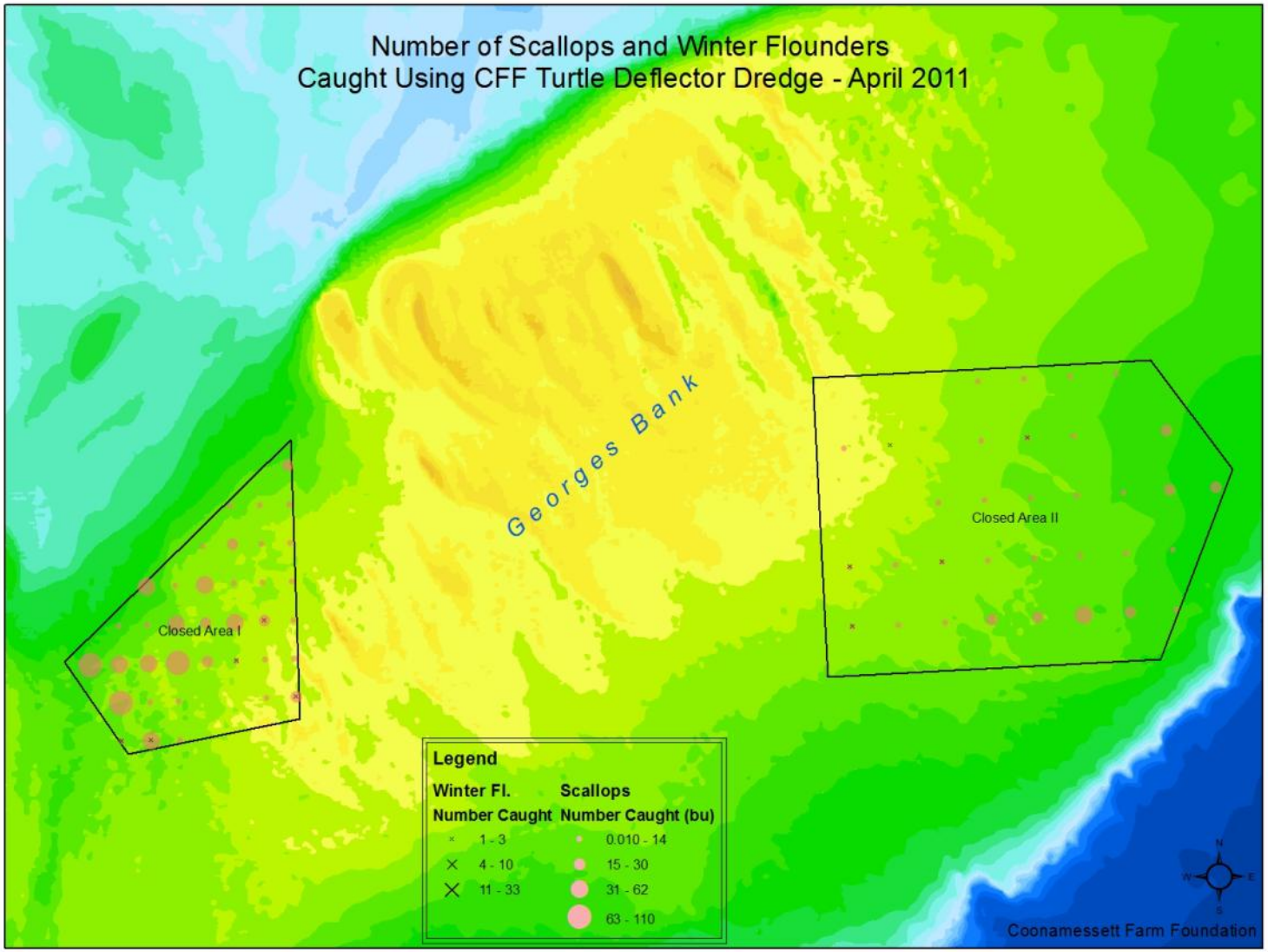
**Scallops and Winter Flounder**

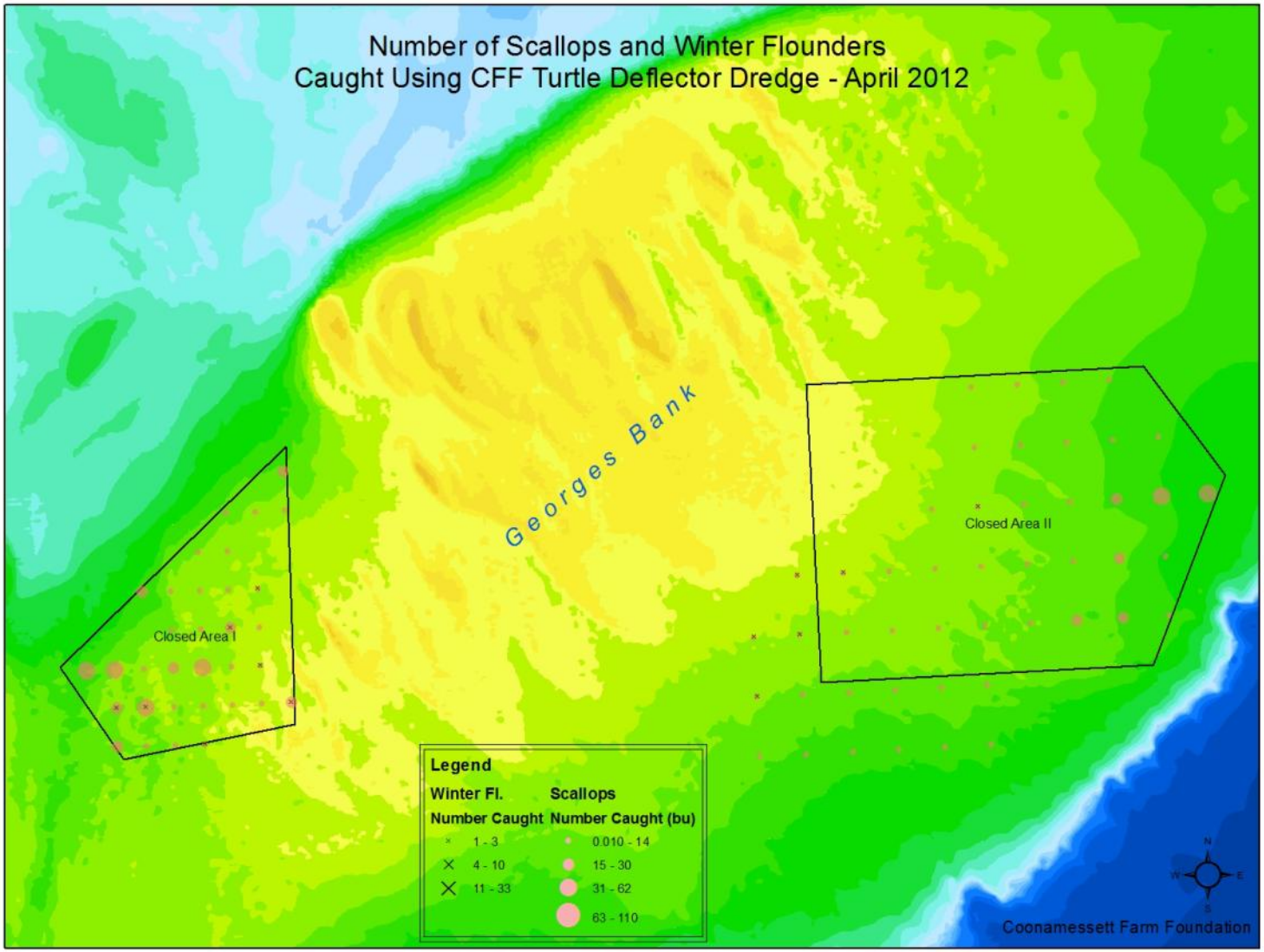


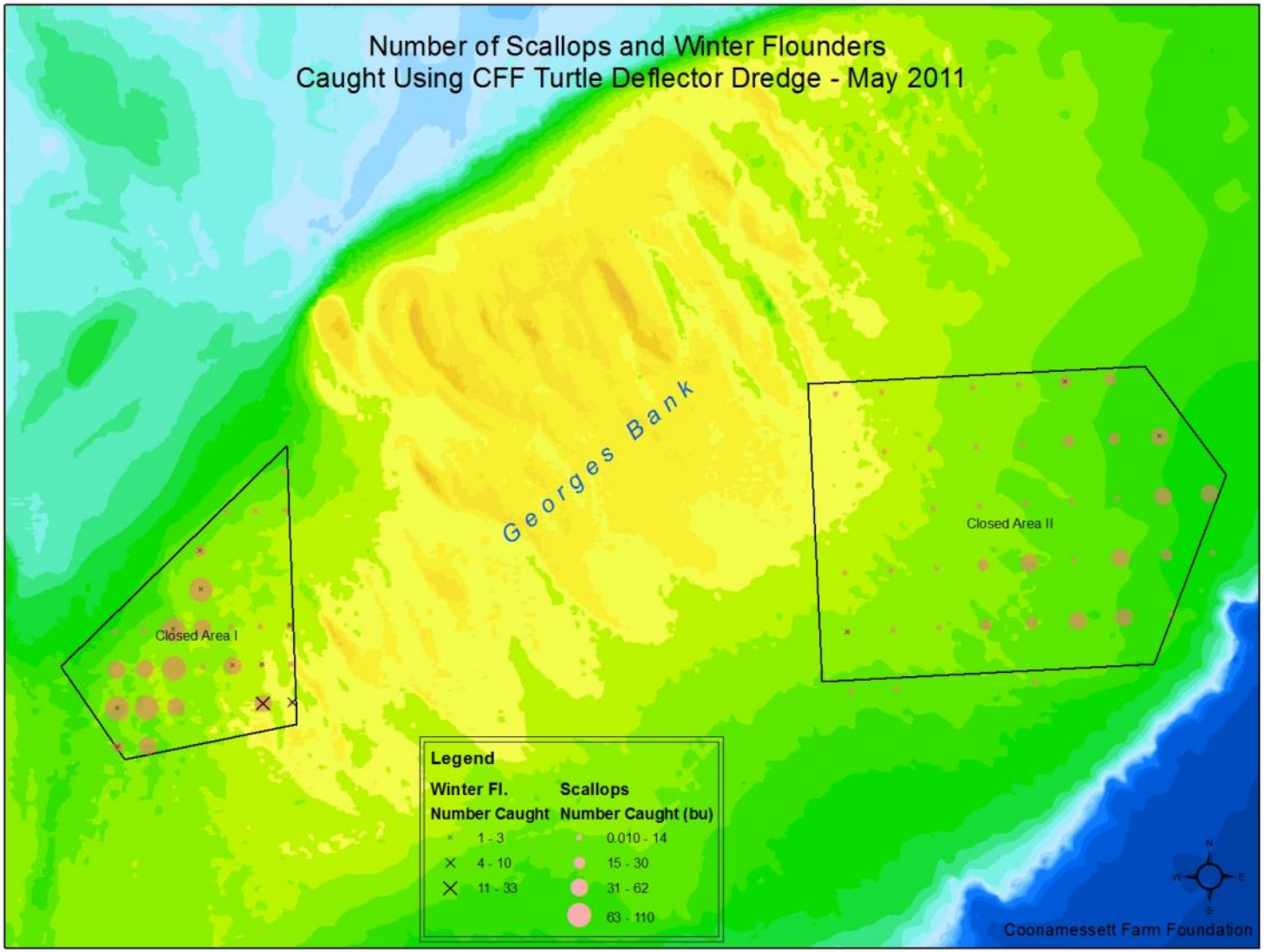

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

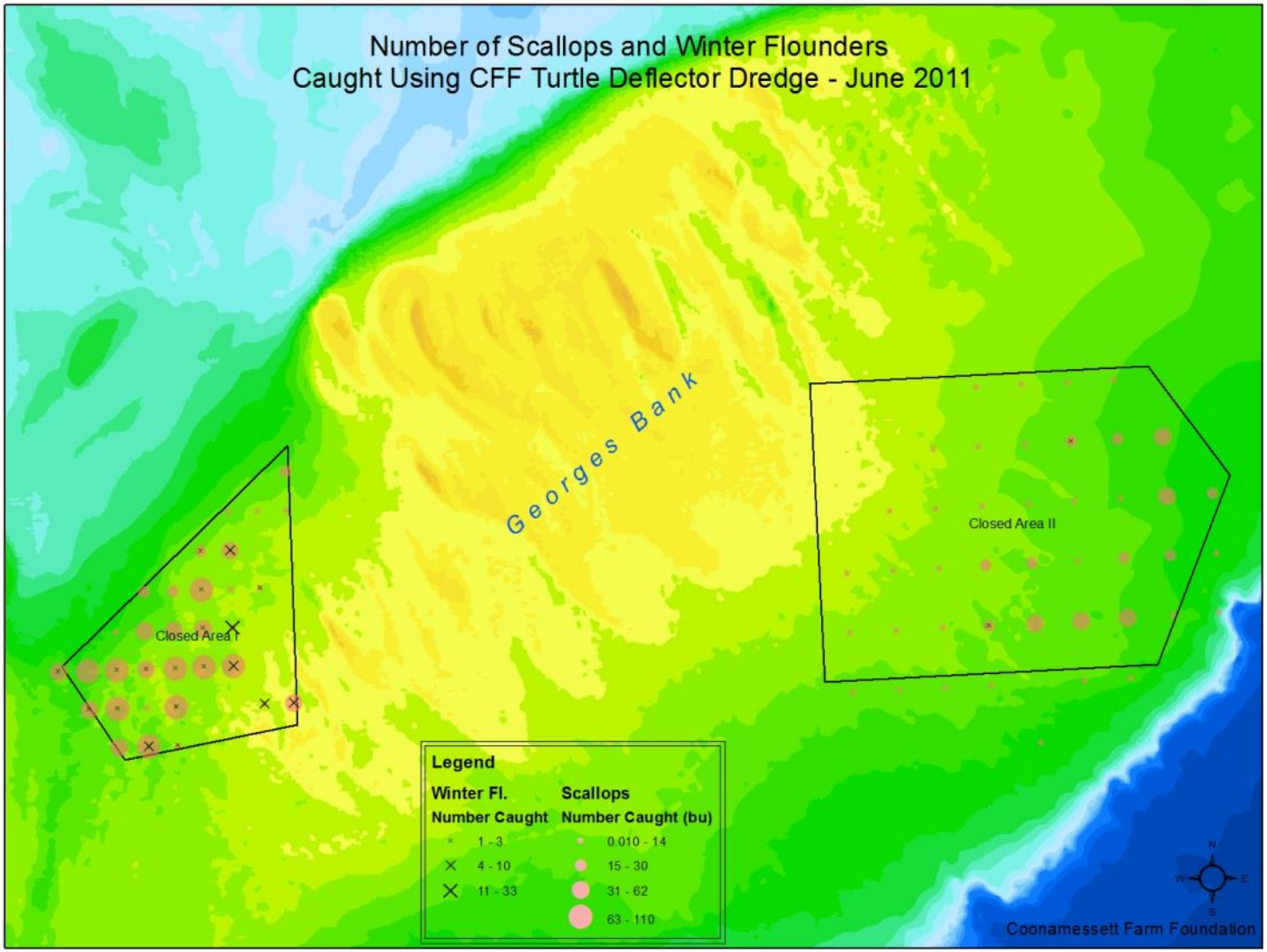

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

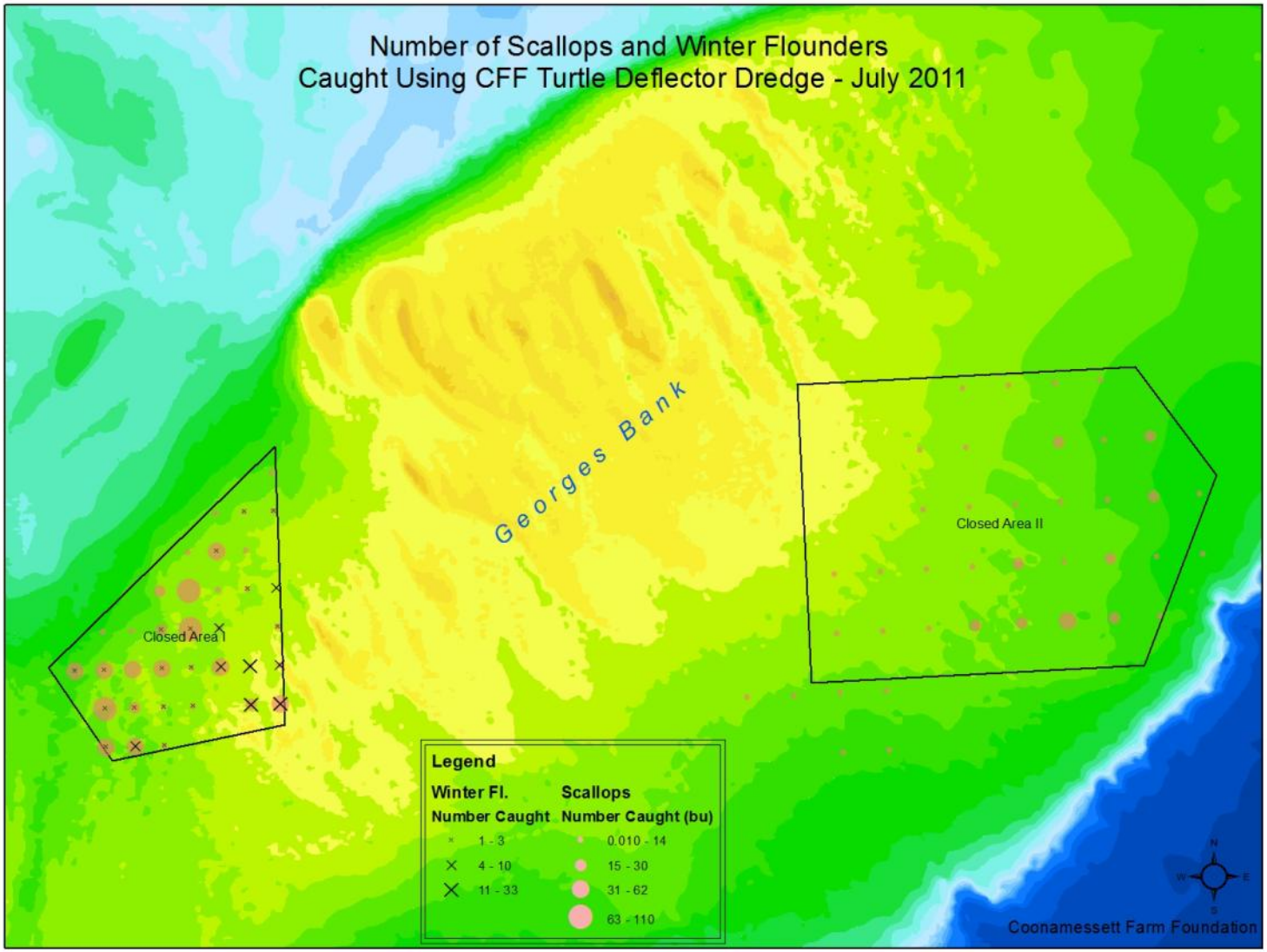

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

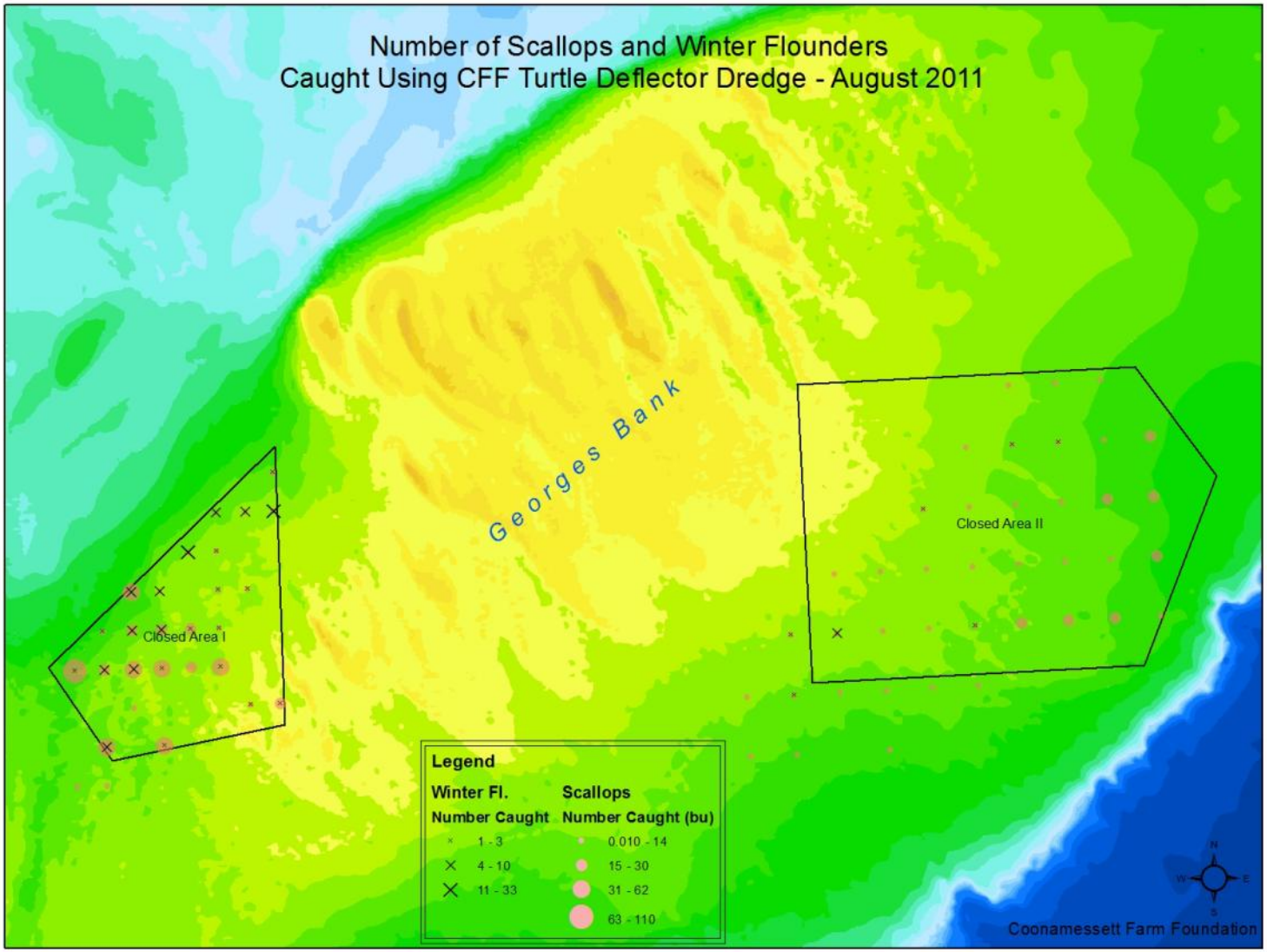

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

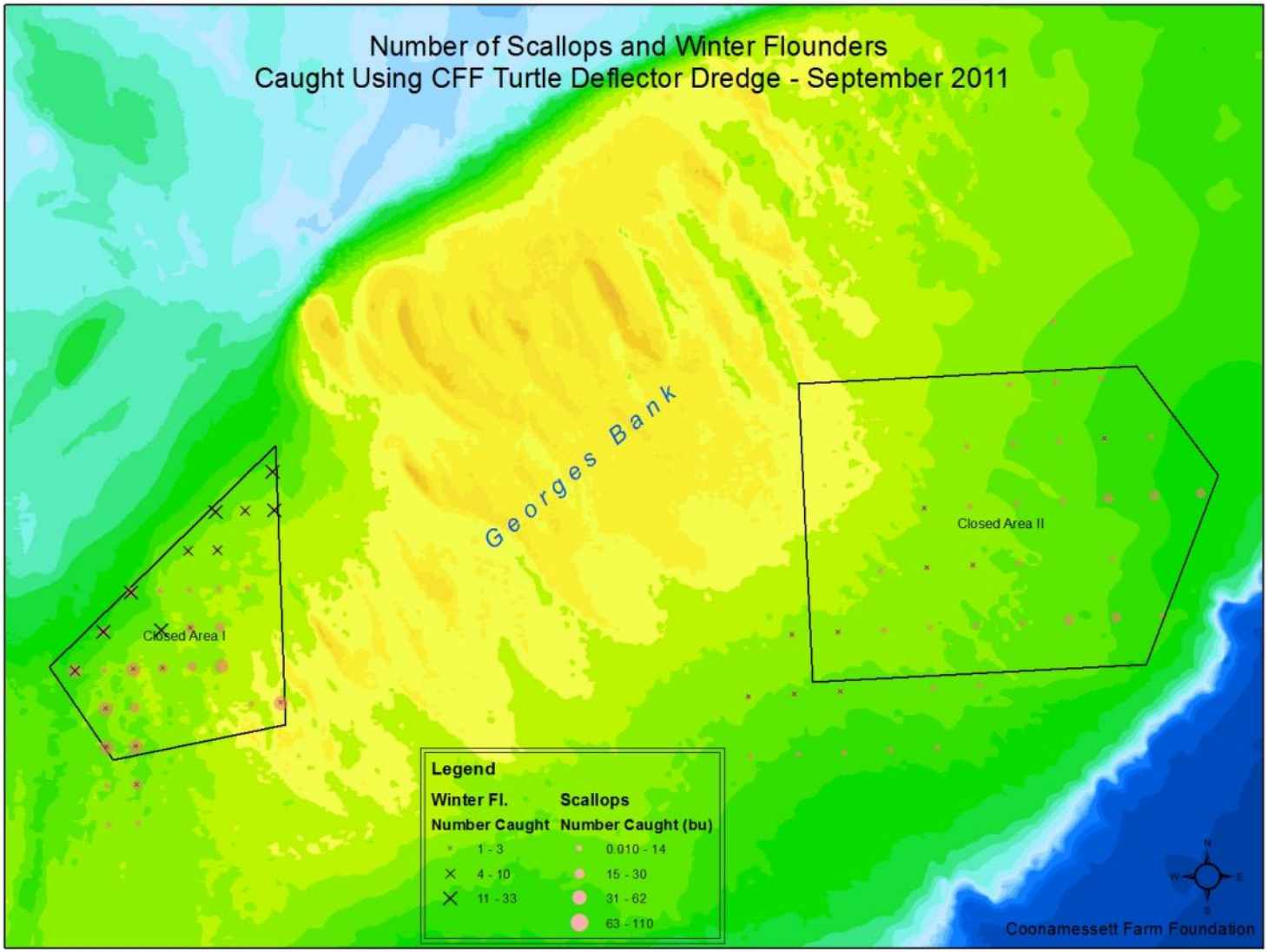

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

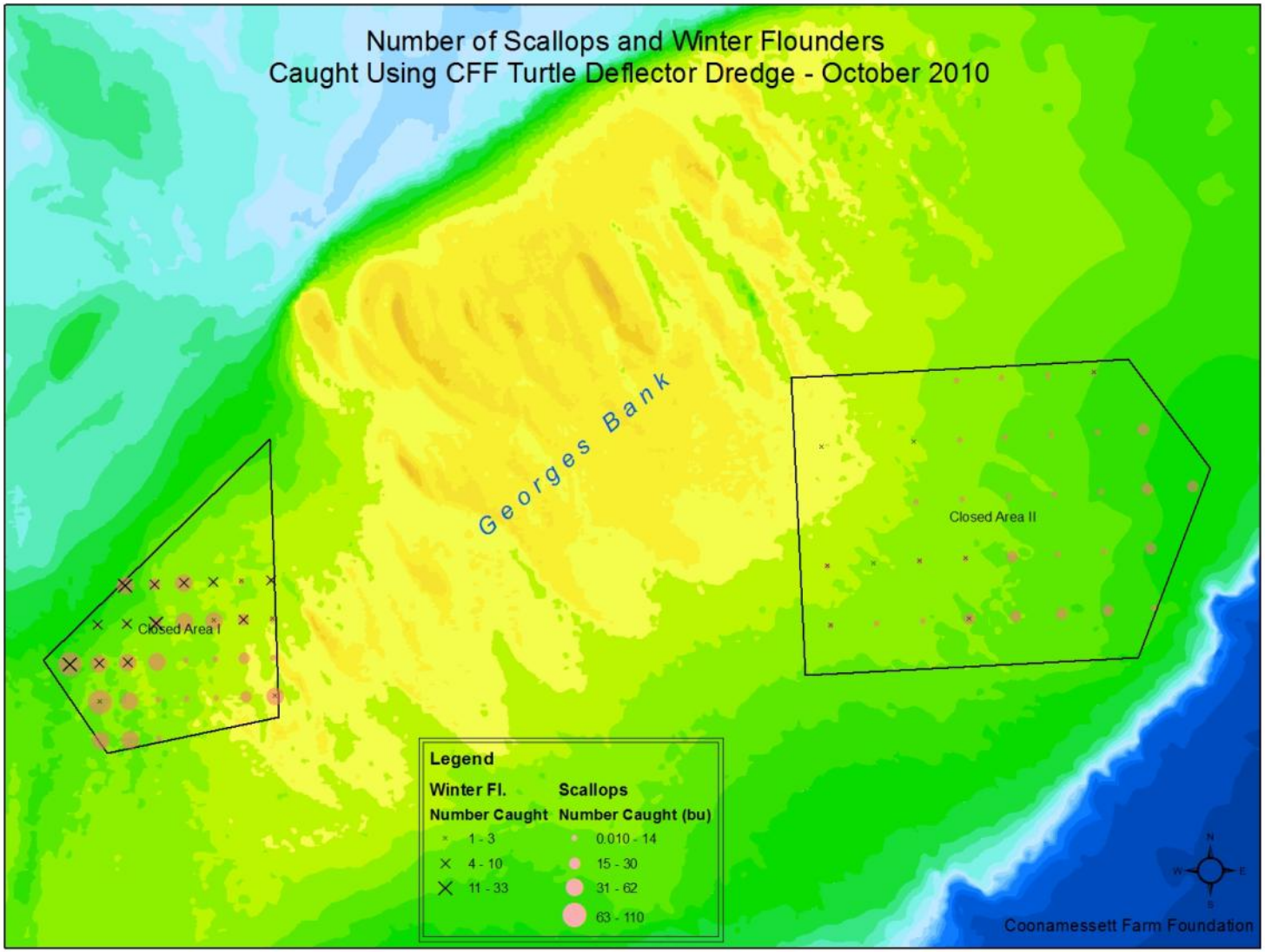

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

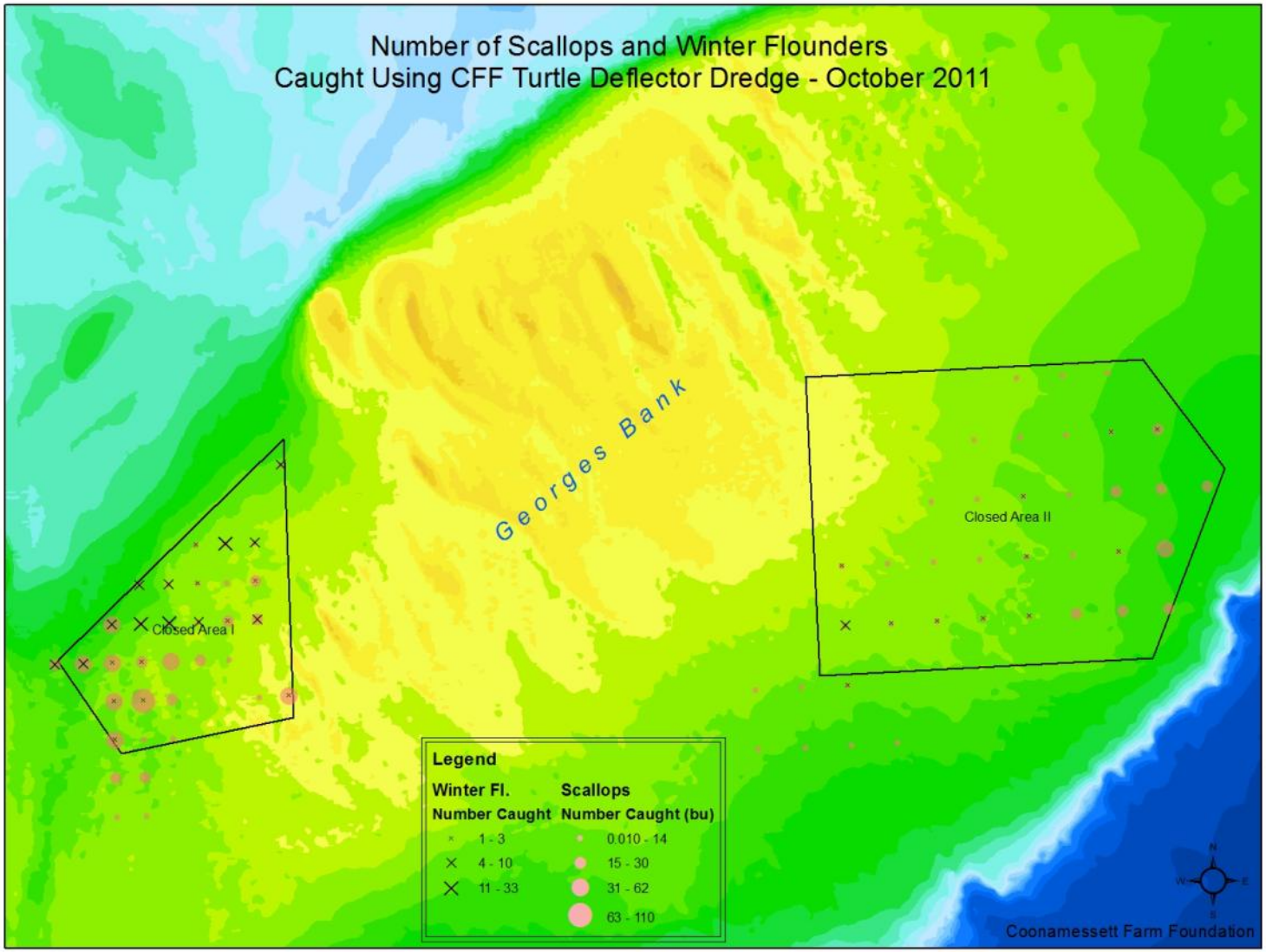

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

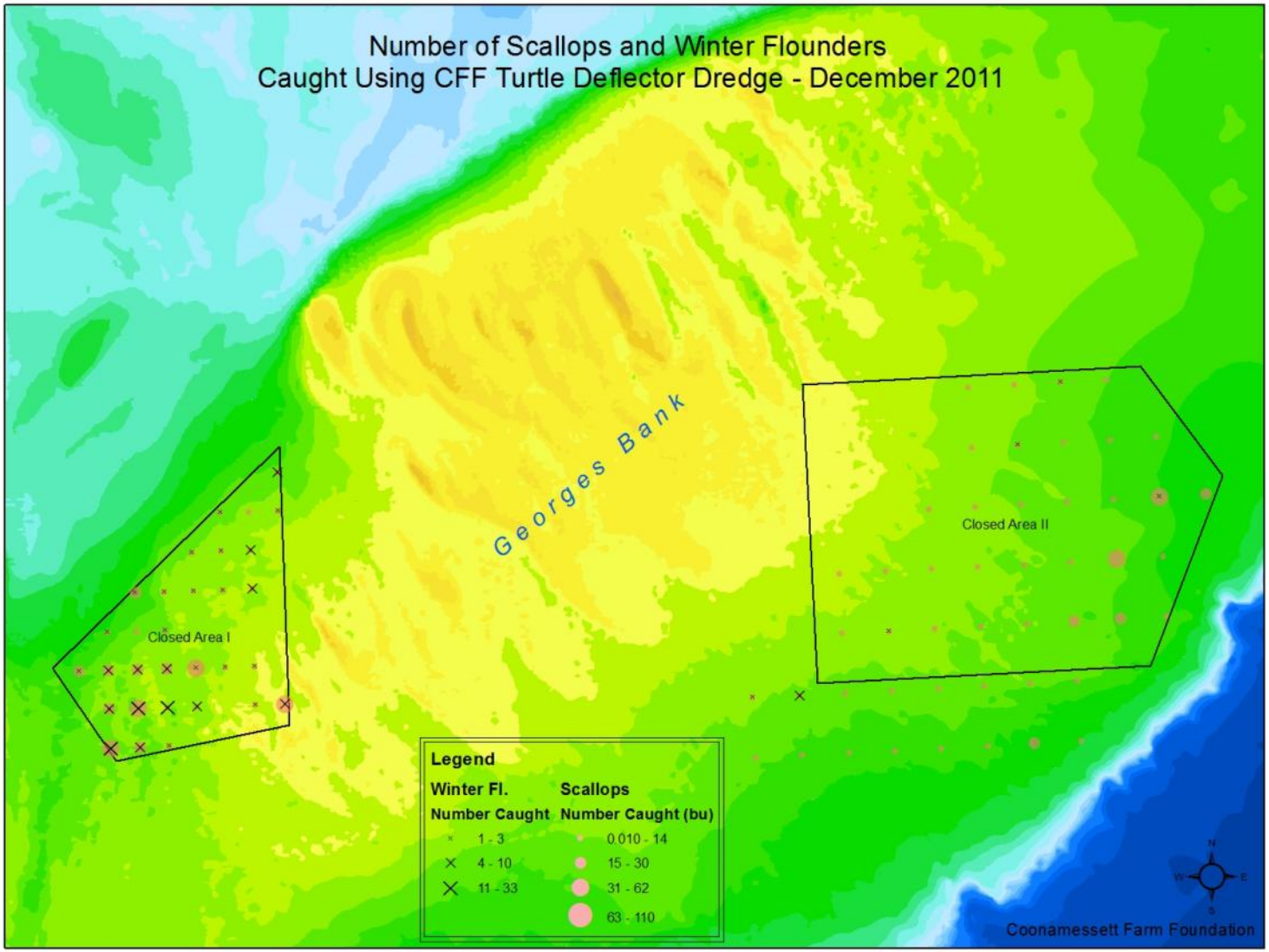

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

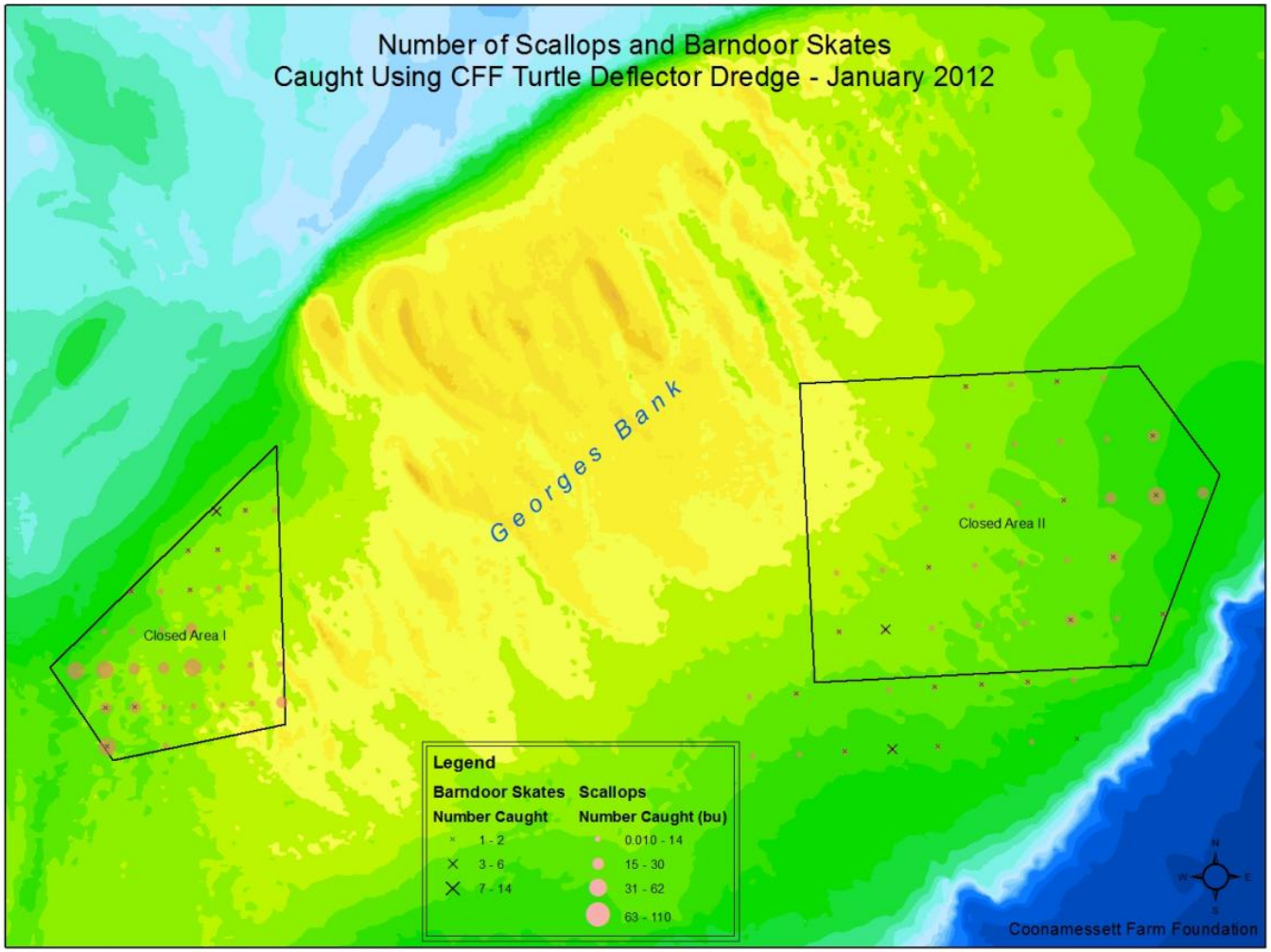

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

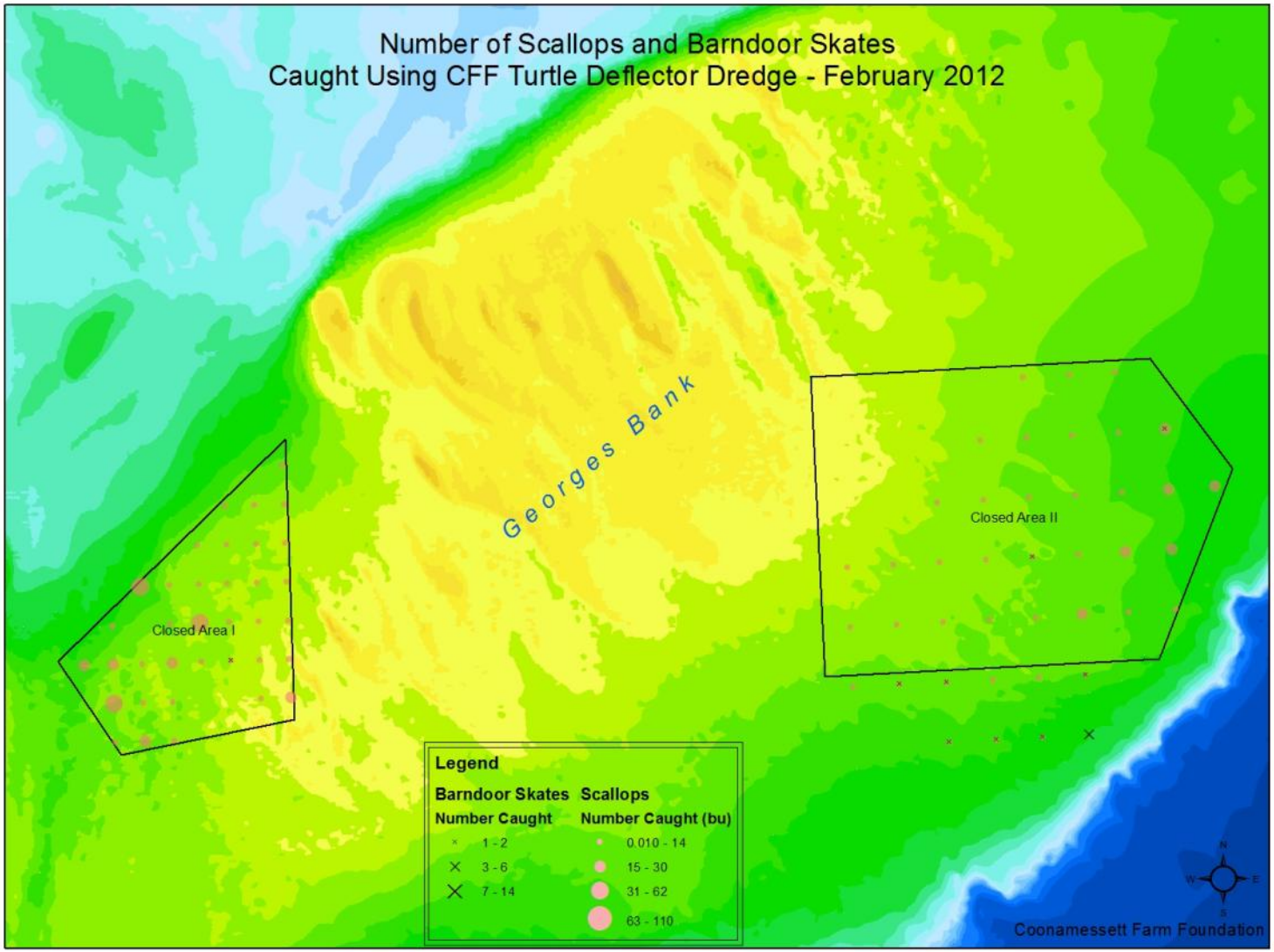

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

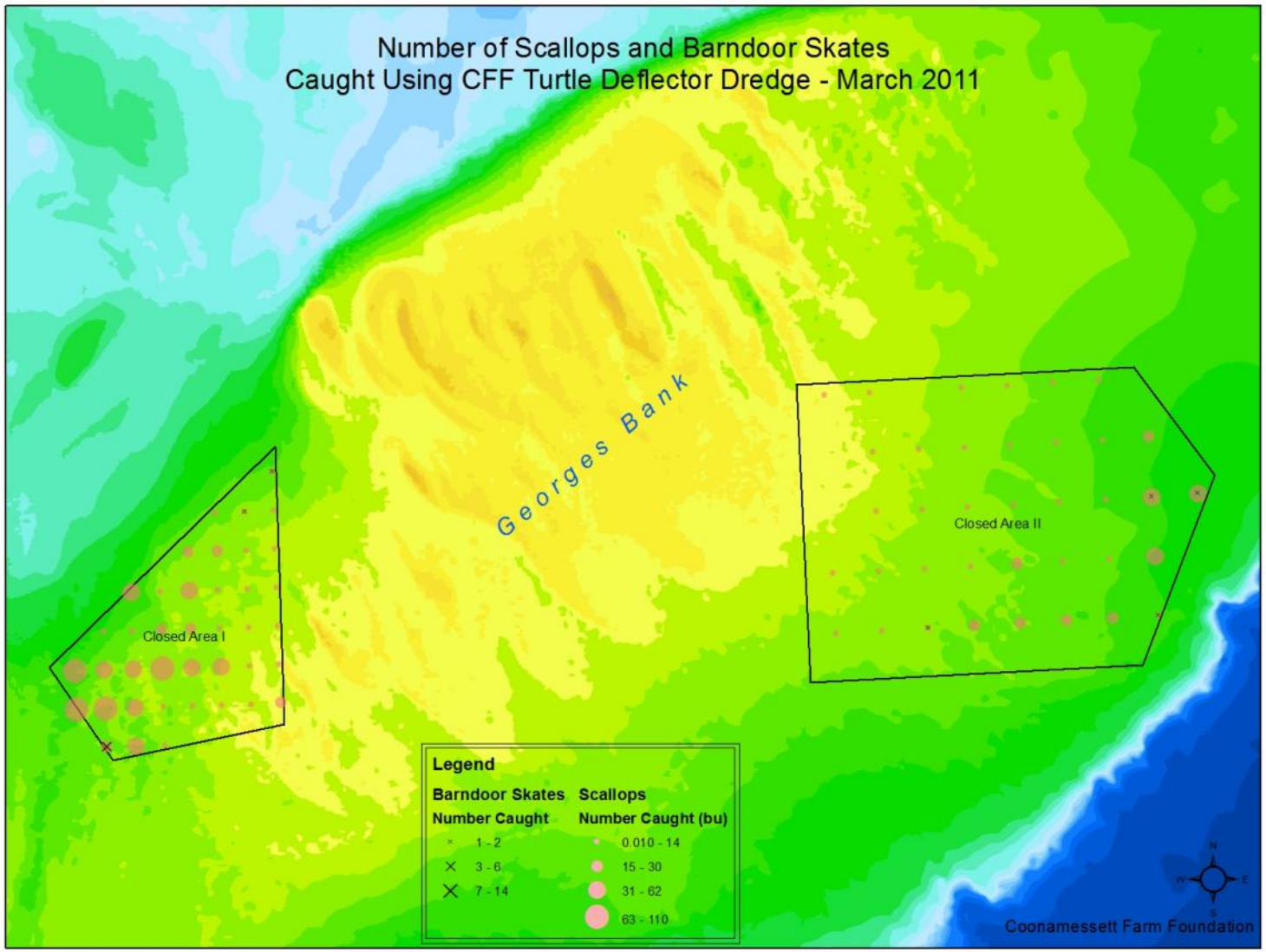

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

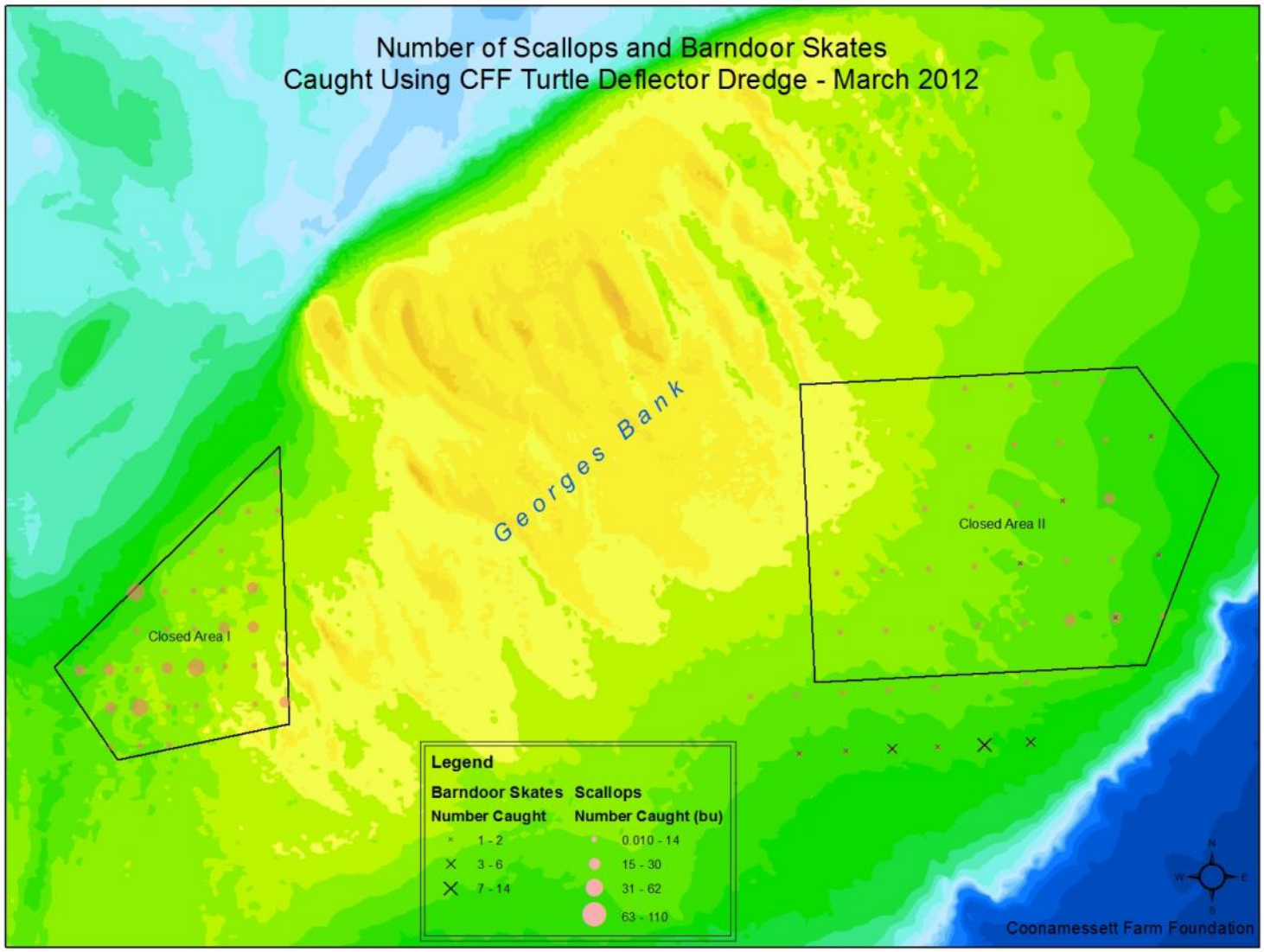

Number of Scallops and Winter Flounders
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Winter Fl.
Number Caught
1 - 3
4 - 10
11 - 33
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

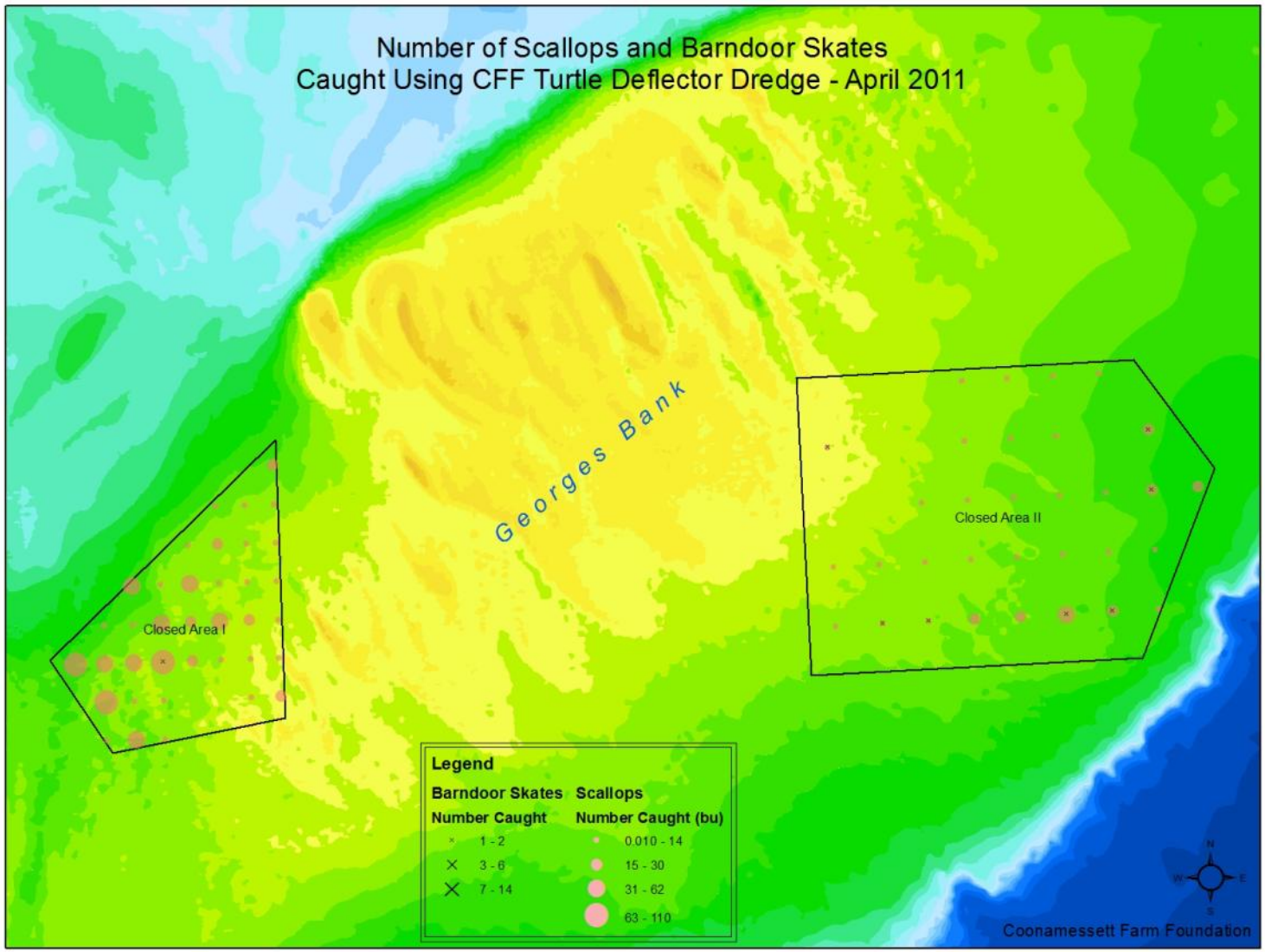
**Scallops and Barndoor Skates**

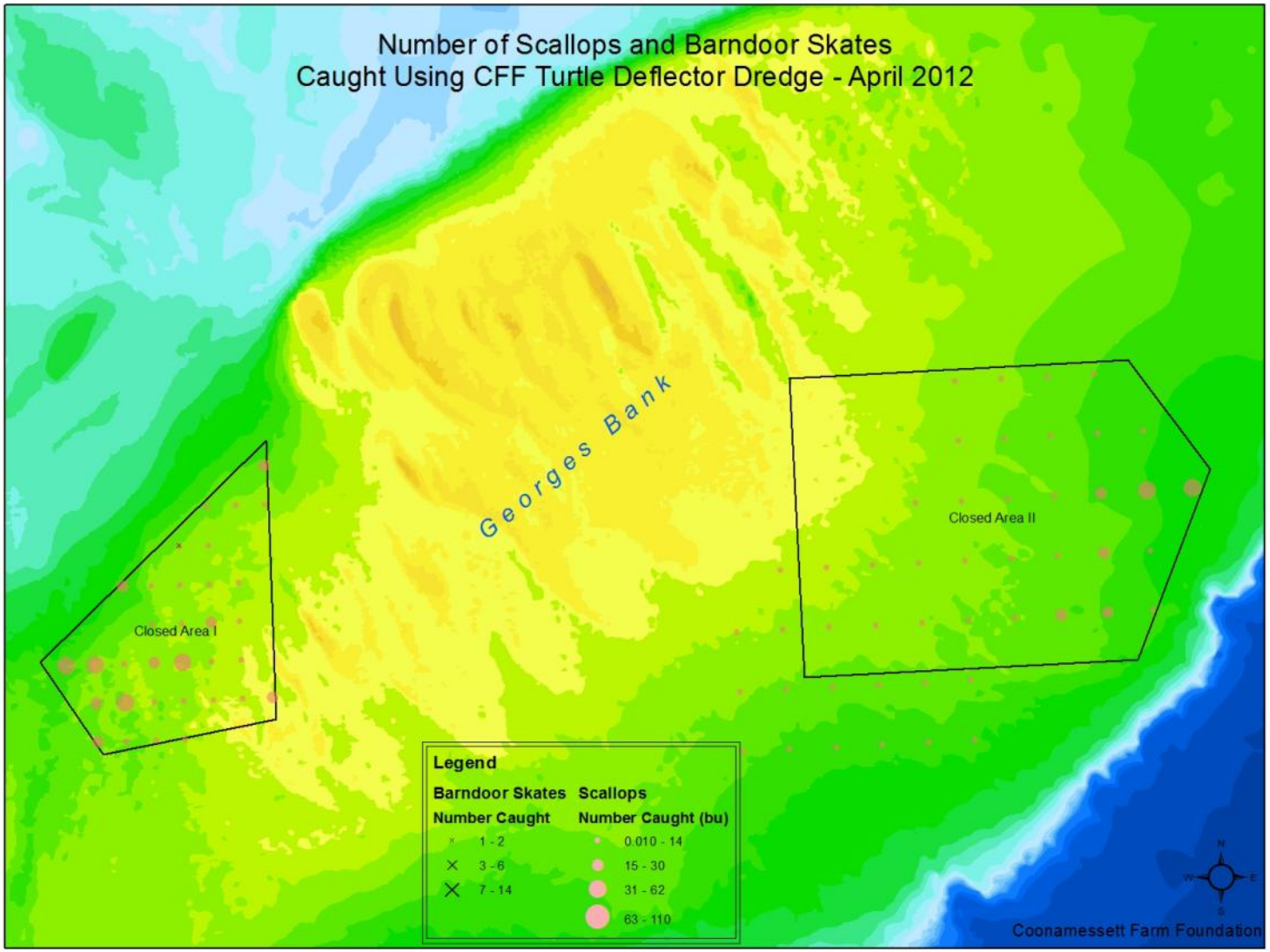


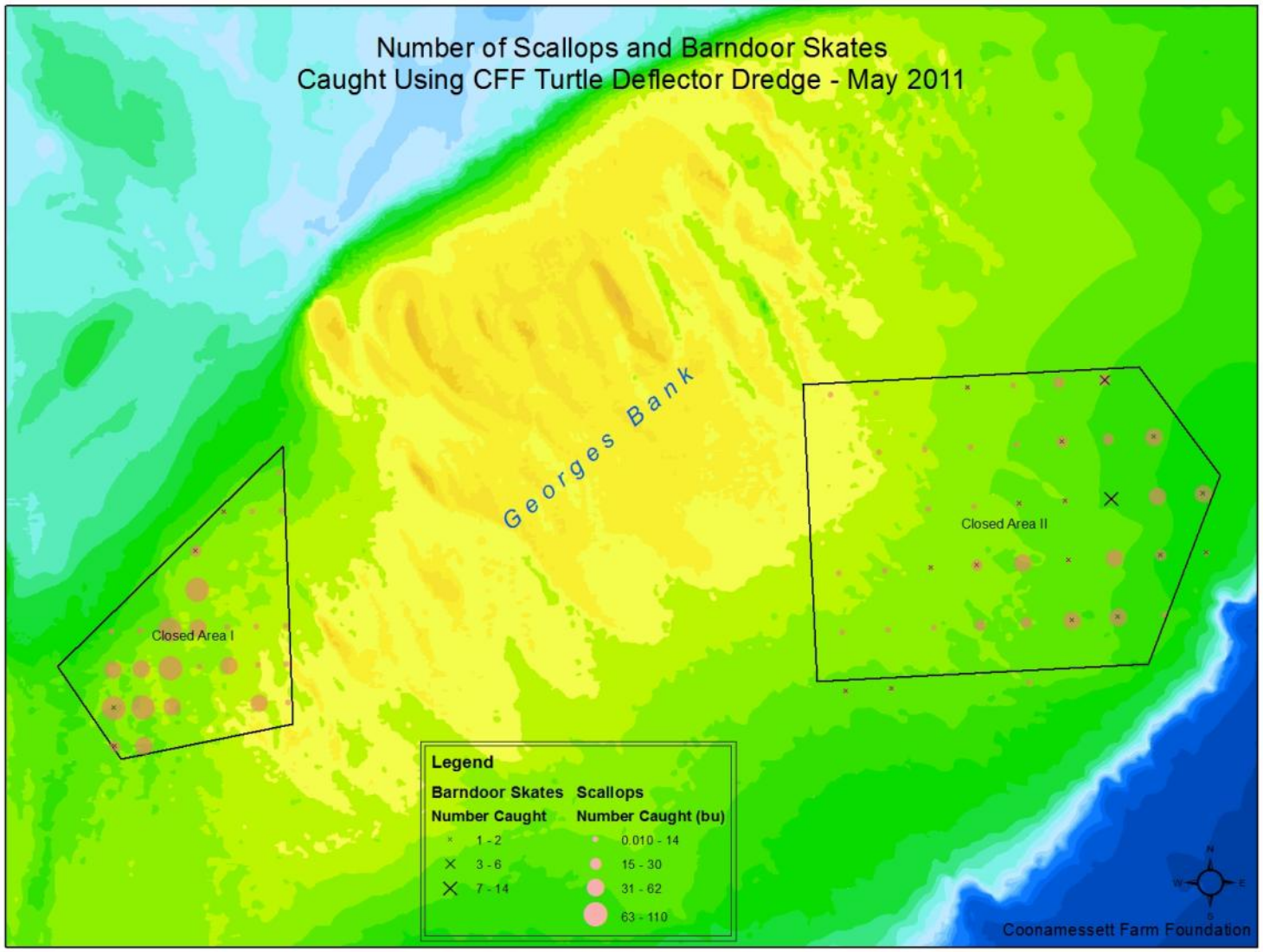

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

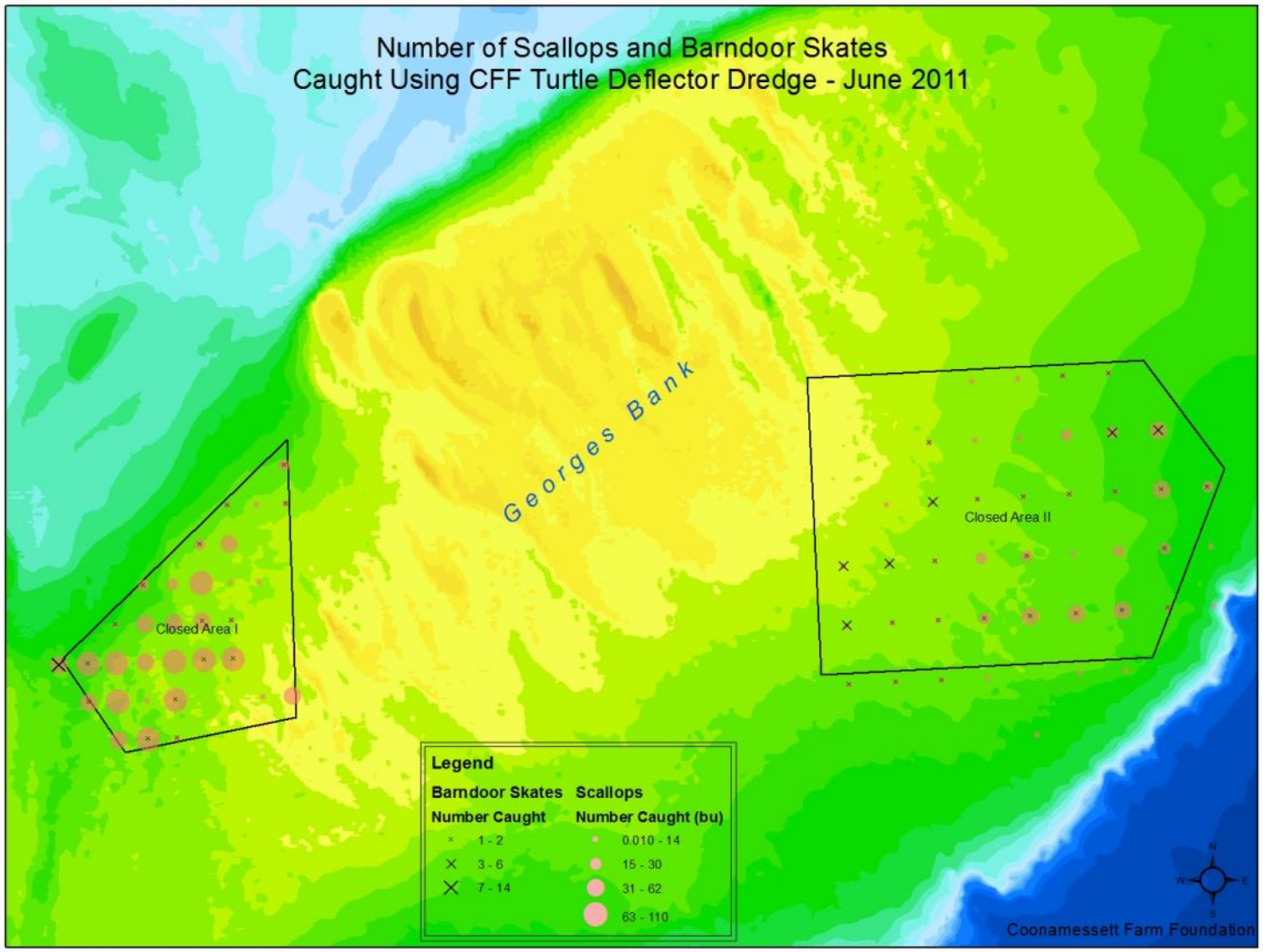

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

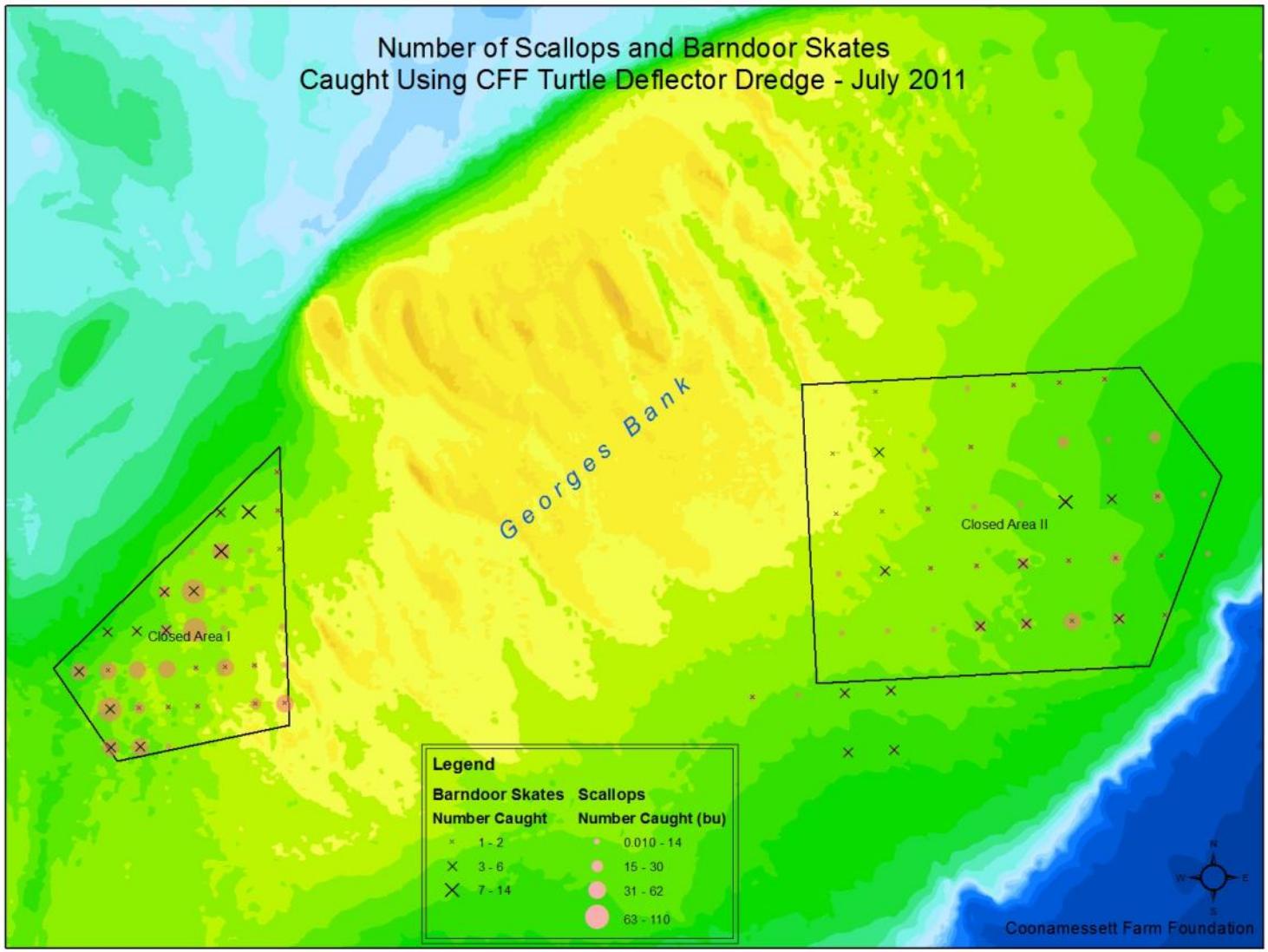

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
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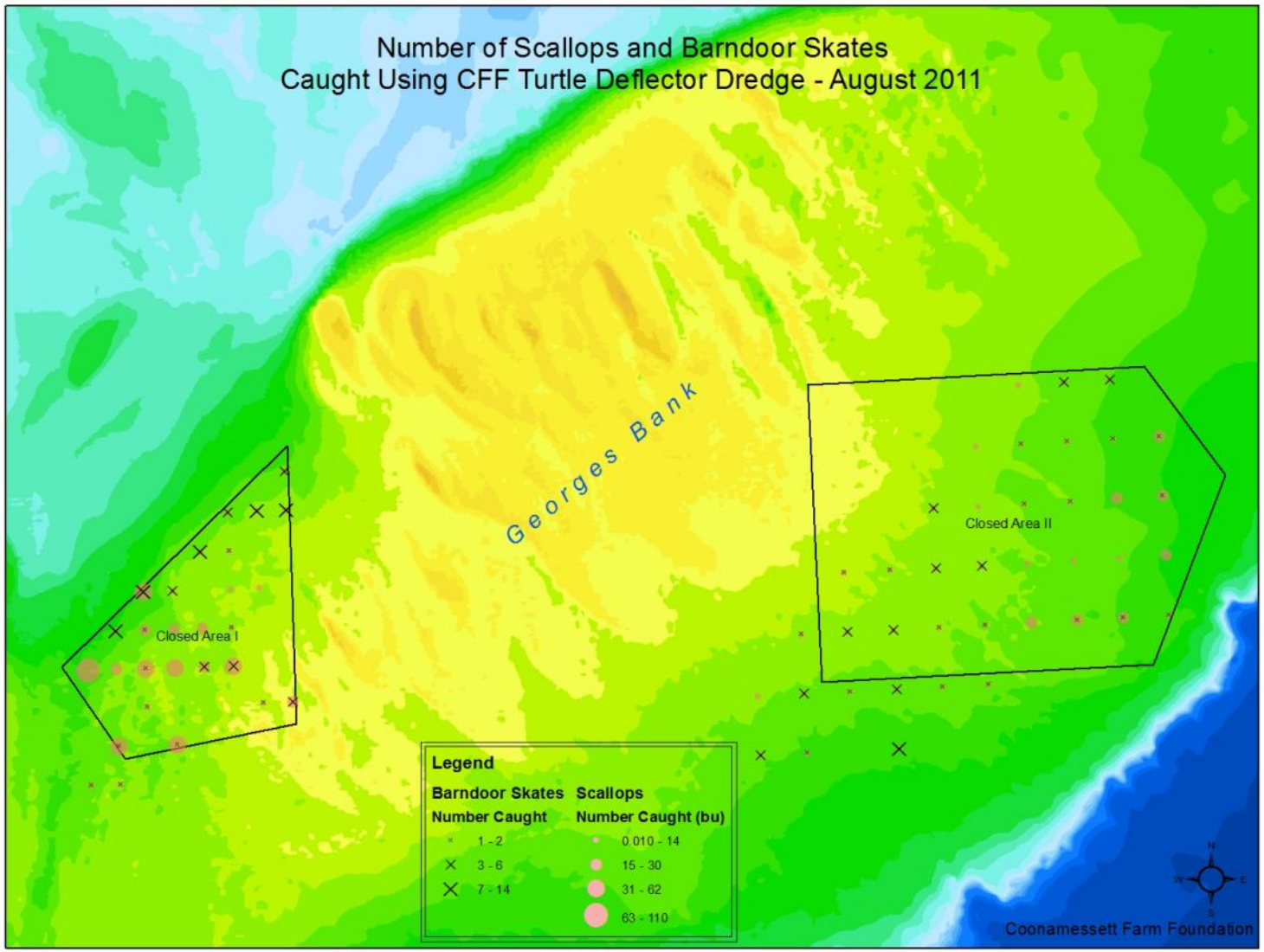
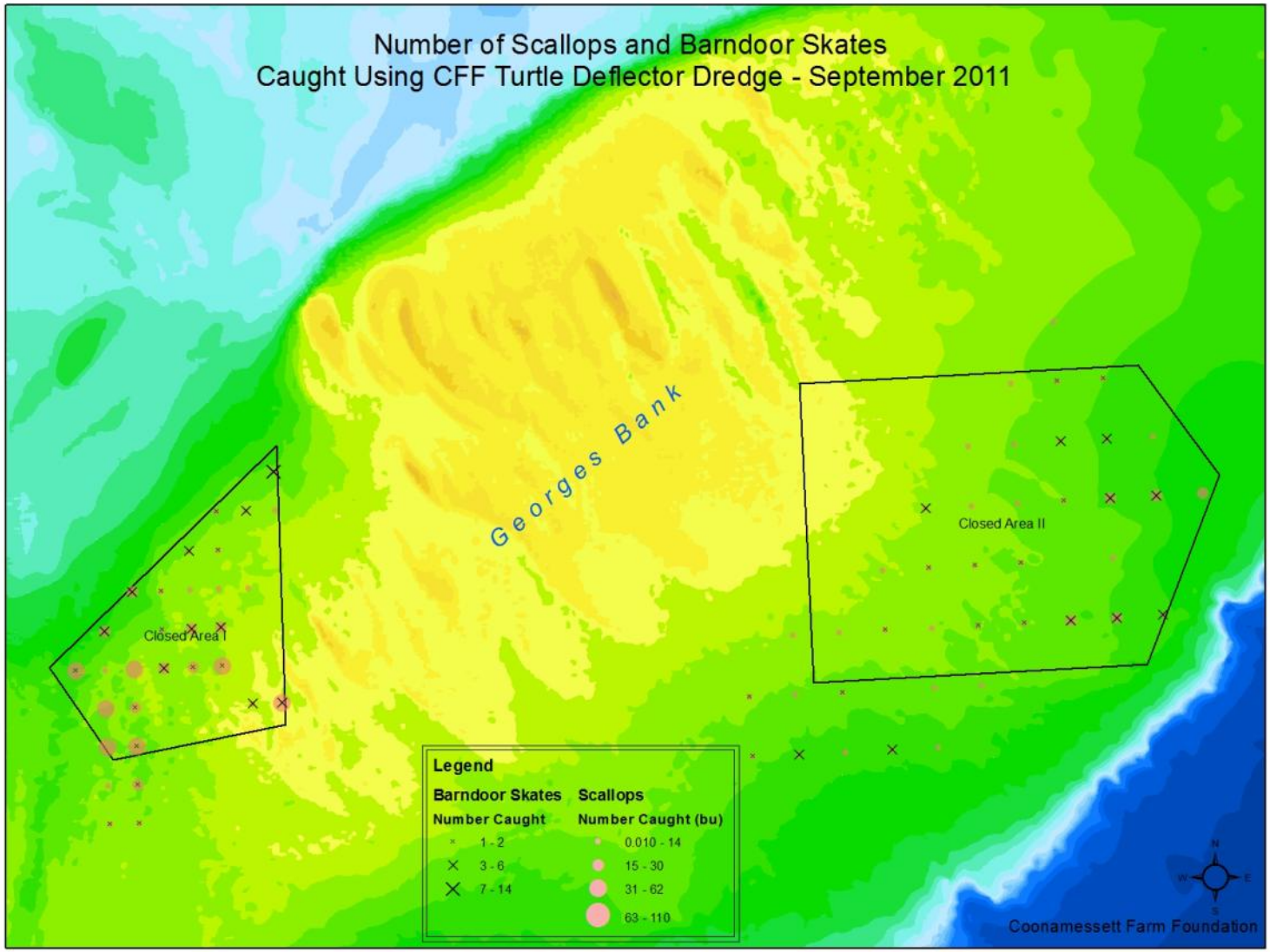
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
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Scallops
Number Caught (bu)
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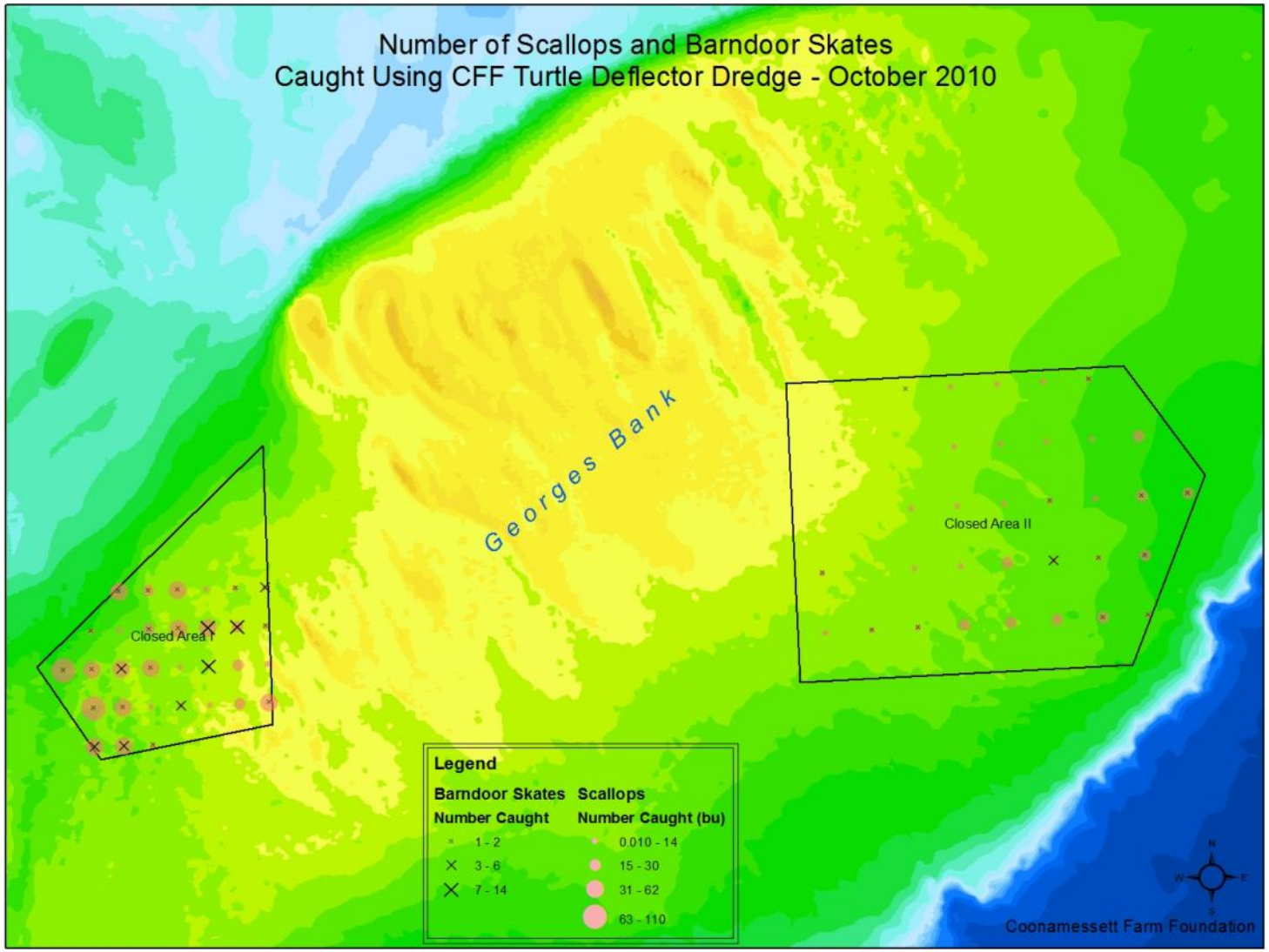
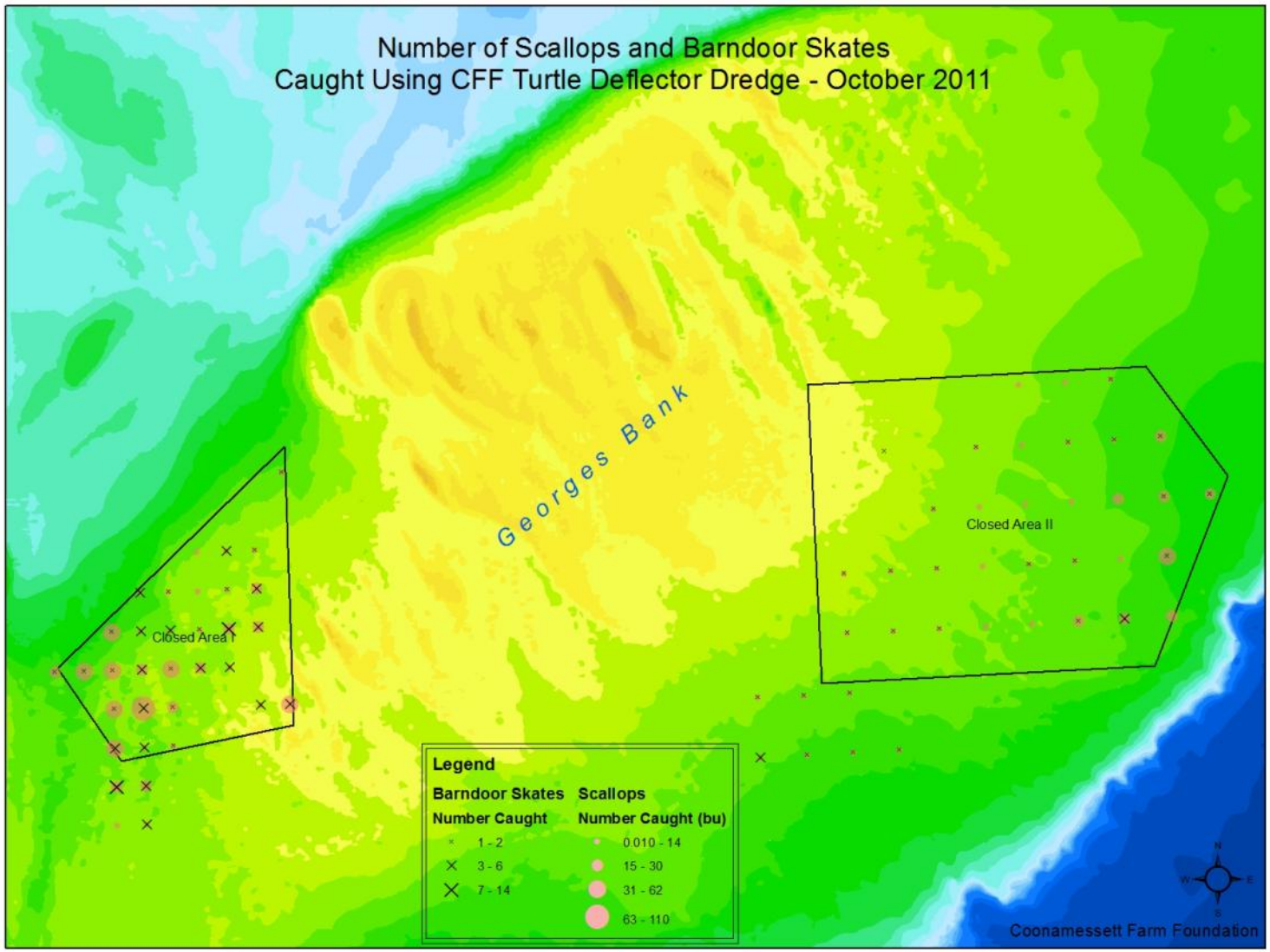
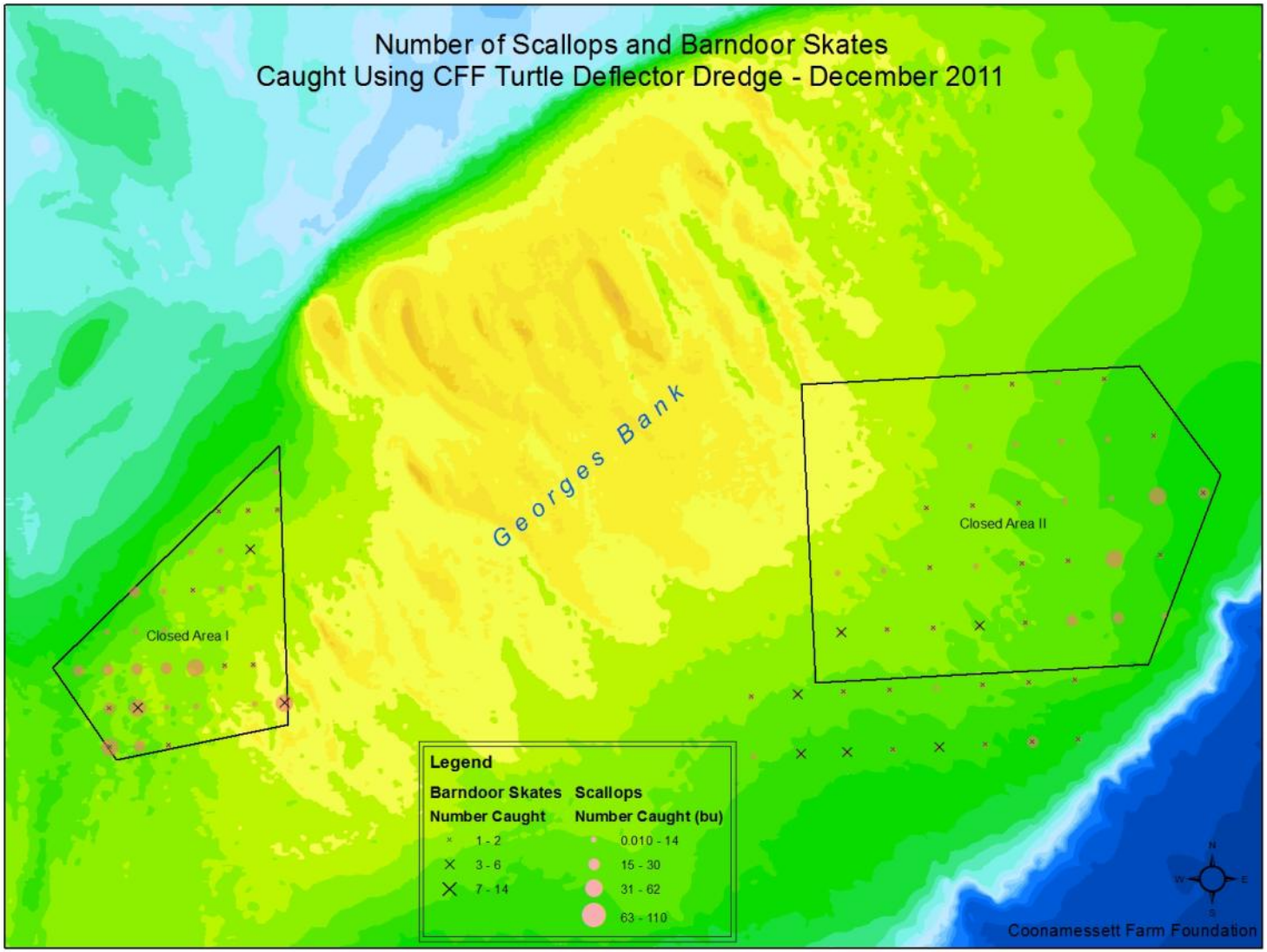
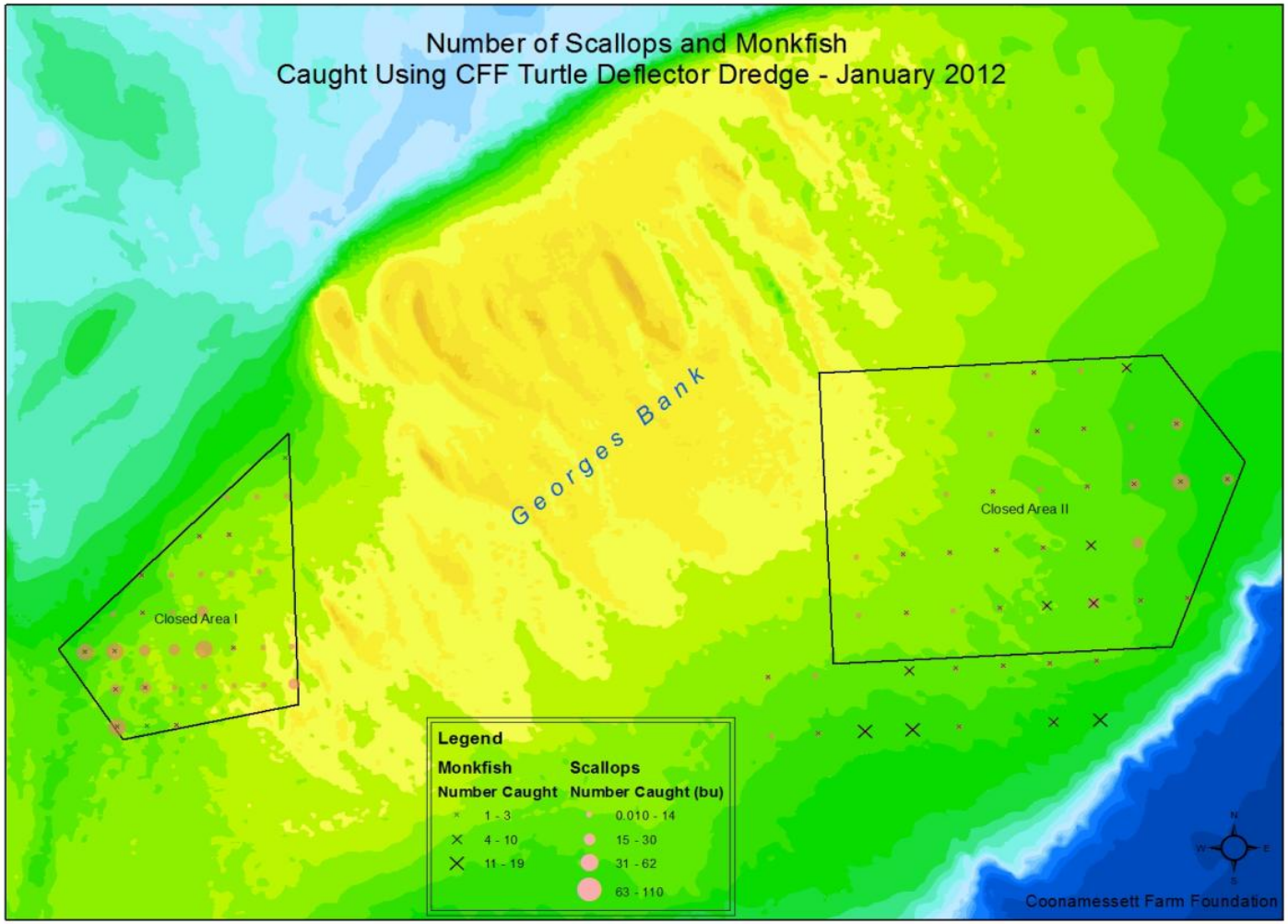
63 - 110
Coonamessett Farm Foundation

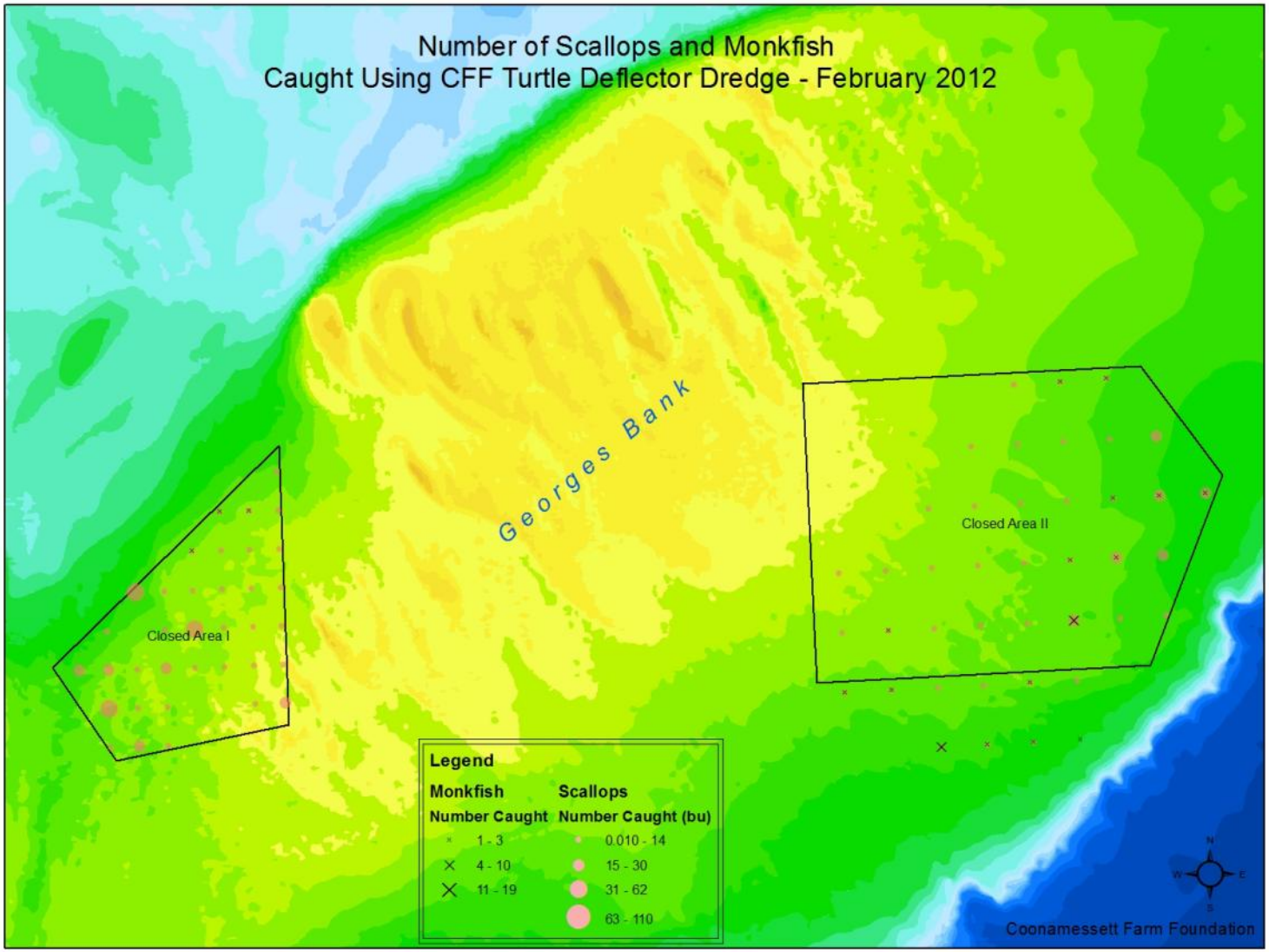

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

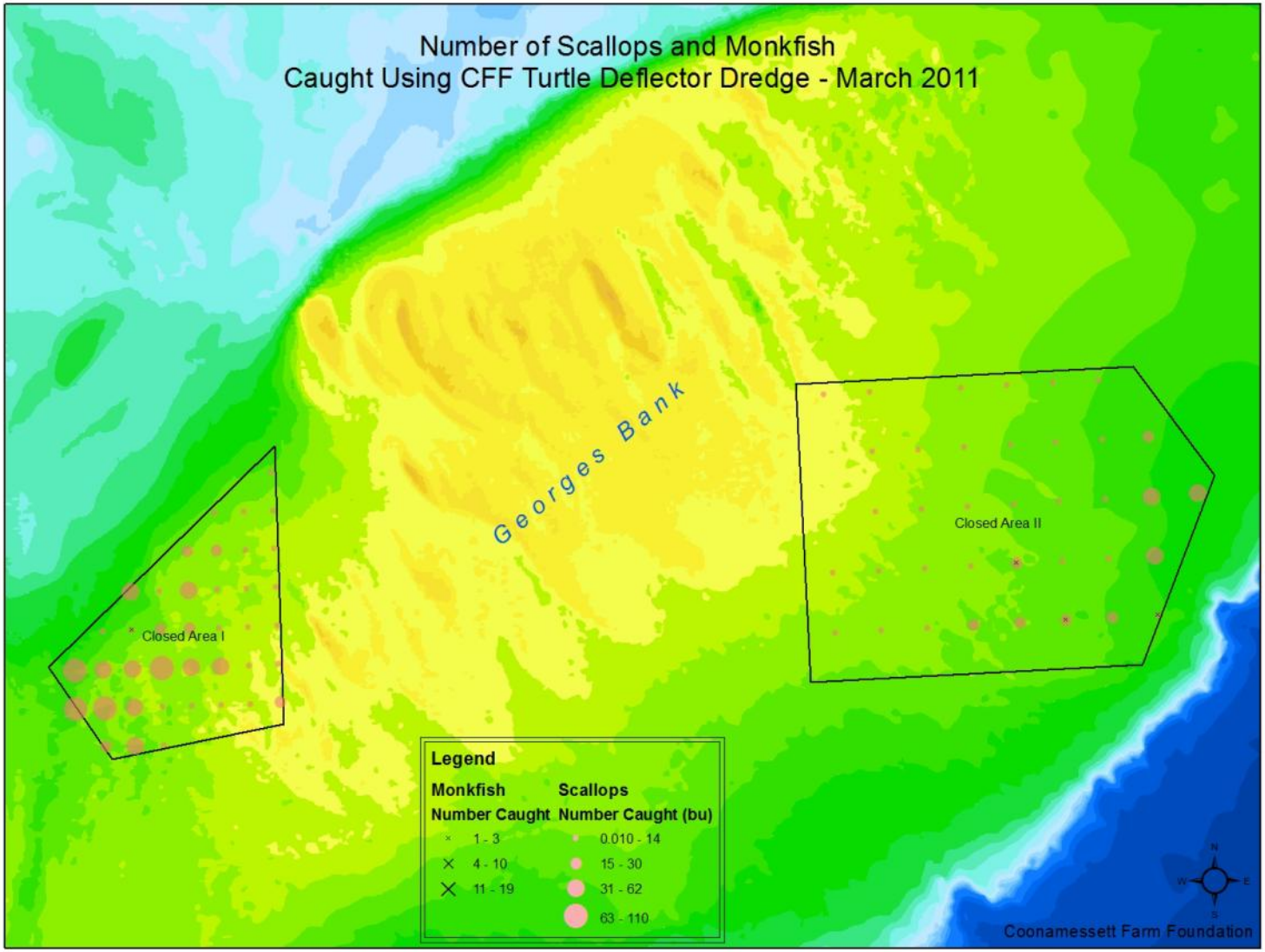

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

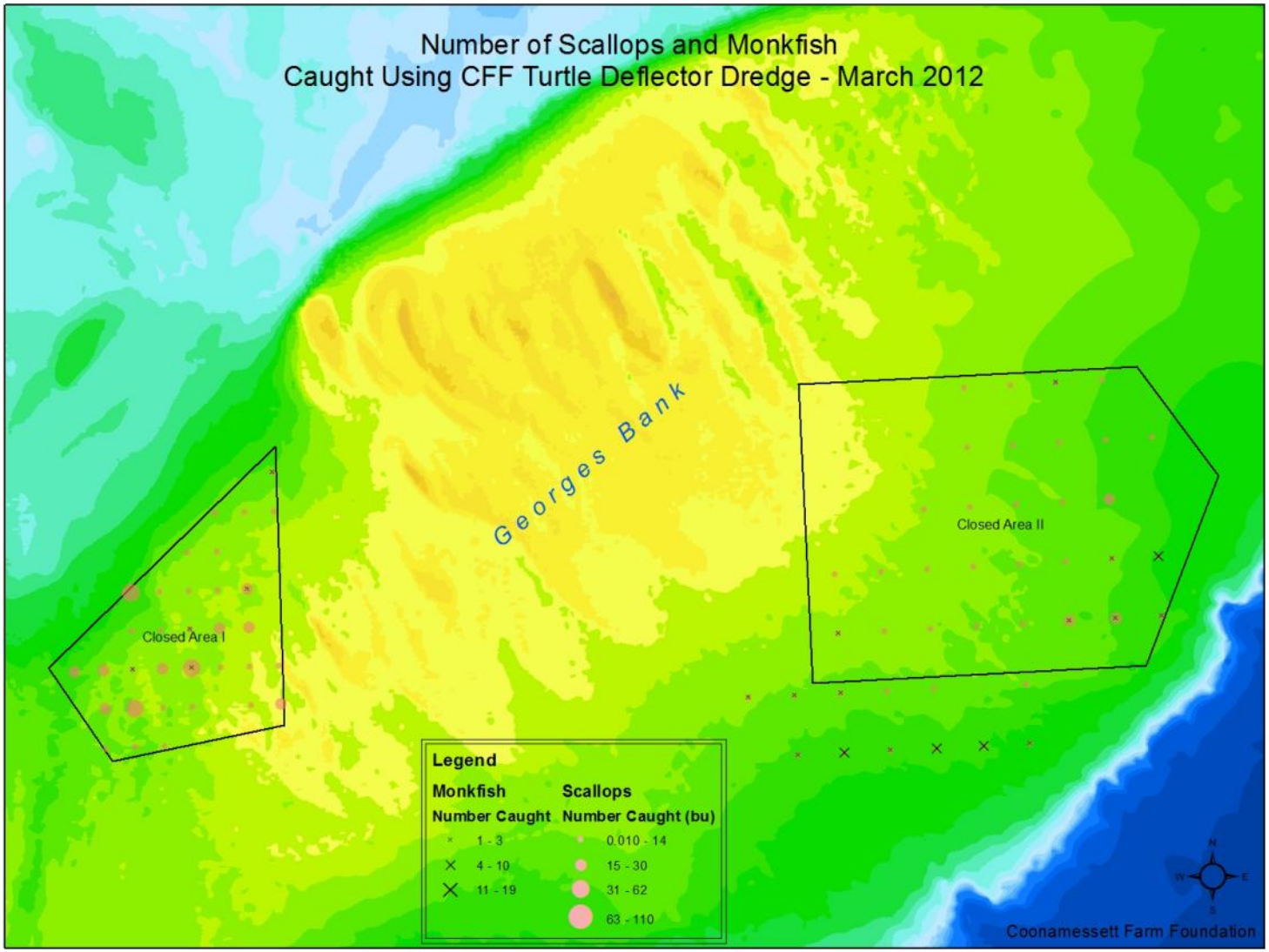

Number of Scallops and Barndoor Skates
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Barndoor Skates
Number Caught
1 - 2
3 - 6
7 - 14
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

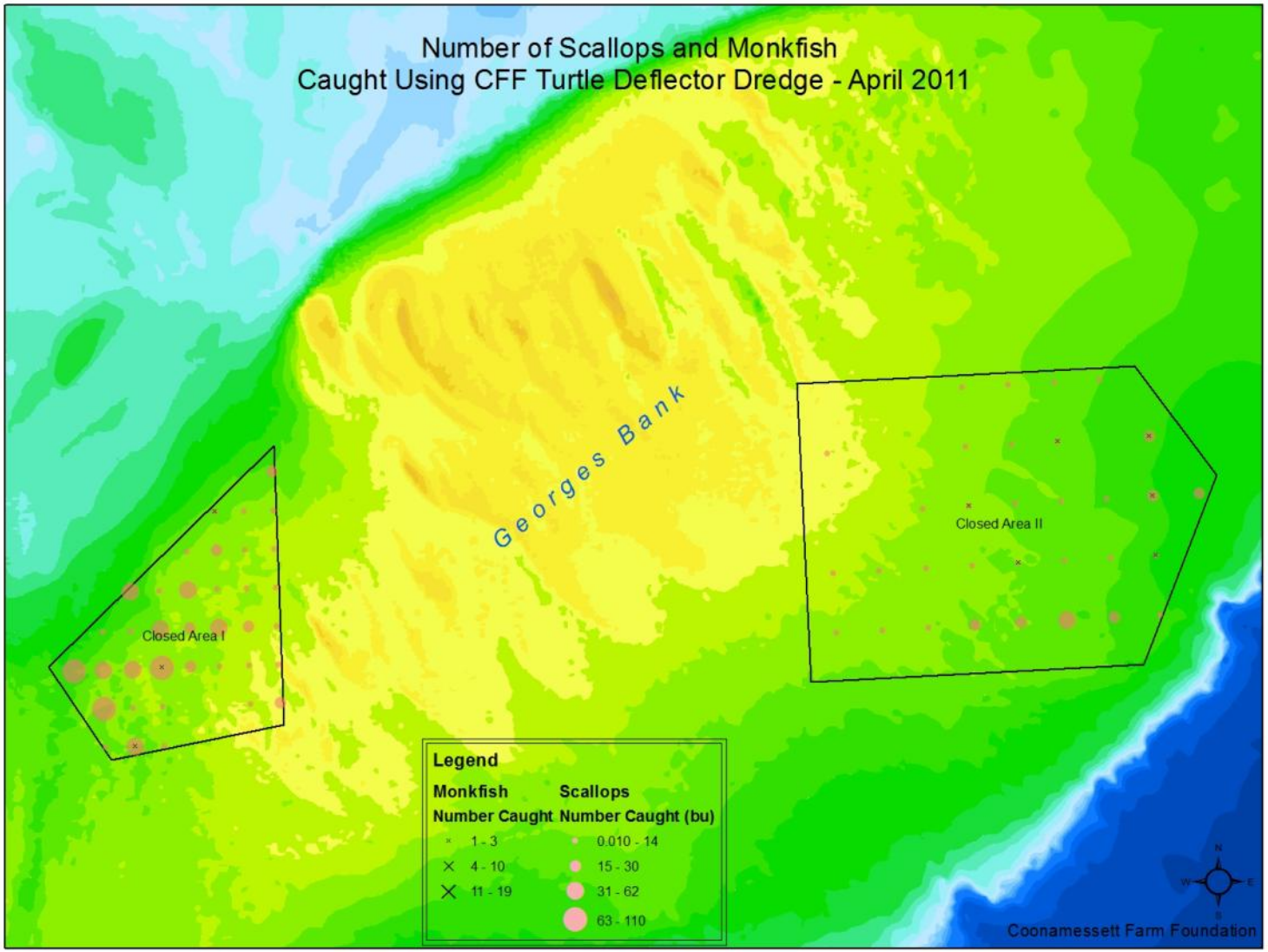
**Scallops and Monkfish**

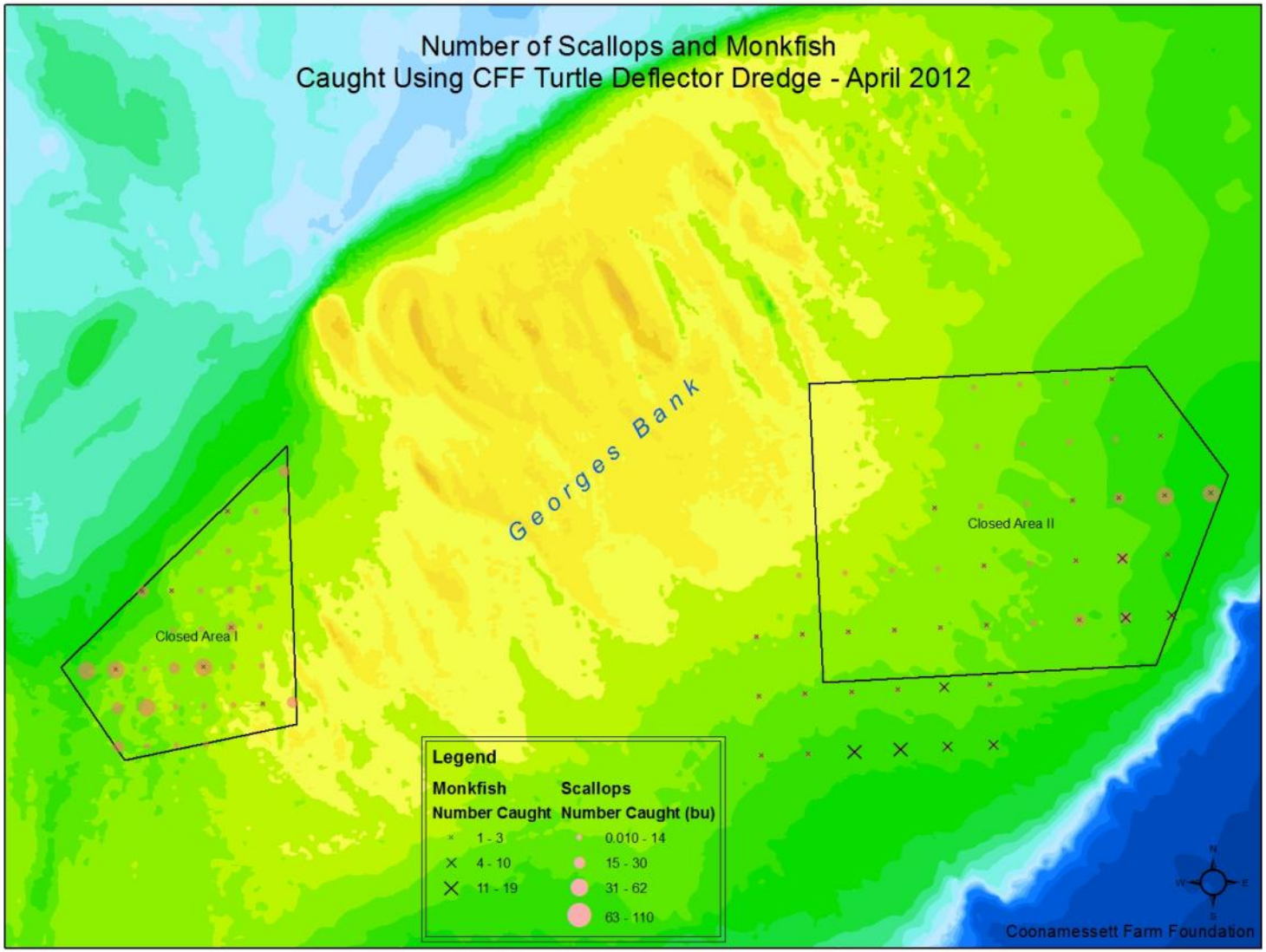


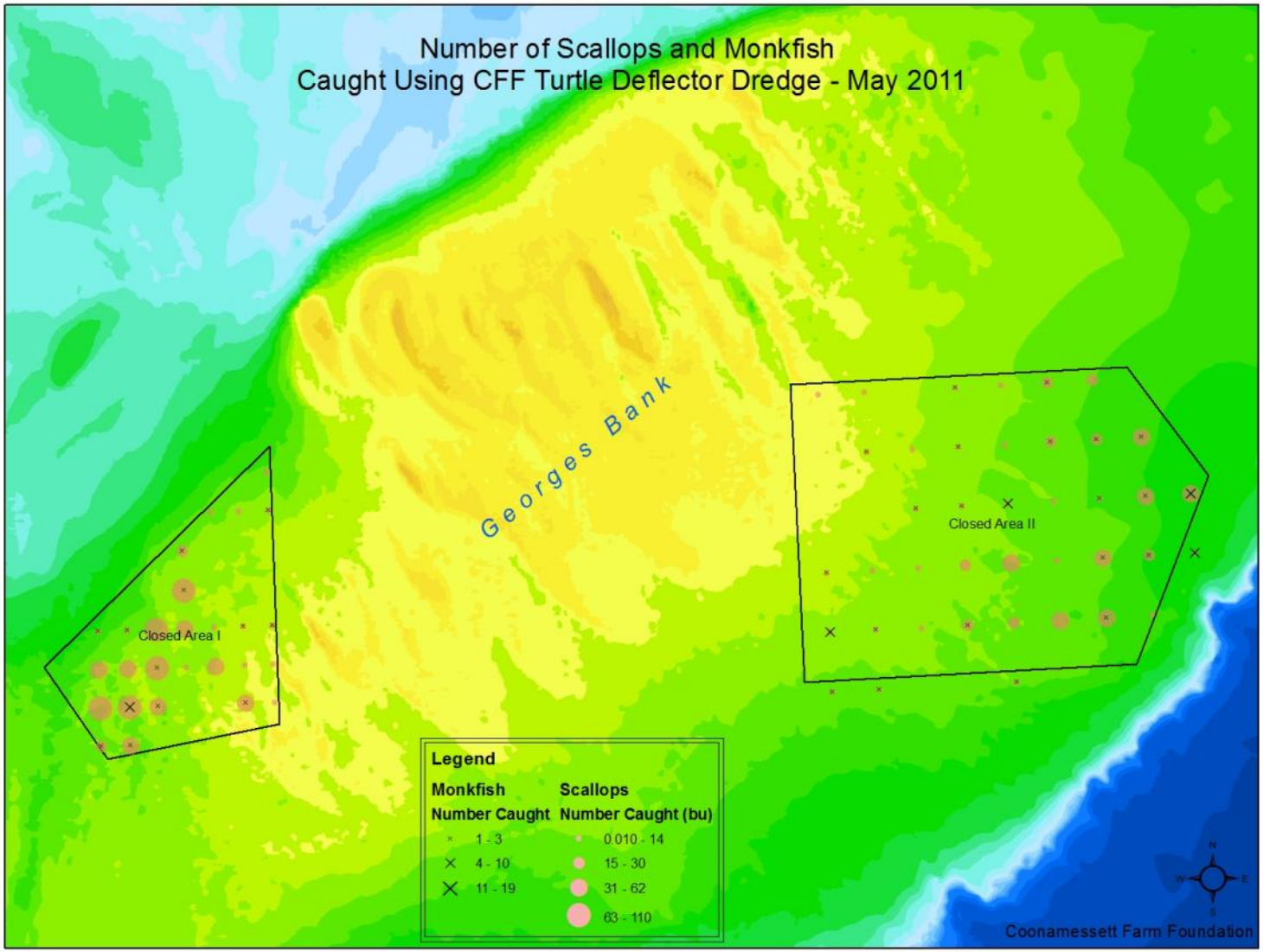

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

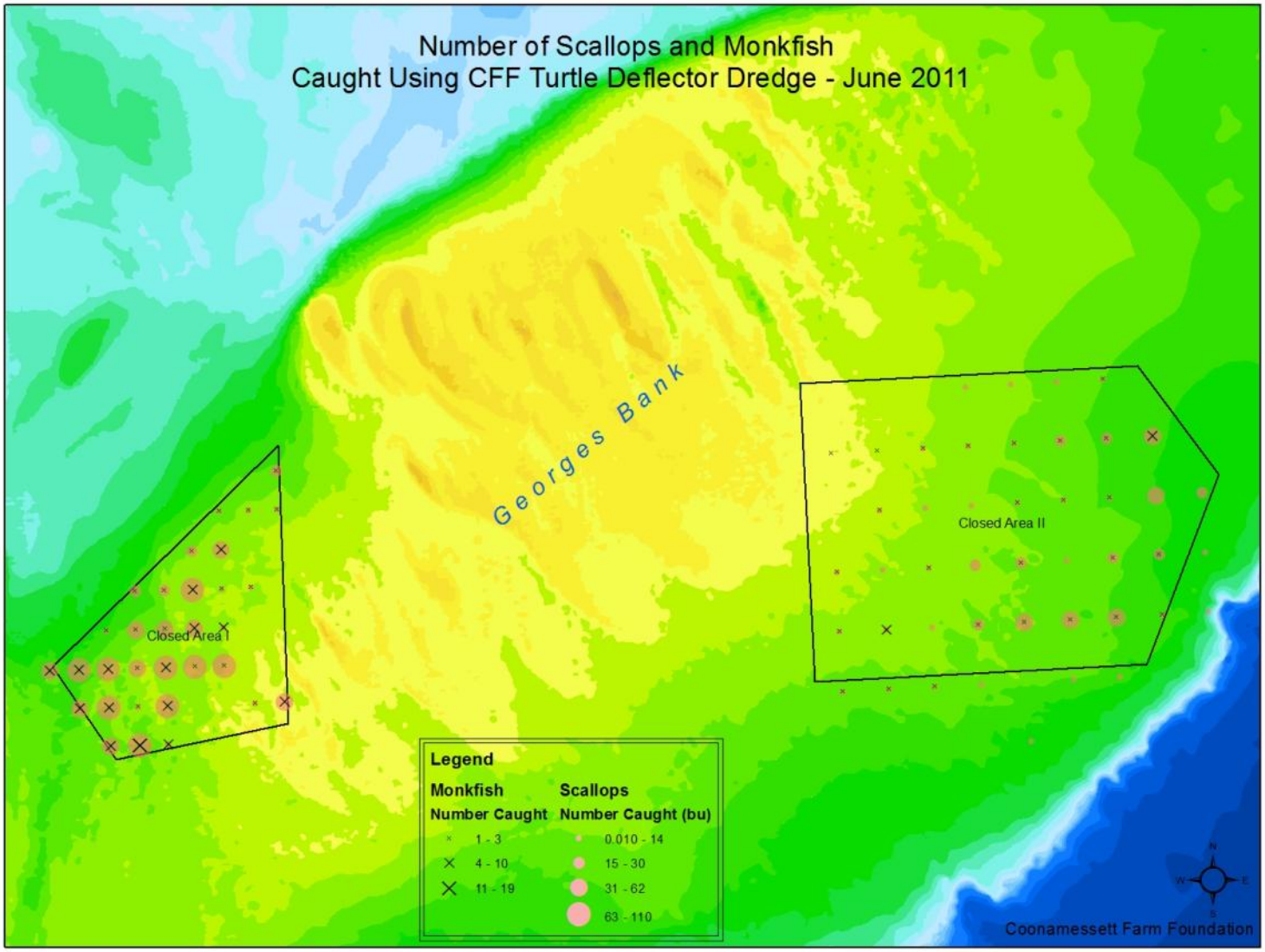

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

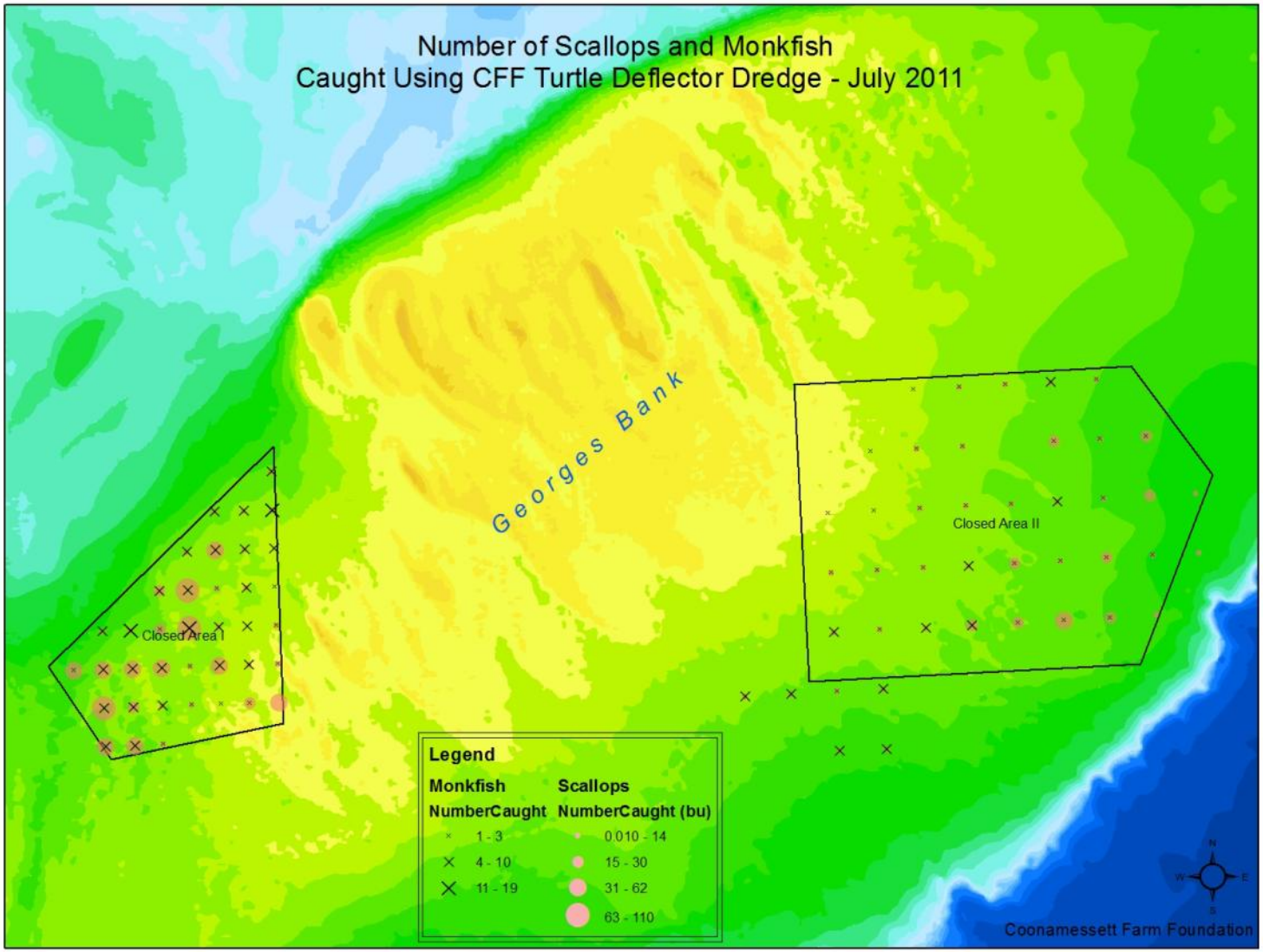

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

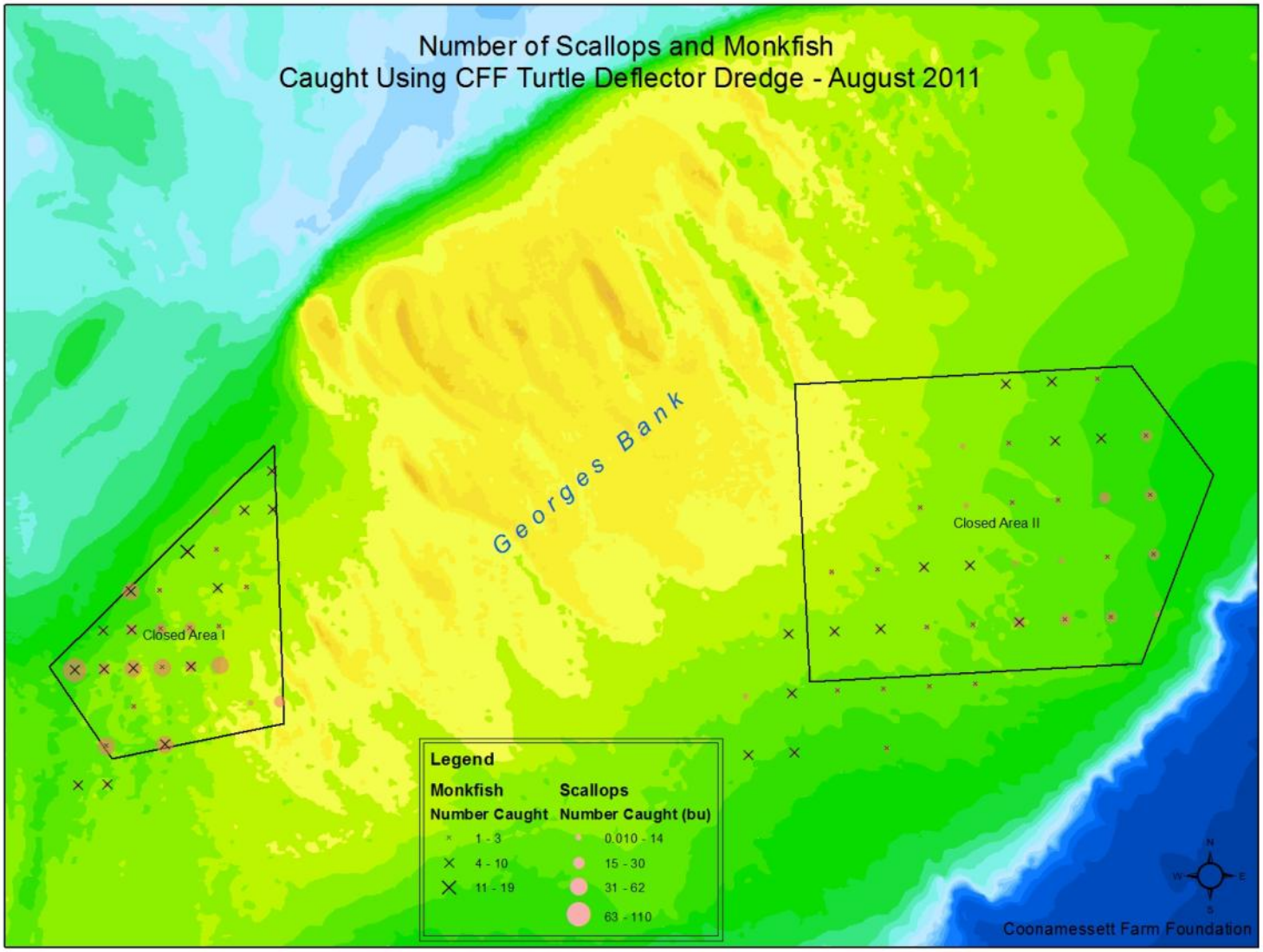

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

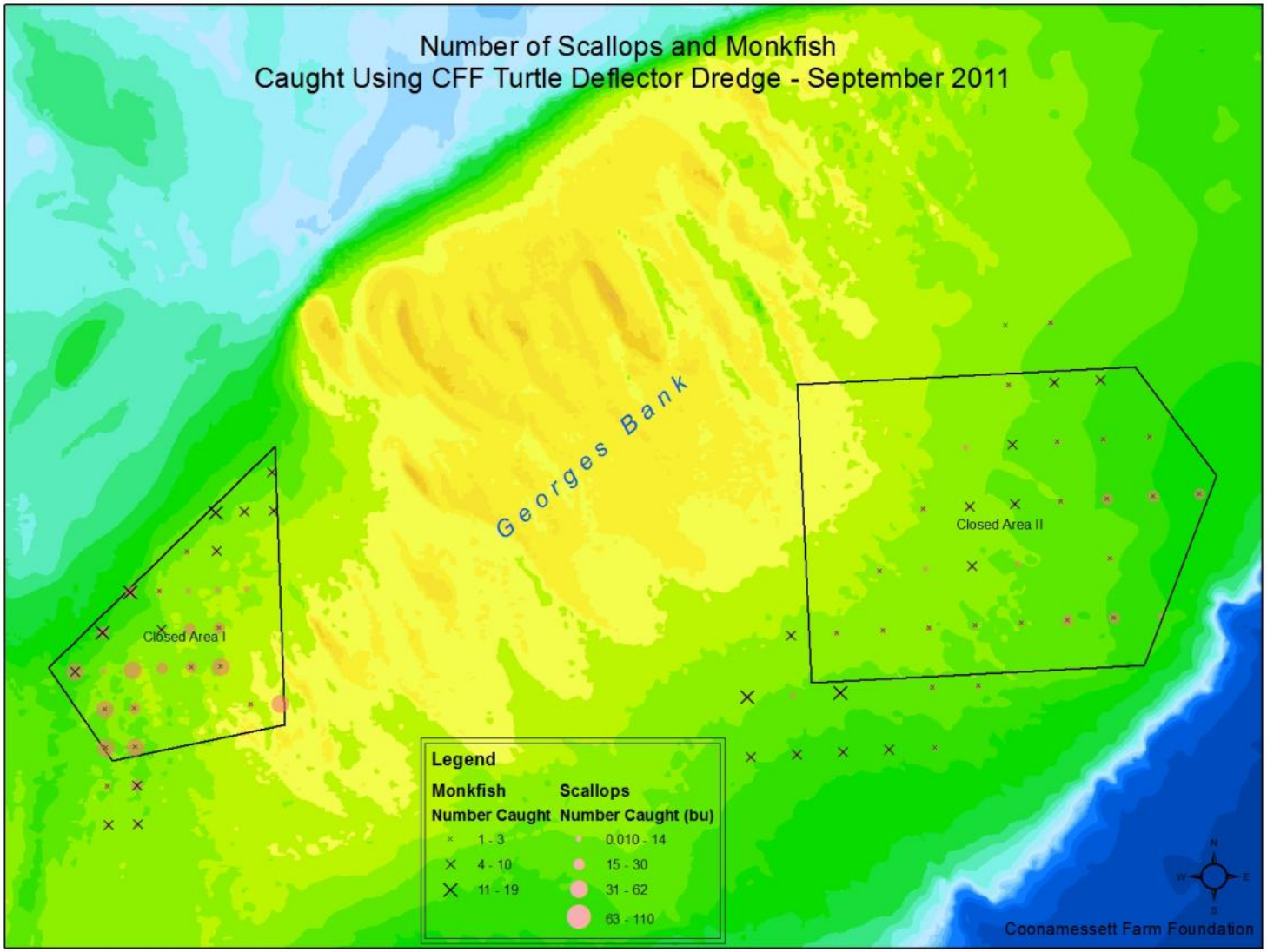

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

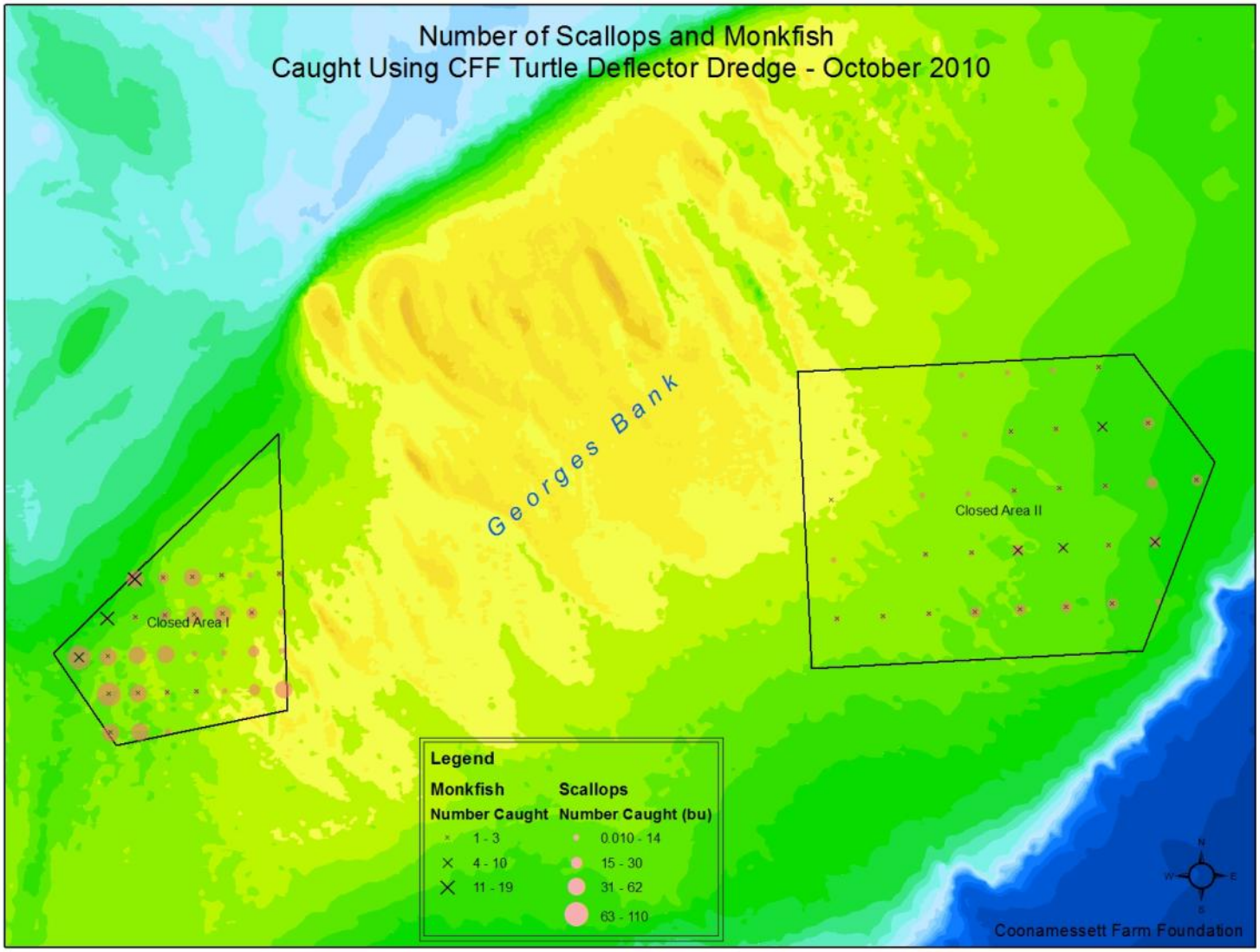

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

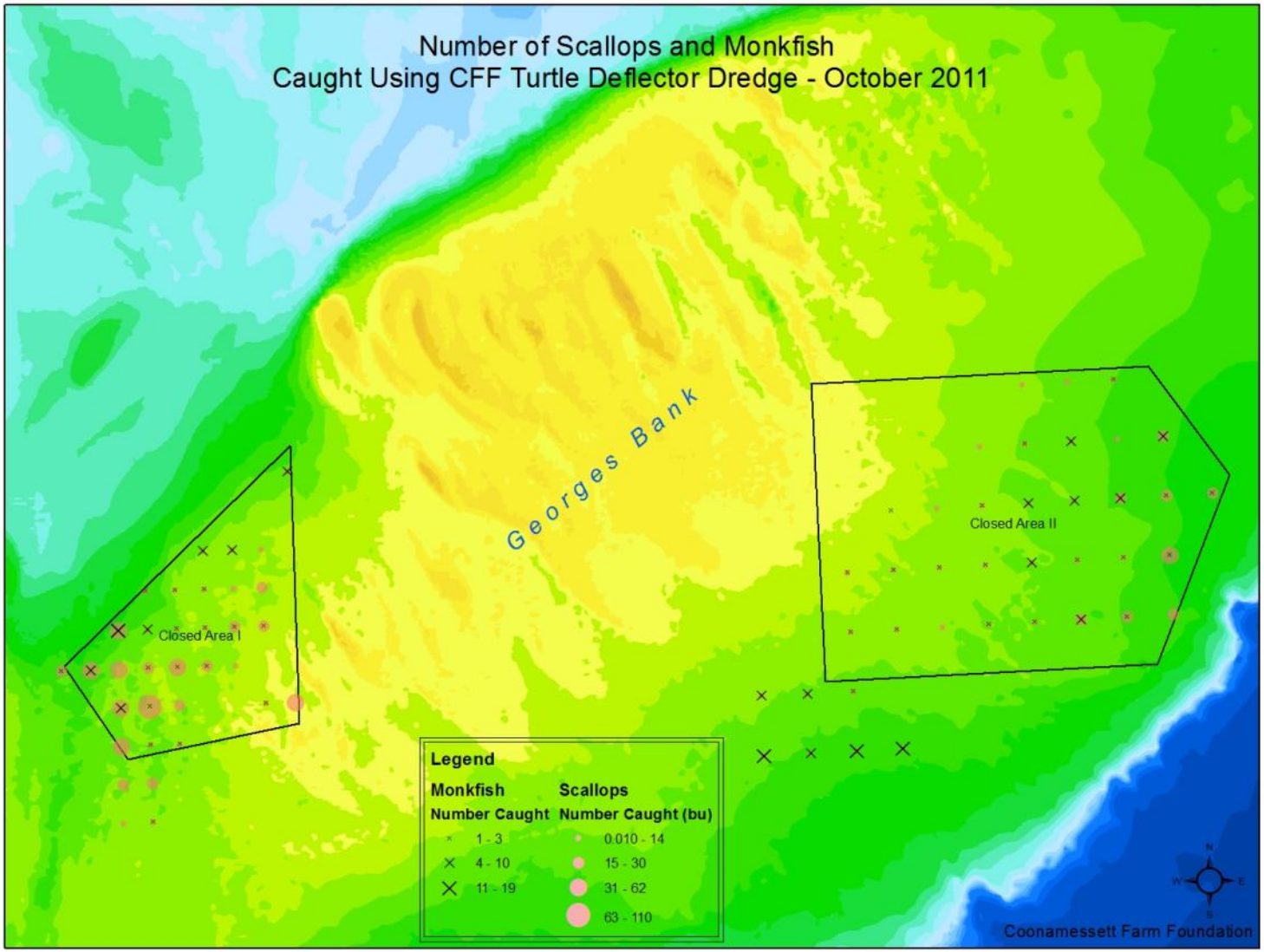

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

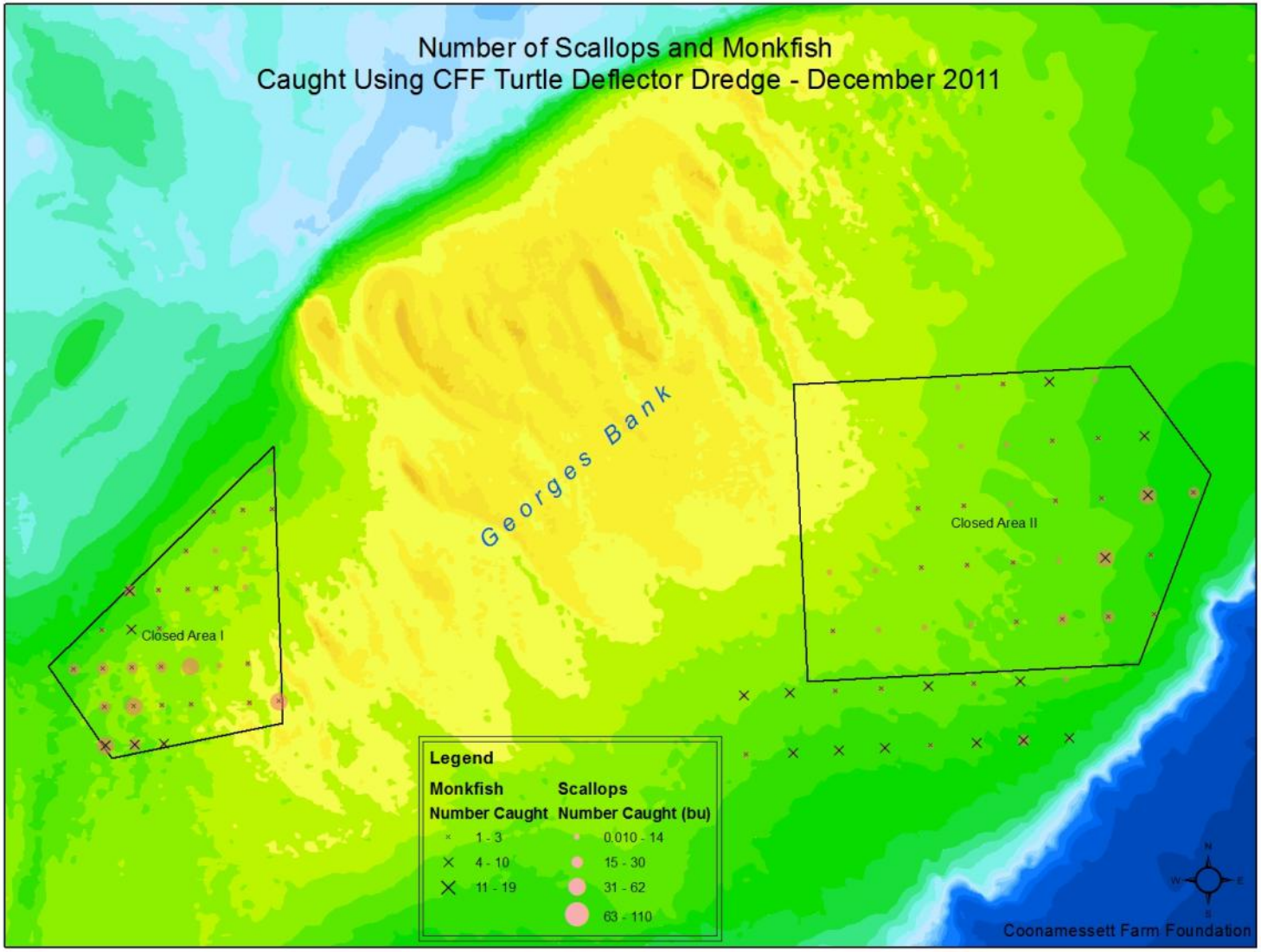

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
NumberCaught
1 - 3
4 - 10
11 - 19
Scallops
NumberCaught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation


Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

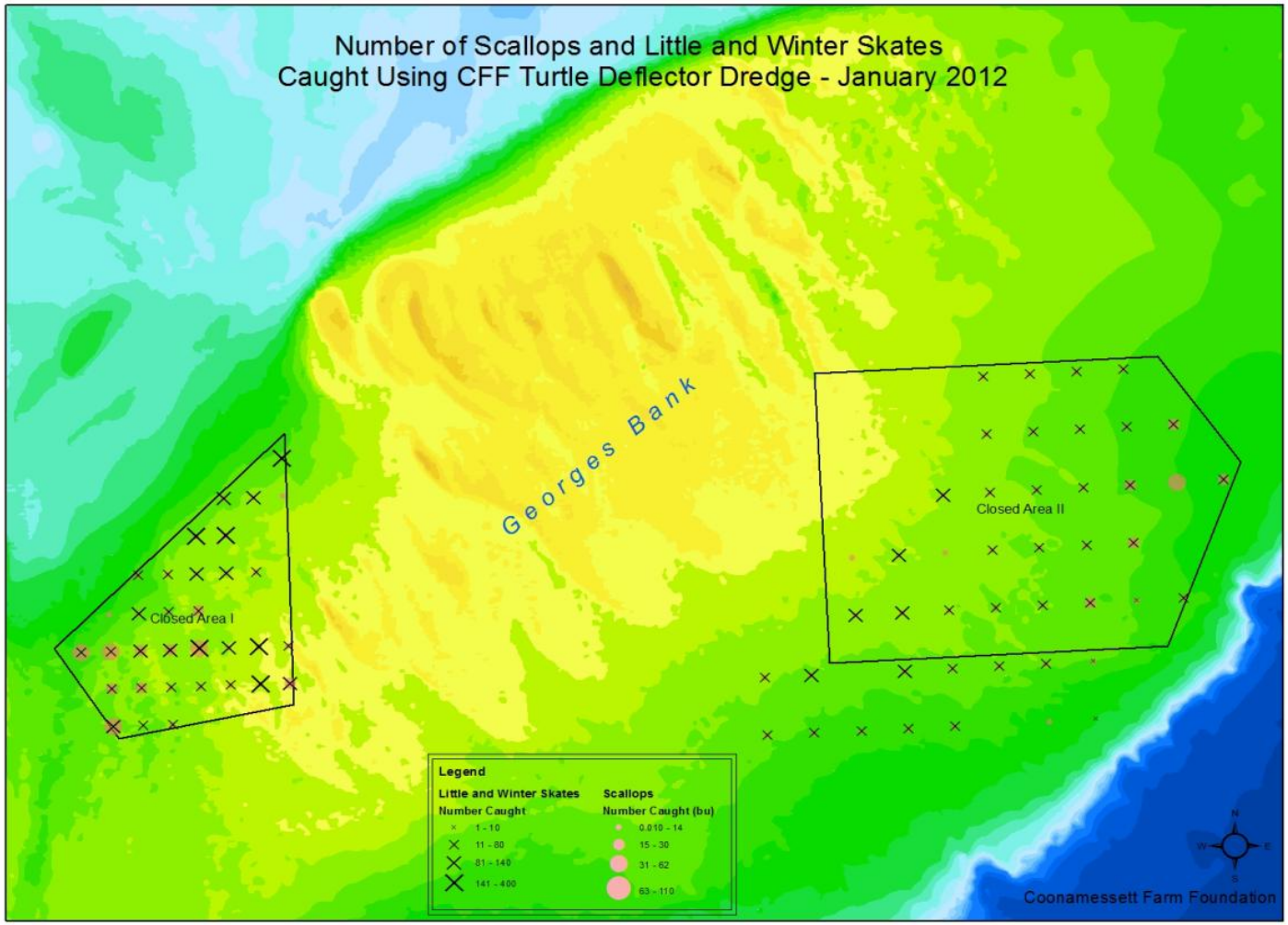

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

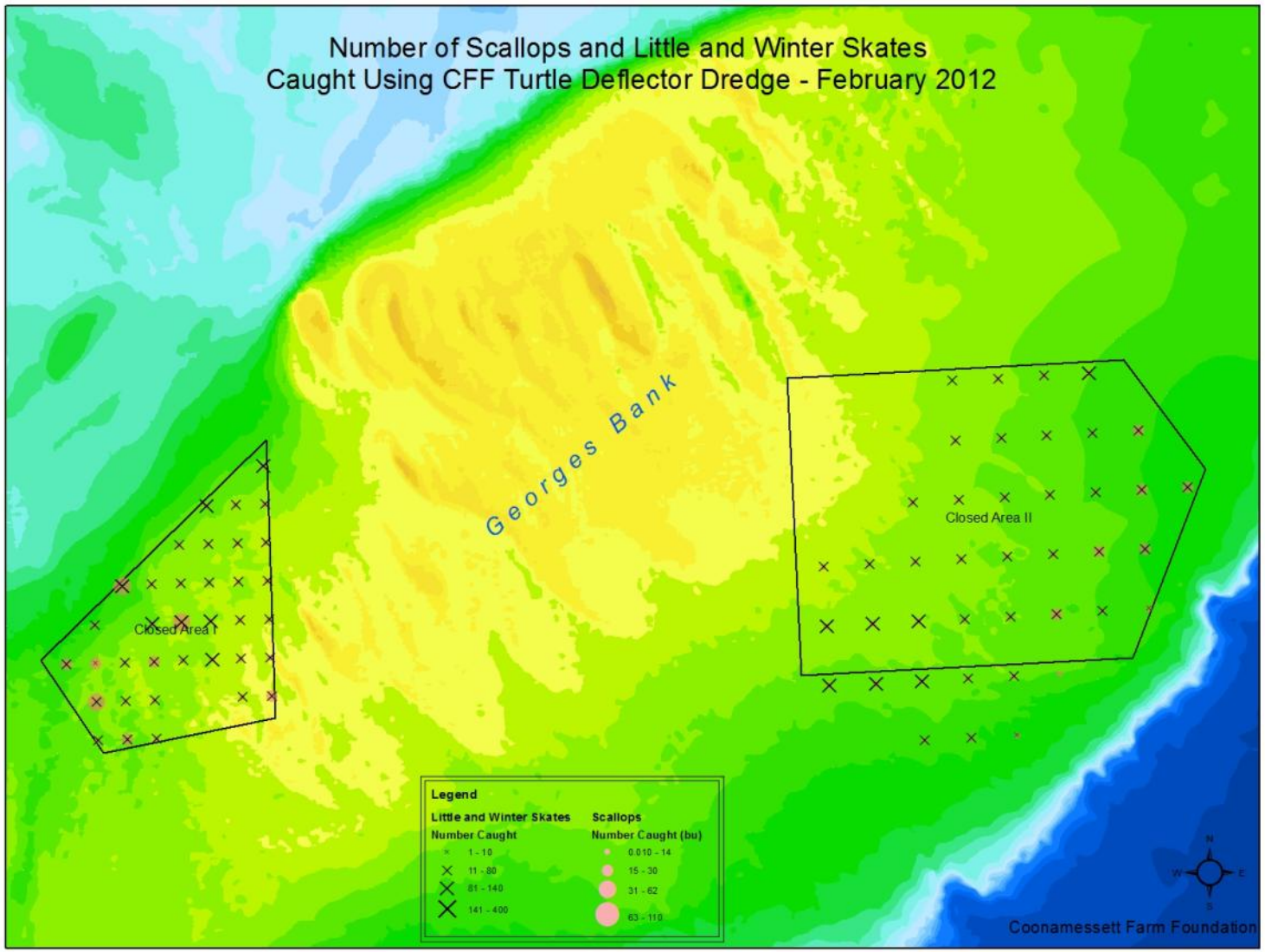

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

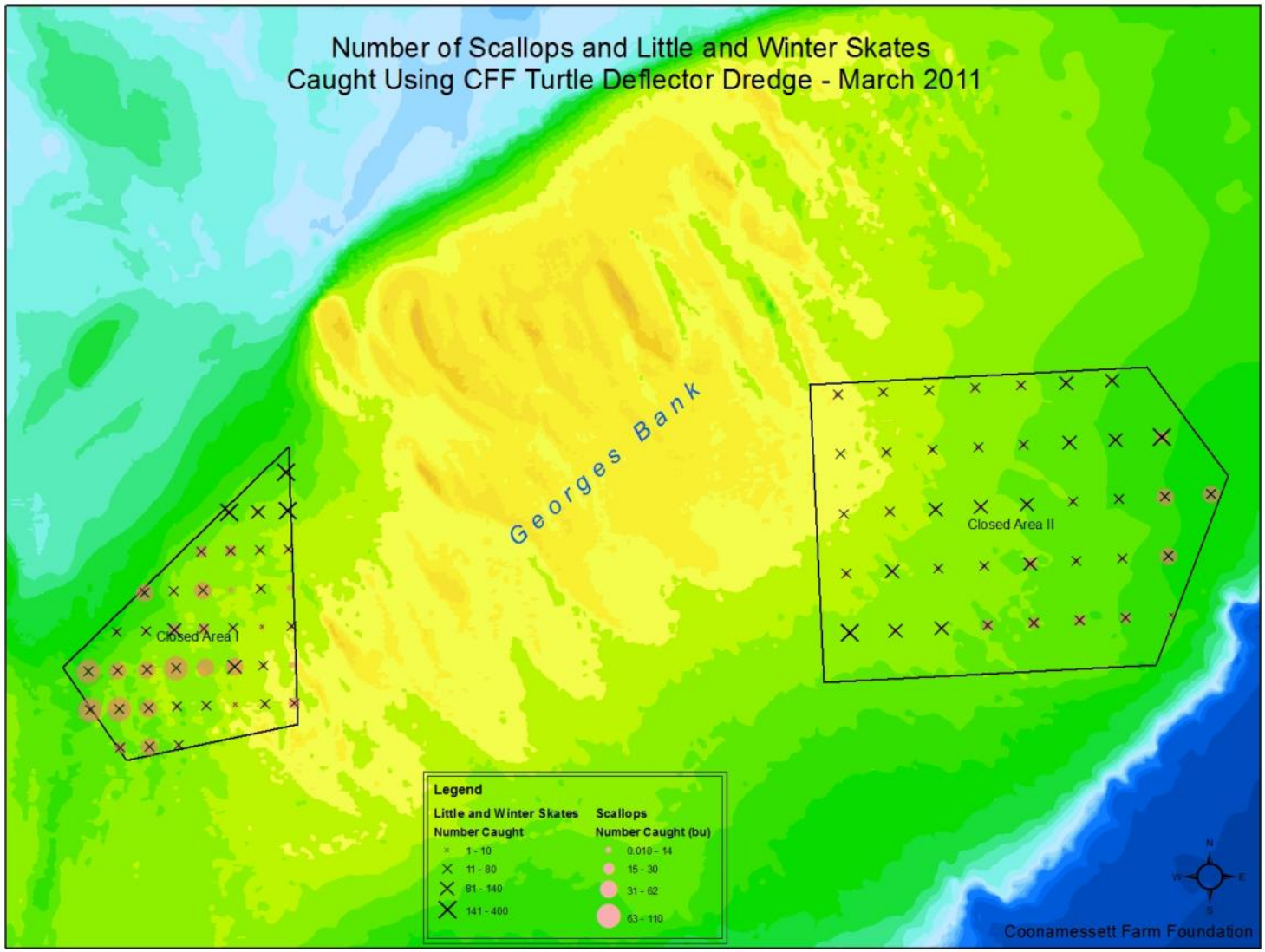

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

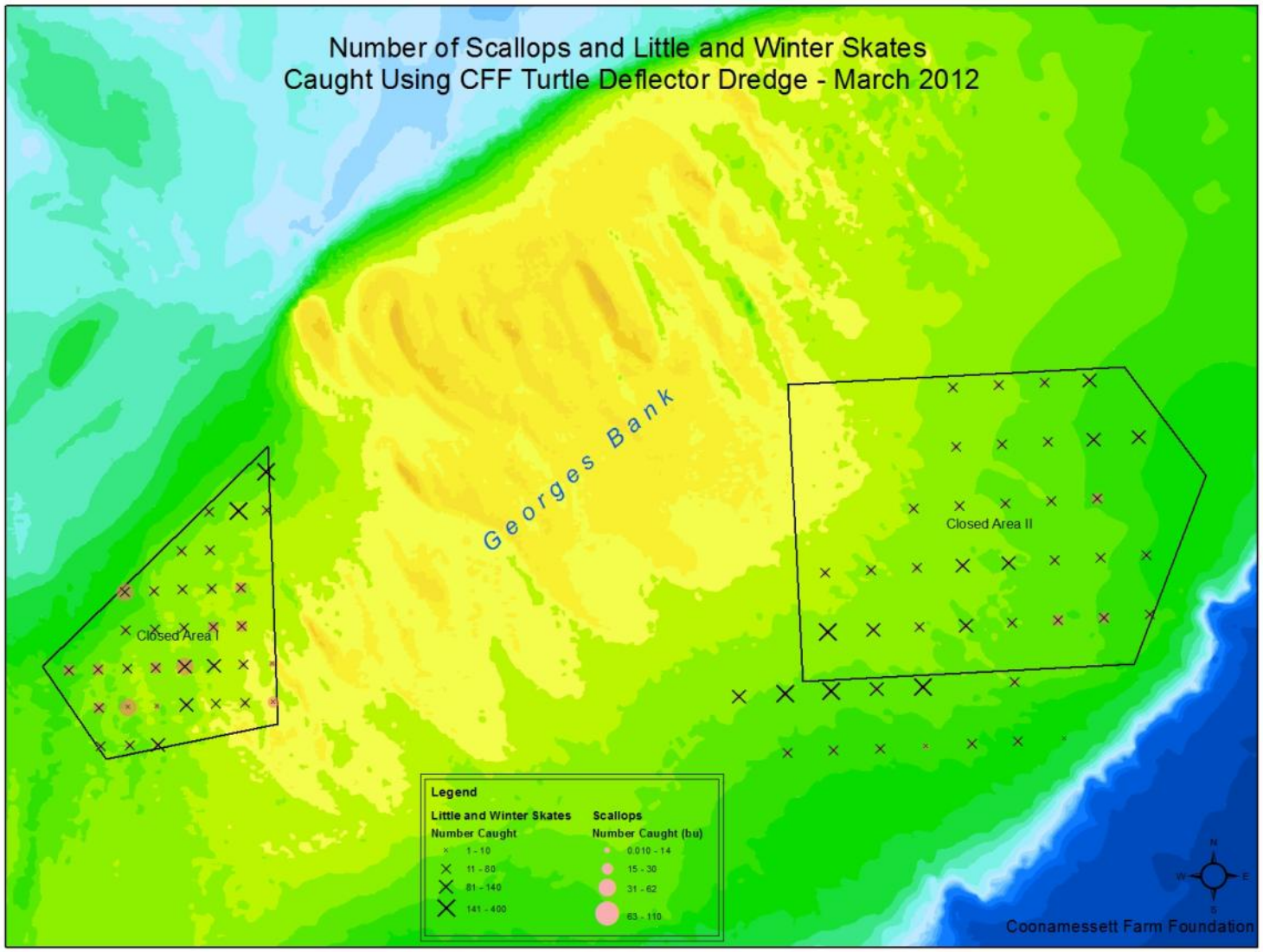

Number of Scallops and Monkfish
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Monkfish
Number Caught
1 - 3
4 - 10
11 - 19
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

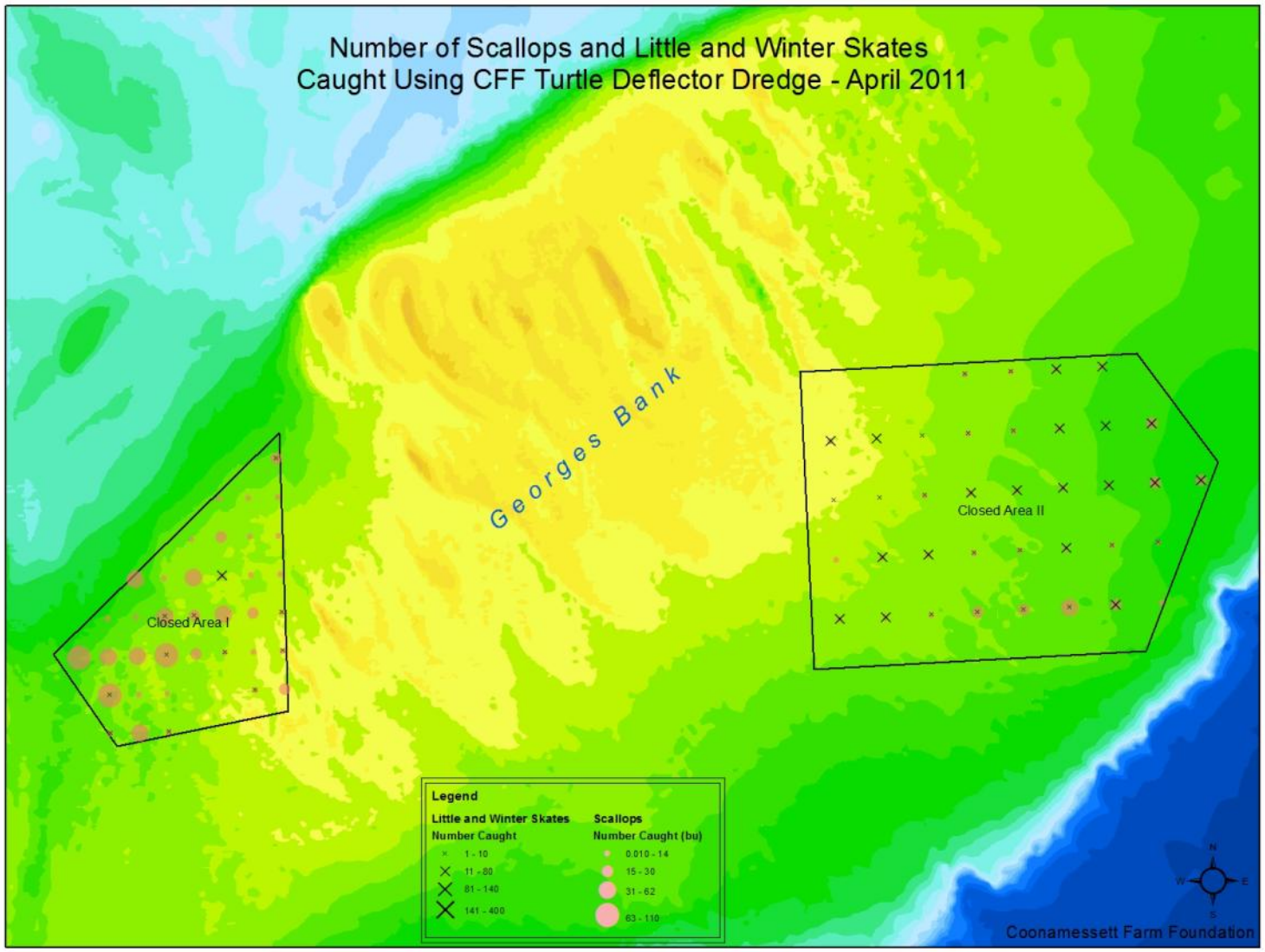
**Scallops and Little and Winter Skates**

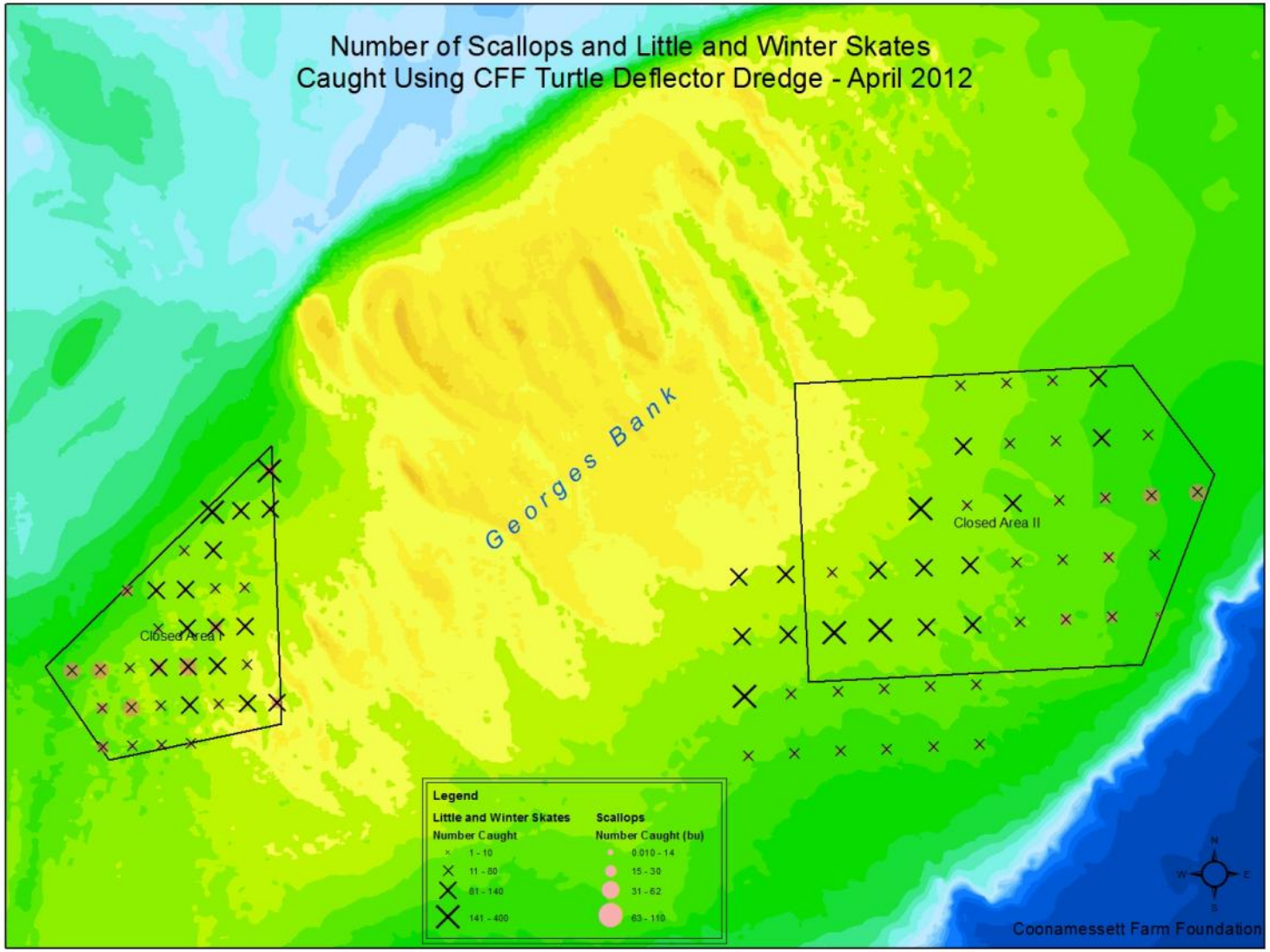


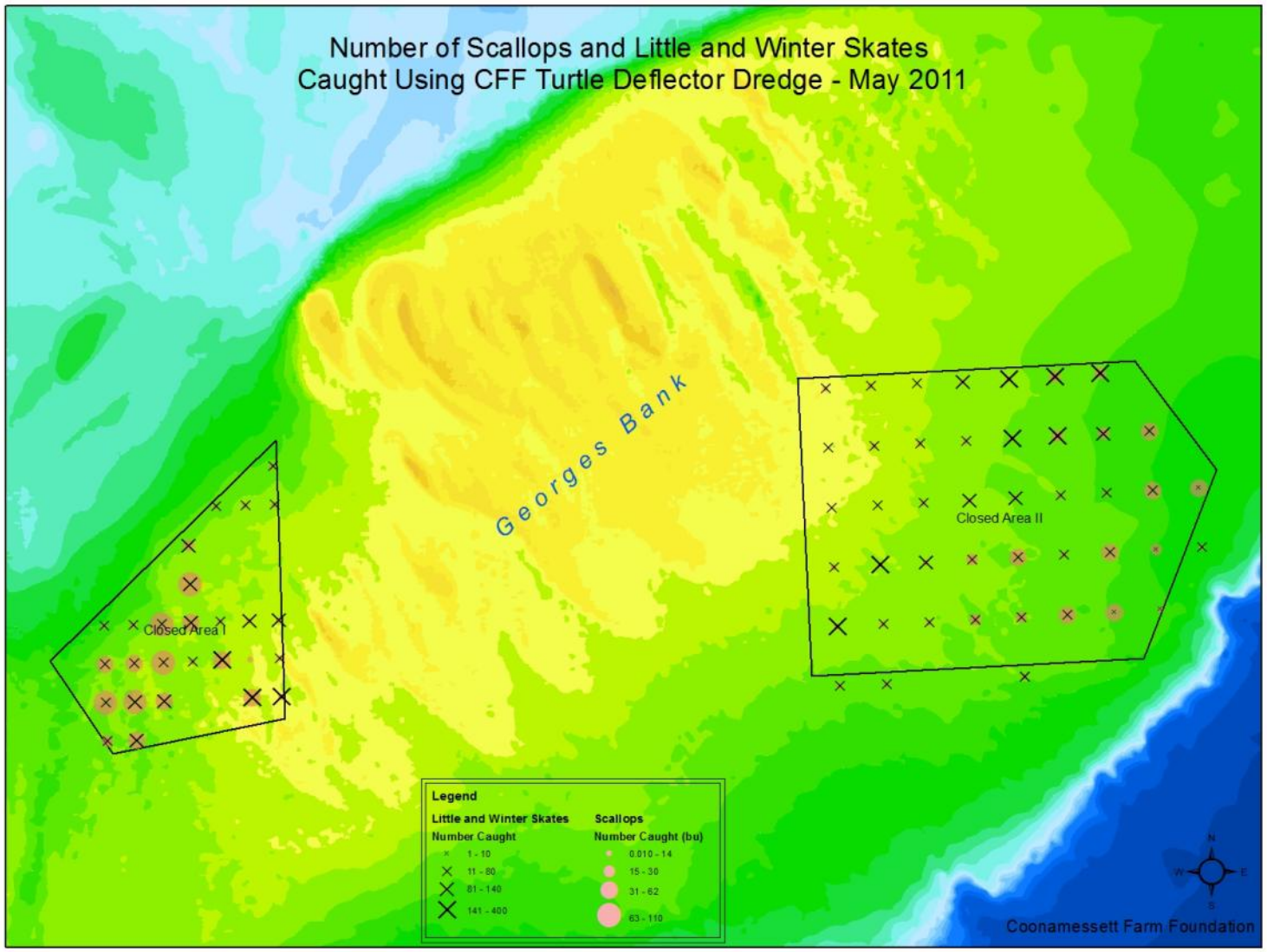

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - February 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

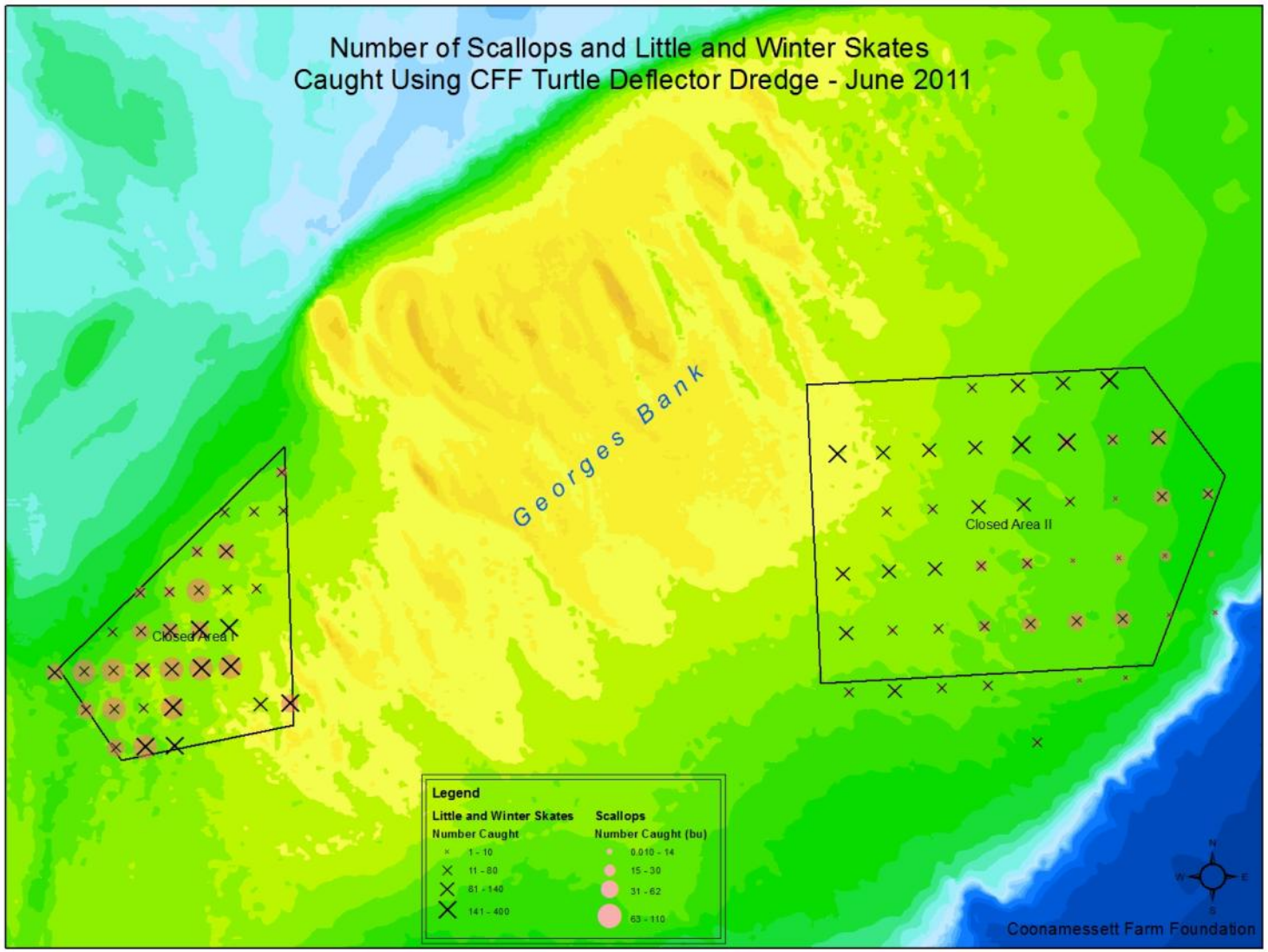

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - March 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

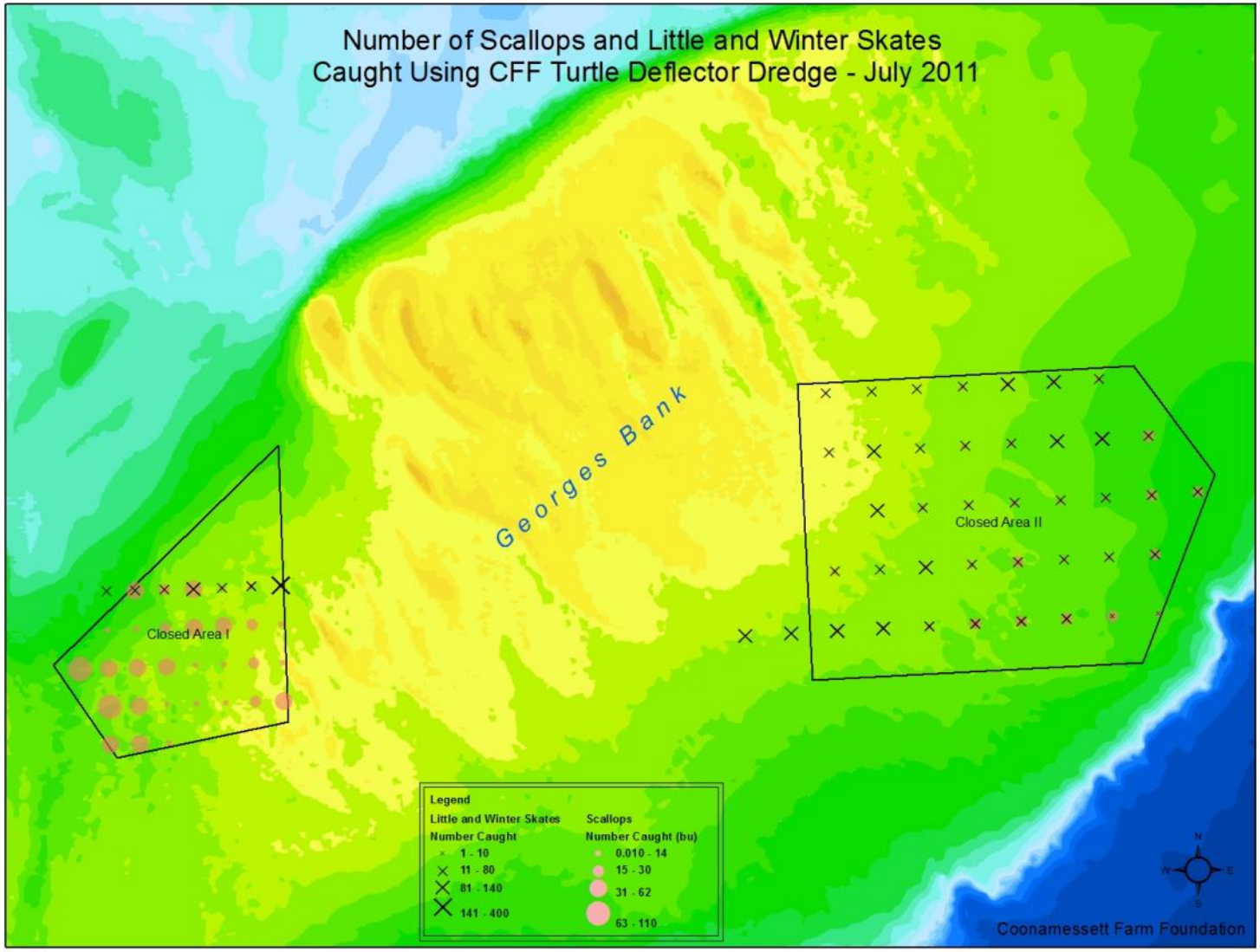

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - March 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

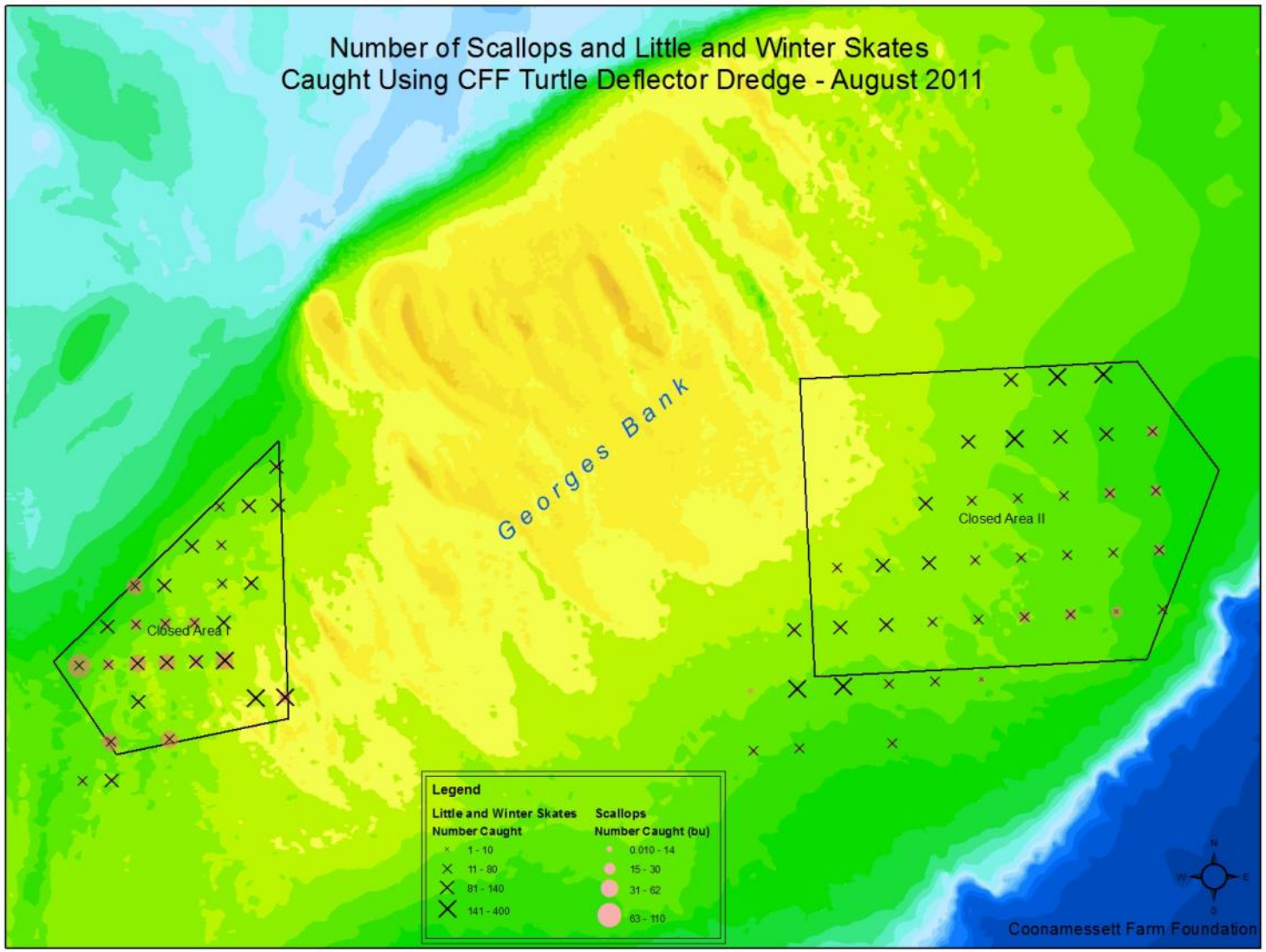

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - April 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

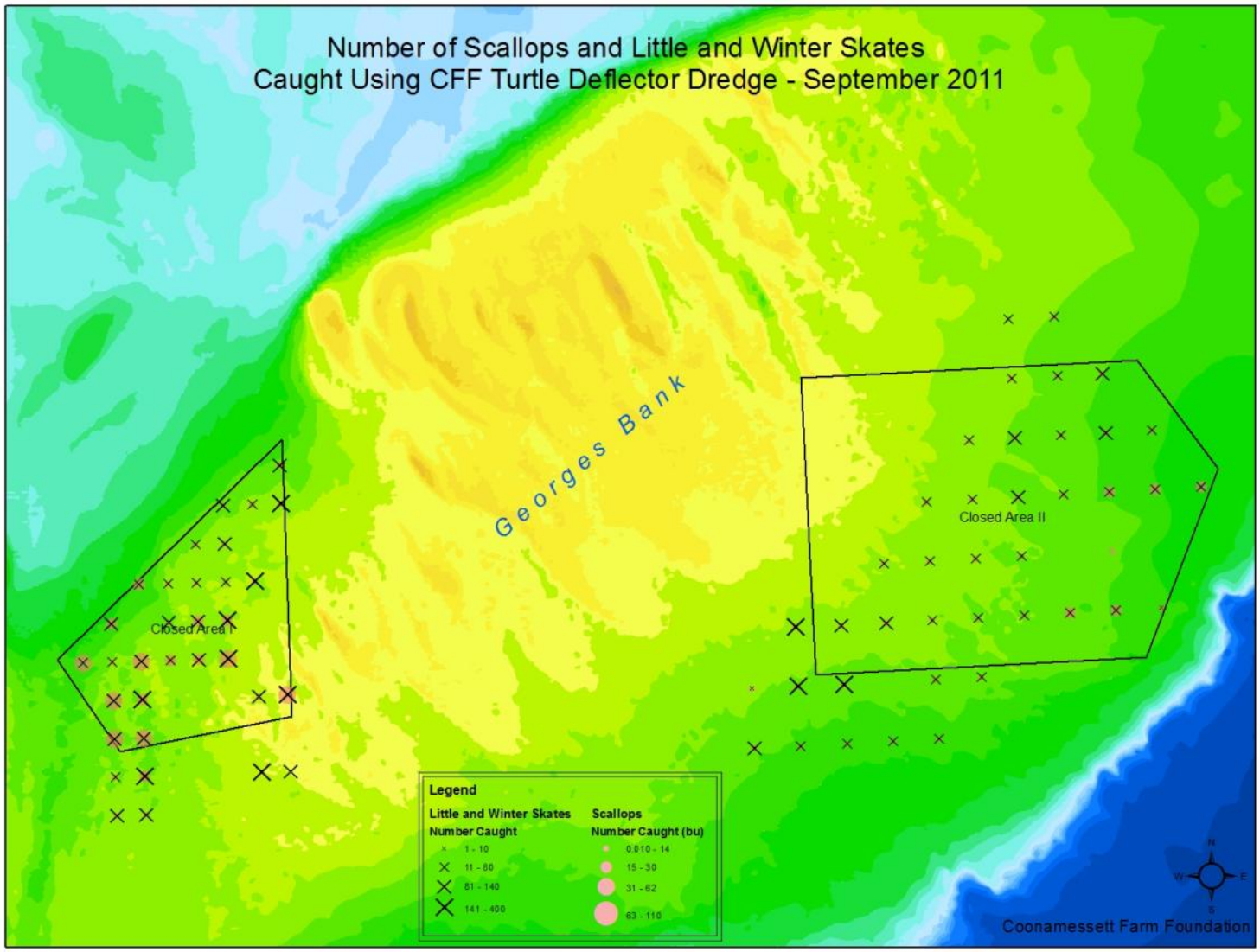

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - April 2012
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

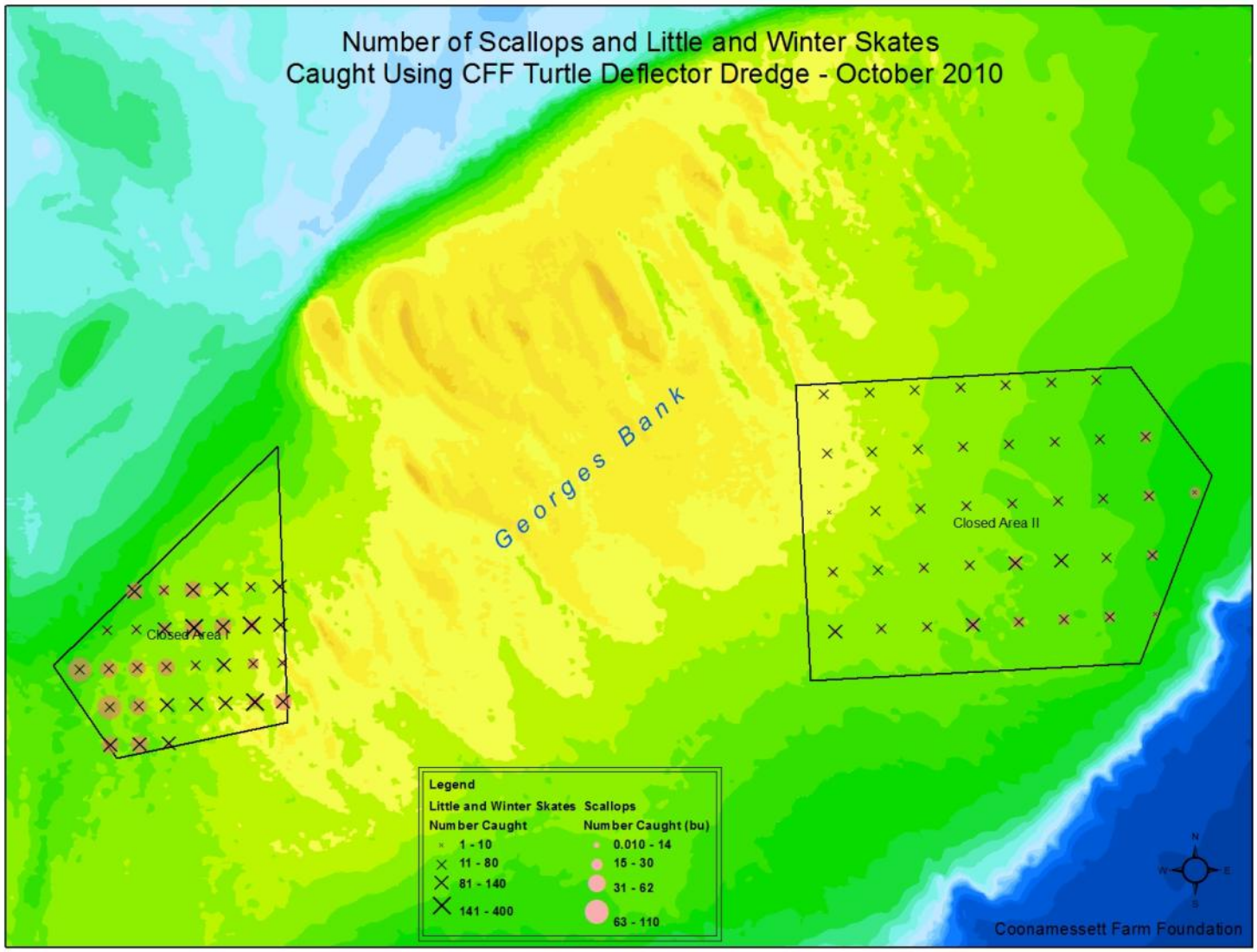

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - May 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

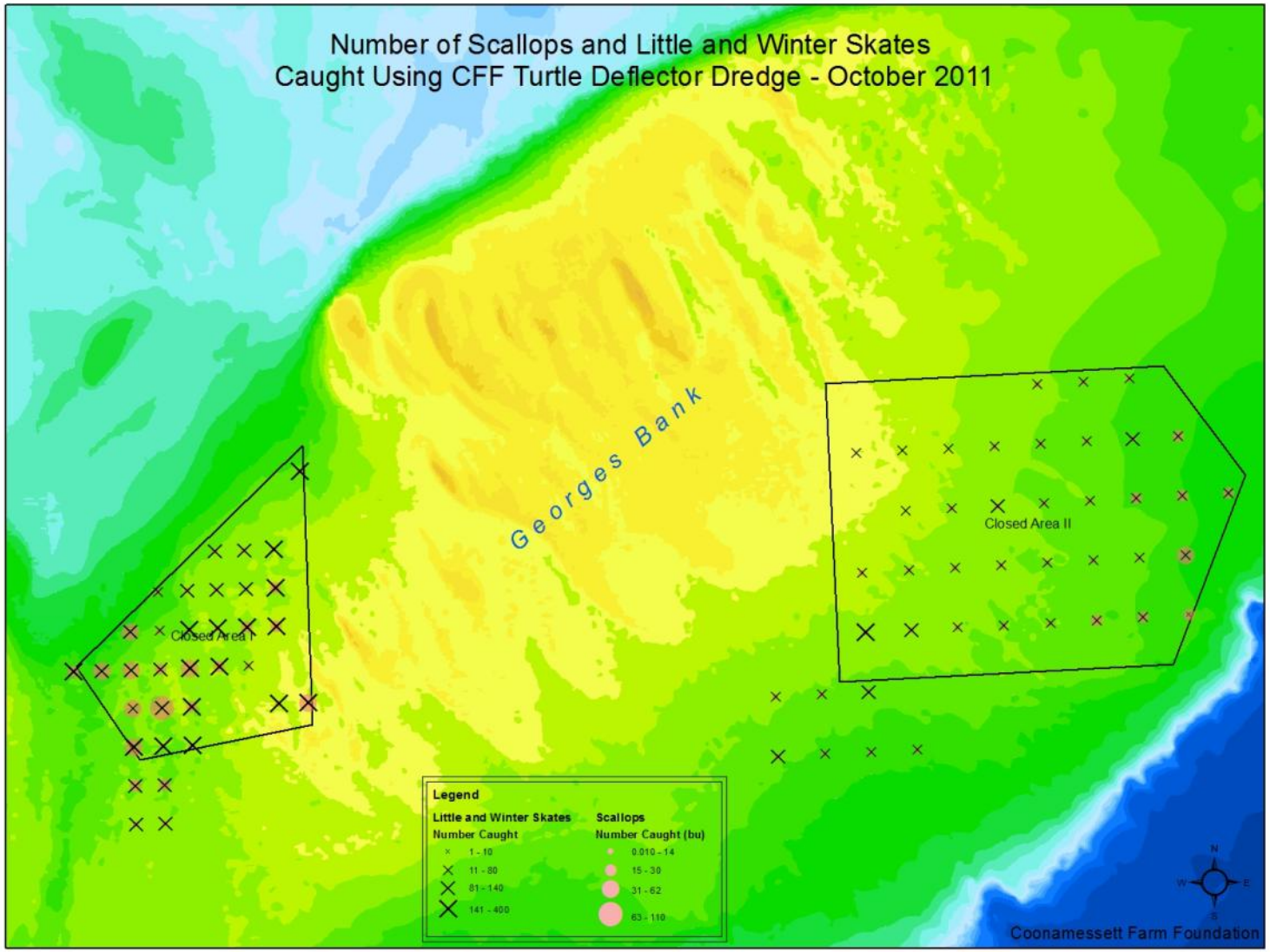

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - June 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

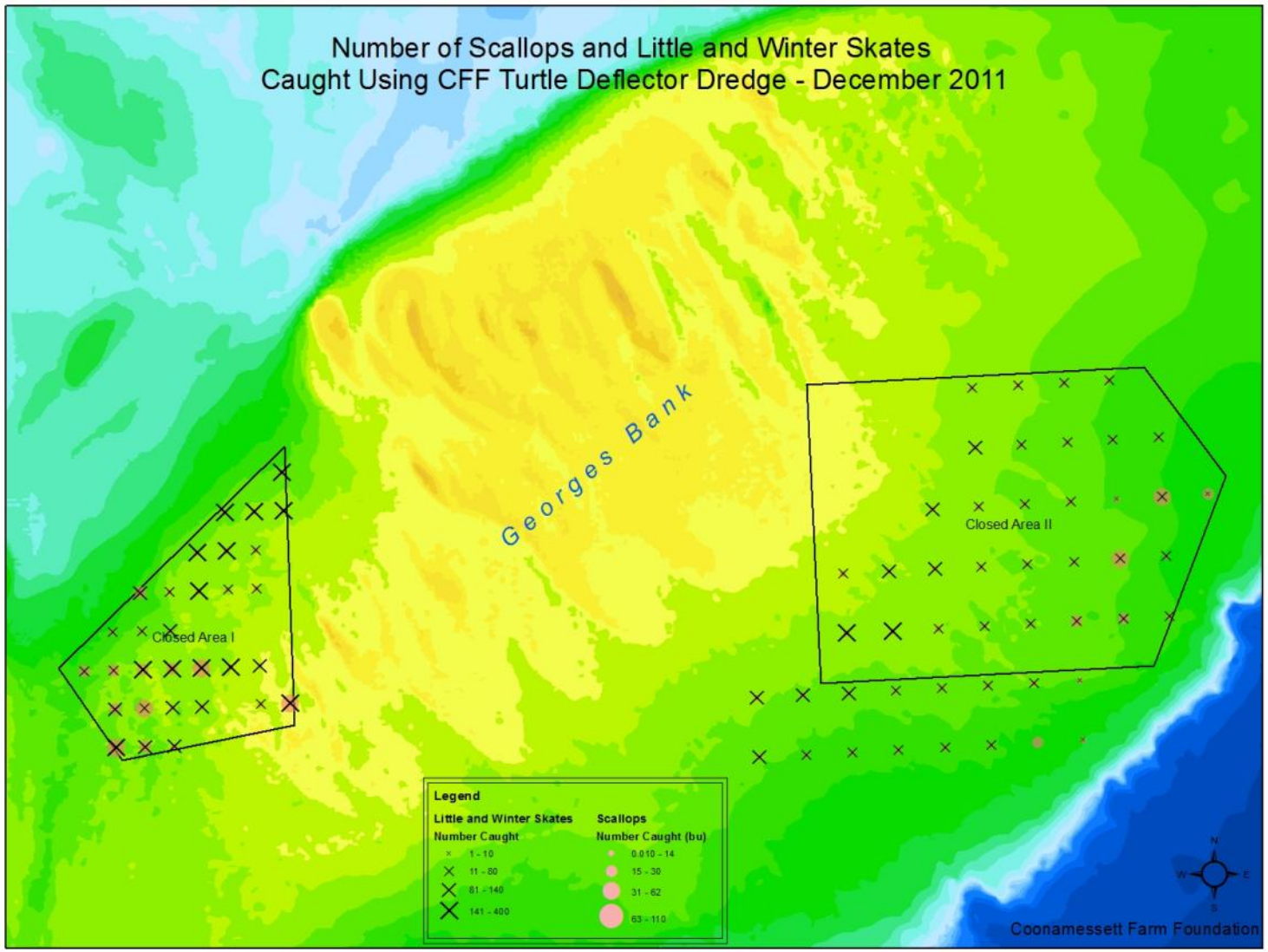

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - July 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation


Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - August 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

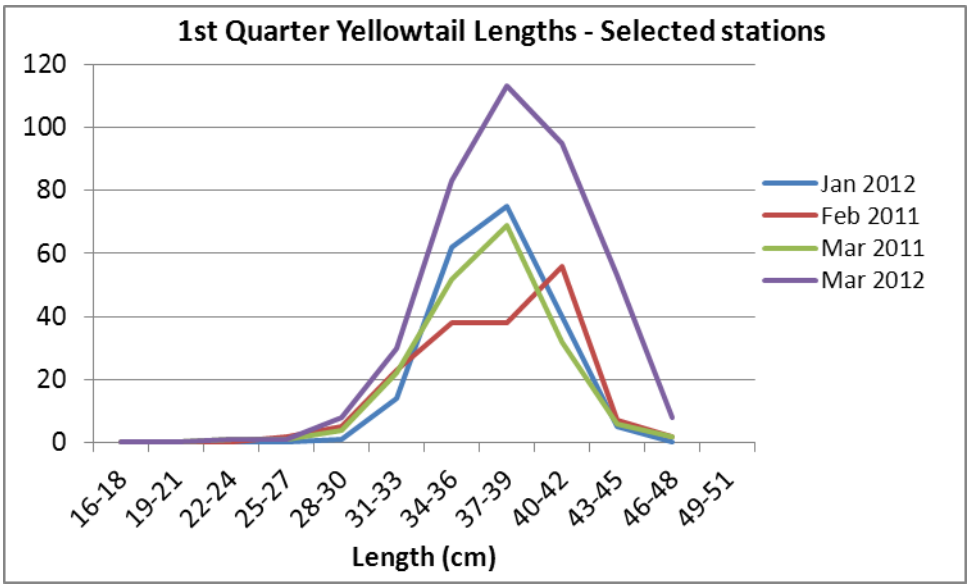

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - September 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

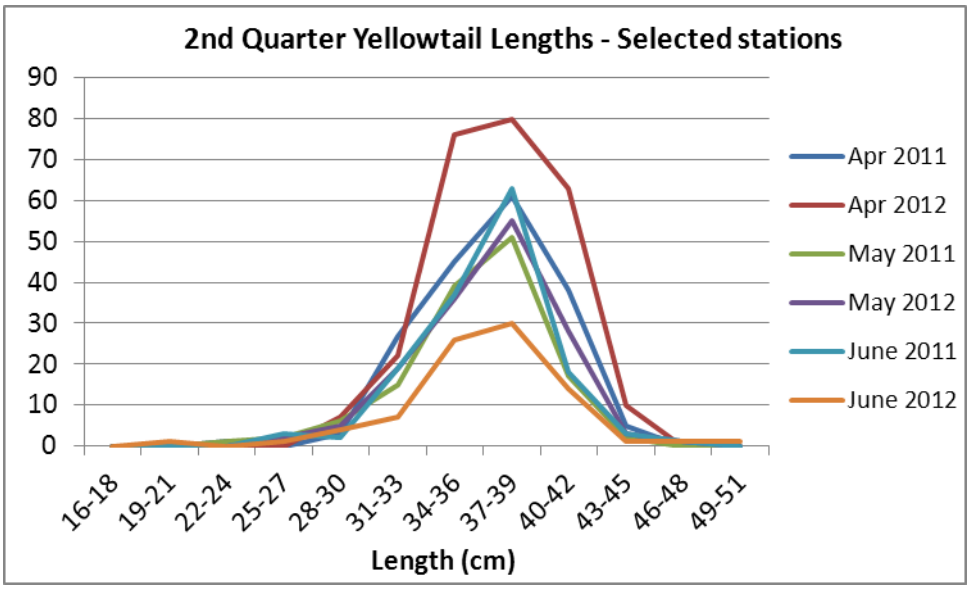

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - October 2010
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
Coonamessett Farm Foundation

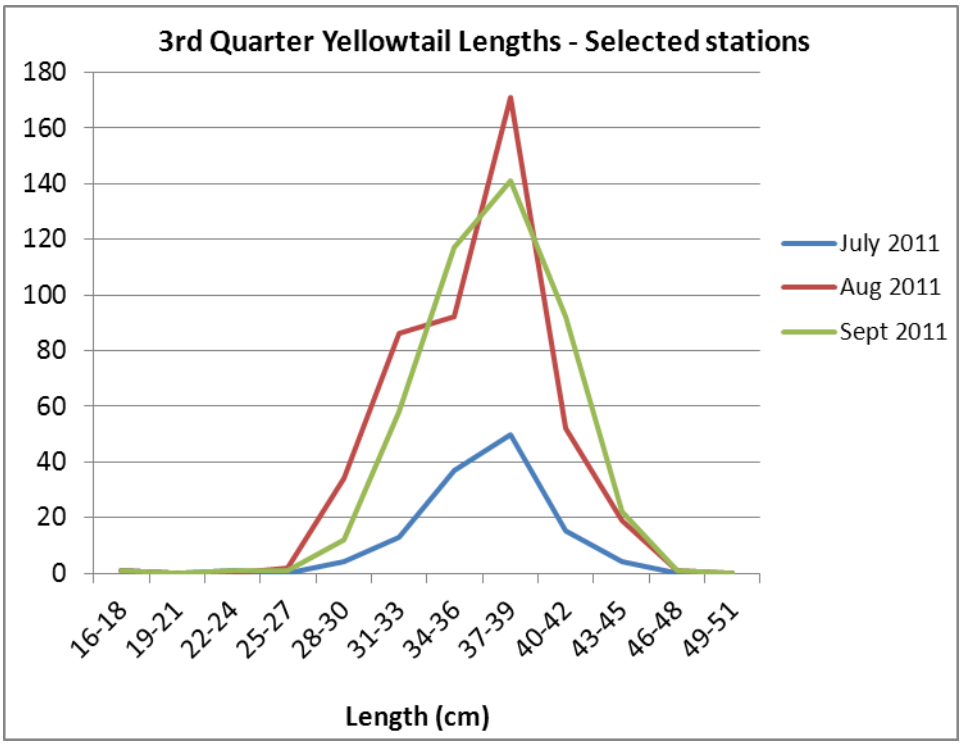

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - October 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

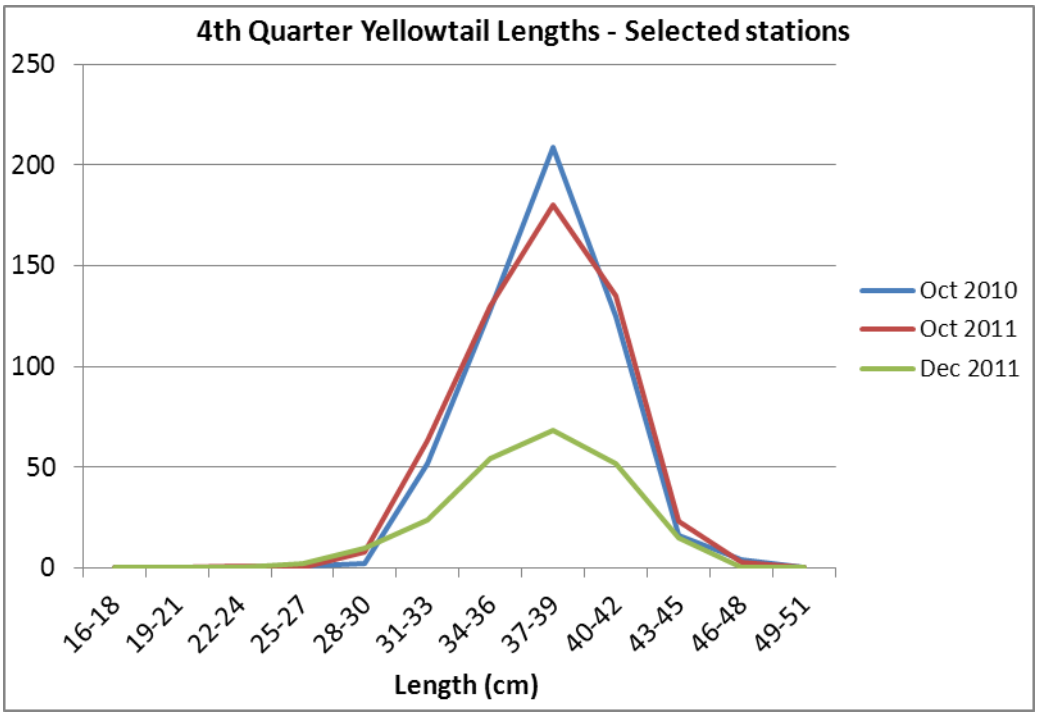

Number of Scallops and Little and Winter Skates
Caught Using CFF Turtle Deflector Dredge - December 2011
Georges Bank
Closed Area I
Closed Area II
Legend
Little and Winter Skates
Number Caught
1 - 10
11 - 80
81 - 140
141 - 400
Scallops
Number Caught (bu)
0.010 - 14
15 - 30
31 - 62
63 - 110
N
W
E
S
Coonamessett Farm Foundation

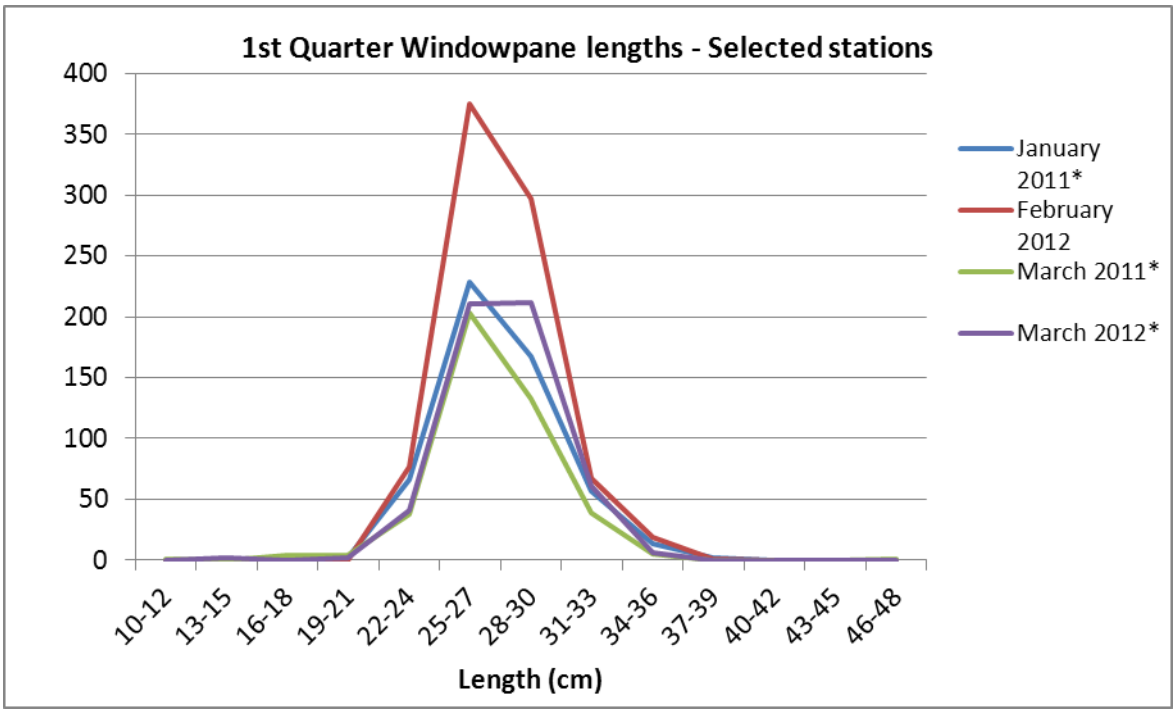
# APPENDIX B: Bycatch species length frequency distributions

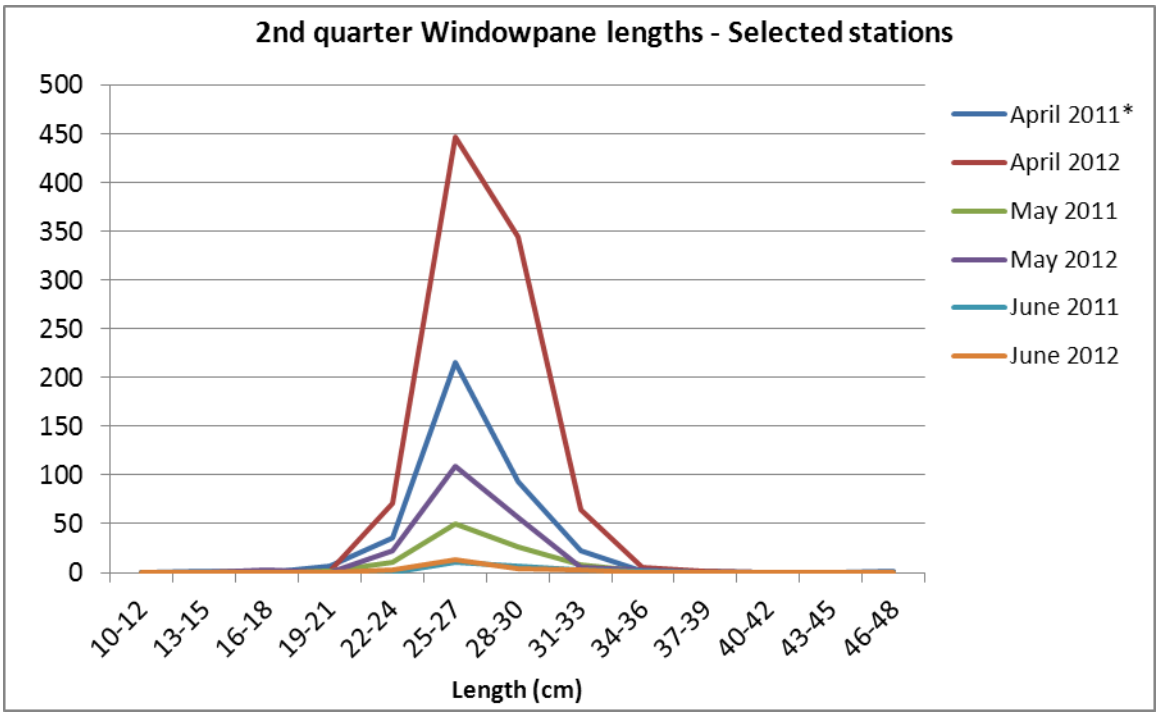


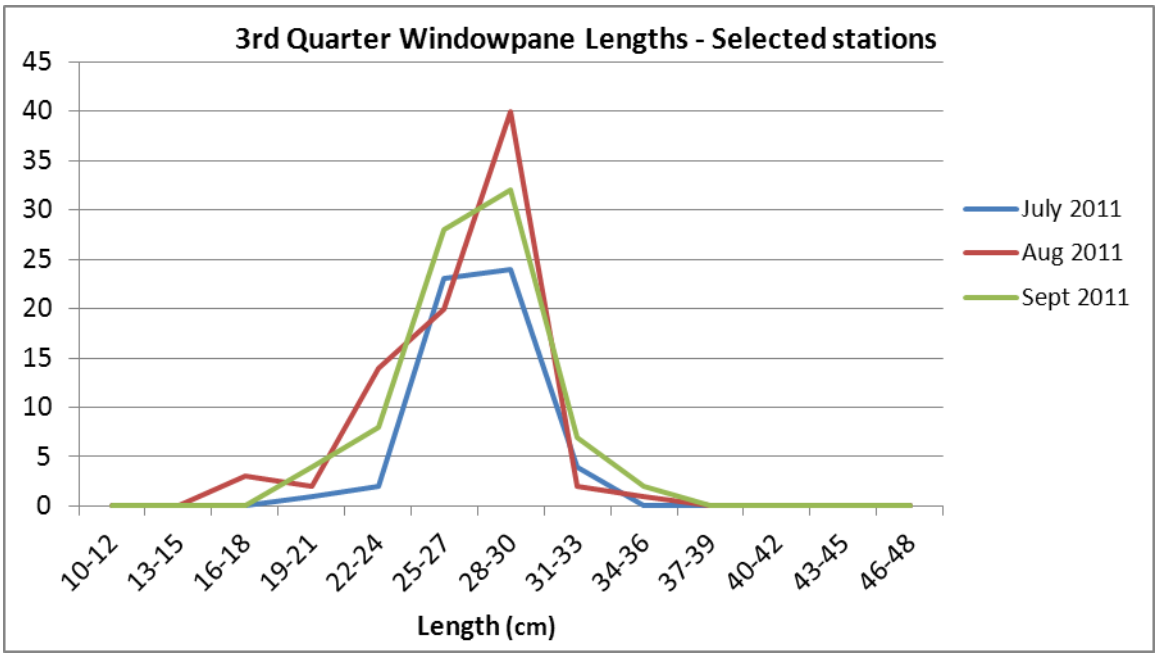



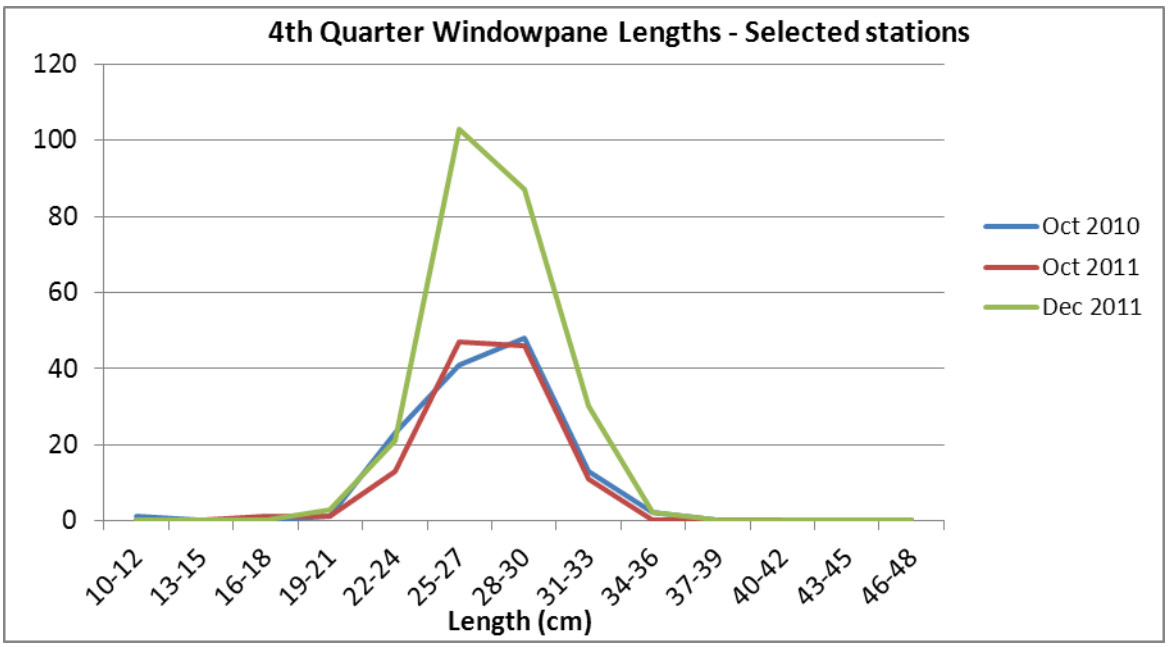

3rd Quarter Yellowtail Lengths - Selected stations
180
160
140
120
100
80
60
40
20
0
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
Length (cm)
July 2011
Aug 2011
Sept 2011

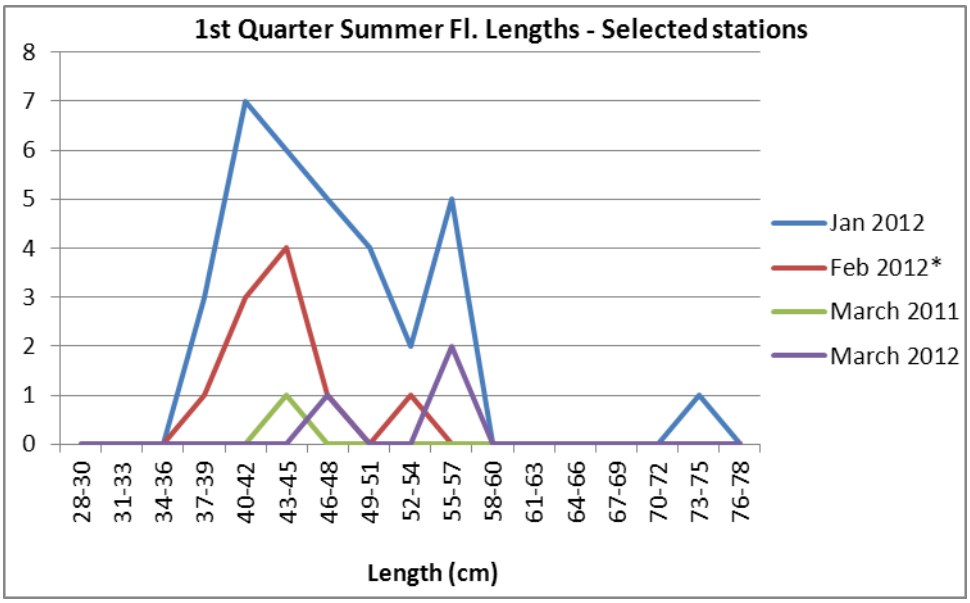

4th Quarter Yellowtail Lengths - Selected stations
250
200
150
100
50
0
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
Length (cm)
Oct 2010
Oct 2011
Dec 2011

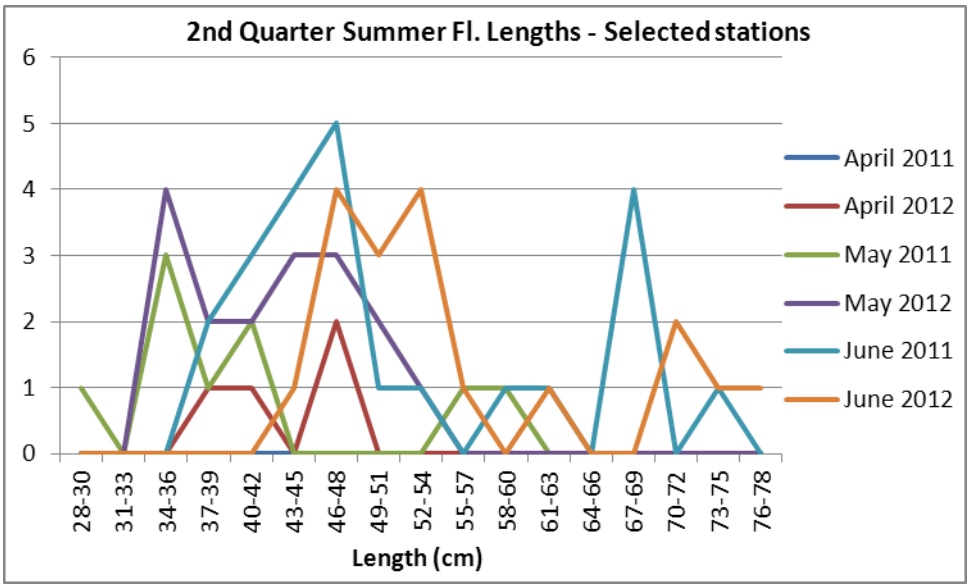

1st Quarter Windowpane lengths - Selected stations
400
350
300
250
200
150
100
50
0
10-12
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
Length (cm)
January 2011*
February 2012
March 2011*
March 2012*

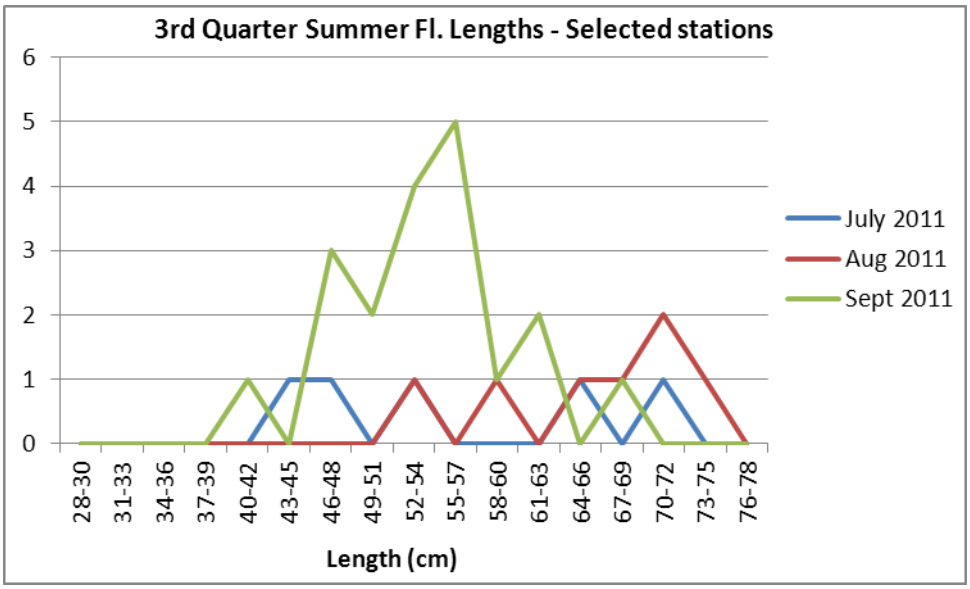

2nd quarter Windowpane lengths - Selected stations
500
450
400
350
300
250
200
150
100
50
0
10-12
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
Length (cm)
April 2011*
April 2012
May 2011
May 2012
June 2011
June 2012

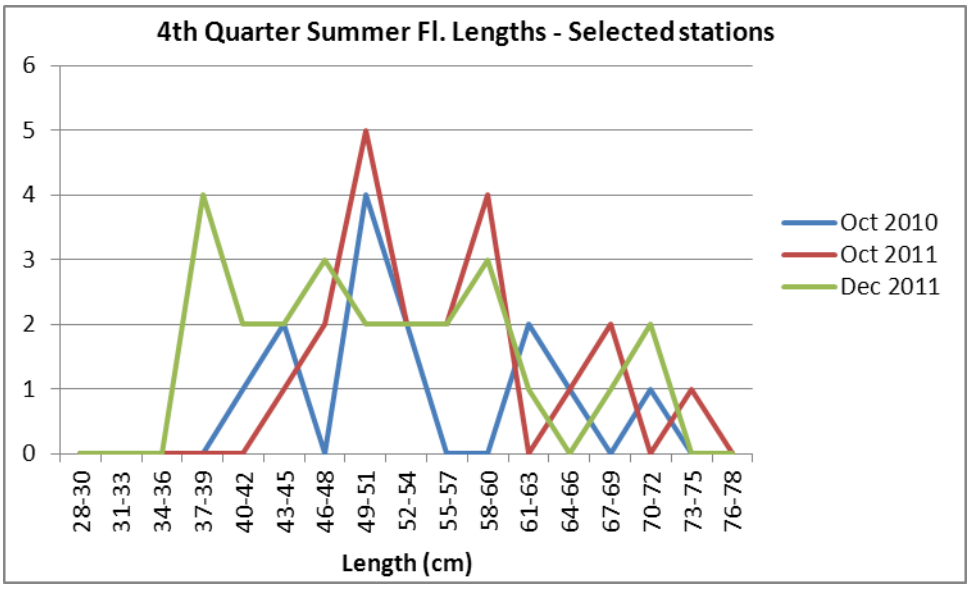

3rd Quarter Windowpane Lengths - Selected stations
45
40
35
30
25
20
15
10
5
0
10-12
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
Length (cm)
July 2011
Aug 2011
Sept 2011

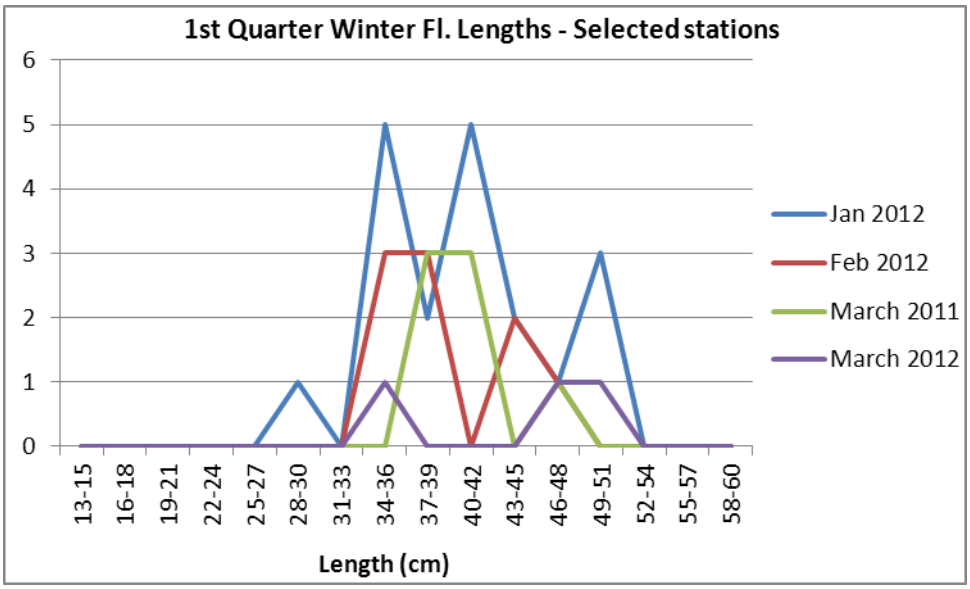

4th Quarter Windowpane Lengths - Selected stations
120
100
80
60
40
20
0
10-12
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
Length (cm)
Oct 2010
Oct 2011
Dec 2011

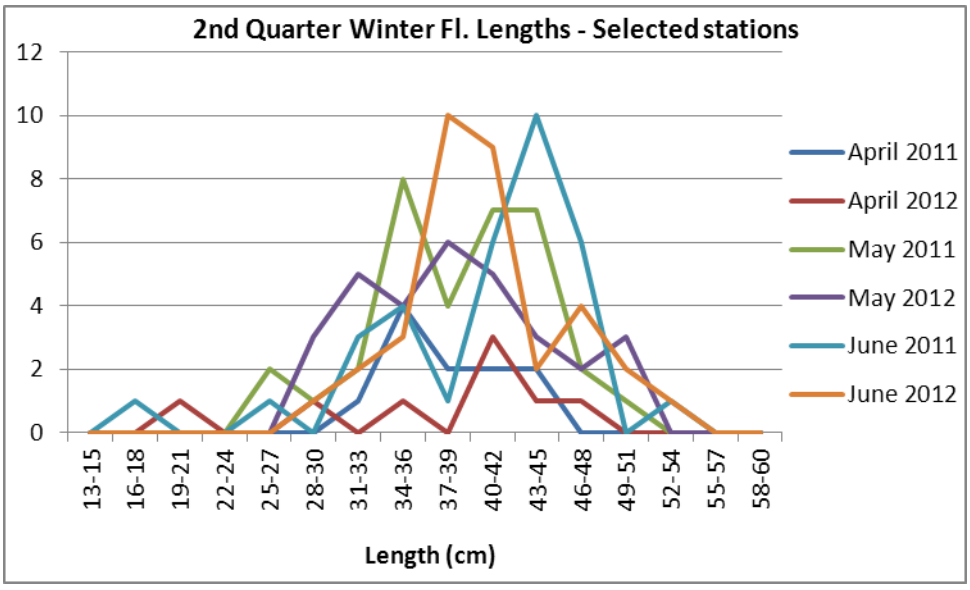

1st Quarter Summer Fl. Lengths - Selected stations
8
7
6
5
4
3
2
1
0
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
61-63
64-66
67-69
70-72
73-75
76-78
Length (cm)
Jan 2012
Feb 2012*
March 2011
March 2012

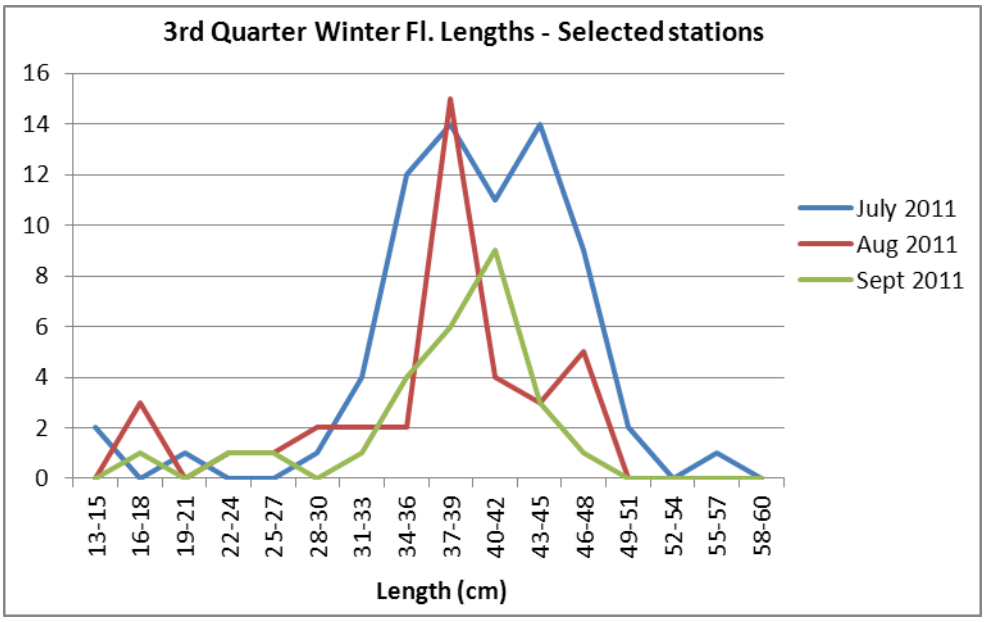

2nd Quarter Summer Fl. Lengths - Selected stations
6
5
4
3
2
1
0
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
61-63
64-66
67-69
70-72
73-75
76-78
Length (cm)
April 2011
April 2012
May 2011
May 2012
June 2011
June 2012

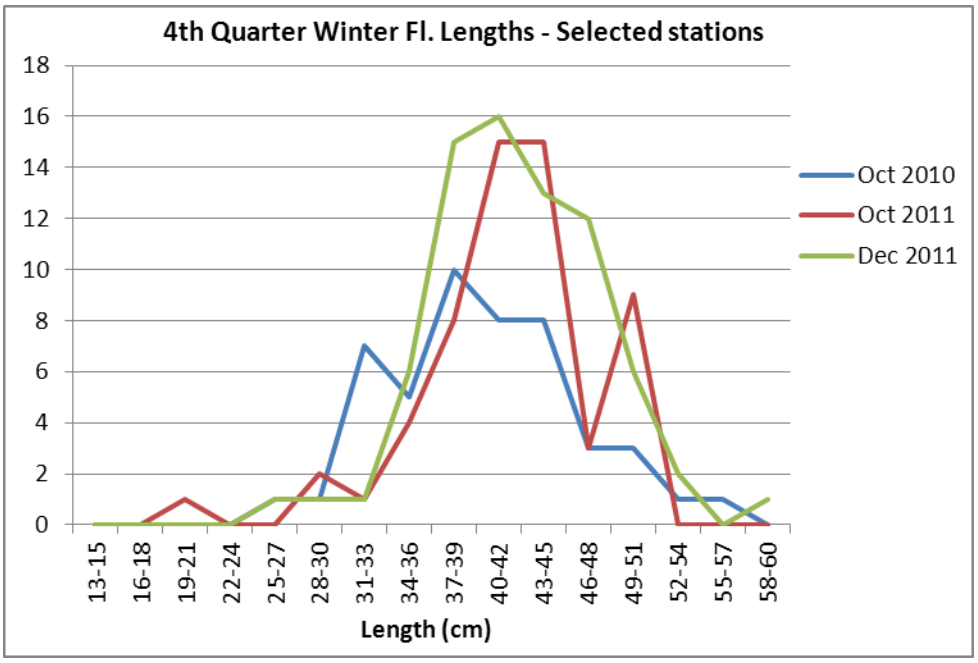

3rd Quarter Summer Fl. Lengths - Selected stations
6
5
4
3
2
1
0
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
61-63
64-66
67-69
70-72
73-75
76-78
Length (cm)
July 2011
Aug 2011
Sept 2011

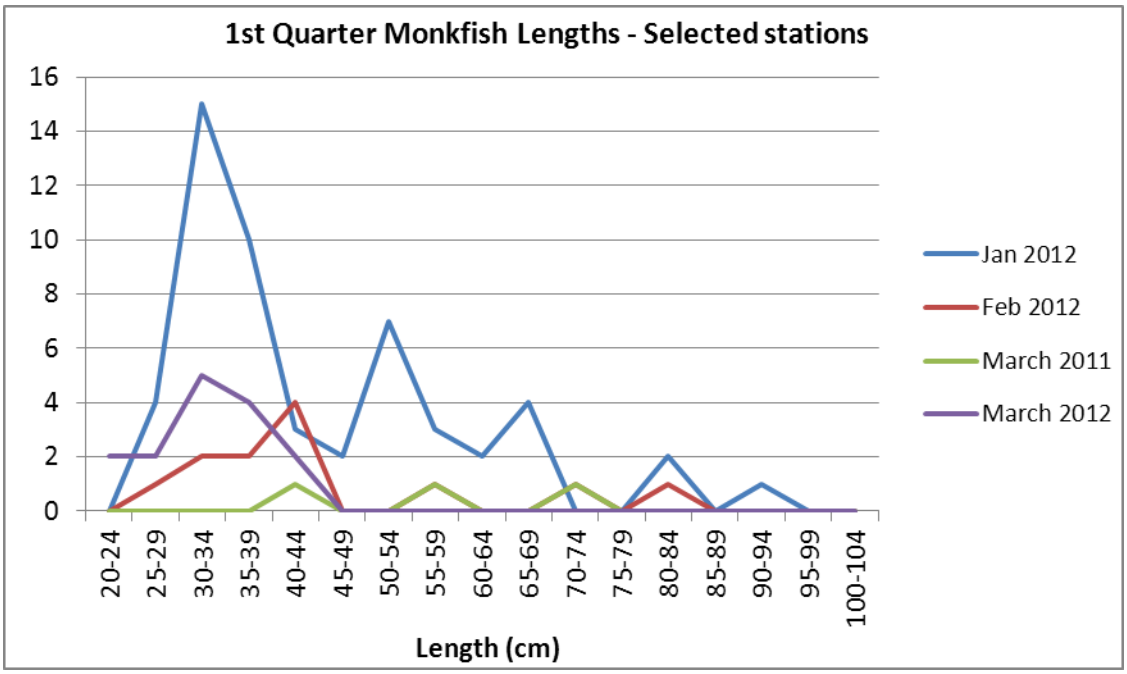

4th Quarter Summer Fl. Lengths - Selected stations
6
5
4
3
2
1
0
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
61-63
64-66
67-69
70-72
73-75
76-78
Length (cm)
Oct 2010
Oct 2011
Dec 2011

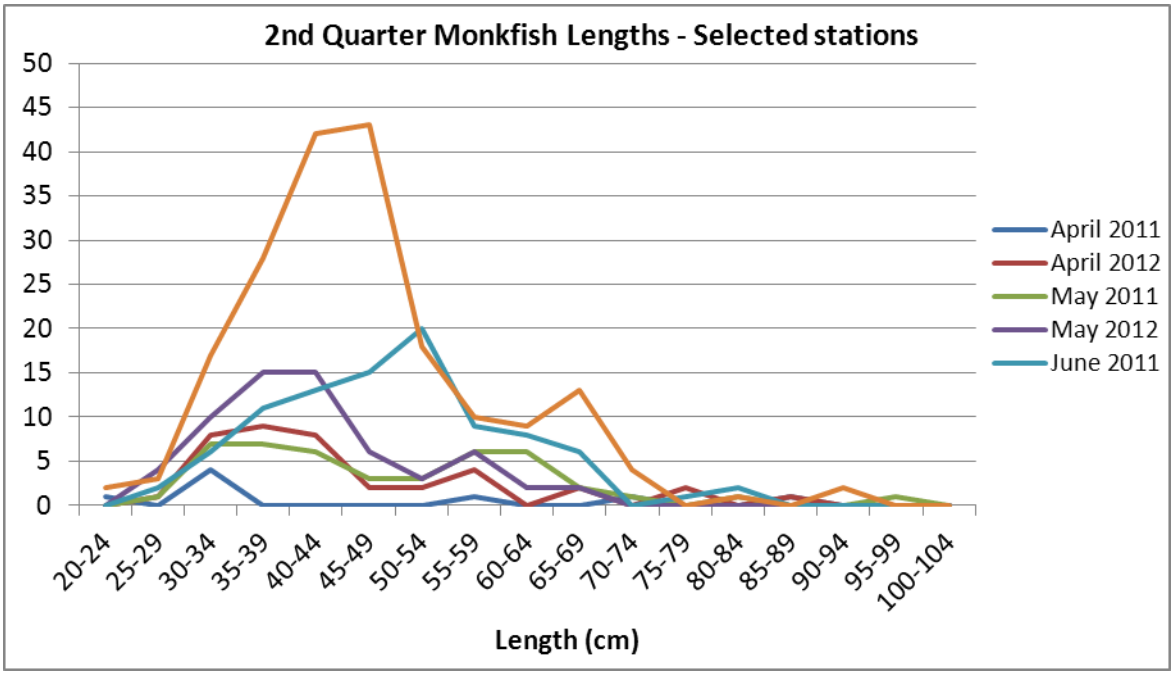

1st Quarter Winter Fl. Lengths - Selected stations
6
5
4
3
2
1
0
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
Length (cm)
Jan 2012
Feb 2012
March 2011
March 2012

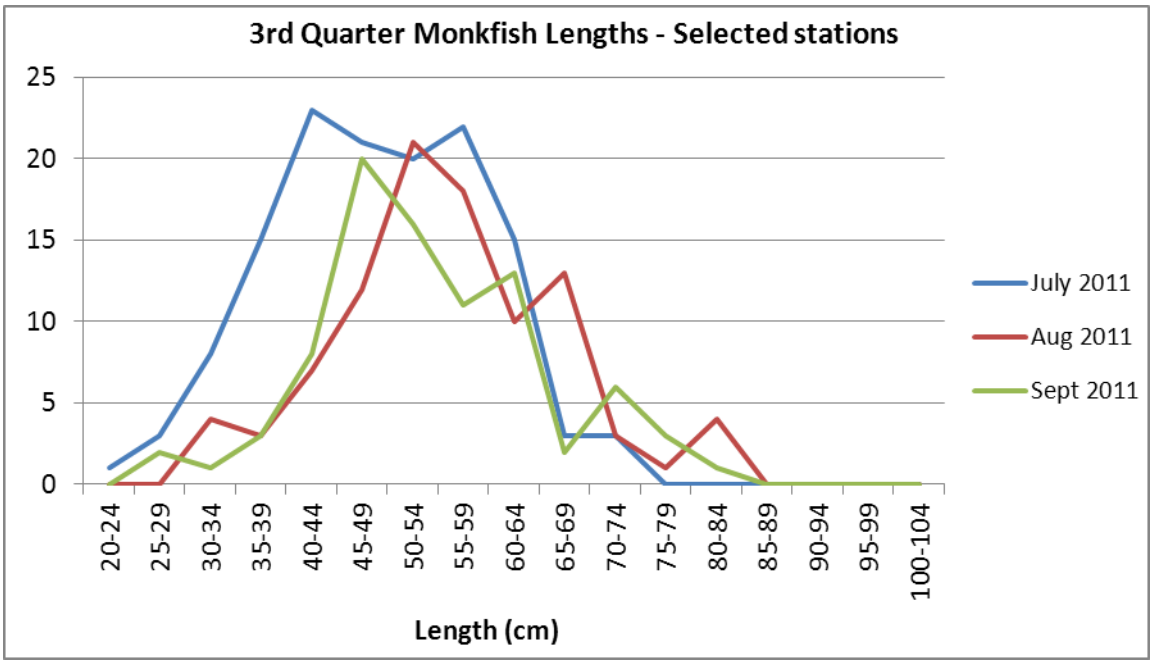

2nd Quarter Winter Fl. Lengths - Selected stations
12
10
8
6
4
2
0
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
Length (cm)
April 2011
April 2012
May 2011
May 2012
June 2011
June 2012

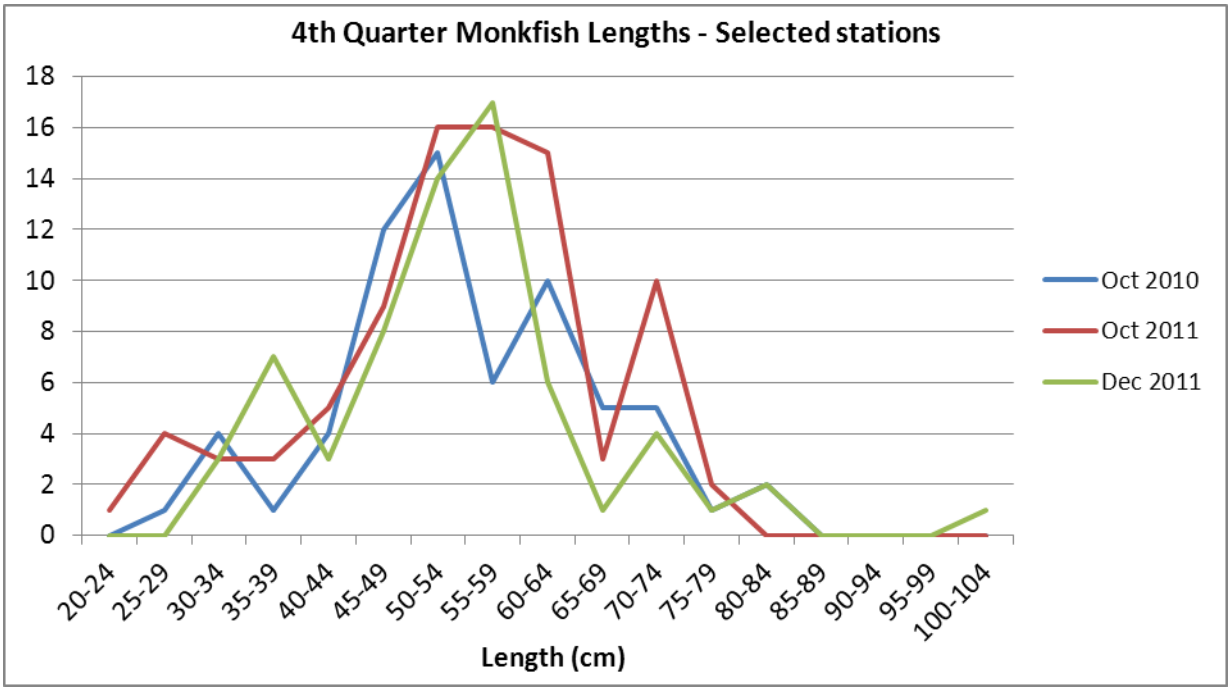

3rd Quarter Winter Fl. Lengths - Selected stations
16
14
12
10
8
6
4
2
0
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
Length (cm)
July 2011
Aug 2011
Sept 2011


4th Quarter Winter Fl. Lengths - Selected stations
18
16
14
12
10
8
6
4
2
0
13-15
16-18
19-21
22-24
25-27
28-30
31-33
34-36
37-39
40-42
43-45
46-48
49-51
52-54
55-57
58-60
Length (cm)
Oct 2010
Oct 2011
Dec 2011


1st Quarter Monkfish Lengths - Selected stations
16
14
12
10
8
6
4
2
0
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
100-104
Length (cm)
Jan 2012
Feb 2012
March 2011
March 2012


2nd Quarter Monkfish Lengths - Selected stations
50
45
40
35
30
25
20
15
10
5
0
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
100-104
Length (cm)
April 2011
April 2012
May 2011
May 2012
June 2011


3rd Quarter Monkfish Lengths - Selected stations
25
20
15
10
5
0
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
100-104
Length (cm)
July 2011
Aug 2011
Sept 2011


4th Quarter Monkfish Lengths - Selected stations
18
16
14
12
10
8
6
4
2
0
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
100-104
Length (cm)
Oct 2010
Oct 2011
Dec 2011

Windowpane Fl. Length Frequency (selected stations)

| Length (cm) | Oct 2010 | March 2011* | April 2011* | May 2011 | June 2011 | July 2011 | Aug 2011 | Sept 2011 | Oct 2011 | Dec 2011 | Jan 2012* | Feb 2012 | March 2012* | April 2012 | May 2012 | June 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10-12** | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13-15** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| **16-18** | 0 | 4 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| **19-21** | 1 | 4 | 6 | 1 | 0 | 1 | 2 | 4 | 1 | 3 | 2 | 0 | 2 | 1 | 0 | 0 |
| **22-24** | 23 | 38 | 36 | 11 | 0 | 2 | 14 | 8 | 13 | 21 | 66 | 77 | 41 | 71 | 23 | 3 |
| **25-27** | 41 | 203 | 215 | 50 | 10 | 23 | 20 | 28 | 47 | 103 | 228 | 375 | 211 | 447 | 109 | 13 |
| **28-30** | 48 | 133 | 93 | 26 | 6 | 24 | 40 | 32 | 46 | 87 | 167 | 297 | 212 | 345 | 56 | 4 |
| **31-33** | 13 | 39 | 22 | 8 | 2 | 4 | 2 | 7 | 11 | 30 | 57 | 67 | 61 | 64 | 5 | 2 |
| **34-36** | 2 | 5 | 1 | 1 | 1 | 0 | 1 | 2 | 0 | 2 | 13 | 19 | 6 | 5 | 2 | 0 |
| **37-39** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 0 | 0 |
| **40-42** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **43-45** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **46-48** | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*not all fish measured

Yellowtail Fl. Length Frequency (selected stations)

| Length (cm) | Oct 2010 | March 2011 | April 2011 | May 2011 | June 2011 | July 2011 | Aug 2011 | Sept 2011 | Oct 2011 | Dec 2011 | Jan 2012 | Feb 2012 | March 2012 | April 2012 | May 2012 | June 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **16-18** | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **19-21** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **22-24** | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| **25-27** | 1 | 1 | 0 | 2 | 3 | 0 | 2 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | 2 | 1 |
| **28-30** | 2 | 4 | 3 | 6 | 2 | 4 | 34 | 12 | 8 | 10 | 1 | 5 | 8 | 7 | 5 | 4 |
| **31-33** | 52 | 22 | 27 | 15 | 19 | 13 | 86 | 58 | 63 | 24 | 14 | 23 | 30 | 22 | 19 | 7 |
| **34-36** | 128 | 52 | 45 | 39 | 37 | 37 | 92 | 117 | 130 | 54 | 62 | 38 | 83 | 76 | 36 | 26 |
| **37-39** | 209 | 69 | 61 | 51 | 63 | 50 | 171 | 141 | 180 | 68 | 75 | 38 | 113 | 80 | 55 | 30 |
| **40-42** | 125 | 32 | 38 | 17 | 18 | 15 | 52 | 92 | 135 | 52 | 40 | 56 | 95 | 63 | 28 | 14 |
| **43-45** | 16 | 6 | 5 | 2 | 3 | 4 | 19 | 22 | 23 | 15 | 5 | 7 | 53 | 10 | 3 | 1 |
| **46-48** | 4 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 0 | 0 | 2 | 8 | 0 | 1 | 1 |
| **49-51** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Monkfish Length Frequency (selected stations)

| Length (cm) | Oct 2010 | March 2011 | April 2011 | May 2011 | June 2011 | July 2011 | Aug 2011 | Sept 2011 | Oct 2011 | Dec 2011 | Jan 2012 | Feb 2012 | March 2012 | April 2012 | May 2012 | June 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **20-24** | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| **25-29** | 1 | 0 | 0 | 1 | 2 | 3 | 0 | 2 | 4 | 0 | 4 | 1 | 2 | 1 | 4 | 3 |
| **30-34** | 4 | 0 | 4 | 7 | 6 | 8 | 4 | 1 | 3 | 3 | 15 | 2 | 5 | 8 | 10 | 17 |
| **35-39** | 1 | 0 | 0 | 7 | 11 | 15 | 3 | 3 | 3 | 7 | 10 | 2 | 4 | 9 | 15 | 28 |
| **40-44** | 4 | 1 | 0 | 6 | 13 | 23 | 7 | 8 | 5 | 3 | 3 | 4 | 2 | 8 | 15 | 42 |
| **45-49** | 12 | 0 | 0 | 3 | 15 | 21 | 12 | 20 | 9 | 8 | 2 | 0 | 0 | 2 | 6 | 43 |
| **50-54** | 15 | 0 | 0 | 3 | 20 | 20 | 21 | 16 | 16 | 14 | 7 | 0 | 0 | 2 | 3 | 18 |
| **55-59** | 6 | 1 | 1 | 6 | 9 | 22 | 18 | 11 | 16 | 17 | 3 | 1 | 0 | 4 | 6 | 10 |
| **60-64** | 10 | 0 | 0 | 6 | 8 | 15 | 10 | 13 | 15 | 6 | 2 | 0 | 0 | 0 | 2 | 9 |
| **65-69** | 5 | 0 | 0 | 2 | 6 | 3 | 13 | 2 | 3 | 1 | 4 | 0 | 0 | 2 | 2 | 13 |
| **70-74** | 5 | 1 | 1 | 1 | 0 | 3 | 3 | 6 | 10 | 4 | 0 | 1 | 0 | 0 | 0 | 4 |
| **75-79** | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 2 | 1 | 0 | 0 | 0 | 2 | 0 | 0 |
| **80-84** | 2 | 0 | 0 | 1 | 2 | 0 | 4 | 1 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 1 |
| **85-89** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **90-94** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| **95-99** | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **100-104** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Winter Fl. Length Frequency (selected stations)

| Length (cm) | Oct 2010 | March 2011 | April 2011 | May 2011 | June 2011 | July 2011 | Aug 2011 | Sept 2011 | Oct 2011 | Dec 2011 | Jan 2012 | Feb 2012 | March 2012 | April 2012 | May 2012 | June 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **13-15** | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **16-18** | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **19-21** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **22-24** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **25-27** | 1 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **28-30** | 1 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 3 | 1 |
| **31-33** | 7 | 0 | 1 | 2 | 3 | 4 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 5 | 2 |
| **34-36** | 5 | 0 | 4 | 8 | 4 | 12 | 2 | 4 | 4 | 6 | 5 | 3 | 1 | 1 | 4 | 3 |
| **37-39** | 10 | 3 | 2 | 4 | 1 | 14 | 15 | 6 | 8 | 15 | 2 | 3 | 0 | 0 | 6 | 10 |
| **40-42** | 8 | 3 | 2 | 7 | 6 | 11 | 4 | 9 | 15 | 16 | 5 | 0 | 0 | 3 | 5 | 9 |
| **43-45** | 8 | 0 | 2 | 7 | 10 | 14 | 3 | 3 | 15 | 13 | 2 | 2 | 0 | 1 | 3 | 2 |
| **46-48** | 3 | 1 | 0 | 2 | 6 | 9 | 5 | 1 | 3 | 12 | 1 | 1 | 1 | 1 | 2 | 4 |
| **49-51** | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 9 | 6 | 3 | 0 | 1 | 0 | 3 | 2 |
| **52-54** | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| **55-57** | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **58-60** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Summer Fl. Length Frequency (selected stations)

| Length (cm) | Oct 2010 | March 2011 | April 2011 | May 2011 | June 2011 | July 2011 | Aug 2011 | Sept 2011 | Oct 2011 | Dec 2011 | Jan 2012 | Feb 2012* | March 2012 | April 2012 | May 2012 | June 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **28-30** | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **31-33** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **34-36** | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 |
| **37-39** | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 4 | 3 | 1 | 0 | 1 | 2 | 0 |
| **40-42** | 1 | 0 | 0 | 2 | 3 | 0 | 0 | 1 | 0 | 2 | 7 | 3 | 0 | 1 | 2 | 0 |
| **43-45** | 2 | 1 | 0 | 0 | 4 | 1 | 0 | 0 | 1 | 2 | 6 | 4 | 0 | 0 | 3 | 1 |
| **46-48** | 0 | 0 | 0 | 0 | 5 | 1 | 0 | 3 | 2 | 3 | 5 | 1 | 1 | 2 | 3 | 4 |
| **49-51** | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 5 | 2 | 4 | 0 | 0 | 0 | 2 | 3 |
| **52-54** | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 4 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 4 |
| **55-57** | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5 | 2 | 2 | 5 | 0 | 2 | 0 | 0 | 1 |
| **58-60** | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| **61-63** | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| **64-66** | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **67-69** | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **70-72** | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| **73-75** | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| **76-78** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

*not all fish measured