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# Assessment of Eastern Georges Bank Haddock for 2014

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## ABSTRACT

The total catch of eastern Georges Bank (EGB) haddock in 2013 was 5,066 mt of the 10,400 mt combined Canada/United States of America (USA) quota. The 2013 Canadian catch decreased from 5,064 in 2012 to 4,631 mt while the USA catch in 2013 was 435 mt, a decrease from the 2012 catch of 569 mt. Haddock discards from the Canadian scallop fishery and the USA groundfish fishery were estimated at 10 and 91 mt, respectively. Under restrictive management measures, combined Canada/USA catches declined from over 6,504 mt in 1991 to a low of 2,150 mt in 1995, varied between about 3,000 mt to 4,000 mt during 1996 to1999 and then generally increased to a peak in 2009 of 19,855 mt. Catches have declined since then as the outstanding 2003 year class moved through the fishery.

Adult population biomass (ages 3+) has increased from near an historical low of 10,300 mt in 1993 to 76,500 mt in 2003. It decreased to 53,000 mt at the beginning of 2005 but subsequently increased to 121,500 mt in 2009, higher than the 1931-1955 maximum of about 90,000 mt. Adult biomass subsequently decreased to 40,600 in 2012 but increased in 2013 and again in 2014 to 160,300 mt. The exceptional 2003 and 2010 year classes, estimated at 243 million and 334 million age 1 fish, respectively, are the largest observed in the assessment time series (1931-1955 and 1969-2013). The preliminary estimate for the 2013 year class is 1,546 million fish at age 1. Except for the strong 2000 and 2011 year classes and the exceptional 2003, 2010 and 2013 year classes, recruitment has fluctuated between 2.1 and 27.3 million since 1990. Fully recruited fishing mortality fluctuated between 0.27 and 0.47 during the 1980s, and increased in 1993 to a high of 0.55, the highest observed. Fully recruited fishing mortality was below $F_{ref}$ = 0.26 during 1995 to 2003, fluctuated around 0.3 during 2004 to 2006, then declined and stayed below $F_{ref}$ and was 0.16 in 2013.

Positive signs of productivity include expanded age structure, broad spatial distribution, large biomass and three exceptional year classes and two strong year classes since 2000. On the negative side, condition has decreased substantially and size at age has declined.

Assuming a 2014 catch equal to the 27,000 mt total quota and downsizing the 2013 year class to the 2010 year class abundance at age 1, a combined Canada/USA catch of 44,000 mt in 2015 results in a neutral risk (50%) that the 2015 fishing mortality rate would exceed $F_{ref}$ = 0.26. A catch of 37,000 mt in 2015 results in a low risk (25%) that the 2015 fishing mortality rate will exceed $F_{ref}$. The 2010 year class at age 5 is expected to contribute 88% of the catch biomass. The next highest contribution to the 2015 catch biomass of 6% is expected from the 2011 year class at age 4. The probability that the 2016 biomass will not increase by 20% is negligible. Adult biomass is projected to be 234,300 mt at the beginning of 2016 fishing at $F_{ref}$.

## RÉSUMÉ

Le total des prises d'aiglefin dans l'est du banc Georges s'est élevé à 5 066 tm en 2013, sur un quota combiné de 10 400 tm pour le Canada et les États-Unis. Les prises canadiennes sont passées de 5 064 tm en 2012 à 4 631 tm en 2013, tandis que les prises américaines sont passées de 569 tm en 2012 à 435 tm en 2013. On estime les rejets d'aiglefins dans la pêche canadienne du pétoncle et dans la pêche du poisson de fond aux États-Unis à 10 tm et 91 tm respectivement. Des mesures de gestion strictes ont entraîné une diminution des prises combinées du Canada et des États-Unis. Après avoir atteint plus de 6 504 tm en 1991, elles ont connu un creux à 2 150 tm en 1995, puis elles ont fluctué entre 3 000 tm et 4 000 tm environ de 1996 à 1999 avant d'augmenter de manière générale pour atteindre un pic de 19 855 tm en 2009. Les prises ont diminué depuis tandis que l'exceptionnelle classe d'âge 2003 a été exploitée par la pêche.

La biomasse de la population adulte (âges 3+) a augmenté, passant d'un creux quasi historique de 10 300 tm en 1993 à 76 500 tm en 2003. Elle est tombée à 53 000 tm au début de 2005, mais elle a augmenté par la suite pour atteindre 121 500 tm en 2009, soit un niveau supérieur à la biomasse maximale de la période 1931-1955 qui était d'environ 90 000 t. Elle a ensuite diminué à 40 600 tm en 2012, mais augmenté en 2013 puis en 2014 pour atteindre 160 300 tm. Les classes d'âge exceptionnelles 2003 et 2010, dont on estime l'effectif des poissons d'âge 1 à 243 millions et 334 millions d'individus, respectivement, sont les plus importantes jamais observées dans les séries chronologiques d'évaluation (1931-1955 et 1969-2013). L'estimation préliminaire pour la classe d'âge 2013 est de 1 546 millions de poissons d'âge 1. Sauf pour les fortes classes d'âge de 2000 et 2011 et les classes d'âge exceptionnelles de 2003, 2010 et 2013, le recrutement a fluctué entre 2,1 et 27,3 millions d'individus depuis 1990. La mortalité par pêche des individus pleinement recrutés a fluctué entre 0,27 et 0,47 dans les années 1980. Elle a connu une augmentation en 1993 pour atteindre 0,55, soit la plus haute valeur jamais observée. La mortalité par pêche des individus pleinement recrutés était inférieure au taux de mortalité par pêche de référence $F_{réf}$ = 0,26 de 1995 à 2003, elle a fluctué autour de 0,3 de 2004 à 2006, puis elle a diminué et est restée inférieure à $F_{réf}$ les années suivantes, et était de 0,16 en 2013.

Parmi les signes encourageants de productivité, il y a l'élargissement de la structure par âge, la vaste répartition spatiale, la biomasse élevée, trois classes d'âge exceptionnelles et deux fortes classes d'âge depuis 2000. Parmi les signes négatifs, on note une détérioration importante de la condition et une diminution de la taille selon l'âge.

Si l'on suppose que les prises de 2014 sont égales au quota total de 27 000 tm et que l'on réduise la classe d'âge de 2013 à l'abondance de la classe d'âge de 2010 à l'âge 1, les prises combinées du Canada et des États-Unis de 44 000 tm en 2015 se traduisent alors par un risque neutre (50 %) que le taux de mortalité par pêche dépasse le taux de mortalité par pêche de référence $F_{réf}$ = 0,26 cette année-là. Des prises totalisant 37 000 tm en 2015 se traduiraient par un faible risque (25 %) que le taux de mortalité par pêche dépasse le taux de mortalité par pêche de référence $F_{réf}$ cette année-là. La classe d'âge 2010, à l'âge 5, devrait constituer 88 % de la biomasse des prises. La deuxième contribution la plus importante à la biomasse des prises de 6 % en 2015 devrait provenir de la classe d'âge 2011 à l'âge 4. La probabilité que la biomasse n'augmentera pas de 20 % en 2016 est négligeable. On prévoit qu'au début de la saison de pêche de 2016, en tenant compte d'un niveau situé à $F_{réf}$, la biomasse des adultes sera de 234 300 tm.

# INTRODUCTION

For the purpose of developing a sharing proposal and consistent management by Canada and the United States of America (USA), an agreement was reached that the transboundary management unit for haddock would be limited to the eastern portion of Georges Bank (EGB; DFO statistical unit areas j and m in the Northwest Atlantic Fisheries Organization (NAFO) Subdivision 5Ze; USA statistical areas 551, 552, 561 and 562 in NAFO sub-division 5Ze; Figure 1; DFO 2002). This assessment applies the approach used by Van Eeckhaute and Brooks (2013) to Canadian and USA fisheries information updated to 2013. Results from the Fisheries and Oceans Canada (DFO) survey, updated to 2014, the USA National Marine Fisheries Service (NMFS) spring survey, updated to 2014 and the NMFS autumn survey, updated to 2013, were incorporated. The NMFS surveys since 2009, which use a new vessel, the NOAA ship *Henry B. Bigelow*, and a new net and protocols, were made equivalent to surveys undertaken by the former National Oceanic and Atmospheric Administration (NOAA) ship *Albatross IV* with length based conversion factors.

# FISHERY

## COMMERCIAL CATCHES

Haddock on Georges Bank have supported a commercial fishery since the early 1920s (Clark *et al*.1982). Catches from EGB during the 1930s to 1950s ranged between 15,000 mt and 40,000 mt (Figure 2), averaging about 25,000 mt (Schuck 1951, R. Brown *pers. com.*). Records of catches by unit area for 1956 to 1968 have not been located; however, based on records for NAFO Subdivision 5Ze, catches from EGB probably attained record high levels of about 60,000 mt during the early 1960s. Catches in the late 1970s and early 1980s (Table 1) reached a maximum of 23,344 mt and were associated with good recruitment. Substantial quantities of small fish were discarded in those years (Overholtz *et al*. 1983). Catches subsequently declined and fluctuated around 5,000 mt during the mid to late 1980s. Under restrictive management measures (Table 2), combined Canada/USA catches declined from 6,504 mt in 1991 to a low of 2,150 mt in 1995, varied between about 3,000 mt and 4,000 mt until 1999, and increased to 15,257 mt in 2005 (Figure 3). Combined catches varied between 12,510 mt and 19,855 mt from 2006 to 2011 then decreased in 2012 to 5633 mt and in 2013 to 5,066 mt. In 2013, the total catch represented 49% of the combined 10,400 mt quota. Canada caught 72% of its 6,448 mt allocation while the USA caught 11% of its 3,952 mt allocation. The total catch is well below the quota due to reduced availability of haddock and bycatch restrictions on the Canadian and USA fisheries.

## Canadian

Some elements of the management measures used on EGB are described in Table 2. Quotas are the principal means used to regulate the Canadian groundfish fisheries on Georges Bank. Quota regulation requires effective monitoring of fishery catch. Weights of all Canadian landings since 1992 have been monitored at dockside. Canadian catches since 1995 have usually been below the quota due to closure of some fleet sectors when the cod quotas were reached. At-sea observer coverage increased from 2011 levels for all gears and represented 66% of otter trawl, 28% of longline and 20% of gillnet landings, which amounted to an overall observed level of 63% of the haddock landings in 2013.

Between 1994 and 2004, the Canadian fishery for groundfish on EGB was prohibited from January 1$^{st}$ to May 30$^{th}$. In 2005, increasing haddock abundance led to permission to conduct an exploratory Canadian groundfish fishery in January and February that has continued since that time. Observer coverage for this fishery has been higher than at other times of the year. So as not to adversely affect the rebuilding of cod on EGB, the winter fishery was closed February 4$^{th}$

in 2013, based on when it was determined that cod were actively spawning in the previous year, i.e. when 30% of cod were in the spawning or post-spawning stages from spawning data collected by observers.

### Canadian Landings

Canadian landings in 2013 decreased to 4,621 mt from 5,034 mt in 2012. The 2012 and 2013 catches are the lowest since 2000. In recent years, the Canadian fishery has been conducted primarily by vessels using otter trawls and longlines with some handlines and gillnets. In 2013, almost all of the catch was taken by tonnage class 3 or smaller (less than 150 tons) vessels, corresponding roughly to vessels less than 65 ft in overall length. Otter trawl gear accounted for 94% and longline gear accounted for 6% of the haddock landings, and there were minimal landings from gillnet (Table 3). The highest catch occurred in October, followed by September, January, December and November, in that order (Table 4, Figure 4). The January/February winter fishery landed 1,028 mt of haddock, accounting for 22% of the total Canadian landings, somewhat higher than the previous year. Quarter 4 had the highest percentage of total Canadian landings at 45%.

Prior to 1985, Canadian landings include haddock landings reported by the scallop fishery. Landings of haddock by the scallop fleet were low (Table 3) with a maximum of 38 mt reported in 1987.

### Canadian Discards

Since 1996, the scallop fishery has been prohibited from landing haddock and this species is therefore discarded. Discards from this fleet ranged between 29 and 186 mt since 1969 (Table 1; Gavaris *et al*. 2007, 2008 and 2009, Van Eeckhaute and Gavaris 2006, Van Eeckhaute *et al*. 2005, 2010 and 2011). In 2013 there were 17 observed scallop trips (Table 5). The monthly discard rates are calculated using a 3-month moving window average. Since 2011, the 3-month moving window used to calculate the discard rate includes December of the previous year for the January discard rate and January of the following year for the December rate (Van Eeckhaute *et al.* 2011). Discards from 2005 onward were recalculated to reflect a change in the effort measure used from freezer trawler hours to hours x meters (Sameoto *et al.* 2013). The effect on haddock discards was minimal. Discards in 2013 were estimated at 10 mt, the lowest in the time series (Table 6).

Compliance with mandatory retention is thought to be high since at least 1992, so discards in the groundfish fishery are considered to be negligible.

## USA

Management measures for the USA fishery have been primarily effort based since 1994; however, in 2004, quota management was introduced to regulate the USA groundfish fishery for EGB haddock (Table 2). From 2008 to 2010, the USA portion of the EGB management area was closed to vessels fishing with trawl gear from May 1$^{st}$ to July 31$^{st}$. From 2011 onwards, the regulation only applies to the common pool, which is a miniscule fraction of USA boats that fish on EGB (the common pool received 0.62%, 0.28%, and 0.32% of the EGB quota in 2011, 2012, and 2013, respectively).

The minimum size for landed haddock had been reduced to 18 inches (45.7 cm) in October 2007 but reverted back to 19 inches (48.2 cm) in August 2008. On May 1, 2009, the minimum size was again reduced to 18 inches through a NMFS interim action. This minimum size limit was retained in Amendment 16, which went into effect on May 1, 2010. On September 15, 2008, the Ruhle trawl (previously called the Eliminator Trawl) was authorized for use in the USA portion of EGB management area. The Ruhle trawl is intended to reduce by-catch of cod. Also, beginning on May 1, 2010, many participants in the multispecies groundfish fishery organized into sectors, with each unique sector receiving a portion of the overall quota known as an Annual Catch Entitlement (ACE). Those vessels not joining a sector remained in the common

pool, which received a portion of the overall quota. A discard provision went into effect on May 1, 2010 requiring that all legal sized fish be retained by vessels in a sector. On May 11, 2011, the Closed Area II Special Access Permit (SAP) was modified to allow targeting of haddock from August 1st to January 31st. Also, on September 14, 2011, the haddock catch cap regulation for the herring midwater trawl fishery increased to 1% of the Georges Bank Annual Biological Catch (ABC). Beginning July 1, 2013, the minimum size was reduced from 18 inches to 16 inches (40.64 cm).

#### USA Landings

USA landings of EGB haddock in 2013 were derived from mandatory fishing vessel trip reports (VTRs) and dealer reports. Statistical methodology was applied to allocate unknown landings to statistical area from 1994 to 2013 (Wigley *et al*. 2008a, Palmer 2008). Some of the landings for trawl gear that were reported in 2008 to 2010, during the months when EGB was closed to trawl gear, come from the allocation algorithm that assigns a statistical area when area is missing or there are inconsistencies in reported areas on logbooks. Trawl landings that were allocated to EGB during May to July for 2008-2010 comprised 3% to 5% of total annual USA landings.

USA calendar year landings (Table 1) of EGB haddock decreased from 443 mt in 2012 to 344 mt in 2013. The 2013 USA landings peaked in quarter 4 (47%), primarily due to landings in December, which represents 24% of total annual landings (Table 7). As in other years, the otter trawl gear accounted for the majority of the USA landings (331 mt; Table 8). The contribution by other gear, 13 mt, was 4%.

For USA fishing year May 1, 2013, to April 30, 2014, the USA catch quota for sectors was 3,742 mt of which only 13.8% was realized in landings (15.2% of quota, including discards). The catch quota for the common pool was 12 mt, none of which was caught. In recent years, landings have been constrained in part by the low cod quota, the closed area, as well as the delayed opening of the EGB area to trawlers until August 1st, in effect from 2008 to 2010 for all USA trawl gear and, since 2011, for the common pool only. The use of the Ruhle and Separator trawls may have reduced interactions with the cod quota.

#### USA Discards

Discards were estimated from the ratio of discarded haddock to kept of all species, a new methodology that was first applied for the 2009 EGB haddock assessment. This ratio is calculated by year-quarter (or other suitable time step)-gear-mesh and prorated to the total landings of all species in the same time-gear category to obtain total discards (mt) (Wigley et al. 2008b). Where time steps within the year are sparse, imputation is carried out.

Total discards in 2013 were 91 mt, a decrease from 126 mt in 2012 (Tables 1 and 9). Discards were mostly from the second half of the year (70%). USA discards from the large mesh otter trawl fishery decreased slightly from 87 mt in 2012 to 84 mt in 2013. Discards from this fleet accounted for 19.3% (by weight) of the USA haddock catch in 2013. Small mesh discards were 6 mt in 2013, a decrease from 38 mt in 2012. The scallop fishery contributed a very small amount of discards in 2013.

## SIZE AND AGE COMPOSITION

### Ageing Precision and Accuracy

D. Knox provided ages for the 2013 Canadian fishery and 2014 DFO survey and S.J. Sutherland provided ages for the 2013 USA fishery and the NMFS 2013 autumn and 2014 spring surveys. Age testing was conducted between the DFO reader and the NMFS reader, and intra-reader testing was conducted at both labs. The NMFS reader also completed two tests against their haddock reference collection, which resulted in 91% and 93% agreement. Inter-lab agreement ranged from 84% to 98%. No bias was detected for the exchange. Intra-reader agreement on non-reference collection samples for the NMFS reader ranged between 96% and

99%. For the DFO reader, intra-reader agreement ranged between 93% and 98%. Age determinations at both labs were considered to be reliable for characterizing catch at age (Table 10; http://www.nefsc.noaa.gov/fbp/QA-QC/hd-results.html).

## Canadian

The size and age composition of haddock in the 2013 Canadian groundfish fishery was characterized using port and at-sea samples from all principal gears (Table 11). Landings were applied to length samples combined by gear-month, then combined to calendar quarters before applying quarterly age length keys. Canadian fishery weights were derived from fishery lengths using a length-weight relationship that was derived from commercial fishery samples (*round weight* (kg) = 0.0000158 *length* (cm)$^{2.91612}$; Waiwood and Neilson 1985). Gillnet landings were low and no length samples were available. Therefore, gillnet landings were added in at the quarter level. For trips that were sampled by both at-sea observers and port samples, the length frequencies from the two sources were combined with appropriate weighting from each source before using to ensure that samples were used in a consistent manner. The size composition of haddock discards in the 2013 Canadian scallop fishery was characterized by quarter using length samples obtained from 17 observed scallop trips, which comprised 11% of the total trips and 11% of the total effort hours. The 2005 to 2012 discards catch at age was updated to reflect changes in estimated amounts due to a change in the effort measure used and changes made to the observer data. The 2013 DFO survey ages, augmented with port samples, were applied to the first quarter landings and discard length compositions. Fishery age samples for quarters 2, 3 and 4 were applied to the corresponding length compositions for both the groundfish fishery and discards.

The modal length of haddock in the 2013 Canadian fishery was 40.5 cm for otter trawlers and 42.5 cm for longliners (Figure 5). Haddock discarded by the scallop fleet had a peak at 14.5 cm and a lesser peak at 36.5 cm.

The 9+ age group, comprised almost exclusively of the 2003 year-class, dominated quarter 1 (48%) Canadian landings, accounted for 25.5% of quarter 2 but decreased in importance for quarters 3 (7%) and 4 (4%). It accounted for 13% in numbers of the total Canadian landings. The 2010 year class (age 3) dominated quarters 3 and 4 at 69% and 86%, respectively (Table 12 and Figure 6). Age 3 (2010 year class) made the highest contribution to the Canadian discards (43% by number) followed by the 2013 year class (age 0) at 37%. For the 4$^{th}$ quarter age 0 contributed 76% of the discards.

## USA

USA landings of EGB haddock are sorted into “large” and “scrod” market categories at sea and are sampled in port for lengths and ages. Landings of large haddock totaled 28 mt and scrod haddock totalled 269 mt in 2013 (Table 9). Length sampling for USA EGB landings in 2013 was very limited, with no samples in quarter 1 for both market categories, and no samples for large haddock in quarter 4. Length and age samples were pooled to estimate catch at age by half-year rather than by quarter, and were augmented with length and age samples from USA statistical areas 522 and 525. After augmenting samples, there was a total of 4,090 lengths for EGB commercial landings and a total of 1,803 ages. USA fishery weights were derived from fishery lengths using a length-weight relationship for each half year. For quarters 1 and 2, that equation is (round weight (kg) = 6.07E-06*length (cm)$^{3.10782}$; for quarters 3 and 4, that equation is (round weight (kg) = 7.12E-06*length (cm)$^{3.08054}$.

USA fishermen are required to discard haddock under the legal size limit (18 inches/45.7 cm from January-June 2013, then 16 inches since July 2013). A new regulation for the 2010 fishing year required vessels participating in a sector to retain all legal sized haddock. USA discards at age of EGB haddock for calendar year 2013 were estimated by half-year from at-sea observer data. In fishing year 2013, the number of observed trips from the at-sea monitoring program

was 129, a decrease from the previous year when there were 148. There were 649 trips to EGB for groundfish gear types; however the fraction of trips sampled varied by gear: 48% of otter trawl trips, 37% of midwater trawl trips, 18% of scallop trips, and 0% for long line and gillnet trips (out of 0 total long line trips and 3 total gillnet trips).

As 92% of the discarding was due to the otter trawl fleet, there were few length samples from remaining gears (scallop dredge and midwater trawl). Therefore, length samples were combined across gears. The resulting combined length frequencies by half-year were converted to discarded number at age by applying the age length keys from the NMFS spring bottom trawl survey (824 ages) to quarters 1 and 2 and from the autumn bottom trawl survey (1013 ages) to quarters 3 and 4.

The length composition of USA landings in 2013 peaked between 42 and 44 cm (Figure 7). The 2010 year-class dominated the landings but the discards were dominated by age 3 in the first half (2010 year class) and by age 0 (2013 year class) in the second half (Table 12 and Figure 8**).** In numbers, discards represented 48% of the age 0+ USA catch (31% of the age 1+ catch).

### Combined Canada/USA Catch at Age

The 2013 Canadian and USA landings and discards at age estimates (Table 12) were summed to obtain the combined annual catch at age and appended to the 1969 to 2012 catch at age data (Van Eeckhaute and Brooks 2013; Table 13; Figure 9). The average fishery weights at age are presented in Tabled 14 and Figure 10 and the average lengths at age are in Table 15. The catch at age tracks year classes well. The contribution from older ages in recent years has increased when compared to the 1990s. In comparison to the observed 2013 catch, the age composition of the catch projections in numbers made in 2012 and 2013 for the 2013 catch predicted at least twice the proportion of age group 9+ and a 10% and 16%, respectively, lower proportion of age 3s. (Figue 11). The 2010 year-class (age 3) dominated the fishery in 2013, accounting for 57% by weight and 66% by number.

Age 2 had contributed a large proportion of the catch during 1969 to 1994, but its contribution decreased dramatically in subsequent years (Figure 12). The increase in the dominant age in the catch is attributable primarily to a change in mesh type by the Canadian fishery, from diamond to square, and an increase in mesh size (Table 2). The combined 2005 to 2013 catch was dominated by ages 5 and 6 with ages 3, 4, 7, 8 and 9+ also contributing substantially, a reflection of the domination of the large and exceptional year classes that are characteristic of this time period. The age composition during the 1969 to 1974 period was also atypical since it was dominated by the outstanding 1962 and 1963 year classes, which continued to contribute substantially at ages 6 and older.

## ABUNDANCE INDICES

## RESEARCH SURVEYS

Surveys of Georges Bank have been conducted by DFO each year (February/March) since 1986 and by NMFS each spring (April) since 1968 and each autumn (October/November) since 1963. All surveys use a stratified random design (Figures 13 and 14). The *Canadian Coast Guard Ship (CCGS) Alfred Needler* is the standard vessel used for the DFO Georges Bank survey, but, due to unavailability of the *Needler*, the *CCGS Wilfred Templeman*, a sister ship to the *Needler*, was used in 1993, 2004, 2007 and 2008. No conversion factors are available for the *Templeman;* however, this vessel is considered to be similar in fishing power to the *Needler*. For the NMFS surveys, two vessels have been employed from 1963 to 2008 and there was a change in the trawl door type in 1985. Vessel and door type conversion factors (Table 16), derived experimentally from comparative fishing, have been applied to the survey results to make the series consistent (Forrester et al. 1997). Additionally, two different trawl nets have

been used on the NMFS spring survey, a modified Yankee 41 during 1973-81 and a Yankee 36 in other years, but no conversion factors are available for haddock.

Since spring 2009, the NMFS surveys have been conducted with the NOAA ship *Henry B. Bigelow*, a new net (4-seam, 3-bridle) and revised protocols. Length based conversion factors have been calculated (Table 17 and Figure 15) and were applied by dividing *Bigelow* catches at length by the length specific conversion value to make the *Bigelow* survey catches equivalent to the NOAA ship *Albatross IV* catches (Brooks *et al.* 2010).

The spatial distributions of catches by age group (1, 2, and 3+ for spring and 0, 1 and 2+ for autumn) for the 2013 NMFS fall survey, the 2014 DFO survey, and the 2014 NMFS spring survey are shown in comparison to the average distribution over the previous 10-year period (Figures 16-18). During the fall, age 0 is spread throughout the 5Zjm area, and age 1 haddock are also spread out over the bank but are more concentrated on the Canadian side than age 0. Older haddock migrate to deeper water along the northern edge and peak and to a lesser extent along the southern edge and so are mainly found on the Canadian side at this time of year. In Feb/March, the DFO survey finds ages 1 and 2 similarly distributed near the bank edges and mostly in the eastern part of the management unit. Ages 3 and older are concentrated on the bank near the northeast peak and edge and also in 5Zm near the Canada/USA boundary and spreading north-eastward from there just north of 41°30'. In March/April the NMFS survey finds age 1 concentrated along the southern flank, age 2 is spread throughout the 5Zjm area, similar to the adults, which are now more widely dispersed than they were earlier in the year as observed from the DFO survey.

The 2013 NMFS fall survey had many very large catches and one exceptionally large catch of 20,000 age 0 haddock (2013 year class) along the southern flank on the USA side. In comparison, the 2014 DFO survey catches of this year class were generally smaller and very variable. Of note is one exceptionally large tow of 36,000 fish near the southern edge on the Canadian side. All except 3 tows from the 2014 NMFS spring survey caught the 2013 year class exhibiting mostly fairly good catches throughout the 5Zjm area. The 3+ (2+ for fall) age group was well represented in all three surveys and they were distributed similarly to past distributions. Catches of the 2012 year class (age 2 in spring surveys and 1 in fall survey) were low for all three surveys (Figures 16-18).

Age-specific, swept area abundance indices show that the three surveys are consistent and track year-class strengths well (Tables 18-20; Figure 19). Some year effects are evident. For example, low spring catches occurred in 1997 in both the DFO and NMFS surveys and the 2010 year class (age 4) catch in the 2014 DFO survey shows a substantial drop from the catch the previous year. The most recent surveys were dominated by the 2013 and 2010 year classes. The 2013 year class index values are the highest values exhibited in both the DFO and NMFS fall survey series. The fall value is 4.5 times and the DFO value is more than 2 times higher than the next highest value in their respective series. The NMFS spring index value for this year class is the second highest in the time series. The abundance of older ages since about 2000 has increased in comparison to the 1980s and 1990s. Adult biomass indices (ages 2-8 in autumn; 3-8 in spring) peaked during the early 1960s (Figure 20). After declining to a record low in the early 1970s, it peaked again in the late 1970s, although at a lower level, and again during the early 1980s at about half the level of the 1970s peak. Adult biomass generally increased during the late 1990s and reached some record highs since the 2000s, with, however, some substantial drops in between. The NMFS fall survey adult biomass increased in 2012 with the addition of the 2010 year class to the 2-8 age groups and increased again in 2013. The NMFS spring and DFO surveys showed decreases in adult biomass from 2013 to 2014. The NMFS spring decrease was small but the DFO index fell substantially from the previous year's value, the series' highest. The indices for the 2010 year class at age 3 (fall) and age 4 (DFO and NMFS spring) are among each series' three highest values for their respective age (Tables 18-20). The recruitment indices for the 2012 year class are similar to but somewhat stronger than the weak 2007 year class (Figure 21).

Georges Bank groundfish fishermen continued to corroborate the findings of the surveys with regard to the high abundance of the 2013 year class, reporting that they were catching a relatively large number of small haddock in their catches.

## GROWTH

Canadian and USA fishery weights at age show similar trends (Figure 10). Low sampling for small year classes at older ages results in increased variability. Except for ages 1 and 2, combined fishery weights at age in 2013 decreased (Table 14). A declining trend is visible starting around 2000. DFO survey weights and lengths at age in 2014 (Tables 21-22; Figure 22) showed some decreases (ages 1, 4, 5 and 8) and some increases (ages 2, 3, 6 and 7) and the size at age remains low compared to the pre-2000 period. Average size at age has declined substantially so that haddock age 3 and older are now at, or smaller, than the size that the next younger age group was in previous years before the declines occurred. Ages 5 to 8 are similar in weight and length indicating that the maximum size at age has decreased substantially as they are now generally less than the size that age 4 was before 2000. The 2013 year class length and weight at age 1 are similar to the 2010 year class at age 1, which, except for age 3, has lower weights and lengths than the 2003 year class.

Weights at age from the DFO survey are used as beginning of year population weights and are calculated using the method described in Gavaris and Van Eeckhaute (1998) in which weights observed from the survey are weighted by population numbers at length and age. Canadian fishery weights are derived from fishery lengths using a length-weight relationship (Waiwood and Neilson 1985).

## HARVEST STRATEGY

The Transboundary Management Guidance Committee (TMGC) has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality limit reference, $F_{ref} = 0.26$ (TMGC 2003). When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding. The TMGC agreed to a common F strategy at its December 2002 TMGC meeting. The F references used by both countries for “healthy” or “rebuilt” stocks were virtually identical, i.e., 0.25 for Canada and 0.26 for the USA (TMGC Meeting Summary, October 2, 2003).

## ESTIMATION OF STOCK PARAMETERS

### CALIBRATION OF VIRTUAL POPULATION ANALYSIS (VPA)

Calibrated Virtual Population Analysis (VPA) was used to estimate stock parameters. The adaptive framework, ADAPT, (Gavaris 1988) was used to calibrate the VPA with the research survey data. Details of the model formulations and model assumptions can be found in the 1998 benchmark assessment (Gavaris and Van Eeckhaute 1998). Minor changes that were made since 1998 are described in Table 23 and include, for this assessment, the updating of the 2005 to 2012 scallop discards catch at age and corrections to the 2011 NMFS fall survey and the 2012 NMFS spring survey.

The VPA was based on an annual catch at age, $C_{a,t}$ for ages $a$ = 0, 1, 2…8, 9+, and time $t$ = 1969, 1970…2013 where $t$ represents the beginning of the time interval during which the catch was taken. Catch discards were included in the catch at age. The population was calculated to the beginning of 2014. The VPA was calibrated to bottom trawl survey abundance indices, $I_{s,a,t}$ for

$s$ = DFO, ages $a$ = 1, 2, 3…8, time $t$ = 1986.17, 1987.17… 2013.17, 2014.00

*s* = NMFS spring (Yankee 36), ages *a* = 1, 2, 3…8, time *t* = 1969.28…1972.28 and 1982.28… 2013.28, 2014.00

*s* = NMFS spring (Yankee 41), ages *a* = 1, 2, 3…8, time *t* = 1973.28, 1974.28…1981.28

*s* = NMFS autumn, ages *a* = 0, 1, 2…5, time *t* = 1969.79, 1970.79… 2013.79.

Since the population is calculated to beginning year 2014, the NMFS and DFO spring surveys in 2014 were designated as occurring at time 2014.00.

Statistical properties of estimators were determined using conditional non-parametric bootstrapping of model residuals (Efron and Tibshirani 1993, Gavaris and Van Eeckhaute 1998). Population abundance estimates for the beginning of 2014 at age 1 and 2 exhibit a large relative error of 59% and 41%, respectively, and a large relative bias at age 1 of 15%. The relative error for other ages is between 24% and 33% with a relative bias for ages 2 and older between 1% and 7% (Table 24). While trends in the three surveys are generally consistent, the survey indices exhibit high variability and the average magnitude of residuals is large relative to other assessments. Although several large residuals are apparent, these do not appear to have a substantial impact on estimates of current abundance (Figures 23-27). Some patterns in the residuals (by cohort and by year) suggest year class and/or year effects. Negative residuals are prevalent in the most recent surveys (2013/2014).

### Retrospective Analysis

Retrospective analyses were used to detect any trends to consistently overestimate or underestimate biomass, fishing mortality and recruitment relative to the terminal year estimates (Figures 28-29). The addition of an extra year's data has caused a bias to appear between the present assessment results and previous assessments. Retrospective analysis shows lower biomass, higher F, and lower recruitment for several years of the analysis; however, previous assessments remain consistent. Recruitment estimates may sometimes change substantially when more data becomes available, e.g., the 2008 year class. The current retrospective analysis indicates a tendency to overestimate initial year class size. The 2010 and 2011 year classes are both estimated about a third smaller than the previous year's retrospective estimates.

A historical retrospective analysis that incorporates all data and model formulation changes by plotting the results from previous assessments back to the last benchmark in 1998 instead of peeling back years from the current assessment is illustrated in Figure 30. This analysis shows that the perception of the stock has remained fairly stable through the data and model changes but is also exhibiting a bias between the results from the current assessment and past assessments.

## STATE OF RESOURCE

Evaluation of the state of the resource was based on results from the VPA for the years 1969 to 2014. For each cohort, the terminal population abundance estimates from ADAPT were adjusted for bias estimated from the bootstrap, and used to construct the history of stock status (Tables 25-27). This approach for bias adjustment was considered preferable to using potentially biased point estimates of stock parameters (O'Boyle 1998). The weights at age from the DFO survey (Table 21) were used to estimate beginning of year population biomass (Table 27). A weight of 2.4 kg, which was midway between the age 6 and 8 weight for that cohort, was used for age 7 in 1995 as no data were available for that age group. The 1986-95 average weight at each age was used for 1969-85.

The adult (ages 3+) population biomass trend reflects the survey adult biomass trends (scaled with catchabilities; Figure 31). Adult biomass increased during the late 1970s and early 1980s to 38,000 mt in 1981. The increase was due to recruitment of the strong 1975 and 1978 year-

classes, which were both estimated to be above 50 million age-1 fish (Figure 32). However, adult biomass declined rapidly in the early 1980s as these two cohorts were fished intensively at ages 2 and 3 and subsequent recruitment was poor. Improved recruitment in the 1990s and the strong 2000 year class (76 million at age 1), lower exploitation, and reduced capture of small fish in the fisheries allowed the biomass to increase from near a historical low of 10,300 mt in 1993 to 76,500 mt in 2003. Adult biomass decreased to 53,000 mt in 2005 but subsequently increased to 121,500 mt in 2009, higher than the 1931-1955 maximum adult biomass of about 90,000 mt. The near tripling of the biomass from 2005 to 2009 was due to the exceptional 2003 year-class, estimated at 243 million age-1 fish. The biomass decreased after the 2009 high and in 2012 the adult biomass was 40,600 mt but increased in 2013, when the 2010 year class joined the 3+ group, to 125,200 mt and again in 2014 to 160,300 (80% confidence interval: 123,500 mt – 206,400 mt, Figure 33). Except for the strong 2000 and 2011 year classes (76 and 51 million fish, respectively) and the exceptional 2003 and 2010 year classes, recruitment has fluctuated between 2.1 and 27.3 million age 1 fish since 1990. The 2001, 2002, 2004, 2006, 2007, 2008 and 2009 year classes, at less than 6 million fish, are below the 1995 to 2014 median of 8.5 million age 1 fish. The preliminary estimate of the 2013 year class at 1,546 million fish is the highest in the time series (1931-1955 and 1969-2014) and is about 3 times the 2010 year class, which is the next highest at 334 million fish.

Since 2003, the age at full recruitment to the fishery has been age 5 (rather than age 4 as in previous years) due to a decline in size at age. Comparison of age 4 and 5 fishing mortality (Table 26) and average weights at age from the fishery and survey (Figure 34) indicate that full recruitment to the fishery since 2003 occurs around age 5. Fishery weights are approaching survey (population) weights at age 5, and, when beginning of year to mid-year growth is accounted for, indicate that age 5 fish are fully selected by the fishery. Fully recruited fishing mortality (population weighted average of fully recruited ages) is presented, therefore, for ages 4-8 for pre-2003 and ages 5-8 for 2003 onwards. Fully recruited fishing mortality fluctuated between 0.27 and 0.47 during the 1980s (Figure 35). After reaching a high of 0.55 in 1993, it decreased to well below $F_{ref}$ = 0.26 after 1994, stayed below $F_{ref}$ until 2003, fluctuated around 0.3 during 2004 to 2006, then declined and stayed below $F_{ref}$ and was 0.16 in 2013 (80% confidence interval: 0.14 – 0.20, Figure 33).

Consistent with the increase in age at full recruitment into the fishery, the partial recruitment at age for EGB haddock is normalized to ages 4-8 population weighted F for 1969 to 2002 and to ages 5-8 population weighted F from 2003 onwards (Table 28; Figure 26). Average partial recruitment estimates are less variable when weighted by population numbers and is considered more appropriate than the unweighted average.

Gains in fishable biomass may be partitioned into those associated with somatic growth of haddock that have previously recruited to the fishery, and those associated with new recruitment to the fishery (Rivard 1980). We used age 2 as the age of first recruitment to the fishery. This choice facilitated comparisons with historic stock productivity but may be less representative of the current fishery selectivity. Since 1993, surplus production (biomass gains from growth and from recruitment, decremented by losses due to natural deaths) often exceeded fishery harvest yields, resulting in net population biomass increases (Figure 37). In 2009 to 2011, surplus production decreased substantially as growth of the 2003 year class slowed and gains from recruitment remained low but increased again, well above yield, in 2012 and 2013 due to the recruitment of the outstanding 2010 year class. Growth of fish is the dominant component of the biomass gain, but recruitment accounts for significant portions when stronger year classes enter the population, e.g. the 2003 year class in 2005 and the 2010 year class in 2012 (Figure 38). The biomass contributed by the 2003 and 2010 year classes, both when they recruited at age 2 and through growth during that year was greater than that of any other cohorts since 1969.

## PRODUCTIVITY

Recruitment, as well as age structure, spatial distribution and fish growth reflect changes in the productive potential. Data to approximate the age composition of the catch from unit areas 5Zj and 5Zm during 1931 to 1955 were used to reconstruct a population analysis of EGB that was suitable for comparison of productivity to recent years (Gavaris and Van Eeckhaute 1997, Figure 32).

The catch and survey age structure displays a broad representation of age groups, reflecting improving recruitment and lower exploitation since 1995 (Figure 9 and Figure 19).

Recruitment, while highly variable, has generally been higher when adult biomass has been above 40,000 mt (Figure 39). Since 1969, only the 1975, 1978, 2000, 2003, 2010, 2011 and 2013 year classes have been above the average abundance of 40.5 million age one fish of year classes observed during the period 1931-55. The recruits-per-adult biomass ratio has been highly variable since 1969. It was generally low during the 1980s but higher during the 1990s, comparable to the 1931-1955 period (Figure 40) when the 3+ biomass was above 40,000 mt. Since 2001, with the exception of 2003, 2010, 2011 and 2013, recruits per spawner have again been low. The very high 3+ biomass (greater than about 100,000 mt) observed since 2006 has produced two exceptional year class but has also produced four below average year classes (Figure 39).

The spatial distribution patterns observed during the most recent bottom trawl surveys were similar to the average patterns over the previous ten years for the spring surveys. Consistent with the pattern observed for previous exceptional year-classes, the 2013 year-class was widely distributed throughout the survey area, especially during the NMFS spring and fall surveys (Figures 16-18).

Fish condition as measured by Fulton's K for ages 1 to 9, combined, derived from the DFO survey exhibits a declining trend since about 2001 and declined to its lowest value in 2014 (Figure 41). Except in 2009, the condition factor of haddock has been below the series average since 2003, similar to the trends in condition observed in Eastern Georges Bank cod (Wang and O'Brien 2013) and Georges Bank yellowtail flounder (Legault *et al.* 2013). Fish condition derived from the NMFS fall survey shows a similar decline (note that weights are available only since 1992 from this survey). The strong 2003 and 2010 year classes sometimes show much lower condition than the ages 1-9 average from the DFO survey. The increase in condition in fall 2008 and spring 2009 coincides with reports from the fishery of high sandlance abundance during this period (*pers. comm*. Alain d'Entremont). Fulton's K for the 2013 year class was very low in fall 2013 but improved in late winter of 2014, though was still below average. Condition of the 2010 year class in the fall has been increasing with each subsequent year and was above the series average in 2013.

Both fishery and survey average lengths and weights at age have declined (Figure 10, Figure 22 and Figure 34) and the 2003 year class appears to have reached its maximum growth potential at a smaller size than previous year classes (Table 22 and Figure 42). Some year classes of low abundance, like 2005 and 2007, initially started out with high growth rates but growth rates decreased as they aged. The 2010 year class lengths at age 1 and 2 are less than the 2003 year class but similar at age 3 and 4 (Figure 42).

Changes in growth in response to changes in stock abundance and episodes of very strong recruitment have been observed throughout this stock's history. Clark *et al.* (1982), reporting on Georges Bank haddock, observed "*a decline in mean weight for all age-groups following every period of very strong recruitment*" and a rapid increase in growth following the late 1960s and early 1970s reduction in stock size. As postulated by Clark *et al.* (1982), increased or decreased availability of food is probably the greatest determining factor for growth increases and decreases, respectively.

In summary, positive signs of productivity include expanded age structure, broad spatial distribution and large biomass and this stock has produced three exceptional and two strong year classes in the last 12 years. On the negative side, condition has decreased, growth has declined and recruitment from the very large biomass has been extremely variable.

## PARTIAL RECRUITMENT ON OLDER AGES

Figure 43 illustrates the results of a calculation of total mortality (Z) for ages 3 to 8 and the 9+ group from the DFO survey. The results for age 8 show that there has been a large increase in Z for about the last 9 years; however, fishing mortality for age 8 has decreased in the last few years. These results support the use of a low partial recruitment (PR) on the 9+ age group for the catch projection for the 2015 fishing year.

Another indication that a low PR on the 9+ age group should be used for projections is the comparison of predicted versus observed landings for 2013 (Figure 11). Even though a low PR of 0.3 was used, the contribution from the 9+ group was about half what the 2012 and 2013 projections predicted. However, with the reduced importance of the 2003 year class to future catches, specification of the 9+ PR for projected catch is less critical.

## OUTLOOK

This outlook is provided in terms of consequences with respect to the harvest reference point for alternative catch quotas in 2015. Uncertainty about standing stock generates uncertainty in forecast results, which is expressed here as the risk of exceeding $F_{ref}$=0.26. The risk calculations assist in evaluating the consequences of alternative catch quotas by providing a general measure of the uncertainties. However, the risk calculations are dependent on the data and model assumptions and do not include uncertainty due to variations in weight at age, partial recruitment to the fishery, natural mortality, systematic errors in data reporting or the possibility that the model may not reflect stock dynamics closely enough.

For projections, the most recent 3-year survey and fishery average weights at age were used for beginning year population and fishery weights at age, respectively, except as indicated below. The 2014 DFO survey weights at age were used for the 2014 population weights at age as this is consistent with the assessment results. The 2003 year class weights were used for the 2010 year class and the 2010 year class values were used for the 2013 year class due to similarity in growth. The weights at age of the 2005 and 2009 year classes were averaged for the 2011 year class weights. Fishery PR is based on the 2003 to 2013 population weighted average except for age 4 where the 2003 year class observed value at that age was used. This is a deviation from the usual protocol (i.e., using the average of the last 3 years), but it was observed that not including the 2003 year class values resulted in PRs that were significantly higher than what was observed for the 2003 year class. Some of the PRs are suspected to have high error as they come from very small year classes. The PR used for the age 9+ group is 0.3, which is consistent with the model results (Table 29). The 9+ group was not considered to be less catchable by the fishery, but lower availability was observed (Table 28), which is thought to be aliasing unknown processes. Ages 5 to 8 were considered fully recruited to the fishery.

EGB haddock are considered 100% mature at ages 3 and older.

Incorporating the patterns in growth and partial recruitment detailed in Table 29, a deterministic projection and risk assessment was conducted to beginning year 2016 (Table 30). Except for the 2013 year class, stock size estimates at the beginning of 2014 were used to start the forecasts. Although the preliminary estimate of the 2013 year class is outstanding, its magnitude is highly uncertain. Given this uncertainty and the effect it will have on the 2016 biomass in the projection, this year class was downsized to the size of the 2010 year class. Abundance of the 2014 and 2015 year classes were assumed to be 11.2 million fish at age 1, the 2004 to 2013 median from the 2013 assessment results. Natural mortality was assumed to be 0.2. Assuming

a 2014 catch equal to the 27,000 mt total quota, a combined Canada/USA catch of 44,000 mt in 2015 results in a neutral risk (50%) that the 2015 fishing mortality rate would exceed $F_{ref}$ = 0.26 (Figure 44). A catch of 37,000 mt in 2015 results in a low risk (25%) that the 2015 fishing mortality rate will exceed $F_{ref}$. A catch of 52,000 mt in 2015 results in a high risk (75%) that the 2015 fishing mortality rate will exceed $F_{ref}$. The 2010 year class at age 5 is expected to contribute 88% of the catch biomass and the 2011 year class at age 4 is expected to contribute the next highest percentage at 6% of the 2015 catch biomass. The probability that the 2016 biomass will not increase by 20% is negligible. Adult biomass is projected to be 234,300 mt at the beginning of 2016 at the $F_{ref}$ catch level.

## SPECIAL CONSIDERATIONS

Catch projections for this stock can be highly influenced by outstanding and influential year classes. There is no direct evidence to indicate that age 9 and older haddock should be less available to the fishery than age 8 haddock; however, the domed partial recruitment at age 9 and older that the assessment model produces may be aliasing increased natural mortality, emigration outside of the management area or to areas inaccessible to the fishery, or some other unknown process. Several corroborating factors influenced the decision to use the lower PR produced by the model, e.g. the percent predicted versus percent observed age 9+ in the 2011, 2012 and 2013 assessments. These factors support the use of the lower PR, as does the analysis of total mortality from the DFO survey (Figure 43). The highest contribution to the 2012 catch was age 9+, which was dominated by the 2003 year class, and it should give a good indication as to whether the 9+ PR of 0.3 from the model should be used for catch projections. The 9+ age group was expected to contribute 69% by numbers in the 2011 projection for the 2012 fishing year that used a 9+ PR of 1.0 (Van Eeckhaute and Brooks 2011). The percent contribution for that age group was well below what was predicted indicating that the PR produced by the model is more appropriate.

If the 2014 quota is caught, the projection indicates that the 2014 F will be above $F_{ref}$ due to the revision of the size of the 2010 year class in the 2014 assessment.

In 2015, a large proportion of the exceptional 2013 year class will be below the current minimum size regulation used by the US, which could lead to significant discarding. The reduction of the minimum size for the US fishery in July 2013 from 18 inches to 16 inches will help to reduce discarding of haddock. This is not expected to be an issue in the Canadian fishery due to the different gear types and management measures.

Cod and haddock are often caught together in groundfish fisheries, although their catchabilities in the fisheries differ and they are not necessarily caught in proportion to their relative abundance. With current fishing practices and catch ratios, the achievement of rebuilding objectives for cod may constrain the harvesting of haddock. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns.

The table in the Appendix summarizes the performance of the management system. It reports the Transboundary Resources Assessment Committee (TRAC) advice, expected beginning of year 3+ biomass in the year following the catch year, the TMGC quota decision, actual catch, and realized stock conditions for this stock. Fishing mortality and trajectory of age 3+ biomass from the assessment following the catch year are compared to results from this assessment. These comparisons were kindly provided in 2011 by Tom Nies (staff member of the New England Fishery Management Council, NEFMC) and updated for this assessment. The largest differences in expected and actual results occurred when projection inputs for partial recruitment and weights at age for large dominant year classes (i.e., 2000 and 2003) were higher than the realized values. When year class specific input values were used, expected and actual results were similar. These results indicate that stock biomass is being adequately estimated by the model for management purposes, but misspecification of partial recruitment and weights at age,

especially of very large and influential year classes, can result in higher than expected fishing mortality due to catch advice being set too high.

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# TABLES

*Table 1. Nominal catches (mt) of haddock from eastern Georges Bank (EGB) during 1969-2013. For "Other" it was assumed that 40% of the total 5Z catch was in EGB. USA landings and 1989 to 2007 USA discards were revised (Van Eeckhaute et al. 2009). Canadian discards are from the scallop fishery and USA discards are from the groundfish fishery.*

| | Landings | | | Discards | | Totals | | | Quotas | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Canada | USA | Other | Canada | USA | Canada | USA | Catch | Canadian | USA[2] |
| 1969 | 3,941 | 6,624 | 695 | 123 | | 4,064 | 6,624 | 11,382 | | |
| 1970 | 1,970 | 3,154 | 357 | 116 | | 2,086 | 3,154 | 5,597 | | |
| 1971 | 1,610 | 3,533 | 770 | 111 | | 1,721 | 3,533 | 6,024 | | |
| 1972 | 609 | 1,551 | 502 | 133 | | 742 | 1,551 | 2,795 | | |
| 1973 | 1,565 | 1,397 | 396 | 98 | | 1,663 | 1,397 | 3,455 | | |
| 1974 | 462 | 955 | 573 | 160 | 757 | 622 | 1,712 | 2,907 | | |
| 1975 | 1,353 | 1,705 | 29 | 186 | | 1,539 | 1,705 | 3,273 | | |
| 1976 | 1,355 | 974 | 24 | 160 | | 1,515 | 974 | 2,513 | | |
| 1977 | 2,871 | 2,428 | | 151 | 2,966 | 3,022 | 5,394 | 8,416 | | |
| 1978 | 9,968 | 4,725 | | 177 | 1,556 | 10,145 | 6,281 | 16,426 | | |
| 1979 | 5,080 | 5,213 | | 186 | | 5,266 | 5,213 | 10,479 | | |
| 1980 | 10,017 | 5,615 | | 151 | 7,561 | 10,168 | 13,176 | 23,344 | | |
| 1981 | 5,658 | 9,081 | | 177 | | 5,835 | 9,081 | 14,916 | | |
| 1982 | 4,872 | 6,286 | | 130 | | 5,002 | 6,286 | 11,287 | | |
| 1983 | 3,208 | 4,453 | | 119 | | 3,327 | 4,453 | 7,780 | | |
| 1984 | 1,463 | 5,121 | | 124 | | 1,587 | 5,121 | 6,708 | | |
| 1985 | 3,484 | 1,684 | | 186 | | 3,670 | 1,684 | 5,354 | | |
| 1986 | 3,415 | 2,201 | | 92 | | 3,507 | 2,201 | 5,708 | | |
| 1987 | 4,703 | 1,418 | | 138 | | 4,841 | 1,418 | 6,259 | | |
| 1988 | 4046[1] | 1,694 | | 151 | | 4,197 | 1,694 | 5,891 | | |
| 1989 | 3,060 | 785 | | 138 | 137 | 3,198 | 922 | 4,121 | | |
| 1990 | 3,340 | 1,189 | | 128 | 76 | 3,468 | 1,265 | 4,732 | | |
| 1991 | 5,456 | 931 | | 117 | 0 | 5,573 | 931 | 6,504 | | |
| 1992 | 4,058 | 1,629 | | 130 | 9 | 4,188 | 1,638 | 5,826 | 5,000 | |
| 1993 | 3,727 | 424 | | 114 | 106 | 3,841 | 530 | 4,371 | 5,000 | |
| 1994 | 2,411 | 24 | | 114 | 1,279 | 2,525 | 1,302 | 3,827 | 3,000 | |
| 1995 | 2,065 | 15 | | 69 | 0 | 2,134 | 16 | 2,150 | 2,500 | |
| 1996 | 3,663 | 26 | | 52 | 5 | 3,715 | 31 | 3,746 | 4,500 | |
| 1997 | 2,749 | 55 | | 60 | 1 | 2,809 | 56 | 2,865 | 3,200 | |
| 1998 | 3,371 | 271 | | 102 | 0 | 3,473 | 271 | 3,744 | 3,900 | |
| 1999 | 3,681 | 359 | | 49 | 5 | 3,729 | 364 | 4,093 | 3,900 | |
| 2000 | 5,402 | 340 | | 29 | 3 | 5,431 | 343 | 5,774 | 5,400 | |
| 2001 | 6,774 | 762 | | 39 | 22 | 6,813 | 784 | 7,597 | 6,989 | |
| 2002 | 6,488 | 1,090 | | 29 | 16 | 6,517 | 1,106 | 7,623 | 6,740 | |
| 2003 | 6,775 | 1,677 | | 98 | 96 | 6,874 | 1,772 | 8,646 | 6,933 | |
| 2004 | 9,745 | 1,847 | | 93 | 235 | 9,838 | 2,081 | 11,919 | 9,900 | 5,100 |
| 2005 | 14,484 | 649 | | 49 | 76 | 14,533 | 724 | 15,257 | 15,410 | 7,590 |
| 2006 | 11,984 | 313 | | 58 | 275 | 12,043 | 588 | 12,630 | 14,520 | 7,480 |
| 2007 | 11,890 | 256[3] | | 58 | 306[3] | 11,948 | 562 | 12,510 | 12,730 | 6,270 |
| 2008 | 14,781 | 1,138[3] | | 33 | 52[3] | 14,814 | 1,190 | 16,003 | 14,950 | 8,050 |
| 2009 | 17,595 | 2,152[3] | | 53 | 55[3] | 17,648 | 2,208 | 19,855 | 18,900 | 11,100 |
| 2010 | 16,578 | 2,167 | | 15 | 34 | 16,593 | 2,201 | 18,794 | 17,612 | 11,988 |
| 2011 | 11,232 | 1,322 | | 16 | 87 | 11,248 | 1,409 | 12,656 | 12,540 | 9,460 |
| 2012 | 5,034 | 443 | | 30 | 126 | 5,064 | 569 | 5,633 | 9,120 | 6,880 |
| 2013 | 4,621 | 344 | | 10 | 91 | 4,631 | 435 | 5,066 | 6,448 | 3,952 |

[1] 1895 mt excluded because of suspected area misreporting.
[2]The USA quota pertains to the USA fishing year of May 1st to April 30th while the USA catches reported in this table pertain to the calendar year.
[3]USA landings and discards revised in 2011.

*Table 2. Regulatory measures implemented for the 5Z and eastern Georges Bank (EGB) fishery management units by the United States (USA) and Canada, respectively, from 1977, when jurisdiction was extended to 200 miles for coastal states, to the present.*

| Year | USA | Canada |
|---|---|---|
| 1977-82 | Mesh size of 5 1/8" (140 mm), seasonal spawning closures, quotas and trip limits. | |
| 1982-85 | All catch controls eliminated, retained closed area and mesh size regulations, implemented minimum landings size (43 cm). | First 5Ze assessment in 1983. |
| *Oct.1984* | *Implementation of the 'Hague' line, the boundary between Canada and the USA.* | |
| 1985 | 5 ½" mesh size, Areas 1 and 2 closed February-May. | |
| 1989 | | Combined cod-haddock-pollock quota for 4X-5Zc |
| 1990 | | EGB adopted as management unit.<br>For mobile gear (MG) < 65 ft. – trip limits with a 30% by-catch of haddock to a maximum of 8 trips of 35,000 lbs per trip between June 1st and October 31st and minimum square mesh size 130 mm.<br>Fixed gear required to use large hooks until June |
| 1991 | Established overfishing definitions for haddock. | MG < 65 ft similar to 1990 but diamond mesh size increased to minimum 145 mm. |
| 1992 | | Introduction of Individual Transferable Quotas (ITQ) and dockside monitoring. Total allowable catch (TAC) = 5000 mt. |
| 1993 | Area 2 closure in effect from January 1st – June 30th. | Otter trawl (OT) fishery permitted to operate in Jan. and Feb.<br>Increase in use of square mesh, minimum 130 mm). TAC = 5000 mt. |
| 1994 | January: Expanded Area II closure to include June and increased extent of area.<br>Area II closure not in effect.<br>500 lb trip limit.<br>Catch data obtained from mandatory log books combined with dealer reports (replaces interview system).<br>May: 6" mesh restriction.<br>Dec.: Areas I and II closed year-round. | Spawning closure extended to January 1st to May 31st.<br>Fixed gear vessels must choose between 5Z or 4X for the period of June to September.<br>Small fish protocol.<br>Increased at sea monitoring.<br>OT > 65 could not begin fishing until July 1st.<br>Predominantly square mesh, minimum 130 mm by end of year.<br>TAC = 3000 mt. |
| 1995 | | All OT vessels using square mesh, mimimum 130 mm.<br>Fixed gear vessels with a history since 1990 of 25t or more for 3 years of cod, haddock, pollock, hake or cusk combined can participate in 5Z fishery.<br>ITQ vessels require at least 2 t of cod and 8 t of haddock quota to fish Georges. TAC = 2500 mt.<br>Restrictions on catching of cod and haddock under 43 cm (small fish protocol). |
| 1996 | July: Additional Days-at-Sea restrictions, trip limit raised to 1000 lbs. | Fixed gear history requirement dropped.<br>TAC = 4500 mt. |
| 1997 | May: Additional scheduled Days-at-sea restrictions. | All OT vessels using square mesh, mimimum 130 mm. |

| Year | USA | Canada |
|---|---|---|
| | September: Trip limit raised to 1000 lbs/day, maximum of 10,000 lbs/trip. | Vessels over 65 ft operated on enterprise allocations, otter trawlers under 65 ft on individual quotas, fixed gear vessels 45-65 ft on self-administered individual quotas and fixed gear vessels under 45 ft on community quotas administered by local boards. TAC = 3,200 mt. |
| 1998 | September 1st: Trip limit raised to 3000 lbs/day, maximum of 30,000 lbs/trip. | All OT vessels using square mesh, mimimum 130 mm. Fixed gear vessels 45-65 ft operated on individual quotas. TAC = 3,900 mt. |
| 1999 | May 1st: Trip limit 2,000 lbs/day, max. 20,000 lbs/trip. Square mesh size increased to 6.5" (diamond is 6"). June 15th: Scallop exemption fishery in Closed Area II. November 5th: Trip limit 5,000 lbs/day, max. 50,000 lbs/trip. | All OT vessels using square mesh, mimimum 130 mm. TAC = 3,900 mt.; mandatory cod separator panel when no observer on board. |
| 2000 | October: Daily trip limit suspended to April 2001 but retained max. trip limit of 50,000 lbs/trip. | All OT vessels using square mesh, mimimum 130 mm. TAC = 5,400 mt. |
| 2001-2002 | Day and trip limit adjustments. Daily trip limit suspended July 5, 2002. | All OT vessels using square mesh, mimimum 130 mm. TAC = 6,989 and 6,740 mt for 2001 and 2002 respectively. |
| 2002-2003 | 30,000 – 50,000 lb/trip limit. Trip limit suspended in Oct. 2003. | All OT vessels using square mesh, mimimum 130 mm. TAC = 6,933 mt for 2003. |
| *Canada – USA Resource Sharing Agreement on Georges Bank* | | |
| 2004 | May 1st, day and trip limits removed. Quota management introduced. (Used primarily effort based management from 1994 to 2003.) TAC[1] = 5,100 mt. October 1st: unit areas 561 and 562 closed to groundfish vessels. November 19th: Special Access Program (SAP) for haddock opened. December 31st: Haddock SAP closed. | All OT vessels using square mesh, mimimum 130 mm. TAC = 9,900 mt. |
| 2005 | TAC[1] = 7,590 mt. January 14th: separator trawl required. Fishery was closed in August when cod by-catch quota reached. | All OT vessels using square mesh, mimimum 130 mm. TAC = 15,410 mt; exploratory winter fishery January to February 18, 2005. |
| 2006 | TAC[1] = 7,480 mt; EGB area closed to USA fishery in first half of year when USA cod quota nearly reached. | All OT vessels using square mesh, mimimum 130 mm. TAC = 14,520 mt; exploratory winter fishery January to February 6, 2006. |
| 2007 | TAC[1] = 6,270 mt. June 20th: EGB area closed to USA fishery due to USA cod catch nearing quota. August 9th: Minimum haddock size reduced to 18 inches; October 20th: EGB area opened to USA fishery. | All OT vessels using square mesh, mimimum 130 mm. TAC = 12,730 mt; exploratory winter fishery January to February 15, 2007. |

| Year | USA | Canada |
|---|---|---|
| 2008 | TAC[1] = 8,050 mt. Minimum size reverts back to 19 in. in August. Prohibitions on yellowtail flounder fishing January 24th to April 30th. Trawl fishery opening delayed until August 1st. Ruhle trawl (type of separator trawl) approved for use beginning September 15th. Restrictions on cod catches. | All OT vessels using square mesh, mimimum 130 mm.<br>TAC = 14,950 mt; winter fishery January 1 to February 8, 2008. |
| 2009 | TAC[1] = 11,100 mt.<br>May 1st: Interim action by NMFS set the minimum size at 18 inches.<br>Trawl fishery opening delayed until August 1st. | All OT vessels using square mesh, mimimum 130 mm.<br>TAC = 18,900 mt; winter fishery January 1 to February 7, 2009. Industry test fishery/survey in deep water in February to assess spawning condition of haddock in deep water. Test fishery terminated after 2 trips. |
| 2010 | TAC[1] = 11,988 mt<br>May 1, 2010: Sector Management with Annual Catch Entitlements (ACEs) and accountability measures implemented (Amendment 16). Minimum haddock size limit of 18 inches retained in Amendment 16, effective May 1st. All legal size fish must be retained by sector vessels. Trawl fishery opening delayed until August 1st. | All OT vessels using square mesh, mimimum 130 mm.<br>TAC = 17,612 mt; winter fishery January 1 to February 7, 2010. |
| 2011 | TAC[1] = 9,460 mt<br>Common pool fishery (very small percentage of quota) closed May 1st to July 31st.<br>On May 11th the Closed Area II Special Access Permit (SAP) modified to allow targeting of haddock from August 1st to January 31st.<br>On September 14th haddock catch cap regulation for herring midwater trawl fishery increased to 1% of the Georges Bank Annual Biological Catch (ABC). | All OT vessels using square mesh, mimimum 130 mm.<br>TAC = 12,540 mt; winter fishery January 1 to February 6, 2011. |
| 2012 | TAC[1] = 6,880 mt<br>Common pool fishery (very small percentage of quota) closed May 1st to July 31st. | All OT vessels using square mesh, minimum 130 mm.<br>TAC = 9,120 mt; winter fishery January 1 to February 4, 2012. |
| 2013 | TAC[1] = 3,952 mt<br>July: Minimum size reduced from 18” to 16”.<br>Common pool fishery (very small percentage of quota) closed May 1st to July 31st. | TAC = 6,448 mt; winter fishery January 1 to February 4, 2013.<br>All OT vessels using square mesh, minimum 130 mm. |
| 2014 | TAC[1] = 10,530 mt<br>Common pool fishery (very small percentage of quota) closed May 1st to July 31st. | TAC = 16,470 mt; winter fishery January 1 to February 3, 2014.<br>Experimental use of 145 mm diamond mesh in winter fishery. Starting in June, 145 mm diamond use continued and experimental use of 125 mm square.<br>Continued use of 130 mm square. |

[1]For fishing year from May 1st to April 30th.

*Table 3. Canadian landings (mt) of haddock from eastern Georges Bank during 1969-2013 by gear category and tonnage class for principal gears.*

| Year | Otter Trawl | | | | | | Longline | | | Scallop Fishery | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Side | Stern | | | | | | | | | | |
| | | 2 | 3 | 4 | 5 | Total[1] | 2 | 3 | Total[1] | | | |
| 1969 | 777 | 0 | 1 | 225 | 2,902 | 3,127 | 2 | 21 | 23 | 15 | 0 | 3,941 |
| 1970 | 575 | 2 | 0 | 133 | 1,179 | 1,314 | 6 | 72 | 78 | 2 | 1 | 1,970 |
| 1971 | 501 | 0 | 0 | 16 | 939 | 955 | 18 | 129 | 151 | 3 | 0 | 1,610 |
| 1972 | 148 | 0 | 0 | 2 | 260 | 263 | 23 | 169 | 195 | 1 | 2 | 609 |
| 1973 | 633 | 0 | 0 | 60 | 766 | 826 | 23 | 80 | 105 | 0 | 1 | 1,565 |
| 1974 | 27 | 0 | 6 | 8 | 332 | 346 | 29 | 59 | 88 | 1 | 0 | 462 |
| 1975 | 222 | 0 | 1 | 60 | 963 | 1,024 | 25 | 81 | 107 | 0 | 0 | 1,353 |
| 1976 | 217 | 0 | 2 | 59 | 905 | 967 | 48 | 108 | 156 | 0 | 15 | 1,355 |
| 1977 | 370 | 92 | 243 | 18 | 2,025 | 2,378 | 43 | 51 | 94 | 1 | 28 | 2,871 |
| 1978 | 2,456 | 237 | 812 | 351 | 5,639 | 7,039 | 121 | 47 | 169 | 17 | 287 | 9,968 |
| 1979 | 1,622 | 136 | 858 | 627 | 1,564 | 3,185 | 190 | 80 | 271 | 2 | 0 | 5,080 |
| 1980 | 1,444 | 354 | 359 | 950 | 6,254 | 7,917 | 129 | 51 | 587 | 4 | 65 | 10,017 |
| 1981 | 478 | 448 | 629 | 737 | 2,344 | 4,159 | 331 | 99 | 1,019 | 1 | 1 | 5,658 |
| 1982 | 115 | 189 | 318 | 187 | 3,341 | 4,045 | 497 | 187 | 712 | 0 | 0 | 4,872 |
| 1983 | 106 | 615 | 431 | 107 | 1,130 | 2,283 | 593 | 195 | 815 | 1 | 3 | 3,208 |
| 1984 | 5 | 180 | 269 | 21 | 149 | 620 | 614 | 192 | 835 | 2 | 1 | 1,463 |
| 1985 | 72 | 840 | 1,401 | 155 | 348 | 2,745 | 562 | 33 | 626 | 2 | 39 | 3,484 |
| 1986 | 51 | 829 | 1,378 | 95 | 432 | 2,734 | 475 | 98 | 594 | 4 | 32 | 3,415 |
| 1987 | 48 | 782 | 1,448 | 49 | 1,241 | 3,521 | 854 | 113 | 1,046 | 38 | 50 | 4,703 |
| 1988[2] | 72 | 1,091 | 1,456 | 186 | 398 | 3,183 | 428 | 200 | 695 | 16 | 80 | 4,046 |
| 1989 | 0 | 489 | 573 | 376 | 536 | 1,976 | 713 | 175 | 977 | 12 | 95 | 3,060 |
| 1990 | 0 | 928 | 890 | 116 | 471 | 2,411 | 623 | 173 | 853 | 7 | 69 | 3,340 |
| 1991 | 0 | 1,610 | 1,647 | 81 | 689 | 4,028 | 900 | 271 | 1,309 | 8 | 111 | 5,456 |
| 1992 | 0 | 797 | 1,084 | 56 | 645 | 2,583 | 984 | 245 | 1,384 | 4 | 87 | 4,058 |
| 1993 | 0 | 535 | 1,179 | 67 | 699 | 2,489 | 794 | 156 | 1,143 | 2 | 93 | 3,727 |
| 1994 | 0 | 495 | 911 | 79 | 112 | 1,597 | 498 | 47 | 714 | 9 | 91 | 2,411 |
| 1995 | 0 | 523 | 896 | 14 | 214 | 1,647 | 256 | 75 | 390 | 7 | 21 | 2,065 |
| 1996 | 1 | 836 | 1,405 | 166 | 270 | 2,689 | 561 | 107 | 947 | 0 | 26 | 3,663 |
| 1997 | 0 | 680 | 1,123 | 91 | 96 | 1,991 | 501 | 116 | 722 | 0 | 36 | 2,749 |
| 1998 | 0 | 863 | 1,340 | 98 | 71 | 2,422 | 570 | 252 | 921 | 0 | 28 | 3,371 |
| 1999 | 0 | 954 | 1,471 | 174 | 145 | 2,761 | 486 | 241 | 887 | 0 | 32 | 3,680 |
| 2000 | 0 | 1,313 | 2,269 | 230 | 246 | 4,146 | 619 | 258 | 1,186 | 0 | 70 | 5,402 |
| 2001 | 0 | 1,564 | 2,555 | 0 | 757 | 5,112 | 754 | 302 | 1,633 | 0 | 29 | 6,774 |
| 2002 | 0 | 1,217 | 2,720 | 0 | 657 | 4,954 | 794 | 151 | 1,521 | 0 | 12 | 6,488 |
| 2003 | 0 | 1,186 | 3,246 | 0 | 0 | 4,985 | 806 | 249 | 1,776 | 0 | 14 | 6,775 |
| 2004 | 0 | 2,152 | 4,651 | 0 | 67 | 7,744 | 716 | 223 | 2,000 | 0 | 1 | 9,745 |
| 2005 | 0 | 2,929 | 7,393 | 326 | 0 | 12,115 | 646 | 78 | 2,368 | 0 | 1 | 14,484 |
| 2006 | 0 | 1,805 | 6,076 | 601 | 0 | 10,088 | 491 | 84 | 1,896 | 0 | 1 | 11,984 |
| 2007 | 0 | 1,982 | 6,112 | 159 | 0 | 10,034 | 363 | 28 | 1,854 | 0 | 1 | 11,890 |
| 2008 | 0 | 2,413 | 7,894 | 0 | 0 | 12,615 | 532 | 0 | 2,164 | 0 | 2 | 14,781 |
| 2009 | 0 | 3,112 | 9,884 | 27 | 0 | 15,407 | 585 | 0 | 2,185 | 0 | 3 | 17,595 |
| 2010 | 0 | 2,645 | 8,921 | 661 | 0 | 14,100 | 544 | 0 | 2,476 | 0 | 2 | 16,578 |
| 2011 | 0 | 1,606 | 6,432 | 113 | 0 | 9,664 | 413 | 0 | 1,566 | 0 | 1 | 11,232 |
| 2012 | 0 | 744 | 2,819 | 29 | 0 | 4,201 | 180 | 0 | 832 | 0 | 1 | 5,034 |
| 2013 | 0 | 647 | 3,030 | 42 | 0 | 4,348 | 24 | 0 | 272 | 0 | 1 | 4,621 |

[1] Total includes catches for tonnage classes which are not listed.

[2] Catches in 1988 of 26 t, 776 t, 1091 t and 2 t for side otter trawlers and stern otter trawlers tonnage classes 2, 3 and 5, respectively, were excluded because of suspected area misreporting.

*Table 4. Monthly landings (mt) of haddock by Canada from eastern Georges Bank during 1969-2013.*

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 105 | 74 | 6 | 291 | 588 | 691 | 559 | 580 | 551 | 360 | 102 | 34 | 3,941 |
| 1970 | 2 | 105 | 0 | 1 | 574 | 345 | 103 | 456 | 242 | 103 | 26 | 12 | 1,970 |
| 1971 | 0 | 9 | 1 | 0 | 400 | 132 | 283 | 278 | 97 | 246 | 141 | 21 | 1,610 |
| 1972 | 0 | 119 | 2 | 0 | 2 | 111 | 84 | 116 | 98 | 68 | 7 | 2 | 609 |
| 1973 | 4 | 10 | 0 | 0 | 0 | 184 | 198 | 572 | 339 | 232 | 22 | 4 | 1,565 |
| 1974 | 19 | 0 | 1 | 0 | 0 | 58 | 63 | 53 | 96 | 61 | 92 | 19 | 462 |
| 1975 | 4 | 14 | 0 | 0 | 0 | 166 | 256 | 482 | 100 | 166 | 118 | 45 | 1,353 |
| 1976 | 0 | 7 | 62 | 68 | 60 | 587 | 152 | 190 | 186 | 26 | 9 | 7 | 1,355 |
| 1977 | 102 | 177 | 7 | 0 | 23 | 519 | 1,059 | 835 | 13 | 59 | 56 | 22 | 2,871 |
| 1978 | 104 | 932 | 44 | 22 | 21 | 319 | 405 | 85 | 642 | 5,433 | 1,962 | 0 | 9,968 |
| 1979 | 123 | 898 | 400 | 175 | 69 | 1,393 | 885 | 396 | 406 | 261 | 53 | 22 | 5,080 |
| 1980 | 38 | 134 | 14 | 29 | 223 | 2,956 | 2,300 | 965 | 1,411 | 1,668 | 104 | 176 | 10,017 |
| 1981 | 38 | 481 | 568 | 4 | 254 | 1,357 | 1,241 | 726 | 292 | 82 | 378 | 239 | 5,658 |
| 1982 | 129 | 309 | 1 | 11 | 46 | 1,060 | 769 | 682 | 585 | 837 | 398 | 44 | 4,872 |
| 1983 | 32 | 67 | 29 | 47 | 60 | 1,288 | 387 | 483 | 526 | 195 | 88 | 6 | 3,208 |
| 1984 | 3 | 5 | 81 | 88 | 73 | 433 | 219 | 254 | 211 | 71 | 25 | 0 | 1,463 |
| 1985 | 1 | 11 | 33 | 99 | 26 | 354 | 392 | 1,103 | 718 | 594 | 61 | 93 | 3,484 |
| 1986 | 11 | 28 | 79 | 99 | 40 | 1,339 | 1,059 | 369 | 233 | 139 | 12 | 8 | 3,415 |
| 1987 | 24 | 26 | 138 | 70 | 12 | 1,762 | 1,383 | 665 | 405 | 107 | 97 | 14 | 4,703 |
| 1988[1] | 39 | 123 | 67 | 79 | 15 | 1,816 | 1,360 | 315 | 130 | 65 | 13 | 24 | 4,046 |
| 1989 | 33 | 94 | 48 | 7 | 20 | 1,398 | 356 | 566 | 141 | 272 | 108 | 18 | 3,060 |
| 1990 | 35 | 14 | 50 | 0 | 7 | 1,178 | 668 | 678 | 469 | 199 | 18 | 22 | 3,340 |
| 1991 | 144 | 166 | 49 | 26 | 21 | 1,938 | 1,004 | 705 | 566 | 576 | 123 | 137 | 5,456 |
| 1992 | 118 | 205 | 97 | 152 | 36 | 1,381 | 619 | 414 | 398 | 401 | 209 | 28 | 4,058 |
| 1993 | 468 | 690 | 96 | 78 | 25 | 723 | 505 | 329 | 202 | 198 | 230 | 183 | 3,727 |
| 1994 | 3 | 3 | 1 | 2 | 0 | 398 | 693 | 373 | 375 | 220 | 211 | 133 | 2,411 |
| 1995 | 5 | 1 | 1 | 1 | 0 | 762 | 327 | 290 | 281 | 109 | 197 | 93 | 2,065 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 1,067 | 672 | 706 | 359 | 278 | 191 | 391 | 3,663 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 328 | 751 | 772 | 426 | 190 | 116 | 166 | 2,749 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 687 | 420 | 580 | 707 | 542 | 164 | 271 | 3,371 |
| 1999 | 37 | 0 | 0 | 0 | 0 | 898 | 975 | 562 | 573 | 295 | 269 | 70 | 3,681 |
| 2000 | 1 | 0 | 0 | 0 | 0 | 1,368 | 1,175 | 1,026 | 848 | 658 | 175 | 150 | 5,402 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 971 | 1,335 | 930 | 1,267 | 1,075 | 647 | 548 | 6,774 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 572 | 1,703 | 983 | 1,364 | 820 | 593 | 452 | 6,488 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 840 | 1,767 | 1,290 | 930 | 952 | 676 | 320 | 6,775 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 1,547 | 2,268 | 2,109 | 1,753 | 1,275 | 556 | 236 | 9,745 |
| 2005 | 1,025 | 1,182 | 0 | 0 | 13 | 1,423 | 3,004 | 3,820 | 2,199 | 1,198 | 357 | 266 | 14,484 |
| 2006 | 1,176 | 381 | 0 | 0 | 0 | 1,093 | 2,433 | 2,668 | 2,211 | 1,149 | 558 | 316 | 11,984 |
| 2007 | 1,100 | 454 | 0 | 0 | 0 | 1,432 | 3,034 | 2,510 | 1,916 | 991 | 231 | 222 | 11,890 |
| 2008 | 1,867 | 1,604 | 0 | 0 | 0 | 1,640 | 2,539 | 2,446 | 2,382 | 1,314 | 645 | 343 | 14,781 |
| 2009 | 2,977 | 947 | 0 | 0 | 0 | 2,217 | 1,996 | 2,889 | 2,479 | 2,191 | 1,239 | 659 | 17,595 |
| 2010 | 2,391 | 574 | 0 | 0 | 0 | 1,861 | 2,893 | 3,809 | 2,257 | 1,572 | 692 | 530 | 16,578 |
| 2011 | 1,954 | 466 | 0 | 0 | 0 | 941 | 2,074 | 2,554 | 1,751 | 931 | 299 | 262 | 11,232 |
| 2012 | 692 | 634 | 0 | 0 | 0 | 583 | 949 | 1,077 | 490 | 419 | 61 | 128 | 5,034 |
| 2013 | 843 | 185 | 0 | 0 | 0 | 193 | 50 | 350 | 939 | 1,004 | 488 | 569 | 4,621 |

[1] Catches in 1988 of 3 t, 1846 t and 46 t for January, February, and March, respectively, for otter trawlers were excluded because of suspected area misreporting.

*Table 5. Prorated discards (kg) and fishing effort (hr) for eastern Georges Bank haddock from the observed trips of the Canadian scallop fishery in December 2012 to January 2014. Note that there were no observed trips in December 2012. Effort hours are in hours x meters.*

| Trip ID | Board Date | Land Date | Proration | | | | | Effort (hrs x m) |
|---|---|---|---|---|---|---|---|---|
| | | | Dredges | | | Discards (kg) | | |
| | | | Obs. | Total | Prop. | Observed | Prorated | |
| T2013-01 | 2013-01-28 | 2013-02-08 | 283 | 498 | 0.57 | 53 | 93 | 1212 |
| T2013-02 | 2013-02-11 | 2013-03-04 | 678 | 1270 | 0.53 | 43 | 81 | 2556 |
| T2013-03 | 2013-02-16 | 2013-03-04 | 502 | 981 | 0.51 | 11 | 21 | 1491 |
| T2013-04 | 2013-03-22 | 2013-04-04 | 555 | 1031 | 0.54 | 123 | 228 | 1656 |
| T2013-05 | 2013-03-27 | 2013-04-04 | 226 | 402 | 0.56 | 39 | 69 | 626 |
| T2013-06 | 2013-04-04 | 2013-04-19 | 581 | 1192 | 0.49 | 115 | 236 | 1791 |
| T2013-07 | 2013-04-17 | 2013-04-26 | 232 | 432 | 0.54 | 4 | 7 | 969 |
| T2013-08 | 2013-05-19 | 2013-05-28 | 135 | 261 | 0.52 | 2 | 4 | 596 |
| T2013-09 | 2013-05-25 | 2013-06-05 | 304 | 584 | 0.52 | 11 | 21 | 856 |
| T2013-10 | 2013-06-18 | 2013-06-27 | 174 | 328 | 0.53 | 2 | 4 | 768 |
| T2013-11 | 2013-07-08 | 2013-07-20 | 528 | 998 | 0.53 | 0 | 0 | 1526 |
| T2013-12 | 2013-07-21 | 2013-08-02 | 616 | 1138 | 0.54 | 4 | 7 | 1526 |
| T2013-13 | 2013-08-21 | 2013-08-30 | 261 | 495 | 0.53 | 33 | 63 | 1060 |
| T2013-14 | 2013-08-22 | 2013-09-05 | 681 | 1341 | 0.51 | 17 | 33 | 1837 |
| T2013-15 | 2013-10-16 | 2013-10-31 | 837 | 1533 | 0.55 | 170 | 311 | 1838 |
| T2013-16 | 2013-10-18 | 2013-10-24 | 172 | 254 | 0.68 | 14 | 21 | 634 |
| T2013-17 | 2013-10-20 | 2013-11-04 | 521 | 1028 | 0.51 | 77 | 152 | 1399 |
| T2014-01 | 2014-01-24 | 2014-01-27 | 37 | 65 | 0.57 | 8 | 14 | 207 |

*Table 6. Haddock discards from the Canadian scallop fishery on Georges Bank for 2013 calculated using a 3-month moving window to estimate discard rates. The discard rates for January and December are calculated by including observed trips from December 2012 and January 2014, respectively. Note that there were several months with no observed trips. Effort hours are in hours x meters.*

| Year | Month | Prorated Discards | Observed Effort (hrs x m) | Discard Rate (kg/hr x m) | Fleet Effort (hrs x m) | Discards (mt) | Cumulative Annual Discards(mt) |
|---|---|---|---|---|---|---|---|
| 2012 | Dec[1] | 0 | 0 | | | | |
| 2013 | Jan[1] | 0 | 0 | 0.037 | 406 | 0.015 | 0.015 |
| | Feb | 195 | 5,259 | 0.065 | 7,800 | 0.510 | 0.525 |
| | Mar | 298 | 2,282 | 0.072 | 12,364 | 0.884 | 1.409 |
| | Apr | 243 | 2,760 | 0.087 | 25,684 | 2.240 | 3.649 |
| | May | 25 | 1,452 | 0.055 | 26,694 | 1.459 | 5.108 |
| | Jun | 4 | 768 | 0.007 | 18,757 | 0.129 | 5.236 |
| | Jul | 7 | 3,052 | 0.016 | 21,088 | 0.337 | 5.573 |
| | Aug | 96 | 2,897 | 0.017 | 32,794 | 0.570 | 6.143 |
| | Sep[1] | 0 | 0 | 0.086 | 27,609 | 2.366 | 8.509 |
| | Oct | 484 | 3,871 | 0.125 | 11,823 | 1.478 | 9.987 |
| | Nov[1] | 0 | 0 | 0.125 | 2,213 | 0.277 | 10.264 |
| | Dec[1] | 0 | 0 | 0.068 | 733 | 0.050 | 10.314 |
| 2014 | Jan | 14 | 207 | | | | |

[1]No observed trips in December 2012 and January, September, November, and December 2013.

*Table 7. Monthly landings (mt) of haddock by the United States from eastern Georges Bank during 1969-2013. An allocation algorithm was applied to landings from 1994 to 2013 to determine area fished (Wigley et al. 2008a).*

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 525 | 559 | 976 | 1826 | 670 | 810 | 204 | 219 | 249 | 226 | 203 | 157 | 6624 |
| 1970 | 169 | 219 | 242 | 375 | 608 | 374 | 324 | 333 | 179 | 219 | 61 | 50 | 3154 |
| 1971 | 155 | 361 | 436 | 483 | 668 | 503 | 338 | 152 | 147 | 165 | 58 | 68 | 3533 |
| 1972 | 150 | 196 | 91 | 90 | 239 | 261 | 97 | 164 | 84 | 63 | 52 | 64 | 1551 |
| 1973 | 90 | 111 | 77 | 85 | 139 | 365 | 217 | 196 | 37 | 3 | 22 | 55 | 1397 |
| 1974 | 135 | 70 | 47 | 70 | 122 | 160 | 165 | 43 | 27 | 6 | 19 | 91 | 955 |
| 1975 | 152 | 123 | 32 | 116 | 388 | 489 | 138 | 95 | 57 | 24 | 52 | 39 | 1705 |
| 1976 | 116 | 147 | 84 | 106 | 323 | 162 | 7 | 6 | 5 | 2 | 3 | 13 | 974 |
| 1977 | 75 | 211 | 121 | 154 | 374 | 372 | 434 | 191 | 73 | 52 | 146 | 226 | 2428 |
| 1978 | 336 | 437 | 263 | 584 | 752 | 750 | 467 | 221 | 245 | 426 | 194 | 49 | 4725 |
| 1979 | 274 | 329 | 352 | 548 | 766 | 816 | 588 | 659 | 224 | 202 | 282 | 172 | 5213 |
| 1980 | 632 | 1063 | 742 | 784 | 711 | 461 | 324 | 254 | 221 | 91 | 110 | 222 | 5615 |
| 1981 | 551 | 1852 | 634 | 628 | 882 | 1327 | 1233 | 873 | 321 | 284 | 242 | 255 | 9081 |
| 1982 | 425 | 755 | 502 | 348 | 719 | 1805 | 757 | 145 | 201 | 216 | 276 | 138 | 6286 |
| 1983 | 492 | 931 | 272 | 181 | 310 | 1145 | 231 | 178 | 187 | 110 | 227 | 190 | 4453 |
| 1984 | 540 | 961 | 366 | 281 | 627 | 1047 | 370 | 303 | 250 | 196 | 92 | 89 | 5121 |
| 1985 | 165 | 190 | 254 | 300 | 352 | 206 | 60 | 47 | 1 | 24 | 41 | 43 | 1683 |
| 1986 | 184 | 396 | 334 | 479 | 496 | 221 | 31 | 6 | 12 | 6 | 6 | 29 | 2201 |
| 1987 | 225 | 52 | 43 | 307 | 233 | 342 | 67 | 30 | 24 | 4 | 23 | 68 | 1418 |
| 1988 | 196 | 152 | 207 | 245 | 366 | 316 | 30 | 19 | 6 | 1 | 45 | 110 | 1694 |
| 1989 | 114 | 56 | 47 | 164 | 161 | 145 | 15 | 8 | 1 | 5 | 25 | 46 | 785 |
| 1990 | 148 | 21 | 155 | 274 | 214 | 306 | 23 | 3 | 5 | 5 | 16 | 19 | 1189 |
| 1991 | 105 | 28 | 76 | 133 | 89 | 434 | 1 | 20 | 6 | 0 | 19 | 19 | 931 |
| 1992 | 253 | 81 | 51 | 149 | 353 | 669 | 20 | 20 | 17 | 3 | 2 | 12 | 1629 |
| 1993 | 15 | 12 | 16 | 55 | 88 | 209 | 6 | 3 | 3 | 7 | 2 | 8 | 424 |
| 1994 | 0 | 1 | 1 | 3 | 1 | 1 | 12 | 1 | 0 | 1 | 1 | 2 | 24 |
| 1995 | 1 | 1 | 3 | 4 | 2 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 15 |
| 1996 | 2 | 1 | 2 | 3 | 7 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 26 |
| 1997 | 5 | 4 | 3 | 4 | 11 | 6 | 2 | 1 | 9 | 4 | 2 | 6 | 55 |
| 1998 | 5 | 19 | 23 | 29 | 31 | 50 | 21 | 17 | 39 | 22 | 1 | 15 | 271 |
| 1999 | 35 | 15 | 30 | 52 | 71 | 62 | 23 | 18 | 28 | 0 | 0 | 22 | 359 |
| 2000 | 6 | 13 | 89 | 48 | 42 | 22 | 21 | 15 | 24 | 2 | 17 | 42 | 340 |
| 2001 | 42 | 9 | 228 | 146 | 81 | 97 | 51 | 12 | 8 | 38 | 21 | 31 | 762 |
| 2002 | 92 | 105 | 91 | 150 | 272 | 175 | 66 | 46 | 17 | 42 | 11 | 24 | 1090 |
| 2003 | 94 | 24 | 86 | 506 | 310 | 319 | 57 | 17 | 4 | 51 | 40 | 169 | 1677 |
| 2004 | 97 | 21 | 174 | 725 | 101 | 349 | 256 | 26 | 57 | 5 | 5 | 31 | 1847 |
| 2005[1] | 2 | 0 | 45 | 34 | 210 | 158 | 103 | 93 | 0 | 0 | 1 | 2 | 649 |
| 2006[1] | 1 | 0 | 0 | 23 | 192 | 87 | 0 | 7 | 0 | 0 | 1 | 3 | 313 |
| 2007[1] | 1 | 0 | 5 | 71 | 43 | 60 | 3 | 0 | 0 | 25 | 47 | 0 | 256 |
| 2008[1] | 0 | 0 | 6 | 26 | 31 | 80 | 47 | 92 | 65 | 153 | 98 | 539 | 1138 |
| 2009 | 13 | 4 | 41 | 677 | 30 | 109 | 38 | 458 | 140 | 31 | 195 | 418 | 2152 |
| 2010 | 130 | 13 | 281 | 503 | 100 | 76 | 16 | 367 | 193 | 118 | 224 | 147 | 2167 |
| 2011 | 75 | 70 | 110 | 341 | 165 | 150 | 76 | 123 | 40 | 34 | 43 | 93 | 1322 |
| 2012 | 50 | 10 | 30 | 112 | 113 | 48 | 17 | 4 | 20 | 18 | 5 | 17 | 443 |
| 2013 | 23 | 4 | 9 | 28 | 11 | 9 | 29 | 40 | 29 | 34 | 43 | 84 | 344 |

[1]Restrictions placed on USA fishery in eastern Georges Bank due to bycatch limitations.

*Table 8. United States landings (mt) of haddock from eastern Georges Bank during 1969-2013 by gear category and tonnage class. An allocation algorithm was applied to landings from 1994 to 2013 to determine area fished (Wigley et al. 2008a).*

| Year | Otter Trawl | | Other | Total |
|---|---|---|---|---|
| | 3 | 4 | | |
| 1969 | 3013 | 3610 | 0 | 6624 |
| 1970 | 1602 | 1551 | 0 | 3154 |
| 1971 | 1760 | 1768 | 0 | 3533 |
| 1972 | 861 | 690 | 0 | 1551 |
| 1973 | 638 | 759 | 0 | 1397 |
| 1974 | 443 | 512 | 0 | 955 |
| 1975 | 1025 | 679 | 0 | 1705 |
| 1976 | 671 | 303 | 0 | 974 |
| 1977 | 1724 | 703 | 0 | 2428 |
| 1978 | 3140 | 1582 | 3 | 4725 |
| 1979 | 3285 | 1927 | 1 | 5213 |
| 1980 | 2654 | 2955 | 4 | 5615 |
| 1981 | 3601 | 5433 | 15 | 9081 |
| 1982 | 2589 | 3660 | 37 | 6286 |
| 1983 | 1162 | 3276 | 15 | 4453 |
| 1984 | 1855 | 3261 | 5 | 5121 |
| 1985 | 857 | 823 | 4 | 1683 |
| 1986 | 993 | 1207 | 1 | 2201 |
| 1987 | 766 | 651 | 1 | 1418 |
| 1988 | 920 | 768 | 6 | 1694 |
| 1989 | 359 | 419 | 6 | 785 |
| 1990 | 488 | 697 | 4 | 1189 |
| 1991 | 404 | 527 | 0 | 931 |
| 1992 | 650 | 979 | 0 | 1629 |
| 1993 | 153 | 272 | 0 | 424 |
| 1994 | 13 | 11 | 0 | 24 |
| 1995 | 4 | 11 | 0 | 15 |
| 1996 | 12 | 14 | 0 | 26 |
| 1997 | 39 | 15 | 1 | 55 |
| 1998 | 123 | 147 | 1 | 271 |
| 1999 | 126 | 229 | 4 | 359 |
| 2000 | 107 | 233 | 0 | 340 |
| 2001 | 248 | 513 | 1 | 762 |
| 2002 | 462 | 626 | 2 | 1090 |
| 2003 | 798 | 879 | 0 | 1677 |
| 2004 | 676 | 1169 | 2 | 1847 |
| 2005 | 255 | 359 | 35 | 649 |
| 2006 | 159 | 110 | 44 | 313 |
| 2007 | 139 | 101 | 16 | 256 |
| 2008 | 284 | 745 | 108 | 1138 |
| 2009 | 632 | 1395 | 125 | 2152 |
| 2010 | 472 | 1532 | 162 | 2167 |
| 2011 | 314 | 954 | 53 | 1322 |
| 2012 | 88 | 350 | 5 | 443 |
| 2013 | 50 | 281 | 13 | 344 |

*Table 9. United States landings and discards of haddock in 2013 by quarter and market category from eastern Georges Bank and National Marine Fisheries Service sampling intensity for lengths and ages. Note that summaries by market category are not possible for discards as the fish are discarded at sea and are not given a market category. Numbers in parentheses refer to sample sizes after augmenting samples from USA commercial statistical areas 522 and 525.*

| Market Category | Large | Scrod | Unclassified | Total |
|---|---|---|---|---|
| | | **Landings (mt)** | | |
| Quarter 1 | 11 | 26 | 0 | 37 |
| Quarter 2 | 8 | 39 | 1 | 48 |
| Quarter 3 | 3 | 77 | 17 | 98 |
| Quarter 4 | 6 | 127 | 29 | 161 |
| Total | 28 | 269 | 47 | 344 |
| | | Number lengths measured | | |
| Quarter 1 | 0 (394) | 0 (368) | 0 | 0 (762) |
| Quarter 2 | 183 (909) | 209 (719) | 0 | 392 (1628) |
| Quarter 3 | 13 (25) | 51 (312) | 0 | 64 (337) |
| Quarter 4 | 0 (271) | 314 (1092) | 0 | 314 (1363) |
| Total | 196 (1599) | 574 (2491) | 0 | 770 (4090) |
| | | Number aged | | |
| Quarter 1 | 0 (188) | 0 (138) | 0 | 0 (326) |
| Quarter 2 | 127 (482) | 101 (328) | 0 | 228 (810) |
| Quarter 3 | 0 (0) | 0 (73) | 0 | 0 (73) |
| Quarter 4 | 0 (118) | 151 (476) | 0 | 151 (594) |
| Total | 127 (788) | 252 (1015) | 0 | 379 (1803) |
| | | **Discards (mt)** | | |
| Quarter 1 | N/A | N/A | N/A | |
| Quarter 2 | N/A | N/A | N/A | 28 |
| Quarter 3 | N/A | N/A | N/A | |
| Quarter 4 | N/A | N/A | N/A | 64 |
| Total | N/A | N/A | N/A | 91 |

*Table 10. Inter- and intra-reader testing for Georges Bank haddock ageing. (SJS = S. Sutherland (National Marine Fisheries Service, (NMFS)) and DK = D. Knox (Canadian Department of Fisheries and Oceans, DFO), CV = coefficient of variation).*

| Sample Source | Test Type | Date Completed | Age Reader | Sample Size | CV (%) | Agreement (%) | Bowker's Test |
|---|---|---|---|---|---|---|---|
| **DFO/NMFS Exchange:** | | | | | | | |
| 2013 US Commercial (Q1&2) | Exchange | Spring 2014 | SJS vs DK | 88 | 1.90 | 84.1 | n/s |
| 2013 Can. Commercial (Q2,3,4) | Exchange | Spring 2014 | SJS vs DK | 66 | 0.49 | 95.5 | |
| 2014 DFO Survey | Exchange | Spring 2014 | SJS vs DK | 114 | 0.47 | 96.5 | |
| 2013 NMFS Autumn Survey | Exchange | Spring 2014 | SJS vs DK | 105 | 0.38 | 98.1 | |
| Combined | Exchange | Spring 2014 | SJS vs DK | 373 | 0.79 | 93.8 | |
| **NMFS Testing:** | | | | | | | |
| 2013 NMFS Autumn Survey | Precision | Feb 2014 | SJS | 96 | 0.49 | 99.0 | |
| 2013 US Commercial (Q4) | Precision | Mar 2014 | SJS | 100 | 0.16 | 99.0 | |
| 2013 US Commercial (Q3) | Precision | Mar 2014 | SJS | 100 | 0.06 | 99.0 | |
| 2013 US Commercial (Q2) | Precision | Feb 2014 | SJS | 97 | 0.08 | 99.0 | |
| 2013 US Commercial (Q1) | Precision | Dec 2013 | SJS | 98 | 0.38 | 95.9 | |
| 2013 NMFS Spring Survey | Precision | June 2013 | SJS | 99 | 0.08 | 99.0 | |
| Haddock Reference Collection | Accuracy | Apr 2014 | SJS | 57 | 1.68 | 92.7 | |
| Haddock Reference Collection | Accuracy | July 2013 | SJS | 56 | 1.69 | 91.1 | |
| **DFO Testing:** | | | | | | | |
| 2014 DFO survey | Precision | Spring 2014 | DK | 129 | 0.68 | 96.1 | |
| 2013 Canadian Commercial (Q4) | Precision | 2014 | DK | 114 | 0.26 | 98.2 | |
| 2013 Canadian Commercial (Q3) | Precision | 2013 | DK | 104 | 1.02 | 93.3 | |
| 2013 Canadian Commercial (Q2) | Precision | 2013 | DK | 112 | 0.69 | 95.5 | |

*Table 11. Haddock age and length samples for landings from the Canadian groundfish fishery and for discards from the scallop dredge fishery in 2013 from eastern Georges Bank. (OTB = Otter Trawl Bottom, LL = Long Line, GN = Gill Net, DR = Scallop Dredge).*

| Qtr. | Gear | Month | Landings (kg) | Length Frequency Samples | | | | Ages[3] |
|---|---|---|---|---|---|---|---|---|
| | | | | At Sea | | Port | | |
| | | | | Trips | Measured | Samples | Measured | |
| 1 | OTB | Jan | 843,439 | 42 | 61,854 | 14 | 3,404 | DFO Survey = 530<br>Port = 50<br>At Sea = 0<br>Total = 580[4] |
| | | Feb | 185,181 | 14 | 12,163 | 1 | 250 | |
| | DR[1] | | 1,409 | 4 | 194 | | | |
| 2 | OTB | June | 193,019 | 26 | 24,021 | 5 | 1,183 | Port = 134<br>At Sea = 170<br>Total = 304[5] |
| | GN[2] | June | 51 | | | | | |
| | DR[1] | | 3,827 | 5 | 131 | | | |
| 3 | OTB | July | 22,720 | 6 | 4,045 | 2 | 480 | Port = 319<br>At Sea = 91<br>Total = 410[6] |
| | | Aug | 222,501 | 20 | 20,482 | 4 | 961 | |
| | | Sept | 871,876 | 47 | 56,860 | 12 | 2,818 | |
| | LL | July | 26,865 | 10 | 3,671 | 1 | 250 | |
| | | Aug | 126,895 | 12 | 12,272 | 4 | 945 | |
| | | Sept | 66,290 | 3 | 1,703 | 2 | 483 | |
| | GN[2] | July | 246 | | | | | |
| | | Aug | 242 | | | | | |
| | | Sept | 376 | | | | | |
| | DR[1] | | 3,273 | 4 | 88 | | | |
| 4 | OTB | Oct | 952,464 | 29 | 35,442 | 12 | 2,818 | Port = 364<br>At Sea = 49<br>Total = 413[7] |
| | | Nov | 487,905 | 15 | 16,354 | 11 | 2,569 | |
| | | Dec | 569,247 | 14 | 14,151 | 8 | 1,892 | |
| | LL | Oct | 51,678 | 3 | 1,800 | 3 | 690 | |
| | DR[1] | | 1,805 | 3 | 356 | | | |
| Totals | | | 4,631,308 | 257 | 265,587 | 79 | 18,743 | 1,707 |

[1]Scallop fishery samples were combined by quarter.
[2]Gillnet added in at quarter level.
[3]When otoliths were not available for a length grouping, ages were inferred.
[4]Ages for 3 length groupings were inferred and are not included in the total.
[5]Ages for 4 length groupings were inferred and are not included in the total.
[6]Ages for 9 length groupings were inferred and are not included in the total.
[7]Ages for 14 length groupings were inferred and are not included in the total.

*Table 12. Components of the 2013 catch at age in numbers of haddock from eastern Georges Bank by quarter or half year.*

| | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9+** | **Total** |
| **Canadian Landings** | | | | | | | | | | | |
| 2013 Q1 | 0 | 0 | 590 | 134,527 | 68,047 | 29,091 | 63,211 | 32,575 | 44,597 | 343,303 | 715,943 |
| 2013 Q2 | 0 | 1 | 782 | 38,172 | 17,653 | 18,365 | 22,517 | 9,940 | 6,782 | 39,019 | 153,232 |
| 2013 Q3 | 0 | 4,539 | 68,346 | 979,077 | 109,837 | 34,497 | 76,192 | 20,091 | 30,711 | 100,818 | 1,424,110 |
| 2013 Q4 | 99 | 2,460 | 99,721 | 1,946,002 | 25,386 | 21,498 | 65,849 | 5,505 | 16,171 | 85,933 | 2,268,625 |
| Year total | 99 | 7,001 | 169,440 | 3,097,779 | 220,925 | 103,451 | 227,770 | 68,111 | 98,262 | 569,074 | 4,561,911 |
| **United States Landings**[1] | | | | | | | | | | | |
| 2013 H1 | 0 | 0 | 0 | 12,013 | 7,035 | 1,510 | 3,422 | 2,602 | 4,894 | 32,939 | 64,415 |
| 2013 H2 | 0 | 0 | 6,262 | 233,899 | 3,218 | 2,048 | 1,234 | 587 | 2,759 | 5,798 | 255,804 |
| Year total | 0 | 0 | 6,262 | 245,912 | 10,252 | 3,558 | 4,656 | 3,189 | 7,653 | 38,737 | 320,219 |
| **Canadian Discards** | | | | | | | | | | | |
| 2013 Q1 | 0 | 49 | 179 | 1,665 | 59 | 9 | 19 | 11 | 20 | 137 | 2,149 |
| 2013 Q2 | 0 | 0 | 235 | 4,394 | 145 | 95 | 72 | 64 | 30 | 357 | 5,393 |
| 2013 Q3 | 1,393 | 2,029 | 527 | 3,104 | 93 | 25 | 49 | 18 | 24 | 59 | 7,320 |
| 2013 Q4 | 7,892 | 279 | 388 | 1,791 | 3 | 1 | 8 | 1 | 1 | 5 | 10,369 |
| Year total | 9,286 | 2,357 | 1,330 | 10,954 | 301 | 131 | 148 | 93 | 75 | 557 | 25,232 |
| **United States Discards**[1] | | | | | | | | | | | |
| 2013 H1 | 0 | 208 | 5,230 | 46,762 | 937 | 356 | 190 | 100 | 208 | 966 | 54,956 |
| 2013 H2 | 152,253 | 14,804 | 14,883 | 56,144 | 743 | 115 | 77 | 964 | 116 | 3,700 | 243,798 |
| Year total | 152,253 | 15,012 | 20,113 | 102,906 | 1,680 | 470 | 267 | 1,064 | 324 | 4,666 | 298,754 |
| **Total Catch** | | | | | | | | | | | |
| 2013 | 161,637 | 24,370 | 197,144 | 3,457,550 | 233,157 | 107,610 | 232,842 | 72,457 | 106,314 | 613,034 | 5,206,116 |

[1]United States landings and discards at age were calculated by half year, however, landings and discards occurred in other quarters.

*Table 13. Total annual commercial catch at age numbers (000's) of haddock from eastern Georges Bank during 1969-2013. Estimates of discards are included.*

| Year | Age Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9+** | **0+** |
| 1969 | 6 | 0 | 18 | 1,451 | 262 | 334 | 2,909 | 831 | 91 | 283 | 6,184 |
| 1970 | 0 | 66 | 84 | 7 | 351 | 151 | 130 | 1,153 | 372 | 193 | 2,508 |
| 1971 | 43 | 0 | 1,201 | 251 | 31 | 252 | 159 | 161 | 774 | 412 | 3,284 |
| 1972 | 118 | 346 | 1 | 390 | 72 | 21 | 94 | 39 | 16 | 451 | 1,547 |
| 1973 | 7 | 1,119 | 1,758 | 6 | 364 | 38 | 10 | 39 | 8 | 169 | 3,517 |
| 1974 | 9 | 37 | 2,257 | 276 | 0 | 32 | 3 | 0 | 29 | 63 | 2,706 |
| 1975 | 553 | 18 | 279 | 1,504 | 216 | 5 | 36 | 2 | 2 | 31 | 2,645 |
| 1976 | 1 | 402 | 157 | 173 | 834 | 135 | 0 | 19 | 0 | 18 | 1,739 |
| 1977 | 0 | 1 | 8,028 | 66 | 182 | 307 | 164 | 0 | 15 | 15 | 8,778 |
| 1978 | 110 | 6 | 291 | 9,956 | 164 | 173 | 306 | 80 | 10 | 9 | 11,105 |
| 1979 | 12 | 212 | 17 | 208 | 4,307 | 364 | 201 | 217 | 43 | 14 | 5,597 |
| 1980 | 31 | 32 | 17,701 | 343 | 302 | 2,425 | 193 | 130 | 52 | 12 | 21,220 |
| 1981 | 6 | 55 | 693 | 6,773 | 400 | 497 | 1,243 | 119 | 33 | 7 | 9,826 |
| 1982 | 1 | 2 | 731 | 1,057 | 2,848 | 205 | 379 | 730 | 62 | 65 | 6,080 |
| 1983 | 75 | 11 | 149 | 663 | 554 | 1,653 | 208 | 104 | 409 | 35 | 3,860 |
| 1984 | 1 | 72 | 100 | 259 | 350 | 270 | 1,131 | 186 | 166 | 318 | 2,854 |
| 1985 | 353 | 9 | 2,147 | 386 | 182 | 199 | 128 | 381 | 53 | 117 | 3,954 |
| 1986 | 0 | 89 | 39 | 2,586 | 175 | 143 | 124 | 119 | 174 | 42 | 3,492 |
| 1987 | 19 | 0 | 2,081 | 131 | 1,536 | 100 | 58 | 83 | 70 | 111 | 4,190 |
| 1988 | 1 | 53 | 53 | 2,199 | 124 | 894 | 111 | 39 | 46 | 100 | 3,619 |
| 1989 | 8 | 2 | 1,274 | 86 | 776 | 143 | 347 | 34 | 23 | 47 | 2,740 |
| 1990 | 18 | 31 | 8 | 1,346 | 133 | 770 | 73 | 168 | 43 | 43 | 2,633 |
| 1991 | 35 | 22 | 466 | 91 | 2,076 | 89 | 391 | 72 | 146 | 61 | 3,450 |
| 1992 | 151 | 49 | 249 | 324 | 129 | 1,466 | 90 | 320 | 26 | 91 | 2,895 |
| 1993 | 4 | 80 | 283 | 357 | 291 | 91 | 667 | 41 | 157 | 76 | 2,049 |
| 1994 | 13 | 36 | 423 | 870 | 186 | 73 | 101 | 190 | 89 | 48 | 2,028 |
| 1995 | 4 | 8 | 79 | 534 | 414 | 53 | 25 | 3 | 52 | 16 | 1,188 |
| 1996 | 6 | 4 | 32 | 489 | 864 | 419 | 60 | 18 | 3 | 72 | 1,967 |
| 1997 | 1 | 29 | 94 | 73 | 535 | 484 | 195 | 13 | 8 | 34 | 1,466 |
| 1998 | 19 | 18 | 195 | 292 | 260 | 541 | 448 | 114 | 12 | 35 | 1,932 |
| 1999 | 2 | 27 | 44 | 752 | 319 | 249 | 347 | 256 | 99 | 25 | 2,119 |
| 2000 | 1 | 6 | 320 | 449 | 1,268 | 264 | 213 | 217 | 186 | 67 | 2,991 |
| 2001 | 0 | 22 | 65 | 1,733 | 533 | 847 | 263 | 204 | 232 | 204 | 4,105 |
| 2002 | 0 | 1 | 333 | 218 | 1,891 | 379 | 671 | 115 | 110 | 289 | 4,008 |
| 2003 | 486 | 7 | 10 | 1,831 | 288 | 1,487 | 426 | 479 | 110 | 234 | 5,358 |
| 2004 | 4 | 332 | 26 | 75 | 3,646 | 605 | 1,498 | 519 | 421 | 263 | 7,388 |
| 2005 | 0 | 14 | 241 | 29 | 224 | 6,891 | 526 | 823 | 128 | 157 | 9,034 |
| 2006 | 1 | 20 | 16 | 2,515 | 44 | 289 | 4,544 | 234 | 551 | 154 | 8,367 |
| 2007 | 0 | 2 | 39 | 181 | 7,345 | 148 | 168 | 1,431 | 136 | 187 | 9,637 |
| 2008 | 0 | 4 | 30 | 273 | 268 | 9,721 | 102 | 85 | 708 | 95 | 11,288 |
| 2009 | 3 | 17 | 125 | 192 | 741 | 261 | 11,222 | 73 | 58 | 379 | 13,074 |
| 2010 | 15 | 31 | 56 | 391 | 314 | 844 | 382 | 9,849 | 50 | 210 | 12,142 |
| 2011 | 1 | 243 | 107 | 181 | 515 | 228 | 676 | 108 | 6,233 | 75 | 8,366 |
| 2012 | 3 | 75 | 638 | 174 | 126 | 351 | 174 | 379 | 138 | 2,055 | 4,112 |
| 2013 | 162 | 24 | 197 | 3,458 | 233 | 108 | 233 | 72 | 106 | 613 | 5,206 |

*Table 14. Average weight at age (kg) of haddock from the combined Canadian and USA commercial groundfish fishery landings on eastern Georges Bank during 1969-2013. From 1969 to 1973 only USA fishery sampling for lengths and ages was available. Between 1974 and 1984 a mix of USA and Canadian samples were used. No USA fishery weights were available for 1997, 1998. For age 1 missing weights (**bold),** an average of 0.600 kg was used. Missing weights for older haddock were extrapolated within year class.*

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| 1969 | **0.600** | 0.763 | 1.282 | 1.531 | 1.649 | 1.836 | 2.298 | 2.879 | 3.354 |
| 1970 | 0.721 | 1.067 | 0.812 | 1.653 | 1.886 | 2.124 | 2.199 | 2.841 | 3.150 |
| 1971 | **0.600** | 0.928 | 1.059 | 1.272 | 2.011 | 2.255 | 2.262 | 2.613 | 3.047 |
| 1972 | 0.759 | **0.983** | 1.562 | 1.750 | 2.147 | 2.505 | 2.411 | 2.514 | 2.989 |
| 1973 | 0.683 | 1.002 | 1.367 | 1.804 | 2.202 | 1.631 | 2.885 | 3.295 | 3.192 |
| 1974 | **0.600** | 1.052 | 1.491 | **1.683** | 2.017 | 3.760 | **2.583** | 3.145 | 3.735 |
| 1975 | **0.600** | 0.877 | 1.557 | 2.085 | 1.999 | 2.429 | 4.107 | 3.534 | 3.429 |
| 1976 | 0.610 | 0.984 | 1.292 | 1.853 | 2.417 | **2.247** | 2.774 | **4.484** | 3.807 |
| 1977 | **0.600** | 0.970 | 1.442 | 1.810 | 2.336 | 2.807 | **2.494** | 3.094 | 4.150 |
| 1978 | 0.619 | 1.158 | 1.432 | 2.067 | 2.602 | 2.926 | 2.971 | 2.741 | 4.334 |
| 1979 | **0.600** | 0.966 | 1.288 | 1.823 | 2.214 | 2.791 | 3.214 | 3.206 | 4.041 |
| 1980 | 0.405 | 0.889 | 1.035 | 1.703 | 2.094 | 2.606 | 3.535 | 3.584 | 3.109 |
| 1981 | **0.600** | 0.888 | 1.270 | 1.650 | 2.310 | 2.627 | 3.545 | 4.086 | 4.455 |
| 1982 | **0.600** | 0.964 | 1.370 | 1.787 | 2.332 | 2.550 | 2.957 | 3.528 | 3.426 |
| 1983 | **0.600** | 1.028 | 1.327 | 1.755 | 2.132 | 2.475 | 2.895 | 3.125 | 4.010 |
| 1984 | **0.600** | 0.872 | 1.338 | 1.798 | 2.151 | 2.577 | 2.842 | 3.119 | 3.411 |
| 1985 | **0.600** | 0.950 | 1.230 | 1.915 | 2.227 | 2.702 | 2.872 | 3.180 | 3.696 |
| 1986 | 0.452 | 0.981 | 1.352 | 1.866 | 2.367 | 2.712 | 2.969 | 3.570 | 3.908 |
| 1987 | **0.600** | 0.833 | 1.431 | 1.984 | 2.148 | 2.594 | 2.953 | 3.646 | 3.880 |
| 1988 | 0.421 | 0.974 | 1.305 | 1.708 | 2.042 | 2.350 | 3.011 | 3.305 | 3.693 |
| 1989 | **0.600** | 0.868 | 1.450 | 1.777 | 2.183 | 2.522 | 3.012 | 3.411 | 3.751 |
| 1990 | 0.639 | 0.999 | 1.419 | 1.787 | 2.141 | 2.509 | 2.807 | 3.002 | 3.668 |
| 1991 | 0.581 | 1.197 | 1.241 | 1.802 | 2.086 | 2.597 | 2.913 | 3.010 | 3.362 |
| 1992 | 0.538 | 1.163 | 1.622 | 1.654 | 2.171 | 2.491 | 2.988 | 3.388 | 3.524 |
| 1993 | 0.659 | 1.160 | 1.724 | 2.181 | 2.047 | 2.623 | 2.386 | 3.112 | 3.486 |
| 1994 | 0.405 | 1.141 | 1.669 | 2.244 | 2.662 | 2.454 | 2.837 | 3.253 | 3.449 |
| 1995 | 0.797 | 1.055 | 1.511 | 2.032 | 2.549 | 2.762 | 2.978 | 3.012 | 3.535 |
| 1996 | 0.576 | 1.026 | 1.441 | 1.796 | 2.296 | 2.490 | 3.331 | 2.220 | 3.620 |
| 1997 | 0.685 | 1.216 | 1.336 | 1.747 | 2.121 | 2.476 | 3.034 | 3.367 | 3.927 |
| 1998 | 0.568 | 1.131 | 1.573 | 1.697 | 1.983 | 2.312 | 2.864 | 3.395 | 3.657 |
| 1999 | 0.678 | 1.094 | 1.568 | 1.907 | 1.893 | 2.216 | 2.577 | 2.816 | 3.743 |
| 2000 | 0.664 | 1.104 | 1.470 | 1.917 | 2.242 | 2.132 | 2.518 | 2.829 | 3.170 |
| 2001 | 0.394 | 1.102 | 1.461 | 1.742 | 2.100 | 2.364 | 2.187 | 2.554 | 3.114 |
| 2002 | 0.405 | 1.010 | 1.400 | 1.739 | 1.905 | 2.352 | 2.742 | 2.550 | 2.895 |
| 2003 | 0.475 | 0.758 | 1.377 | 1.577 | 1.845 | 1.913 | 2.389 | 2.859 | 2.909 |
| 2004 | 0.482 | 0.589 | 1.100 | 1.502 | 1.610 | 1.872 | 1.993 | 2.307 | 2.558 |
| 2005 | 0.056[1] | 0.697 | 0.988 | 1.429 | 1.678 | 1.842 | 2.005 | 2.055 | 2.419 |
| 2006 | 0.335 | 0.514 | 0.977 | 0.977 | 1.598 | 1.776 | 1.861 | 2.021 | 2.216 |
| 2007 | 0.464 | 0.584 | 0.990 | 1.187 | 1.385 | 1.658 | 1.833 | 1.671 | 2.122 |
| 2008 | 0.458 | 0.791 | 1.003 | 1.230 | 1.390 | 1.610 | 1.572 | 1.912 | 2.434 |
| 2009 | 0.551 | 0.864 | 0.987 | 1.255 | 1.422 | 1.531 | 1.740 | 2.245 | 2.248 |
| 2010 | 0.436 | 0.739 | 1.063 | 1.231 | 1.338 | 1.503 | 1.594 | 1.728 | 2.220 |
| 2011 | 0.346 | 1.027 | 1.024 | 1.217 | 1.319 | 1.360 | 1.556 | 1.630 | 2.125 |
| 2012 | 0.256 | 0.646 | 1.027 | 1.222 | 1.310 | 1.437 | 1.477 | 1.559 | 1.705 |
| 2013 | 0.323 | 0.660 | 0.848 | 1.205 | 1.254 | 1.301 | 1.469 | 1.547 | 1.692 |
| Low | 0.256 | 0.514 | 0.812 | 0.977 | 1.254 | 1.301 | 1.469 | 1.547 | 1.692 |
| High | 0.797 | 1.216 | 1.724 | 2.244 | 2.662 | 3.760 | 4.107 | 4.086 | 4.455 |
| Median | 0.538 | 0.972 | 1.338 | 1.749 | 2.094 | 2.442 | 2.807 | 3.006 | 3.426 |
| Average | 0.529 | 0.938 | 1.300 | 1.679 | 1.996 | 2.281 | 2.590 | 2.829 | 3.253 |
| 2011-13 Avg | 0.308 | 0.778 | 0.966 | 1.215 | 1.294 | 1.366 | 1.501 | 1.579 | 1.841 |

[1]One haddock measured.
[2]Excludes 2005 value.

*Table 15. Average lengths at age (cm) of haddock from the combined Canadian and USA commercial groundfish fishery landings on eastern Georges Bank during 1969-2013.*

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| 1969 | | | 42.5 | 50.2 | 53.4 | 54.9 | 56.6 | 61.2 | 66.7 | 70.6 |
| 1970 | | 40.1 | 47.0 | 43.4 | 54.9 | 57.4 | 60.0 | 60.4 | 66.4 | 68.6 |
| 1971 | | | 44.7 | 46.6 | 50.0 | 58.4 | 61.3 | 61.9 | 64.2 | 68.1 |
| 1972 | | 40.6 | | 53.3 | 55.4 | 59.4 | 63.3 | 63.5 | 62.0 | 67.3 |
| 1973 | | 39.2 | 45.2 | 52.5 | 55.4 | 60.3 | 54.7 | 65.8 | 69.2 | 69.0 |
| 1974 | | | 45.6 | 52.1 | | 59.6 | 72.5 | | 69.2 | 73.3 |
| 1975 | | | 42.5 | 52.8 | 59.7 | 59.8 | 63.7 | 75.8 | 72.7 | 71.7 |
| 1976 | | 37.4 | 44.6 | 49.5 | 57.1 | 62.3 | | 65.8 | | 72.6 |
| 1977 | | | 44.1 | 51.2 | 55.9 | 61.1 | 65.4 | | 68.8 | 76.7 |
| 1978 | | 37.6 | 46.4 | 50.5 | 57.3 | 63.5 | 65.8 | 65.9 | 66.1 | 76.1 |
| 1979 | | | 44.3 | 49.0 | 55.3 | 59.3 | 64.7 | 68.4 | 67.8 | 74.0 |
| 1980 | | 32.5 | 42.5 | 44.9 | 54.3 | 58.6 | 63.1 | 71.6 | 71.0 | 67.0 |
| 1981 | | | 42.9 | 48.8 | 53.2 | 60.4 | 63.4 | 70.7 | 75.5 | 76.3 |
| 1982 | | | 44.4 | 50.1 | 55.1 | 60.6 | 63.1 | 66.3 | 71.5 | 70.9 |
| 1983 | | | 45.0 | 49.2 | 54.4 | 58.8 | 62.0 | 65.4 | 67.6 | 73.4 |
| 1984 | | | 44.1 | 50.5 | 55.8 | 59.8 | 63.6 | 66.5 | 68.2 | 70.3 |
| 1985 | | | 43.3 | 47.5 | 55.8 | 59.2 | 63.6 | 65.9 | 67.9 | 70.8 |
| 1986 | | 33.7 | 43.8 | 49.6 | 55.1 | 60.1 | 63.7 | 66.3 | 70.8 | 72.0 |
| 1987 | | | 41.4 | 50.3 | 56.5 | 58.0 | 62.2 | 66.3 | 71.3 | 71.9 |
| 1988 | | 32.8 | 43.7 | 48.6 | 53.7 | 58.0 | 60.6 | 67.1 | 68.5 | 69.3 |
| 1989 | | | 41.9 | 50.0 | 54.1 | 59.2 | 61.9 | 66.6 | 70.3 | 70.0 |
| 1990 | | 37.9 | 44.2 | 50.0 | 55.4 | 58.2 | 63.4 | 63.7 | 64.9 | 69.4 |
| 1991 | | 36.2 | 47.0 | 48.3 | 54.2 | 58.3 | 62.2 | 66.7 | 64.9 | 66.6 |
| 1992 | | 35.7 | 46.4 | 52.7 | 53.9 | 58.2 | 63.2 | 65.5 | 71.6 | 67.8 |
| 1993 | | 38.3 | 46.4 | 53.3 | 58.0 | 57.0 | 61.7 | 62.4 | 65.2 | 67.9 |
| 1994 | | 32.5 | 46.1 | 52.6 | 58.1 | 61.6 | 59.7 | 62.9 | 65.6 | 67.4 |
| 1995 | | 40.2 | 45.0 | 50.9 | 56.3 | 60.8 | 62.5 | 64.1 | 64.2 | 67.9 |
| 1996 | | 36.4 | 44.6 | 50.0 | 53.9 | 58.6 | 60.1 | 66.7 | 58.1 | 68.4 |
| 1997 | | 38.7 | 47.2 | 48.8 | 53.4 | 57.0 | 60.2 | 64.4 | 66.9 | 70.5 |
| 1998 | | 36.5 | 46.1 | 51.6 | 52.8 | 55.7 | 58.7 | 63.3 | 67.2 | 68.8 |
| 1999 | | 38.7 | 45.6 | 51.5 | 55.1 | 54.9 | 57.9 | 61.0 | 63.0 | 69.3 |
| 2000 | | 38.5 | 45.7 | 50.4 | 55.2 | 58.3 | 57.1 | 60.4 | 62.9 | 65.3 |
| 2001 | | 32.1 | 45.5 | 50.4 | 53.5 | 56.9 | 59.2 | 57.6 | 60.3 | 64.5 |
| 2002 | | 32.5 | 44.3 | 49.6 | 53.5 | 55.2 | 59.2 | 62.6 | 60.7 | 63.5 |
| 2003 | | 34.2 | 40.2 | 49.3 | 51.8 | 54.7 | 55.3 | 59.7 | 63.8 | 64.0 |
| 2004 | | 34.5 | 36.9 | 45.6 | 50.8 | 52.3 | 54.7 | 55.9 | 58.3 | 60.1 |
| 2005 | | 16.5[1] | 38.8 | 44.1 | 49.9 | 52.8 | 54.5 | 56.1 | 56.5 | 59.2 |
| 2006 | | 30.4 | 35.2 | 43.7 | 43.9 | 51.9 | 53.8 | 54.7 | 56.1 | 57.8 |
| 2007 | | 34.0 | 36.7 | 43.9 | 46.8 | 49.3 | 52.5 | 54.3 | 52.3 | 57.1 |
| 2008 | | 33.3 | 40.7 | 44.3 | 47.6 | 49.6 | 52.0 | 51.3 | 55.0 | 59.6 |
| 2009 | | 36.0 | 42.0 | 44.4 | 47.9 | 49.7 | 51.4 | 52.9 | 57.7 | 57.8 |
| 2010 | | 33.1 | 39.9 | 45.1 | 47.6 | 49.1 | 50.9 | 52.1 | 53.3 | 58.4 |
| 2011 | | 30.7 | 44.0 | 44.7 | 47.4 | 48.9 | 49.5 | 51.8 | 52.5 | 57.8 |
| 2012 | | 27.7 | 37.9 | 44.8 | 47.4 | 48.6 | 50.2 | 50.7 | 51.5 | 53.2 |
| 2013 | 22.8 | 30.0 | 38.2 | 41.8 | 47.2 | 47.8 | 48.4 | 50.5 | 51.4 | 53.0 |
| Low | 22.8 | 27.7[2] | 35.2 | 41.8 | 43.9 | 47.8 | 48.4 | 50.5 | 51.4 | 53.2 |
| High | 22.8 | 40.6[2] | 47.2 | 53.3 | 59.7 | 63.5 | 72.5 | 75.8 | 75.5 | 76.7 |
| Median | 22.8 | 35.7[2] | 44.1 | 49.6 | 54.1 | 58.2 | 60.4 | 63.5 | 65.4 | 68.4 |
| Average | 22.8 | 35.2[2] | 43.3 | 48.7 | 53.3 | 56.8 | 59.5 | 62.2 | 64.0 | 66.9 |
| Avg. 2011-13 | 22.8 | 29.5 | 40.0 | 43.7 | 47.3 | 48.4 | 49.4 | 51.0 | 51.8 | 54.7 |

[1]One haddock measured.
[2]Excludes 16.5 cm value in 2005.

*Table 16. Conversion factors used to adjust for changes in door type and survey vessel in the National Marine Fisheries Service surveys during 1968-2014.*

| Year | Door | Spring | | Fall | |
|---|---|---|---|---|---|
| | | Vessel | Conversion | Vessel | Conversion |
| 1968 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1969 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1970 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1971 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1972 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1973 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1974 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1975 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1976 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1977 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1978 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1979 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1980 | BMV | Albatross IV | 1.49 | Delaware II | 1.2218 |
| 1981 | BMV | Delaware II | 1.2218 | Delaware II | 1.2218 |
| 1982 | BMV | Delaware II | 1.2218 | Albatross IV | 1.49 |
| 1983 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1984 | BMV | Albatross IV | 1.49 | Albatross IV | 1.49 |
| 1985 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1986 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1987 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1988 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1989 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1990 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1991 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 1992 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1993 | Polyvalent | Albatross IV | 1 | Delaware II | 0.82 |
| 1994 | Polyvalent | Delaware II | 0.82 | Albatross IV | 1 |
| 1995 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1996 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1997 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1998 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 1999 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2000 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2001 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2002 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2003 | Polyvalent | Delaware II | 0.82 | Delaware II | 0.82 |
| 2004 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2005 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2006 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2007 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2008 | Polyvalent | Albatross IV | 1 | Albatross IV | 1 |
| 2009 – 2014 | 3 bridle, 4 seam | Henry B Bigelow | See Table 17 | Henry B Bigelow | See Table 17 |

*Table 17. Conversion factors for Georges Bank haddock used to adjust for changes in net, doors, survey vessel and protocols for the National Marine Fisheries Service surveys during 2009 to 2013 when the Henry B. Bigelow was the research vessel used. Bigelow catches are divided by the conversion factor to equate to Albatross IV catches.*

| Length (cm) | Conversion factor |
|---|---|
| 1 – 18 | 2.626169 |
| 19 | 2.580551 |
| 20 | 2.534933 |
| 21 | 2.489315 |
| 22 | 2.443697 |
| 23 | 2.398079 |
| 24 | 2.352462 |
| 25 | 2.306844 |
| 26 | 2.261226 |
| 27 | 2.215608 |
| 28 | 2.169990 |
| 29 | 2.124372 |
| 30 | 2.078754 |
| 31 | 2.033136 |
| 32 | 1.987518 |
| 33 | 1.941900 |
| 34 | 1.896283 |
| 35 | 1.850665 |
| 36 | 1.805047 |
| 37 | 1.759429 |
| 38 | 1.713811 |
| 39 | 1.668193 |
| 40 | 1.622575 |
| 41 | 1.576957 |
| 42 | 1.531339 |
| 43 | 1.485721 |
| 44 | 1.440104 |
| 45 | 1.394486 |
| 46 | 1.348868 |
| 47 | 1.303250 |
| 48 | 1.257632 |
| 49 | 1.212014 |
| 50 | 1.166396 |
| 51 and greater | 1.163990 |

*Table 18. Total swept area estimates of abundance at age (numbers in 000's) of eastern Georges Bank haddock from the Canadian Department of Fisheries and Oceans (DFO) surveys during 1986-2014.*

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | Total |
| 1986 | 5,057 | 306 | 8,176 | 997 | 189 | 348 | 305 | 425 | 401 | 16,205 |
| 1987 | 46 | 4,286 | 929 | 3,450 | 653 | 81 | 387 | 135 | 1,132 | 11,099 |
| 1988 | 971 | 49 | 12,714 | 257 | 4,345 | 274 | 244 | 130 | 686 | 19,670 |
| 1989 | 48 | 6,664 | 991 | 2,910 | 245 | 526 | 40 | 34 | 265 | 11,724 |
| 1990 | 726 | 108 | 12,300 | 168 | 4,466 | 299 | 1,370 | 144 | 389 | 19,968 |
| 1991 | 383 | 2,163 | 134 | 10,819 | 114 | 1,909 | 117 | 505 | 225 | 16,368 |
| 1992 | 1,914 | 3,879 | 1,423 | 221 | 4,810 | 18 | 1,277 | 52 | 656 | 14,249 |
| 1993 | 3,448 | 1,759 | 545 | 431 | 34 | 1,186 | 19 | 281 | 147 | 7,849 |
| 1994 | 4,197 | 15,163 | 5,332 | 549 | 314 | 20 | 915 | 18 | 356 | 26,864 |
| 1995 | 1,231 | 3,224 | 6,236 | 3,034 | 720 | 398 | 0 | 729 | 849 | 16,422 |
| 1996 | 1,455 | 2,290 | 4,784 | 5,305 | 3,113 | 303 | 274 | 38 | 684 | 18,247 |
| 1997 | 1,033 | 1,550 | 1,222 | 2,742 | 2,559 | 1,397 | 150 | 65 | 372 | 11,090 |
| 1998 | 2,379 | 10,626 | 5,348 | 3,190 | 5,312 | 5,028 | 2,248 | 348 | 601 | 35,080 |
| 1999 | 24,593 | 4,787 | 10,067 | 3,104 | 1,963 | 1,880 | 1,764 | 448 | 174 | 48,780 |
| 2000 | 3,177 | 15,865 | 7,679 | 12,108 | 2,900 | 2,074 | 2,726 | 1,591 | 813 | 48,932 |
| 2001 | 23,026 | 3,519 | 14,633 | 4,255 | 5,608 | 1,808 | 1,426 | 1,963 | 2,299 | 58,536 |
| 2002 | 732 | 28,174 | 5,977 | 12,660 | 2,981 | 2,646 | 648 | 529 | 2,423 | 56,769 |
| 2003 | 1,682 | 1,503 | 82,161 | 5,533 | 15,105 | 3,675 | 2,355 | 1,106 | 1,986 | 115,107 |
| 2004 | 91,843 | 539 | 2,682 | 54,882 | 5,001 | 9,695 | 1,654 | 954 | 634 | 167,883 |
| 2005 | 1,669 | 20,958 | 531 | 1,557 | 25,559 | 3,403 | 4,815 | 1,087 | 548 | 60,125 |
| 2006 | 9,130 | 5,817 | 178,604 | 2,521 | 2,251 | 15,695 | 764 | 1,633 | 261 | 216,675 |
| 2007 | 3,051 | 9,541 | 3,289 | 67,311 | ,984 | 154 | 3,584 | 251 | 652 | 88,816 |
| 2008 | 3,832 | 1,219 | 4,647 | 5,025 | 103,874 | 1,006 | 191 | 8,553 | 724 | 129,071 |
| 2009 | 2,001 | 3,977 | 2,668 | 5,989 | 652 | 43,838 | 637 | 125 | 1,568 | 61,456 |
| 2010 | 868 | 606 | 3,005 | 2,335 | 4,855 | 1,433 | 42,302 | 314 | 1,071 | 56,788 |
| 2011 | 209,508 | 1,892 | 1,649 | 3,079 | 1,329 | 2,974 | 741 | 29,157 | 535 | 250,864 |
| 2012 | 20,047 | 353,084 | 4,108 | 746 | 1,061 | 410 | 684 | 401 | 4,454 | 384,995 |
| 2013 | 2,988 | 33,059 | 320,949 | 5,319 | 786 | 1,390 | 588 | 969 | 5,442 | 371,491 |
| 2014 | 474,896 | 8,419 | 17,468 | 51,849 | 654 | 88 | 28 | 183 | 548 | 554,132 |

*Table 19. Total swept area estimated abundance at age (numbers in 000's) of eastern Georges Bank haddock from the National Marine Fisheries Service spring surveys during 1968-2014. From 1973-81, a 41 Yankee trawl was used while a 36 Yankee trawl was used in other years up to and including 2008. Since 2009 a new net, vessel and protocols were used and conversion factors to equate to Albatross IV catches were applied. Note that the 2012 survey results have been revised.*

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | Total |
| 1968 | 0 | 3,254 | 68 | 679 | 4,853 | 2,045 | 240 | 123 | 234 | 11,496 |
| 1969 | 17 | 35 | 614 | 235 | 523 | 3,232 | 1,220 | 358 | 489 | 6,724 |
| 1970 | 478 | 190 | 0 | 560 | 998 | 441 | 3,165 | 2,491 | 769 | 9,092 |
| 1971 | 0 | 655 | 261 | 0 | 144 | 102 | 58 | 1,159 | 271 | 2,650 |
| 1972 | 2,594 | 0 | 771 | 132 | 25 | 47 | 211 | 27 | 1,214 | 5,020 |
| 1973 | 2,455 | 5,639 | 0 | 1,032 | 154 | 0 | 276 | 0 | 1,208 | 10,763 |
| 1974 | 1,323 | 20,596 | 4,084 | 0 | 354 | 0 | 43 | 72 | 322 | 26,795 |
| 1975 | 528 | 567 | 6,016 | 1,063 | 0 | 218 | 127 | 45 | 208 | 8,773 |
| 1976 | 8,228 | 402 | 424 | 1,127 | 532 | 0 | 0 | 0 | 22 | 10,735 |
| 1977 | 126 | 26,003 | 262 | 912 | 732 | 568 | 0 | 22 | 102 | 28,727 |
| 1978 | 0 | 743 | 20,859 | 641 | 880 | 1,163 | 89 | 23 | 116 | 24,516 |
| 1979 | 10,496 | 441 | 1,313 | 9,764 | 475 | 72 | 445 | 42 | 9 | 23,056 |
| 1980 | 4,355 | 66,450 | 1,108 | 1,086 | 5,761 | 613 | 371 | 693 | 360 | 80,797 |
| 1981 | 3,281 | 2,823 | 27,085 | 2,906 | 751 | 2,455 | 347 | 56 | 21 | 39,725 |
| 1982 | ,584 | 3,703 | 1,658 | 7,802 | 767 | 455 | 697 | 0 | 0 | 15,666 |
| 1983 | 238 | 770 | 686 | 359 | 2,591 | 30 | 0 | 798 | 58 | 5,529 |
| 1984 | 1,366 | 1,414 | 1,046 | 910 | 847 | 1,189 | 133 | 73 | 490 | 7,469 |
| 1985 | 40 | 8,911 | 1,396 | 674 | 1,496 | 588 | 1,995 | 127 | 483 | 15,709 |
| 1986 | 3,334 | 280 | 3,597 | 246 | 210 | 333 | 235 | 560 | 159 | 8,953 |
| 1987 | 122 | 5,480 | 144 | 1,394 | 157 | 231 | 116 | 370 | 0 | 8,013 |
| 1988 | 305 | 61 | 1,868 | 235 | 611 | 203 | 218 | 178 | 0 | 3,678 |
| 1989 | 84 | 6,665 | 619 | 1,343 | 267 | 791 | 58 | 92 | 47 | 9,966 |
| 1990 | 1,654 | 70 | 10,338 | 598 | 1,042 | 110 | 182 | 0 | 0 | 13,995 |
| 1991 | 740 | 2,071 | 432 | 3,381 | 192 | 203 | 66 | 87 | 25 | 7,198 |
| 1992 | 529 | 287 | 205 | 158 | 602 | 32 | 46 | 46 | 0 | 1,905 |
| 1993 | 1,870 | 1,116 | 197 | 232 | 195 | 717 | 77 | 35 | 43 | 4,480 |
| 1994 | 1,025 | 4,272 | 1,487 | 269 | 184 | 118 | 278 | 28 | 84 | 7,745 |
| 1995 | 921 | 2,312 | 4,184 | 1,727 | 265 | 152 | 51 | 272 | 214 | 10,099 |
| 1996 | 912 | 1,365 | 3,789 | 3,190 | 1,905 | 237 | 36 | 0 | 496 | 11,931 |
| 1997 | 1,635 | 1,226 | 380 | 595 | 470 | 343 | 24 | 44 | 20 | 4,736 |
| 1998 | 549 | 6,046 | 2,005 | 1,281 | 1,184 | 303 | 58 | 15 | 122 | 11,562 |
| 1999 | 6,286 | 1,914 | 3,655 | 661 | 1,128 | 1,062 | 468 | 476 | 46 | 15,696 |
| 2000 | 2,675 | 2,131 | 3,399 | 1,624 | 636 | 564 | 438 | 305 | 165 | 11,938 |
| 2001 | 10,503 | 1,186 | 3,304 | 1,232 | 374 | 294 | 113 | 20 | 20 | 17,047 |
| 2002 | 231 | 40,432 | 10,938 | 4,044 | 1,492 | 473 | 287 | 229 | 236 | 58,362 |
| 2003 | 125 | 1,105 | 16,915 | 2,245 | 3,773 | 476 | 200 | 82 | 286 | 25,206 |
| 2004 | 195,013 | 4,724 | 2,644 | 45,872 | 3,544 | 5,261 | 960 | 1,245 | 842 | 260,104 |
| 2005 | 540 | 32,911 | 257 | 614 | 5,818 | 671 | 1,196 | 240 | 67 | 42,313 |
| 2006 | 2,961 | 1,247 | 48,882 | 213 | 949 | 6,650 | 325 | 574 | 187 | 61,988 |
| 2007 | 1,468 | 11,383 | 2,055 | 95,882 | 180 | 441 | 2,168 | 222 | 312 | 114,110 |
| 2008 | 3,402 | 1,671 | 4,332 | 240 | 38,569 | 836 | 371 | 1,739 | 480 | 51,639 |
| 2009 | 2,896 | 2,758 | 1,589 | 5,126 | 801 | 23,985 | 563 | 483 | 1,259 | 39,462 |
| 2010 | 481 | 644 | 3,326 | 1,461 | 3,785 | 517 | 20,735 | 0 | 600 | 31,548 |
| 2011 | 16,812 | 1,319 | 834 | 707 | 551 | 1,052 | 303 | 6,751 | 155 | 28,484 |
| 2012 | 19,701 | 99,410 | 1,372 | 362 | 725 | 657 | 908 | 43 | 3,532 | 126,709 |
| 2013 | 2,583 | 9,575 | 60,096 | 1,197 | 506 | 411 | 349 | 292 | 1,101 | 76,111 |
| 2014 | 91,436 | 4,429 | 8,306 | 28,732 | 291 | 65 | 78 | 49 | 153 | 133,540 |

*Table 20. Total swept area estimated abundance at age (numbers in 000's) of eastern Georges Bank haddock from National Marine Fisheries Service fall surveys during 1963-2013. Since 2009 a new net, vessel and protocols were used and conversion factors to equate to Albatross IV catches were applied. Note that the 2011 survey has been revised.*

| Year | Age Group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ | Total |
| 1963 | 105,993 | 40,995 | 10,314 | 3,378 | 5,040 | 4,136 | 1,477 | 451 | 276 | 172,061 |
| 1964 | 1,178 | 123,976 | 46,705 | 4,358 | 807 | 1,865 | 477 | 211 | 167 | 179,742 |
| 1965 | 259 | 1,503 | 51,338 | 8,538 | 479 | 302 | 142 | 148 | 208 | 62,918 |
| 1966 | 9,325 | 751 | 1,742 | 20,323 | 3,631 | 671 | 138 | 133 | 84 | 36,798 |
| 1967 | 0 | 3,998 | 73 | 327 | 1,844 | 675 | 141 | 88 | 88 | 7,233 |
| 1968 | 55 | 113 | 800 | 28 | 37 | 2,223 | 547 | 177 | 313 | 4,293 |
| 1969 | 356 | 0 | 0 | 509 | 62 | 30 | 739 | 453 | 108 | 2,257 |
| 1970 | 0 | 6,400 | 336 | 16 | 415 | 337 | 500 | 902 | 578 | 9,483 |
| 1971 | 2,626 | 0 | 788 | 97 | 0 | 265 | 27 | 73 | 594 | 4,471 |
| 1972 | 4,747 | 2,396 | 0 | 232 | 0 | 0 | 53 | 0 | 275 | 7,702 |
| 1973 | 1,223 | 16,797 | 1,598 | 0 | 168 | 0 | 0 | 8 | 16 | 19,809 |
| 1974 | 151 | 234 | 961 | 169 | 0 | 6 | 0 | 0 | 70 | 1,589 |
| 1975 | 30,365 | 664 | 192 | 1,042 | 239 | 0 | 0 | 0 | 28 | 32,530 |
| 1976 | 738 | 121,717 | 431 | 25 | 484 | 71 | 0 | 17 | 37 | 123,521 |
| 1977 | 47 | 238 | 26,323 | 445 | 125 | 211 | 84 | 4 | 4 | 27,480 |
| 1978 | 14,642 | 547 | 530 | 7,706 | 56 | 42 | 94 | 0 | 0 | 23,617 |
| 1979 | 1,598 | 21,605 | 14 | 335 | 1,489 | 45 | 12 | 0 | 0 | 25,098 |
| 1980 | 3,556 | 2,788 | 5,829 | 0 | 101 | 1,081 | 108 | 25 | 4 | 13,492 |
| 1981 | 596 | 4,617 | 2,585 | 2,748 | 89 | 136 | 318 | 0 | 15 | 11,103 |
| 1982 | 62 | 0 | 673 | 465 | 2,508 | 153 | 97 | 528 | 42 | 4,527 |
| 1983 | 3,609 | 444 | 236 | 501 | 289 | 402 | 17 | 12 | 86 | 5,598 |
| 1984 | 45 | 3,775 | 856 | 233 | 194 | 45 | 262 | 0 | 41 | 5,451 |
| 1985 | 12,148 | 381 | 1,646 | 199 | 70 | 68 | 46 | 30 | 21 | 14,611 |
| 1986 | 30 | 7,471 | 109 | 961 | 52 | 50 | 72 | 24 | 23 | 8,793 |
| 1987 | 508 | 0 | 843 | 28 | 152 | 38 | 22 | 0 | 0 | 1,592 |
| 1988 | 122 | 3,983 | 184 | 2,348 | 155 | 400 | 142 | 140 | 38 | 7,513 |
| 1989 | 167 | 83 | 2,645 | 112 | 509 | 68 | 73 | 0 | 0 | 3,656 |
| 1990 | 1,217 | 1,041 | 36 | 1,456 | 65 | 196 | 24 | 5 | 0 | 4,040 |
| 1991 | 705 | 331 | 267 | 52 | 289 | 25 | 10 | 0 | 0 | 1,679 |
| 1992 | 3,484 | 1,052 | 172 | 110 | 0 | 95 | 0 | 18 | 18 | 4,948 |
| 1993 | 687 | 6,656 | 3,601 | 585 | 0 | 87 | 96 | 30 | 0 | 11,742 |
| 1994 | 625 | 782 | 927 | 419 | 96 | 32 | 0 | 24 | 0 | 2,905 |
| 1995 | 892 | 1,436 | 5,993 | 3,683 | 550 | 30 | 0 | 0 | 53 | 12,637 |
| 1996 | 1,742 | 453 | 570 | 2,302 | 963 | 167 | 0 | 0 | 0 | 6,196 |
| 1997 | 217 | 5,738 | 3,368 | 592 | 690 | 385 | 0 | 0 | 13 | 11,004 |
| 1998 | 2,566 | 2,966 | 4,214 | 1,085 | 705 | 526 | 722 | 0 | 0 | 12,784 |
| 1999 | 3,268 | 1,236 | 5,364 | 5,060 | 837 | 2,825 | 148 | 1,150 | 991 | 20,879 |
| 2000 | 1,368 | 5,284 | 6,226 | 3,712 | 622 | 229 | 0 | 146 | 97 | 17,684 |
| 2001 | 659 | 16,626 | 1,382 | 6,939 | 3,000 | 1,586 | 306 | 127 | 58 | 30,684 |
| 2002 | 172 | 1,864 | 44,602 | 6,040 | 5,120 | 1,660 | 863 | 457 | 354 | 61,131 |
| 2003 | 196,182 | 60 | 285 | 3,415 | 655 | 739 | 20 | 99 | 158 | 201,613 |
| 2004 | 2,864 | 116,289 | 322 | 775 | 17,200 | 1,034 | 2,410 | 416 | 528 | 141,837 |
| 2005 | 4,981 | 3,114 | 95,159 | 340 | 532 | 3,631 | 347 | 242 | 155 | 108,502 |
| 2006 | 930 | 8,752 | 1,040 | 65,817 | 1,083 | 82 | 796 | 0 | 16 | 78,517 |
| 2007 | 1,264 | 1,922 | 11,764 | 965 | 52,456 | 955 | 562 | 244 | 0 | 70,132 |
| 2008 | 1,902 | 1,865 | 1,162 | 2,564 | 477 | 21,289 | 0 | 74 | 484 | 29,818 |
| 2009 | 2,010 | 862 | 1,352 | 1,082 | 2,504 | 388 | 20,906 | 88 | 237 | 29,430 |
| 2010 | 172,390 | 1,154 | 585 | 1,069 | 393 | 1,166 | 589 | 9,909 | 172 | 187,428 |
| 2011 | 14,019 | 106,939 | 349 | 225 | 281 | 331 | 650 | 219 | 3,673 | 126,686 |
| 2012 | 3,493 | 10,311 | 72,573 | 237 | 151 | 83 | 102 | 80 | 754 | 87,784 |
| 2013 | 909,714 | 3,149 | 6,643 | 52,237 | 445 | 106 | 21 | 0 | 360 | 972,675 |

*Table 21. Average weight at age (kg) of eastern Georges Bank haddock from the Canadian Department of Fisheries and Oceans surveys during 1986-2014. These weights are used to represent beginning of year population weights. Age 9+ weights are population weighted averages. Highlighted cells indicated exceptionally strong year classes.*

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| 1986 | 0.135 | 0.451 | 0.974 | 1.445 | 3.044 | 2.848 | 3.598 | 3.376 | 3.918 |
| 1987 | 0.150 | 0.500 | 0.716 | 1.672 | 2.012 | 2.550 | 3.148 | 3.151 | 3.629 |
| 1988 | 0.097 | 0.465 | 0.931 | 1.795 | 1.816 | 1.918 | 2.724 | 3.264 | 3.871 |
| 1989 | 0.062 | 0.474 | 0.650 | 1.392 | 1.995 | 2.527 | 2.158 | 2.859 | 3.141 |
| 1990 | 0.149 | 0.525 | 0.924 | 1.181 | 1.862 | 2.073 | 2.507 | 2.815 | 3.472 |
| 1991 | 0.120 | 0.685 | 0.800 | 1.512 | 1.695 | 2.434 | 2.105 | 3.122 | 3.432 |
| 1992 | 0.122 | 0.602 | 1.118 | 1.061 | 2.078 | 2.165 | 2.709 | 2.284 | 3.440 |
| 1993 | 0.122 | 0.481 | 1.227 | 1.803 | 1.274 | 2.332 | 2.343 | 2.739 | 3.280 |
| 1994 | 0.107 | 0.469 | 1.047 | 1.621 | 1.927 | 2.154 | 3.154 | 2.688 | 3.084 |
| 1995 | 0.086 | 0.493 | 0.963 | 1.556 | 2.222 | 2.445 | 2.4[1] | 2.991 | 3.184 |
| 1996 | 0.139 | 0.495 | 0.919 | 1.320 | 1.932 | 2.555 | 2.902 | 2.611 | 3.588 |
| 1997 | 0.132 | 0.506 | 0.782 | 1.205 | 1.664 | 2.176 | 2.454 | 2.577 | 3.158 |
| 1998 | 0.107 | 0.535 | 1.035 | 1.161 | 1.570 | 1.954 | 2.609 | 3.559 | 3.462 |
| 1999 | 0.130 | 0.474 | 0.911 | 1.290 | 1.259 | 1.869 | 2.131 | 2.722 | 2.992 |
| 2000 | 0.116 | 0.543 | 0.949 | 1.478 | 1.871 | 1.789 | 2.298 | 2.508 | 2.901 |
| 2001 | 0.093 | 0.524 | 1.005 | 1.371 | 1.798 | 2.165 | 2.250 | 2.593 | 2.928 |
| 2002 | 0.096 | 0.332 | 0.778 | 1.138 | 1.494 | 1.965 | 2.177 | 2.206 | 2.708 |
| 2003 | 0.080 | 0.369 | 0.846 | 1.063 | 1.477 | 1.645 | 2.208 | 2.229 | 2.487 |
| 2004 | 0.064 | 0.310 | 0.781 | 1.151 | 1.306 | 1.558 | 1.622 | 1.956 | 2.216 |
| 2005 | 0.028 | 0.218 | 0.493 | 0.696 | 1.226 | 1.321 | 1.531 | 1.600 | 2.444 |
| 2006 | 0.059 | 0.171 | 0.389 | 0.657 | 0.870 | 1.366 | 1.591 | 1.742 | 2.355 |
| 2007 | 0.077 | 0.246 | 0.405 | 0.709 | 0.992 | 1.745 | 1.559 | 1.671 | 1.862 |
| 2008 | 0.107 | 0.329 | 0.573 | 0.795 | 0.927 | 1.254 | 1.729 | 1.476 | 1.897 |
| 2009 | 0.114 | 0.387 | 0.775 | 0.999 | 0.987 | 1.258 | 1.482 | 2.680 | 2.228 |
| 2010 | 0.072 | 0.385 | 0.749 | 0.960 | 1.120 | 1.207 | 1.333 | 1.772 | 2.066 |
| 2011 | 0.038 | 0.322 | 0.612 | 0.900 | 0.953 | 1.018 | 1.120 | 1.371 | 1.721 |
| 2012 | 0.070 | 0.186 | 0.457 | 0.506 | 0.997 | 1.104 | 1.084 | 1.190 | 1.346 |
| 2013 | 0.070 | 0.261 | 0.412 | 0.789 | 1.092 | 0.972 | 1.100 | 1.142 | 1.457 |
| 2014 | 0.042 | 0.323 | 0.537 | 0.648 | 0.911 | 1.214 | 1.214 | 0.953 | 1.432 |
| Low | 0.028 | 0.171 | 0.389 | 0.506 | 0.870 | 0.972 | 1.084 | 0.953 | 1.346 |
| High | 0.150 | 0.685 | 1.227 | 1.803 | 3.044 | 2.848 | 3.598 | 3.559 | 3.918 |
| Median | 0.097 | 0.465 | 0.782 | 1.161 | 1.494 | 1.918 | 2.167 | 2.577 | 2.928 |
| Average | 0.096 | 0.416 | 0.785 | 1.168 | 1.530 | 1.848 | 2.101 | 2.339 | 2.748 |
| Avg. 1991-2000 | 0.118 | 0.528 | 0.975 | 1.401 | 1.749 | 2.187 | 2.523 | 2.780 | 3.252 |
| Avg. 2012-2014 | 0.061 | 0.257 | 0.469 | 0.648 | 1.000 | 1.097 | 1.133 | 1.095 | 1.412 |

[1]The weight midway between the age 6 and 8 weight for that cohort was used as data were not available for this age group.

*Table 22. Average lengths at age (cm) of eastern Georges Bank haddock from the Canadian Department of Fisheries and Oceans surveys during 1986-2014. Highlighted cells indicated exceptionally strong year classes.*

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| 1986 | 22.9 | 36.2 | 45.4 | 51.0 | 63.7 | 61.9 | 67.8 | 66.0 | 70.7 |
| 1987 | 24.2 | 36.3 | 39.7 | 53.4 | 57.1 | 61.1 | 65.1 | 65.8 | 69.6 |
| 1988 | 22.3 | 36.4 | 45.1 | 55.7 | 55.9 | 58.0 | 62.4 | 65.8 | 71.5 |
| 1989 | 19.5 | 35.9 | 39.1 | 50.4 | 56.8 | 61.3 | 58.0 | 64.6 | 66.3 |
| 1990 | 24.7 | 35.8 | 44.4 | 48.0 | 55.9 | 58.7 | 61.6 | 63.1 | 67.5 |
| 1991 | 23.1 | 40.7 | 42.7 | 51.7 | 52.9 | 60.2 | 58.3 | 65.1 | 67.8 |
| 1992 | 23.2 | 39.2 | 47.7 | 46.8 | 57.7 | 62.5 | 63.9 | 60.3 | 68.1 |
| 1993 | 23.6 | 36.6 | 49.7 | 55.5 | 50.0 | 60.4 | 59.3 | 63.7 | 67.3 |
| 1994 | 22.3 | 35.8 | 45.8 | 53.8 | 57.6 | 58.5 | 65.9 | 66.5 | 65.4 |
| 1995 | 20.2 | 36.3 | 45.1 | 52.7 | 59.0 | 62.5 | | 65.0 | 66.0 |
| 1996 | 24.2 | 36.2 | 44.4 | 50.1 | 56.9 | 62.7 | 66.2 | 61.8 | 68.4 |
| 1997 | 23.6 | 37.1 | 42.1 | 48.9 | 54.2 | 59.5 | 62.4 | 63.5 | 66.8 |
| 1998 | 21.8 | 37.6 | 46.4 | 47.3 | 52.9 | 57.2 | 62.5 | 69.3 | 68.7 |
| 1999 | 23.7 | 35.9 | 44.8 | 49.8 | 48.9 | 56.1 | 58.9 | 63.6 | 66.6 |
| 2000 | 22.7 | 37.6 | 44.3 | 52.1 | 56.4 | 54.7 | 59.6 | 61.7 | 64.7 |
| 2001 | 21.7 | 37.5 | 46.1 | 51.1 | 56.2 | 60.0 | 59.0 | 62.5 | 65.5 |
| 2002 | 21.5 | 31.8 | 42.1 | 47.5 | 52.0 | 58.1 | 60.3 | 59.2 | 64.4 |
| 2003 | 20.2 | 34.0 | 43.3 | 46.8 | 52.0 | 53.8 | 61.2 | 61.3 | 63.3 |
| 2004 | 19.1 | 31.8 | 42.0 | 47.9 | 50.6 | 53.3 | 55.3 | 59.1 | 60.2 |
| 2005 | 15.1 | 29.1 | 37.2 | 41.1 | 49.7 | 51.6 | 53.8 | 54.3 | 62.7 |
| 2006 | 18.7 | 27.0 | 34.0 | 40.2 | 42.6 | 51.8 | 52.8 | 55.7 | 62.2 |
| 2007 | 20.6 | 29.6 | 34.2 | 41.0 | 46.7 | 55.0 | 53.5 | 54.1 | 55.4 |
| 2008 | 23.1 | 33.1 | 39.4 | 43.0 | 45.7 | 50.5 | 56.3 | 52.9 | 57.9 |
| 2009 | 23.2 | 34.7 | 42.6 | 45.8 | 44.9 | 49.3 | 51.9 | 61.7 | 59.4 |
| 2010 | 20.3 | 34.8 | 43.0 | 46.3 | 48.3 | 50.5 | 51.4 | 55.7 | 59.8 |
| 2011 | 16.6 | 32.5 | 40.1 | 45.8 | 47.5 | 47.6 | 49.3 | 52.3 | 56.9 |
| 2012 | 19.9 | 26.7 | 36.2 | 37.1 | 47.0 | 48.7 | 48.6 | 50.1 | 52.0 |
| 2013 | 19.8 | 30.0 | 35.0 | 43.9 | 48.3 | 48.2 | 49.4 | 50.4 | 53.5 |
| 2014 | 16.4 | 32.4 | 37.9 | 40.5 | 46.8 | 49.2 | 50.5 | 47.8 | 54.0 |
| Low | 15.1 | 26.7 | 34.0 | 37.1 | 42.6 | 47.6 | 48.6 | 47.8 | 52.0 |
| High | 24.7 | 40.7 | 49.7 | 55.7 | 63.7 | 62.7 | 67.8 | 69.3 | 71.5 |
| Median | 21.8 | 35.8 | 42.7 | 47.9 | 52.0 | 57.2 | 59.0 | 61.7 | 65.4 |
| Average | 21.3 | 34.4 | 42.1 | 47.8 | 52.2 | 56.0 | 58.0 | 60.1 | 63.5 |

*Table 23. Data and model changes to the eastern Georges Bank haddock assessment framework from 1998 to 2013.*

| Assessment Year | Change |
|---|---|
| 1998 | Framework:<br>Random error in catch at age negligible.<br>Errors in abundance indices assumed independent and identically distributed after taking the natural logarithms.<br>Annual natural mortality rate (M) = 0.2.<br>Fishing mortality (F) on age 8 = weighted F on ages 4 to 7.<br>9+ age group calculated but not calibrated to indices.<br>In Q1 of first year, 9+ based on assumption that F9+ = popn weighted F4-8. In Q1 of subsequent years, 9+ abundance calculated as sum of age 8 and 9+ at end of last quarter of previous year.<br>Quarterly catch at age: 0,1,2…8,9+; 1969.0, 1969.25, 1969. 75, 1970.0…1996.75.<br>DFO survey: ages 1,2,3…8; 1986.16, 1987.16…1998.0.<br>NMFS spring (Yankee 36): age 1,2,3…8; 1969.29, 1970.29…1997.29.<br>NMFS spring (Yankee 41): age 1,2,3…8; 1973.29, 1974.29…1981.29.<br>NMFS fall: 0,1,2…5, 1969.69, 1970.69…1997.69.<br>Zero survey observations treated as missing data. |
| 1999 | Minor differences in the handling of zero terminal catches for a year class were implemented as a refinement to the software to afford more flexibility. |
| 2003 | NMFS spring (Yankee 36): age 1,2,3…8; 1969.29, 1970.29…2003.25. (In previous years, the last survey available was the same year as the last catch at age year.)<br>Catch of 0 was assumed for the 1st quarter of 2003 and the population calculated to beginning of 2003.25. |
| 2005 | Discards ages 1 and older from Canadian scallop fishery included in catch at age but age 0 set to zero.<br>Population calculated to beginning year 2005.<br>NMFS and DFO spring surveys in 2005 set to time = 2005.00. |
| 2007 | Discards at age 0 included in catch at age. |
| 2008 | 1) an annual catch at age instead of a quarterly catch at age.<br>2) revised survey timing: DFO spring from 0.16 to 0.17, NMFS spring from 0.29 to 0.28 and the NMFS fall survey from 0.69 to 0.79.<br>3) a change from ages 4 to 7 to 5 to 7 (weighted by population numbers) used to estimate oldest age F from 2003 to present. |
| 2009 | USA 2007 catch corrected from previous year (calculation error).<br>The landings at age for 2006 to 2007 were recalculated.<br>USA landings for 1994 to 2007 revised using new methodology. (Effect was negligible.)<br>USA landings at age from 1991 to 2005 were revised to reflect the recalculated landings using a scalar adjustment.<br>USA discards recalculated using ratio of discarded haddock to kept of all species for 1989 to 2007.<br>Discards at age were not revised for 1989 to 2000 as amounts were low, except for 1994 (old = 258 vs new = 1,021 mt). No adjustment to the 1994 discards at age was made due to the uncertainty of this estimate.<br>Discard at age estimates for 2001 to 2007 were revised by a scalar.<br>2009 NMFS spring survey not used (no conversion factors). |
| 2010 | 9+ group in catch at age expanded to 9 to 16+; ages 15 and 16 dropped; 9+ group reconstructed from ages 9 to 14.<br>Revisions made to USA landings, Canadian scallop discards and USA groundfish fishery discards at age. Largest change for 1994 discards from 258 mt to 1279 mt. |
| 2011 - 2013 | No additional changes.<br>Note that the 2010 fall survey was used at twice its actual value in the 2011 and 2012 assessments. The effect on the 2012 assessment results are as follows:<br>• 2010 yc declined from 589 M to 532 M<br>• 1+ population declined from 644,586 K to 597,434 K |

| Assessment Year | Change |
|---|---|
| | • 3+ population declined from 57,745 to 55,964 K<br>• 3+ biomass declined from 70,679 mt to 68,521 mt<br>• risk analysis for 2013 $F_{ref}$ catch declined by 700 mt from 10,400 mt to 9,700 mt |
| 2014 | NMFS 2012 spring survey:<br>For the 2012 and 2013 assessments the survey results did not incorporate some lengths for which there were no ages. The numbers involved were small. Updated values also reflect an increase in the number of tows, changes to the numbers per tow and a large increase in the numbers aged.<br>NMFS 2011 fall survey:<br>The NMFS 2011 fall survey used incorrect stratum area values for strata 5Z3 and 5Z4 for the 2012 and 2013 assessments. Updated values also reflect changes to the numbers per tow.<br>Canadian scallop discards:<br>Revised 2005 to 2012 to reflect updated values due to change from freezer trawler equivalents to hours x meters as new effort measure and other data changes. Largest percent difference from previous values for age/year was 19%. Largest annual change was 7%. Canadian scallop discards contribute a very small amount to the total catch. |

*Table 24. Statistical properties of estimates of population abundance (numbers in 000's) at beginning of year 2014 and survey calibration constants (unitless, survey:population) for eastern Georges Bank haddock obtained from a bootstrap with 1000 replications.*

| Age | Estimate | Standard Error | Relative Error | Bias | Relative Bias |
|---|---|---|---|---|---|
| Population Abundance (000's) | | | | | |
| 1 | 1,811,316 | 1,071,226 | 0.591 | 265,143 | 0.146 |
| 2 | 13,012 | 5,268 | 0.405 | 967 | 0.074 |
| 3 | 34,989 | 11,186 | 0.320 | 1,350 | 0.039 |
| 4 | 186,702 | 49,466 | 0.265 | 6,955 | 0.037 |
| 5 | 1496 | 391 | 0.261 | 51 | 0.034 |
| 6 | 711 | 189 | 0.266 | 18 | 0.025 |
| 7 | 630 | 209 | 0.331 | 19 | 0.030 |
| 8 | 797 | 191 | 0.240 | 11 | 0.014 |
| Survey Calibration Constants | | | | | |
| *Canadian Department of Fisheries and Oceans Survey* | | | | | |
| 1 | 0.277 | 0.046 | 0.166 | 0.004 | 1.307 |
| 2 | 0.493 | 0.084 | 0.171 | 0.010 | 0.020 |
| 3 | 0.897 | 0.147 | 0.163 | 0.009 | 0.010 |
| 4 | 0.907 | 0.146 | 0.161 | 0.009 | 0.010 |
| 5 | 0.916 | 0.157 | 0.171 | 0.009 | 0.010 |
| 6 | 0.762 | 0.128 | 0.168 | 0.013 | 0.017 |
| 7 | 0.797 | 0.136 | 0.171 | 0.015 | 0.019 |
| 8 | 0.827 | 0.140 | 0.169 | 0.005 | 0.006 |
| *National Marine Fisheries Service (NMFS) Spring Survey – Yankee 36 – 1969-72/1982-2014* | | | | | |
| 1 | 0.146 | 0.022 | 0.150 | 0.003 | 0.020 |
| 2 | 0.355 | 0.053 | 0.149 | 0.000 | 0.001 |
| 3 | 0.451 | 0.070 | 0.155 | 0.001 | 0.003 |
| 4 | 0.414 | 0.059 | 0.143 | 0.003 | 0.007 |
| 5 | 0.471 | 0.067 | 0.142 | 0.005 | 0.011 |
| 6 | 0.403 | 0.057 | 0.142 | 0.005 | 0.012 |
| 7 | 0.401 | 0.058 | 0.145 | 0.005 | 0.012 |
| 8 | 0.387 | 0.061 | 0.158 | 0.007 | 0.017 |
| *NMFS Spring Survey – Yankee 41 – 1973-81* | | | | | |
| 1 | 0.228 | 0.071 | 0.312 | 0.009 | 0.038 |
| 2 | 0.534 | 0.165 | 0.309 | 0.022 | 0.042 |
| 3 | 0.652 | 0.202 | 0.310 | 0.028 | 0.044 |
| 4 | 0.806 | 0.257 | 0.319 | 0.039 | 0.049 |
| 5 | 0.895 | 0.287 | 0.321 | 0.031 | 0.035 |
| 6 | 0.811 | 0.306 | 0.378 | 0.065 | 0.080 |
| 7 | 1.488 | 0.541 | 0.363 | 0.125 | 0.084 |
| 8 | 0.724 | 0.238 | 0.329 | 0.036 | 0.050 |
| *NMFS Fall Survey* | | | | | |
| 0 | 0.157 | 0.022 | 0.137 | 0.002 | 0.012 |
| 1 | 0.321 | 0.046 | 0.144 | 0.003 | 0.009 |
| 2 | 0.255 | 0.034 | 0.133 | 0.002 | 0.009 |
| 3 | 0.246 | 0.033 | 0.134 | 0.002 | 0.009 |
| 4 | 0.207 | 0.029 | 0.138 | 0.001 | 0.006 |
| 5 | 0.170 | 0.023 | 0.137 | 0.001 | 0.007 |

*Table 25. Beginning of year population abundance (numbers in 000's) for eastern Georges Bank haddock during 1969-2014 from a virtual population analysis using the bootstrap bias adjusted population abundance at the beginning of 2014. Highlighted cells follow three recent large year classes, the 2000, 2003 and 2010.*

| Year | Age Group | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ | 2+ | 3+ |
| 1969 | 804 | 193 | 3,639 | 872 | 911 | 7,650 | 2,497 | 250 | 776 | 17,592 | 16,789 | 16,596 |
| 1970 | 3,593 | 658 | 141 | 1,681 | 479 | 447 | 3,659 | 1,299 | 506 | 12,463 | 8,870 | 8,212 |
| 1971 | 235 | 2,881 | 463 | 109 | 1,061 | 256 | 249 | 1,961 | 971 | 8,187 | 7,952 | 5,071 |
| 1972 | 5,303 | 192 | 1,285 | 155 | 62 | 642 | 69 | 61 | 1,340 | 9,109 | 3,806 | 3,614 |
| 1973 | 11,637 | 4,029 | 157 | 702 | 63 | 32 | 441 | 21 | 728 | 17,811 | 6,174 | 2,144 |
| 1974 | 3,082 | 8,519 | 1,728 | 123 | 251 | 18 | 17 | 327 | 454 | 14,517 | 11,436 | 2,917 |
| 1975 | 3,448 | 2,490 | 4,947 | 1,166 | 100 | 176 | 12 | 14 | 557 | 12,910 | 9,462 | 6,973 |
| 1976 | 54,074 | 2,807 | 1,787 | 2,701 | 761 | 78 | 112 | 8 | 437 | 62,765 | 8,691 | 5,884 |
| 1977 | 6,038 | 43,909 | 2,157 | 1,307 | 1,463 | 501 | 64 | 74 | 348 | 55,862 | 49,824 | 5,914 |
| 1978 | 4,057 | 4,942 | 28,725 | 1,706 | 906 | 922 | 263 | 52 | 319 | 41,893 | 37,836 | 32,894 |
| 1979 | 52,344 | 3,317 | 3,784 | 14,595 | 1,249 | 587 | 480 | 144 | 287 | 76,785 | 24,441 | 21,125 |
| 1980 | 6,238 | 42,664 | 2,700 | 2,910 | 8,084 | 695 | 300 | 199 | 301 | 64,091 | 57,853 | 15,189 |
| 1981 | 4,616 | 5,078 | 19,099 | 1,901 | 2,111 | 4,443 | 396 | 130 | 352 | 38,124 | 33,508 | 28,431 |
| 1982 | 2,096 | 3,730 | 3,533 | 9,569 | 1,197 | 1,281 | 2,521 | 217 | 358 | 24,501 | 22,406 | 18,676 |
| 1983 | 2,553 | 1,714 | 2,396 | 1,944 | 5,278 | 796 | 708 | 1,409 | 356 | 17,155 | 14,602 | 12,887 |
| 1984 | 16,098 | 2,081 | 1,269 | 1,367 | 1,094 | 2,838 | 465 | 486 | 1,047 | 26,744 | 10,646 | 8,565 |
| 1985 | 1,639 | 13,115 | 1,614 | 806 | 804 | 652 | 1,312 | 214 | 821 | 20,977 | 19,338 | 6,223 |
| 1986 | 13,906 | 1,334 | 8,805 | 974 | 496 | 480 | 419 | 731 | 694 | 27,841 | 13,935 | 12,601 |
| 1987 | 2,188 | 11,305 | 1,057 | 4,888 | 640 | 278 | 282 | 237 | 973 | 21,846 | 19,659 | 8,354 |
| 1988 | 16,040 | 1,791 | 7,383 | 747 | 2,624 | 434 | 176 | 156 | 828 | 30,178 | 14,138 | 12,347 |
| 1989 | 1,021 | 13,085 | 1,419 | 4,071 | 500 | 1,347 | 255 | 109 | 674 | 22,481 | 21,459 | 8,375 |
| 1990 | 2,381 | 834 | 9,565 | 1,083 | 2,635 | 281 | 791 | 178 | 578 | 18,326 | 15,945 | 15,111 |
| 1991 | 2,064 | 1,921 | 676 | 6,618 | 767 | 1,466 | 164 | 497 | 542 | 14,715 | 12,651 | 10,730 |
| 1992 | 8,107 | 1,670 | 1,154 | 471 | 3,556 | 548 | 849 | 71 | 664 | 17,090 | 8,983 | 7,313 |
| 1993 | 12,144 | 6,593 | 1,143 | 654 | 270 | 1,600 | 368 | 408 | 496 | 23,677 | 11,532 | 4,939 |
| 1994 | 11,429 | 9,870 | 5,142 | 616 | 276 | 139 | 714 | 264 | 531 | 28,981 | 17,552 | 7,681 |
| 1995 | 5,723 | 9,324 | 7,700 | 3,427 | 337 | 160 | 25 | 414 | 528 | 27,638 | 21,915 | 12,591 |
| 1996 | 5,644 | 4,678 | 7,563 | 5,822 | 2,433 | 228 | 108 | 18 | 709 | 27,205 | 21,561 | 16,882 |
| 1997 | 16,814 | 4,618 | 3,801 | 5,751 | 3,989 | 1,615 | 133 | 72 | 528 | 37,321 | 20,507 | 15,889 |
| 1998 | 8,188 | 13,740 | 3,696 | 3,046 | 4,225 | 2,830 | 1,146 | 97 | 454 | 37,423 | 29,235 | 15,495 |
| 1999 | 27,252 | 6,688 | 11,074 | 2,763 | 2,259 | 2,972 | 1,913 | 836 | 409 | 56,167 | 28,915 | 22,227 |
| 2000 | 8,776 | 22,288 | 5,436 | 8,388 | 1,974 | 1,626 | 2,121 | 1,336 | 907 | 52,852 | 44,077 | 21,789 |
| 2001 | 75,893 | 7,179 | 17,959 | 4,045 | 5,726 | 1,379 | 1,139 | 1,541 | 1,609 | 116,470 | 40,577 | 33,397 |
| 2002 | 3,670 | 62,116 | 5,819 | 13,140 | 2,832 | 3,924 | 893 | 749 | 2,186 | 95,329 | 91,659 | 29,543 |
| 2003 | 2,132 | 3,003 | 50,556 | 4,568 | 9,055 | 1,977 | 2,609 | 628 | 2,043 | 76,569 | 74,438 | 71,434 |
| 2004 | 243,376 | 1,739 | 2,450 | 39,738 | 3,480 | 6,075 | 1,235 | 1,705 | 1,876 | 301,675 | 58,298 | 56,559 |
| 2005 | 5,750 | 198,960 | 1,401 | 1,938 | 29,247 | 2,304 | 3,628 | 547 | 2,317 | 246,092 | 240,342 | 41,382 |
| 2006 | 10,551 | 4,695 | 162,677 | 1,121 | 1,385 | 17,752 | 1,413 | 2,231 | 2,088 | 203,911 | 193,361 | 188,665 |
| 2007 | 5,519 | 8,620 | 3,830 | 130,917 | 877 | 874 | 10,452 | 947 | 2,901 | 164,938 | 159,419 | 150,798 |
| 2008 | 5,429 | 4,517 | 7,023 | 2,972 | 100,557 | 585 | 564 | 7,268 | 2,860 | 131,776 | 126,347 | 121,830 |
| 2009 | 2,794 | 4,441 | 3,671 | 5,504 | 2,192 | 73,565 | 387 | 385 | 7,567 | 100,505 | 97,711 | 93,270 |
| 2010 | 4,148 | 2,272 | 3,523 | 2,832 | 3,838 | 1,559 | 50,124 | 251 | 6,116 | 74,662 | 70,514 | 68,242 |
| 2011 | 334,338 | 3,368 | 1,810 | 2,532 | 2,036 | 2,384 | 933 | 32,176 | 4,978 | 384,554 | 50,216 | 46,848 |
| 2012 | 50,532 | 273,513 | 2,661 | 1,318 | 1,610 | 1,461 | 1,345 | 667 | 24,743 | 357,851 | 307,319 | 33,806 |
| 2013 | 14,738 | 41,305 | 223,357 | 2,022 | 966 | 1,002 | 1,040 | 761 | 18,827 | 304,018 | 289,280 | 247,975 |
| 2014 | 1,546,172 | 12,045 | 33,639 | 179,747 | 1,445 | 694 | 611 | 786 | 15,388 | 1,790,528 | 244,355 | 232,310 |

*Table 26. Fishing mortality rates for eastern Georges Bank haddock during 1969-2013 from a virtual population analysis using the bootstrap bias adjusted population abundance at the beginning of 2013. The aggregated rates are weighted by population numbers. The rates for ages 4 to 8 and 5 to 8 are also shown as exploitation rate (%). Highlighted cells follow two recent large year classes, the 2000 and 2003.*

| Year | Age Group | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 4-8 | 4-8(%) | 5-8 | 5-8(%) |
| 1969 | 0.000 | 0.111 | 0.572 | 0.399 | 0.512 | 0.538 | 0.453 | 0.508 | 0.508 | 0.508 | 36.4 | 0.516 | 36.9 |
| 1970 | 0.021 | 0.152 | 0.057 | 0.261 | 0.425 | 0.383 | 0.424 | 0.377 | 0.538 | 0.377 | 28.7 | 0.410 | 30.7 |
| 1971 | 0.000 | 0.608 | 0.892 | 0.369 | 0.302 | 1.114 | 1.202 | 0.564 | 0.623 | 0.564 | 39.5 | 0.570 | 39.8 |
| 1972 | 0.075 | 0.005 | 0.404 | 0.705 | 0.468 | 0.175 | 0.973 | 0.342 | 0.460 | 0.342 | 26.4 | 0.275 | 21.9 |
| 1973 | 0.112 | 0.647 | 0.045 | 0.830 | 1.056 | 0.410 | 0.101 | 0.571 | 0.294 | 0.571 | 39.8 | 0.245 | 19.7 |
| 1974 | 0.013 | 0.343 | 0.193 | 0.000 | 0.154 | 0.181 | 0.015 | 0.103 | 0.164 | 0.103 | 8.9 | 0.124 | 10.6 |
| 1975 | 0.006 | 0.132 | 0.405 | 0.227 | 0.051 | 0.255 | 0.218 | 0.218 | 0.063 | 0.218 | 17.8 | 0.184 | 15.3 |
| 1976 | 0.008 | 0.064 | 0.113 | 0.413 | 0.217 | 0.000 | 0.208 | 0.000 | 0.046 | 0.357 | 27.3 | 0.197 | 16.2 |
| 1977 | 0.000 | 0.224 | 0.035 | 0.166 | 0.262 | 0.444 | 0.000 | 0.247 | 0.048 | 0.247 | 19.9 | 0.297 | 23.4 |
| 1978 | 0.002 | 0.067 | 0.477 | 0.112 | 0.235 | 0.452 | 0.405 | 0.244 | 0.033 | 0.244 | 19.7 | 0.349 | 26.9 |
| 1979 | 0.004 | 0.006 | 0.062 | 0.391 | 0.385 | 0.471 | 0.679 | 0.401 | 0.056 | 0.401 | 30.2 | 0.464 | 33.9 |
| 1980 | 0.006 | 0.604 | 0.151 | 0.121 | 0.399 | 0.363 | 0.639 | 0.335 | 0.046 | 0.335 | 26.0 | 0.402 | 30.2 |
| 1981 | 0.013 | 0.163 | 0.491 | 0.263 | 0.299 | 0.366 | 0.401 | 0.330 | 0.024 | 0.330 | 25.6 | 0.348 | 26.8 |
| 1982 | 0.001 | 0.242 | 0.398 | 0.395 | 0.208 | 0.393 | 0.382 | 0.377 | 0.224 | 0.377 | 28.7 | 0.344 | 26.6 |
| 1983 | 0.005 | 0.101 | 0.361 | 0.375 | 0.420 | 0.338 | 0.176 | 0.383 | 0.114 | 0.383 | 29.0 | 0.385 | 29.1 |
| 1984 | 0.005 | 0.054 | 0.254 | 0.330 | 0.317 | 0.572 | 0.577 | 0.467 | 0.405 | 0.467 | 34.1 | 0.505 | 36.2 |
| 1985 | 0.006 | 0.198 | 0.305 | 0.285 | 0.316 | 0.242 | 0.384 | 0.320 | 0.170 | 0.320 | 25.0 | 0.330 | 25.6 |
| 1986 | 0.007 | 0.033 | 0.389 | 0.221 | 0.379 | 0.333 | 0.372 | 0.303 | 0.069 | 0.303 | 23.8 | 0.341 | 26.4 |
| 1987 | 0.000 | 0.226 | 0.147 | 0.422 | 0.189 | 0.259 | 0.391 | 0.389 | 0.135 | 0.389 | 29.4 | 0.275 | 21.9 |
| 1988 | 0.004 | 0.033 | 0.395 | 0.201 | 0.467 | 0.331 | 0.277 | 0.394 | 0.143 | 0.394 | 29.7 | 0.436 | 32.3 |
| 1989 | 0.002 | 0.113 | 0.070 | 0.235 | 0.378 | 0.332 | 0.158 | 0.265 | 0.079 | 0.265 | 21.2 | 0.319 | 24.9 |
| 1990 | 0.014 | 0.010 | 0.168 | 0.145 | 0.386 | 0.335 | 0.266 | 0.309 | 0.085 | 0.309 | 24.2 | 0.355 | 27.2 |
| 1991 | 0.012 | 0.310 | 0.161 | 0.421 | 0.137 | 0.346 | 0.646 | 0.389 | 0.132 | 0.389 | 29.4 | 0.315 | 24.6 |
| 1992 | 0.007 | 0.179 | 0.367 | 0.356 | 0.599 | 0.198 | 0.531 | 0.527 | 0.164 | 0.527 | 37.4 | 0.543 | 38.3 |
| 1993 | 0.007 | 0.049 | 0.419 | 0.665 | 0.462 | 0.607 | 0.132 | 0.546 | 0.185 | 0.546 | 38.5 | 0.517 | 36.9 |
| 1994 | 0.003 | 0.048 | 0.206 | 0.401 | 0.344 | 1.509 | 0.345 | 0.458 | 0.105 | 0.458 | 33.6 | 0.483 | 35.0 |
| 1995 | 0.002 | 0.009 | 0.079 | 0.143 | 0.190 | 0.191 | 0.119 | 0.149 | 0.035 | 0.149 | 12.5 | 0.170 | 14.2 |
| 1996 | 0.001 | 0.008 | 0.074 | 0.178 | 0.210 | 0.342 | 0.201 | 0.192 | 0.119 | 0.192 | 15.9 | 0.220 | 18.0 |
| 1997 | 0.002 | 0.023 | 0.021 | 0.108 | 0.143 | 0.143 | 0.111 | 0.125 | 0.073 | 0.125 | 10.7 | 0.142 | 12.0 |
| 1998 | 0.002 | 0.016 | 0.091 | 0.099 | 0.152 | 0.191 | 0.116 | 0.144 | 0.088 | 0.144 | 12.2 | 0.160 | 13.5 |
| 1999 | 0.001 | 0.007 | 0.078 | 0.136 | 0.129 | 0.137 | 0.159 | 0.139 | 0.071 | 0.139 | 11.8 | 0.140 | 11.9 |
| 2000 | 0.001 | 0.016 | 0.095 | 0.182 | 0.159 | 0.155 | 0.119 | 0.166 | 0.085 | 0.166 | 13.9 | 0.148 | 12.5 |
| 2001 | 0.000 | 0.010 | 0.112 | 0.157 | 0.178 | 0.235 | 0.219 | 0.181 | 0.151 | 0.181 | 15.1 | 0.191 | 15.8 |
| 2002 | 0.000 | 0.006 | 0.042 | 0.172 | 0.159 | 0.208 | 0.152 | 0.176 | 0.157 | 0.176 | 14.7 | 0.183 | 15.2 |
| 2003 | 0.004 | 0.004 | 0.041 | 0.072 | 0.199 | 0.270 | 0.225 | 0.214 | 0.135 | 0.180 | 15.0 | 0.214 | 17.6 |
| 2004 | 0.002 | 0.016 | 0.034 | 0.106 | 0.212 | 0.315 | 0.613 | 0.316 | 0.167 | 0.157 | 13.2 | 0.316 | 24.7 |
| 2005 | 0.003 | 0.001 | 0.023 | 0.136 | 0.299 | 0.288 | 0.286 | 0.297 | 0.078 | 0.289 | 22.8 | 0.297 | 23.4 |
| 2006 | 0.002 | 0.004 | 0.017 | 0.045 | 0.260 | 0.329 | 0.200 | 0.316 | 0.085 | 0.303 | 23.8 | 0.316 | 24.7 |
| 2007 | 0.000 | 0.005 | 0.053 | 0.064 | 0.204 | 0.237 | 0.163 | 0.171 | 0.073 | 0.073 | 6.4 | 0.171 | 14.3 |
| 2008 | 0.001 | 0.007 | 0.044 | 0.104 | 0.112 | 0.213 | 0.181 | 0.113 | 0.037 | 0.113 | 9.7 | 0.113 | 9.7 |
| 2009 | 0.007 | 0.031 | 0.058 | 0.160 | 0.140 | 0.183 | 0.231 | 0.182 | 0.057 | 0.180 | 15.0 | 0.182 | 15.1 |
| 2010 | 0.008 | 0.027 | 0.128 | 0.127 | 0.275 | 0.311 | 0.242 | 0.246 | 0.038 | 0.240 | 19.4 | 0.246 | 19.8 |
| 2011 | 0.001 | 0.034 | 0.112 | 0.246 | 0.127 | 0.370 | 0.134 | 0.237 | 0.017 | 0.237 | 19.2 | 0.237 | 19.2 |
| 2012 | 0.001 | 0.002 | 0.071 | 0.106 | 0.261 | 0.134 | 0.364 | 0.254 | 0.095 | 0.221 | 18.0 | 0.251 | 20.2 |
| 2013 | 0.002 | 0.005 | 0.016 | 0.128 | 0.123 | 0.269 | 0.076 | 0.163 | 0.036 | 0.147 | 12.4 | 0.157 | 13.2 |

*Table 27. Beginning of year biomass (mt) for eastern Georges Bank haddock during 1969-2014. Weights at age from the DFO survey were applied to the virtual population analysis bootstrap bias adjusted population numbers at age at the beginning of 2013 to determine biomass. Highlighted cells follow two recent large year classes, the 2000, 2003 and 2010.*

| Year | Age Group | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ | 2+ | 3+ |
| 1969 | 92 | 99 | 3,402 | 1,311 | 1,816 | 17,938 | 6,702 | 733 | 2,674 | 34,768 | 34,676 | 34,577 |
| 1970 | 413 | 339 | 132 | 2,528 | 954 | 1,048 | 9,823 | 3,805 | 1,743 | 20,784 | 20,371 | 20,032 |
| 1971 | 27 | 1,483 | 433 | 164 | 2,113 | 600 | 670 | 5,745 | 3,346 | 14,580 | 14,553 | 13,071 |
| 1972 | 610 | 99 | 1,201 | 234 | 123 | 1,506 | 185 | 180 | 4,616 | 8,752 | 8,143 | 8,044 |
| 1973 | 1,338 | 2,073 | 146 | 1,056 | 125 | 74 | 1,185 | 62 | 2,509 | 8,569 | 7,231 | 5,158 |
| 1974 | 354 | 4,383 | 1,615 | 184 | 499 | 42 | 46 | 956 | 1,565 | 9,646 | 9,292 | 4,909 |
| 1975 | 396 | 1,281 | 4,626 | 1,754 | 200 | 412 | 33 | 41 | 1,918 | 10,660 | 10,264 | 8,983 |
| 1976 | 6,216 | 1,444 | 1,671 | 4,062 | 1,516 | 183 | 299 | 24 | 1,507 | 16,921 | 10,705 | 9,261 |
| 1977 | 694 | 22,593 | 2,016 | 1,965 | 2,915 | 1,175 | 171 | 217 | 1,200 | 32,947 | 32,253 | 9,661 |
| 1978 | 466 | 2,543 | 26,856 | 2,565 | 1,805 | 2,162 | 706 | 153 | 1,100 | 38,358 | 37,892 | 35,348 |
| 1979 | 6,017 | 1,706 | 3,538 | 21,949 | 2,489 | 1,375 | 1,289 | 421 | 987 | 39,772 | 33,754 | 32,048 |
| 1980 | 717 | 21,952 | 2,524 | 4,377 | 16,107 | 1,631 | 805 | 584 | 1,036 | 49,732 | 49,015 | 27,063 |
| 1981 | 531 | 2,613 | 17,856 | 2,859 | 4,205 | 10,417 | 1,063 | 380 | 1,212 | 41,135 | 40,605 | 37,992 |
| 1982 | 241 | 1,919 | 3,303 | 14,390 | 2,385 | 3,004 | 6,768 | 636 | 1,232 | 33,879 | 33,638 | 31,719 |
| 1983 | 293 | 882 | 2,240 | 2,923 | 10,517 | 1,866 | 1,902 | 4,127 | 1,226 | 25,976 | 25,683 | 24,801 |
| 1984 | 1,851 | 1,071 | 1,186 | 2,056 | 2,179 | 6,655 | 1,247 | 1,424 | 3,606 | 21,275 | 19,424 | 18,354 |
| 1985 | 188 | 6,748 | 1,509 | 1,212 | 1,603 | 1,530 | 3,521 | 626 | 2,830 | 19,765 | 19,577 | 12,829 |
| 1986 | 1,872 | 602 | 8,579 | 1,407 | 1,510 | 1,367 | 1,509 | 2,469 | 2,720 | 22,036 | 20,164 | 19,562 |
| 1987 | 329 | 5,647 | 757 | 8,175 | 1,287 | 709 | 886 | 746 | 3,530 | 22,066 | 21,738 | 16,090 |
| 1988 | 1,560 | 832 | 6,870 | 1,341 | 4,766 | 832 | 479 | 509 | 3,204 | 20,392 | 18,832 | 18,000 |
| 1989 | 63 | 6,204 | 922 | 5,669 | 998 | 3,404 | 550 | 312 | 2,116 | 20,237 | 20,174 | 13,970 |
| 1990 | 355 | 437 | 8,840 | 1,280 | 4,906 | 582 | 1,984 | 502 | 2,006 | 20,892 | 20,537 | 20,100 |
| 1991 | 247 | 1,316 | 541 | 10,004 | 1,301 | 3,568 | 346 | 1,550 | 1,860 | 20,731 | 20,484 | 19,169 |
| 1992 | 991 | 1,006 | 1,290 | 500 | 7,391 | 1,186 | 2,299 | 161 | 2,285 | 17,109 | 16,118 | 15,112 |
| 1993 | 1,481 | 3,172 | 1,402 | 1,180 | 344 | 3,732 | 862 | 1,119 | 1,625 | 14,918 | 13,437 | 10,265 |
| 1994 | 1,219 | 4,631 | 5,383 | 998 | 531 | 300 | 2,251 | 710 | 1,637 | 17,660 | 16,441 | 11,810 |
| 1995 | 493 | 4,601 | 7,415 | 5,333 | 750 | 391 | 61 | 1,237 | 1,681 | 21,963 | 21,469 | 16,868 |
| 1996 | 782 | 2,315 | 6,950 | 7,686 | 4,699 | 584 | 314 | 48 | 2,546 | 25,924 | 25,142 | 22,827 |
| 1997 | 2,222 | 2,339 | 2,971 | 6,931 | 6,638 | 3,514 | 326 | 187 | 1,667 | 26,796 | 24,573 | 22,235 |
| 1998 | 879 | 7,356 | 3,826 | 3,538 | 6,633 | 5,529 | 2,991 | 347 | 1,572 | 32,670 | 31,791 | 24,435 |
| 1999 | 3,533 | 3,168 | 10,086 | 3,563 | 2,844 | 5,555 | 4,077 | 2,274 | 1,225 | 36,325 | 32,792 | 29,624 |
| 2000 | 1,016 | 12,110 | 5,157 | 12,401 | 3,693 | 2,909 | 4,875 | 3,350 | 2,633 | 48,145 | 47,129 | 35,019 |
| 2001 | 7,085 | 3,759 | 18,054 | 5,546 | 10,293 | 2,985 | 2,564 | 3,997 | 4,710 | 58,993 | 51,908 | 48,149 |
| 2002 | 351 | 20,596 | 4,527 | 14,950 | 4,231 | 7,711 | 1,943 | 1,653 | 5,918 | 61,879 | 61,528 | 40,932 |
| 2003 | 171 | 1,109 | 42,774 | 4,855 | 13,375 | 3,252 | 5,761 | 1,399 | 5,081 | 77,777 | 77,605 | 76,496 |
| 2004 | 15,551 | 539 | 1,915 | 45,748 | 4,545 | 9,466 | 2,004 | 3,335 | 4,156 | 87,259 | 71,708 | 71,169 |
| 2005 | 160 | 43,324 | 690 | 1,350 | 35,860 | 3,044 | 5,554 | 876 | 5,663 | 96,521 | 96,361 | 53,037 |
| 2006 | 619 | 804 | 63,259 | 737 | 1,205 | 24,249 | 2,248 | 3,885 | 4,917 | 101,923 | 101,304 | 100,501 |
| 2007 | 422 | 2,116 | 1,551 | 92,826 | 870 | 1,525 | 16,299 | 1,582 | 5,401 | 122,592 | 122,170 | 120,053 |
| 2008 | 581 | 1,486 | 4,026 | 2,362 | 93,246 | 734 | 976 | 10,724 | 5,424 | 119,559 | 118,978 | 117,492 |
| 2009 | 319 | 1,718 | 2,845 | 5,497 | 2,163 | 92,553 | 574 | 1,032 | 16,859 | 123,560 | 123,242 | 121,523 |
| 2010 | 301 | 875 | 2,638 | 2,718 | 4,300 | 1,882 | 66,799 | 445 | 12,638 | 92,595 | 92,294 | 91,420 |
| 2011 | 12,852 | 1,084 | 1,108 | 2,277 | 1,940 | 2,427 | 1,045 | 44,107 | 8,568 | 75,408 | 62,557 | 61,473 |
| 2012 | 3,554 | 50,829 | 1,217 | 667 | 1,605 | 1,614 | 1,458 | 794 | 33,294 | 95,031 | 91,477 | 40,648 |
| 2013 | 1,032 | 10,786 | 92,095 | 1,596 | 1,054 | 974 | 1,144 | 869 | 27,434 | 136,983 | 135,952 | 125,165 |
| 2014 | 65,000 | 3,891 | 18,059 | 116,506 | 1,317 | 842 | 742 | 749 | 22,040 | 229,147 | 164,147 | 160,256 |

*Table 28. Partial recruitment of haddock normalized to ages 4 to 8 for 1969 to 2002 and to ages 5 to 8 for 2003 to 2013 from the eastern Georges Bank Canadian commercial fishery. Average F's used to normalize the partial recruitment were weighted by population numbers. [1]Weighted by population.*

| | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9+** |
| 1969 | 0.00 | 0.22 | 1.13 | 0.79 | 1.01 | 1.06 | 0.89 | 1.00 | 1.00 |
| 1970 | 0.05 | 0.40 | 0.15 | 0.69 | 1.13 | 1.02 | 1.12 | 1.00 | 1.43 |
| 1971 | | 1.08 | 1.58 | 0.65 | 0.53 | 1.97 | 2.13 | 1.00 | 1.10 |
| 1972 | 0.22 | 0.01 | 1.18 | 2.06 | 1.37 | 0.51 | 2.84 | 1.00 | 1.34 |
| 1973 | 0.20 | 1.13 | 0.08 | 1.45 | 1.85 | 0.72 | 0.18 | 1.00 | 0.51 |
| 1974 | 0.11 | 2.78 | 1.56 | | 1.24 | 1.46 | 0.12 | 0.83 | 1.33 |
| 1975 | 0.03 | 0.60 | 1.85 | 1.04 | 0.24 | 1.17 | 1.00 | 1.00 | 0.29 |
| 1976 | 0.02 | 0.17 | 0.31 | 1.13 | 0.59 | | 0.57 | | 0.13 |
| 1977 | 0.00 | 0.91 | 0.14 | 0.67 | 1.06 | 1.80 | 0.00 | 1.00 | 0.19 |
| 1978 | 0.01 | 0.28 | 1.95 | 0.46 | 0.96 | 1.85 | 1.66 | 1.00 | 0.14 |
| 1979 | 0.01 | 0.01 | 0.16 | 0.97 | 0.96 | 1.17 | 1.69 | 1.00 | 0.14 |
| 1980 | 0.02 | 1.80 | 0.45 | 0.36 | 1.19 | 1.08 | 1.91 | 1.00 | 0.14 |
| 1981 | 0.04 | 0.49 | 1.49 | 0.80 | 0.91 | 1.11 | 1.22 | 1.00 | 0.07 |
| 1982 | 0.00 | 0.64 | 1.05 | 1.05 | 0.55 | 1.04 | 1.01 | 1.00 | 0.60 |
| 1983 | 0.01 | 0.26 | 0.94 | 0.98 | 1.10 | 0.88 | 0.46 | 1.00 | 0.30 |
| 1984 | 0.01 | 0.12 | 0.54 | 0.71 | 0.68 | 1.23 | 1.24 | 1.00 | 0.87 |
| 1985 | 0.02 | 0.62 | 0.95 | 0.89 | 0.99 | 0.76 | 1.20 | 1.00 | 0.53 |
| 1986 | 0.02 | 0.11 | 1.28 | 0.73 | 1.25 | 1.10 | 1.23 | 1.00 | 0.23 |
| 1987 | 0.00 | 0.58 | 0.38 | 1.09 | 0.49 | 0.67 | 1.01 | 1.00 | 0.35 |
| 1988 | 0.01 | 0.08 | 1.00 | 0.51 | 1.19 | 0.84 | 0.70 | 1.00 | 0.36 |
| 1989 | 0.01 | 0.43 | 0.26 | 0.89 | 1.43 | 1.25 | 0.60 | 1.00 | 0.30 |
| 1990 | 0.05 | 0.03 | 0.54 | 0.47 | 1.25 | 1.08 | 0.86 | 1.00 | 0.27 |
| 1991 | 0.03 | 0.80 | 0.41 | 1.08 | 0.35 | 0.89 | 1.66 | 1.00 | 0.34 |
| 1992 | 0.01 | 0.34 | 0.70 | 0.68 | 1.14 | 0.38 | 1.01 | 1.00 | 0.31 |
| 1993 | 0.01 | 0.09 | 0.77 | 1.22 | 0.85 | 1.11 | 0.24 | 1.00 | 0.34 |
| 1994 | 0.01 | 0.11 | 0.45 | 0.88 | 0.75 | 3.29 | 0.75 | 1.00 | 0.23 |
| 1995 | 0.01 | 0.06 | 0.53 | 0.96 | 1.28 | 1.28 | 0.80 | 1.00 | 0.23 |
| 1996 | 0.00 | 0.04 | 0.39 | 0.93 | 1.09 | 1.78 | 1.05 | 1.00 | 0.62 |
| 1997 | 0.01 | 0.18 | 0.17 | 0.86 | 1.14 | 1.14 | 0.89 | 1.00 | 0.59 |
| 1998 | 0.02 | 0.11 | 0.63 | 0.69 | 1.06 | 1.33 | 0.81 | 1.00 | 0.61 |
| 1999 | 0.01 | 0.05 | 0.56 | 0.98 | 0.93 | 0.99 | 1.14 | 1.00 | 0.51 |
| 2000 | 0.00 | 0.10 | 0.57 | 1.09 | 0.96 | 0.93 | 0.72 | 1.00 | 0.51 |
| 2001 | 0.00 | 0.06 | 0.62 | 0.86 | 0.98 | 1.30 | 1.21 | 1.00 | 0.83 |
| 2002 | 0.00 | 0.03 | 0.24 | 0.98 | 0.90 | 1.18 | 0.86 | 1.00 | 0.89 |
| 2003 | 0.016 | 0.02 | 0.19 | 0.34 | 0.93 | 1.26 | 1.05 | 1.00 | 0.63 |
| 2004 | 0.005 | 0.05 | 0.11 | 0.34 | 0.67 | 1.00 | 1.94 | 1.00 | 0.53 |
| 2005 | 0.009 | 0.004 | 0.08 | 0.46 | 1.01 | 0.97 | 0.96 | 1.00 | 0.26 |
| 2006 | 0.006 | 0.01 | 0.05 | 0.14 | 0.82 | 1.04 | 0.63 | 1.00 | 0.27 |
| 2007 | 0.002 | 0.03 | 0.31 | 0.37 | 1.19 | 1.38 | 0.95 | 1.00 | 0.43 |
| 2008 | 0.008 | 0.06 | 0.39 | 0.92 | 0.99 | 1.88 | 1.60 | 1.00 | 0.33 |
| 2009 | 0.036 | 0.17 | 0.32 | 0.88 | 0.77 | 1.01 | 1.27 | 1.00 | 0.31 |
| 2010 | 0.033 | 0.11 | 0.52 | 0.52 | 1.12 | 1.26 | 0.98 | 1.00 | 0.16 |
| 2011 | 0.003 | 0.14 | 0.47 | 1.04 | 0.54 | 1.56 | 0.57 | 1.00 | 0.07 |
| 2012 | 0.006 | 0.01 | 0.28 | 0.42 | 1.04 | 0.54 | 1.45 | 1.01 | 0.38 |
| 2013 | 0.010 | 0.03 | 0.10 | 0.82 | 0.78 | 1.72 | 0.48 | 1.04 | 0.23 |
| Avg. 1998-02[1] | 0.004 | 0.06 | 0.55 | 0.97 | 0.98 | 1.15 | 0.94 | 1.00 | 0.76 |
| Avg. 2009-13[1] | 0.004 | 0.02 | 0.12 | 0.78 | 0.89 | 1.03 | 0.98 | 1.00 | 0.28 |
| Avg. 2011-13[1] | 0.004 | 0.01 | 0.11 | 0.82 | 0.76 | 1.28 | 0.90 | 1.00 | 0.29 |
| Avg. 2003-13[1] | 0.005 | 0.01 | 0.11 | 0.40 | 0.98 | 1.04 | 0.99 | 1.00 | 0.30 |

*Table 29. Input for projections and risk analyses of eastern Georges Bank haddock for the 2015 fishery. A catch of 27,000 mt in 2014 and natural mortality = 0.2 were assumed and the 2013 year class was downsized to the size of the 2010 year class for the forecasts. The 2010 and 2013 year classes are highlighted.*

| Year | Age Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
| *Population Numbers (000s)* | | | | | | | | | |
| 2014 | 333,973 | 11,835 | 32,954 | 176,141 | 1,434 | 686 | 598 | 757 | 1,5038 |
| *Partial Recruitment to the Fishery*[1] | | | | | | | | | |
| 2014 | 0.005 | 0.01 | 0.11 | 0.37[2] | 1 | 1 | 1 | 1 | 0.3 |
| 2015 | 0.005 | 0.01 | 0.11 | 0.37[2] | 1 | 1 | 1 | 1 | 0.3 |
| *Weight at beginning of year for population (kg)*[3] | | | | | | | | | |
| 2014 | 0.04[4] | 0.32[4] | 0.54[4] | 0.65[4] | 0.91[4] | 1.21[4] | 1.21[4] | 0.95[4] | 1.43[4] |
| 2015 | 0.06 | 0.19[5] | 0.47 | 0.89[6] | 0.93[7] | 1.1 | 1.13 | 1.1 | 1.41 |
| 2016 | 0.06 | 0.26 | 0.41[5] | 0.65 | 1.01[6] | 1.26[7] | 1.13 | 1.1 | 1.41 |
| *Weight at age for catch (kg)*[8] | | | | | | | | | |
| 2014 | 0.35[9] | 0.78 | 1.01[10] | 1.19[11] | 1.29 | 1.37 | 1.5 | 1.58 | 1.84 |
| 2015 | 0.31 | 0.65[9] | 0.97 | 1.23[10] | 1.39[11] | 1.37 | 1.5 | 1.58 | 1.84 |
| *Maturity* | | | | | | | | | |
| 2014 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2015 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

[1]Based on 2003 to 2013 weighted average except where indicated and ages 5 to 8 assumed fully recruited.
[2]Based on observed values from 2003 year class.
[3]2012-2014 average weights at age from the Canadian Department of Fisheries and Oceans (DFO) survey unless indicated otherwise.
[4]2014 average weights at age from DFO survey.
[5]2010 year class average weights at age from DFO survey used for 2013 year class.
[6]Average of 2005 and 2009 year class average weights at age from DFO survey used for 2011 year class.
[7]2003 year class average weights at age from DFO survey used for 2010 year class.
[8]2011 to 2013 average weights at age from Canadian/USA landings except where indicated.
[9]2010 year class average weights at age from Canadian/USA landings used for 2013 year class..
[10]2005 and 2009 year class average weights at age from Canadian/USA landings used for 2011 year class.
[11]2003 year class average weights at age from Canadian/USA landings used for 2010 year class.

*Table 30. Bias adjusted deterministic projection results for eastern Georges Bank haddock for the 2015 fishery using 11.2 million age 1 recruits (2004 to 2013 median from 2013 assessment results) for the 2014 and 2015 year classes, the input values detailed in Table 29 and assuming that the 2014 quota of 27,000 mt is caught. The 2013 year class was downsized to the size of the 2010 year class. Natural mortality was assumed to be 0.2. Highlighted values indicate the 2013 and 2010 year classes.*

| Year | Age Group | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ | 1+ | 2+ | 3+ |
| *Population Numbers (000s)* | | | | | | | | | | | | |
| 2014 | 333,973 | 11,835 | 32,954 | 176,141 | 1,434 | 686 | 598 | 757 | 15,038 | 573,416 | 239,443 | 227,608 |
| 2015 | 11,177 | 272,978 | 9,657 | 26,008 | 127,468 | 841 | 403 | 351 | 11,584 | 460,467 | 449,290 | 176,312 |
| 2016 | 11,177 | 9,139 | 222,915 | 7,684 | 19,341 | 80,468 | 531 | 254 | 8,994 | 360,503 | 349,326 | 340,187 |
| *Population Biomass (mt)* | | | | | | | | | | | | |
| 2014 | 14,040 | 3,823 | 17,691 | 114,170 | 1,307 | 834 | 726 | 721 | 21,539 | 174,850 | 160,810 | 156,987 |
| 2015 | 682 | 50,774 | 4,529 | 23,251 | 118,163 | 923 | 456 | 384 | 16,356 | 215,518 | 214,836 | 164,062 |
| 2016 | 682 | 2,349 | 91,841 | 4,979 | 19,592 | 101,229 | 602 | 278 | 12,699 | 234,251 | 233,569 | 231,220 |
| *Fishing mortality* | | | | | | | | | | | | |
| 2014 | 0.002 | 0.003 | 0.037 | 0.123 | 0.334 | 0.334 | 0.334 | 0.334 | 0.1 | | | |
| 2015 | 0.001 | 0.003 | 0.029 | 0.096 | 0.26 | 0.26 | 0.26 | 0.26 | 0.078 | | | |
| *Projected Catch Numbers (000s)* | | | | | | | | | | | | |
| 2014 | 504 | 36 | 1,077 | 18,575 | 371 | 177 | 155 | 196 | 1,300 | 22,391 | 21,887 | 21,851 |
| 2015 | 13 | 642 | 247 | 2,165 | 26,565 | 175 | 84 | 73 | 789 | 30,753 | 30,740 | 30,098 |
| *Catch Biomass (mt)* | | | | | | | | | | | | |
| 2014 | 175 | 28 | 1,093 | 22,048 | 480 | 242 | 232 | 309 | 2,394 | 27,000 | 26,825 | 26,798 |
| 2015 | 4 | 415 | 239 | 2,666 | 36,925 | 239 | 126 | 115 | 1,452 | 42,182 | 42,177 | 41,762 |

## FIGURES

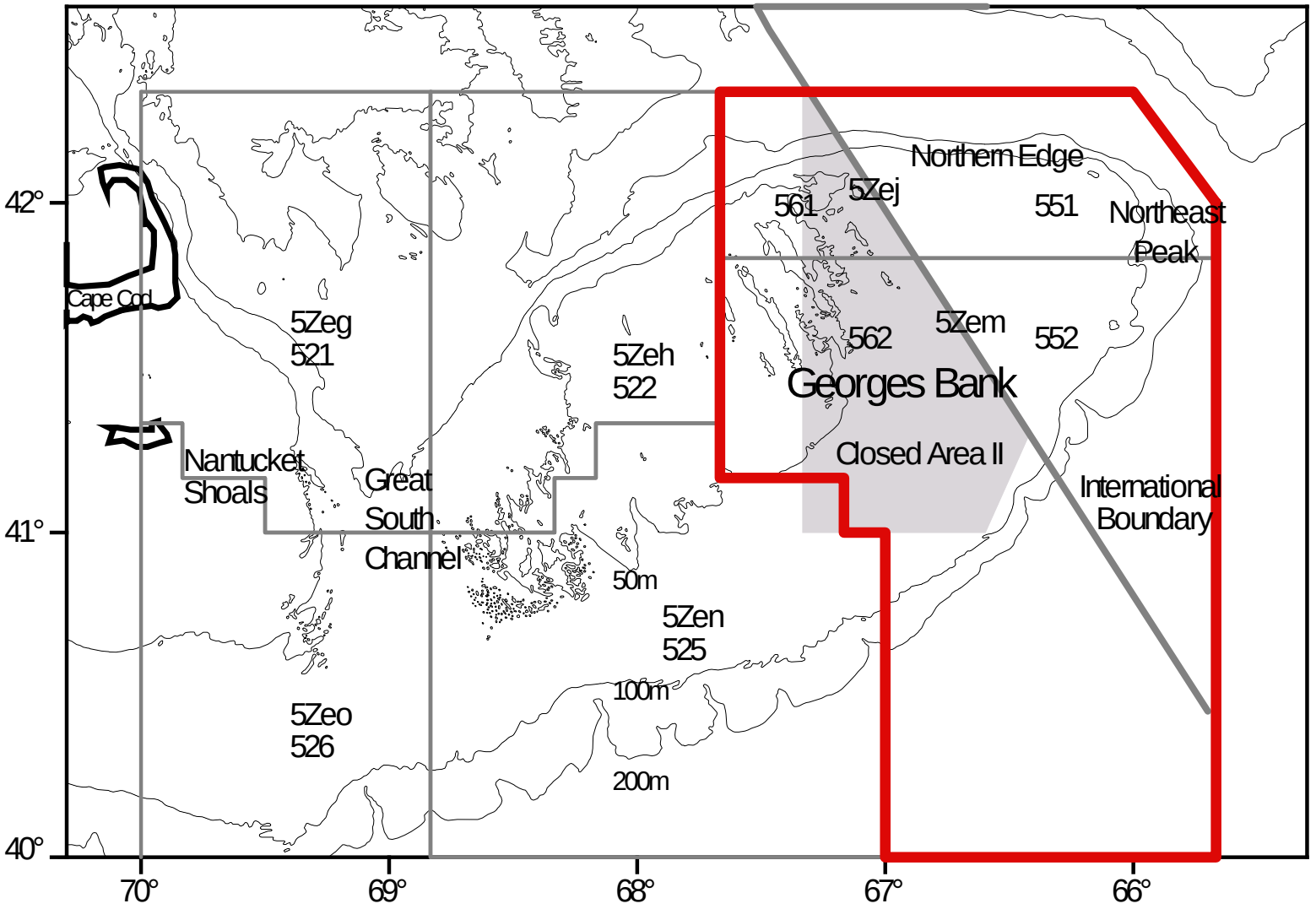


*Figure 1. Fisheries statistical unit areas in North Atlantic Fisheries Organization Subdivision 5Ze. Alpha-numeric codes, e.g. 5Zej, are the Canadian Department of Fisheries and Oceans designations and numeric codes, e.g. 561, are National Marine Fisheries Service designations. The eastern Georges Bank management unit is outlined by a heavy red line.*

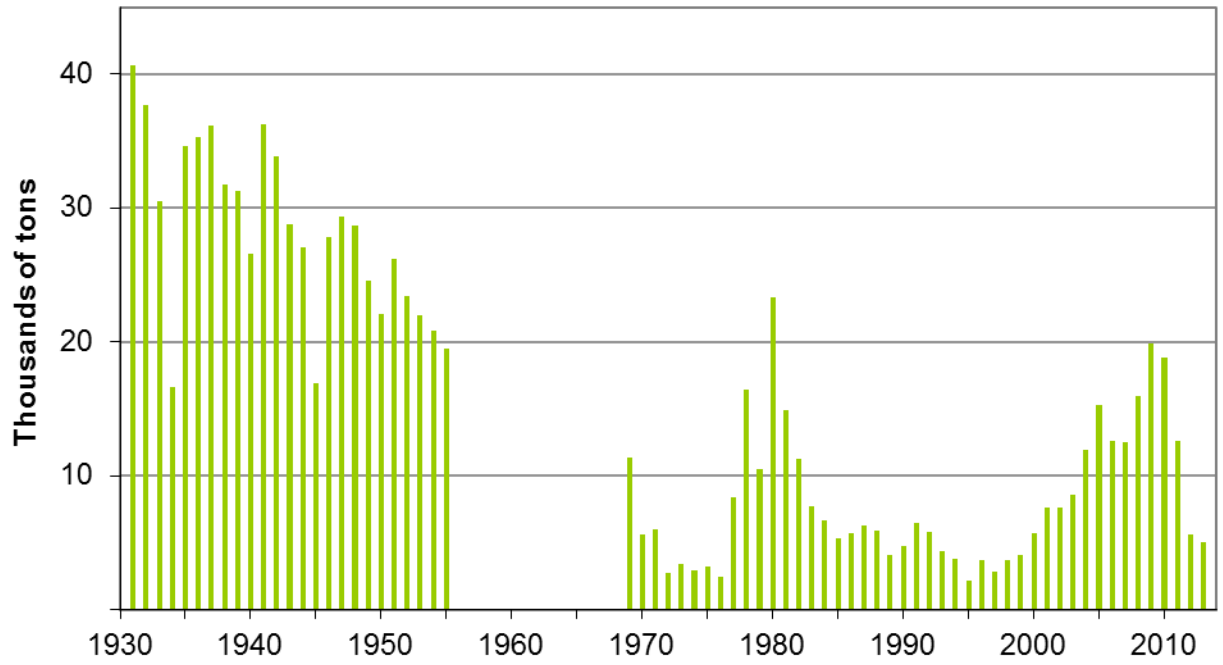


*Figure 2. Historical catch of eastern Georges Bank haddock during 1931-1955 (Gavaris and Van Eeckhaute 1997) compared to recent catches during 1969-2013. Catch data for 1956 to 1968 were not available by unit area.*

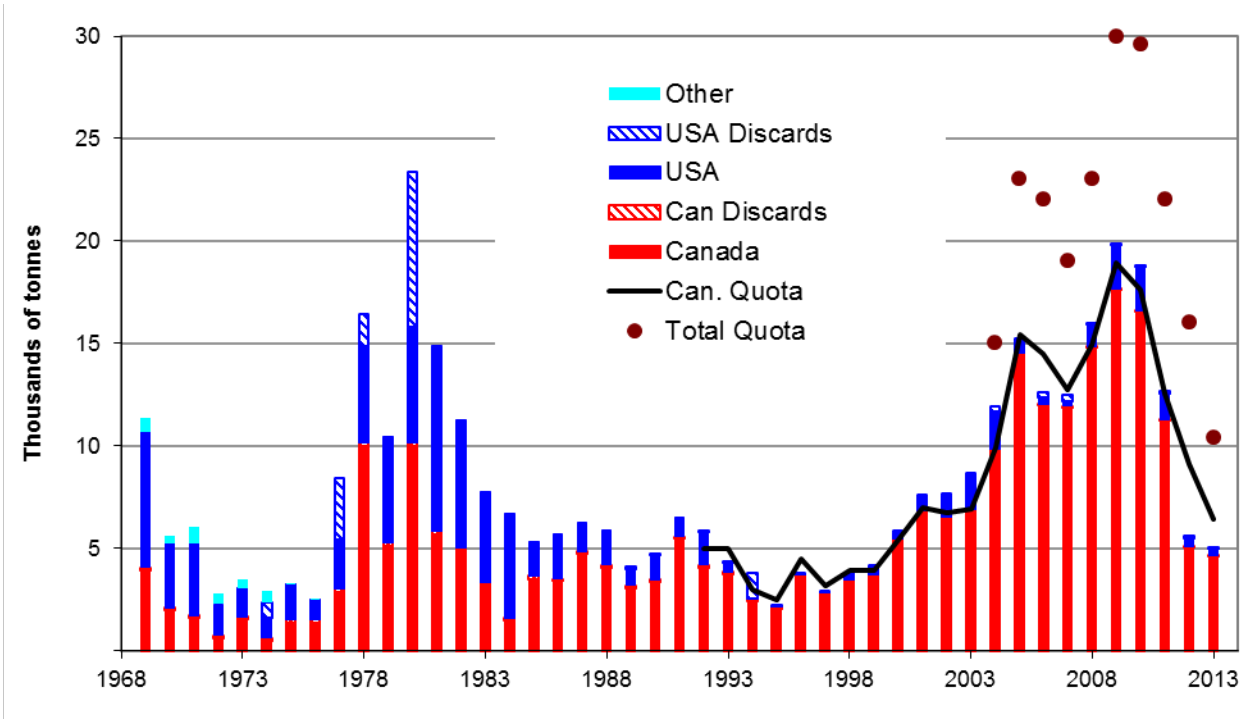


*Figure 3. Nominal catches of eastern Georges Bank haddock during 1969-2013.*

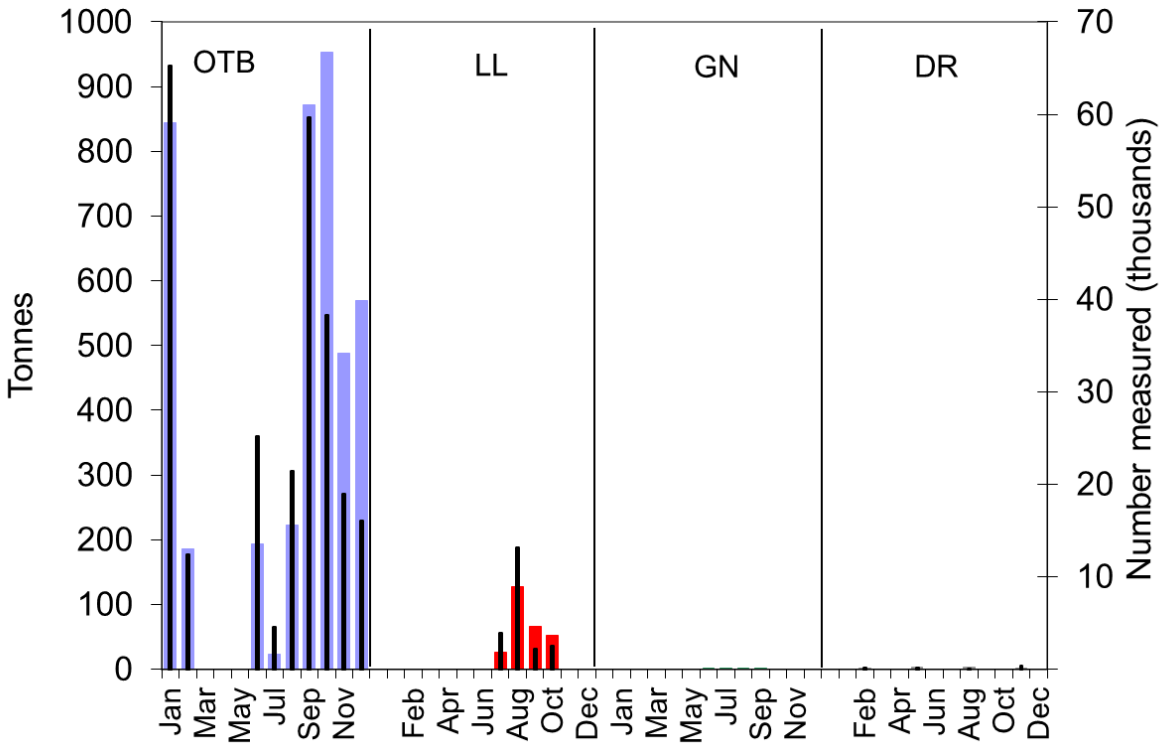


*Figure 4. Haddock landings by the Canadian commercial groundfish fishery and discards from the scallop fishery from eastern Georges Bank by month and gear in 2013 (wide bars) with sampling levels (narrow bars). Landings from the gillnet fishery were very low and no samples were available. OTB = Otter Trawl Bottom, LL = Longline, GN = Gill Net, DR = Dcallop Dredge.*

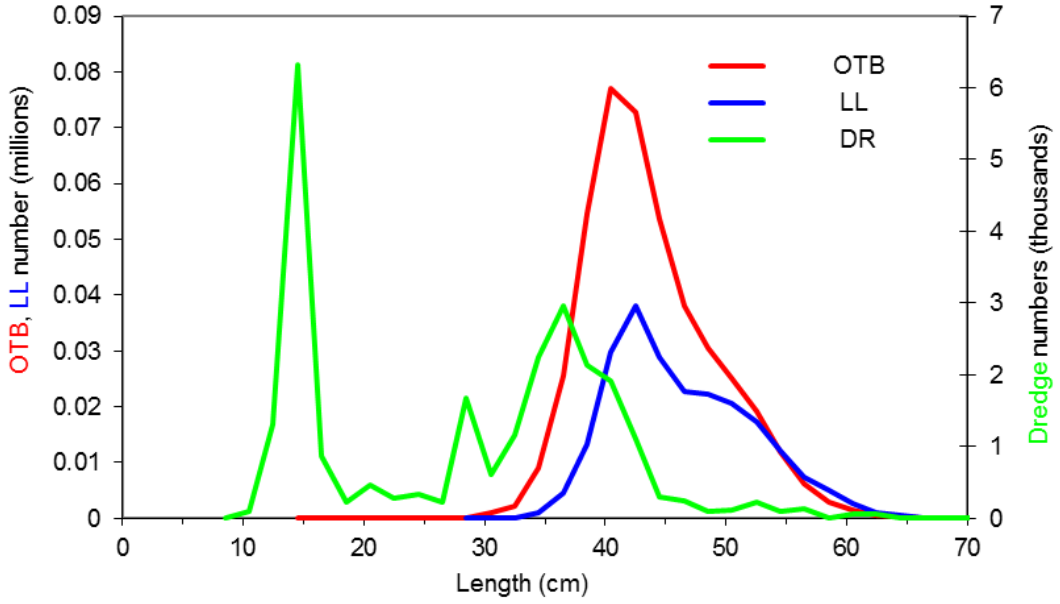


*Figure 5. Haddock numbers at length landed by components of the Canadian commercial groundfish fisheries and haddock discards at length from the Canadian scallop fishery on eastern Georges Bank in 2013. The scallop dredge length frequencies are expanded according to the axis on the right. OTB = Otter Trawl Bottom, LL = Longline, DR = Scallop Dredge. Landings and sampling from the gillnet fishery were very low.*

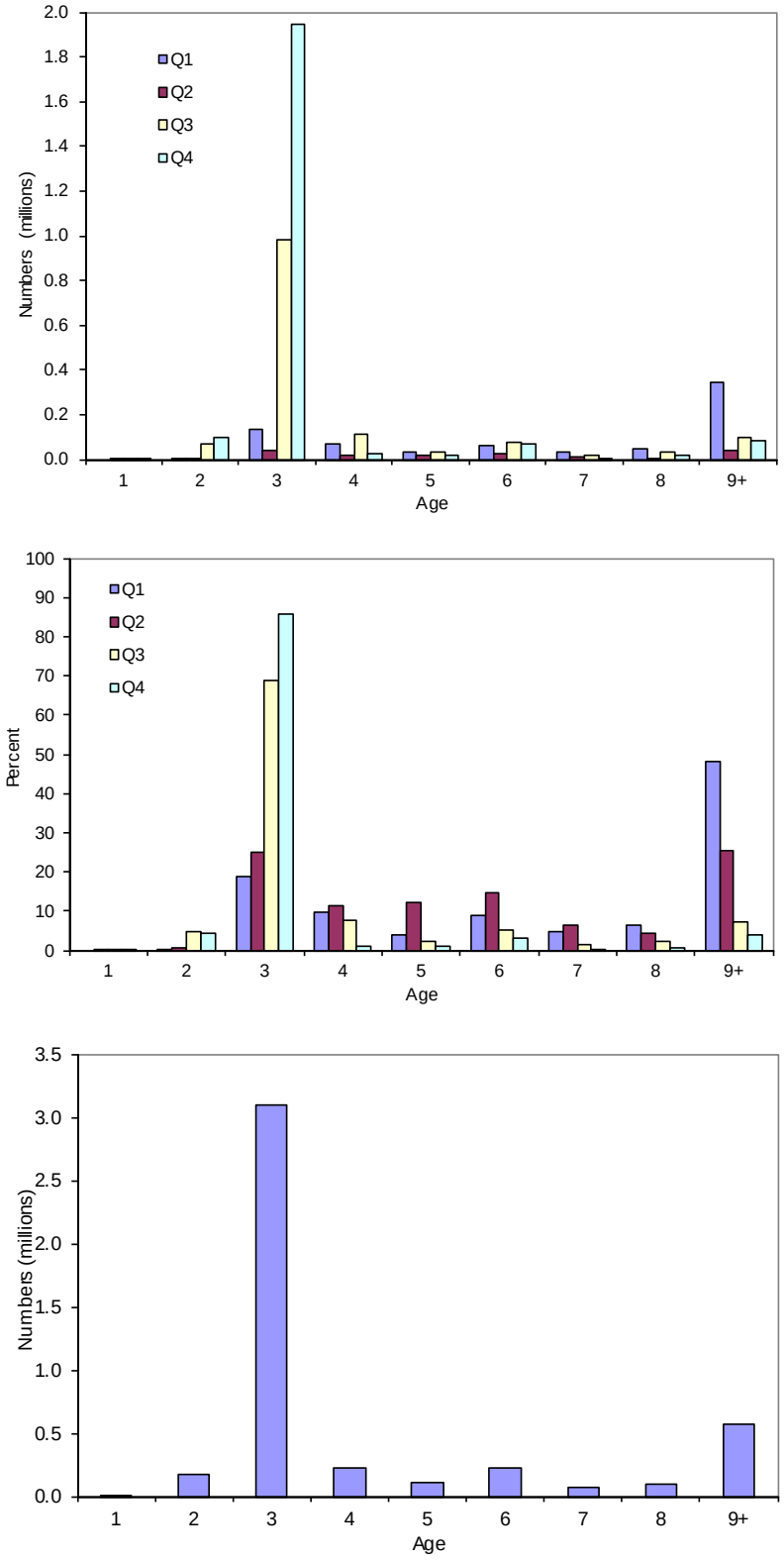


*Figure 6. Numbers (top panel) and percent (middle panel) of haddock landings at age by quarter and numbers for the year by the Canadian groundfish fishery on eastern Georges Bank in 2013.*

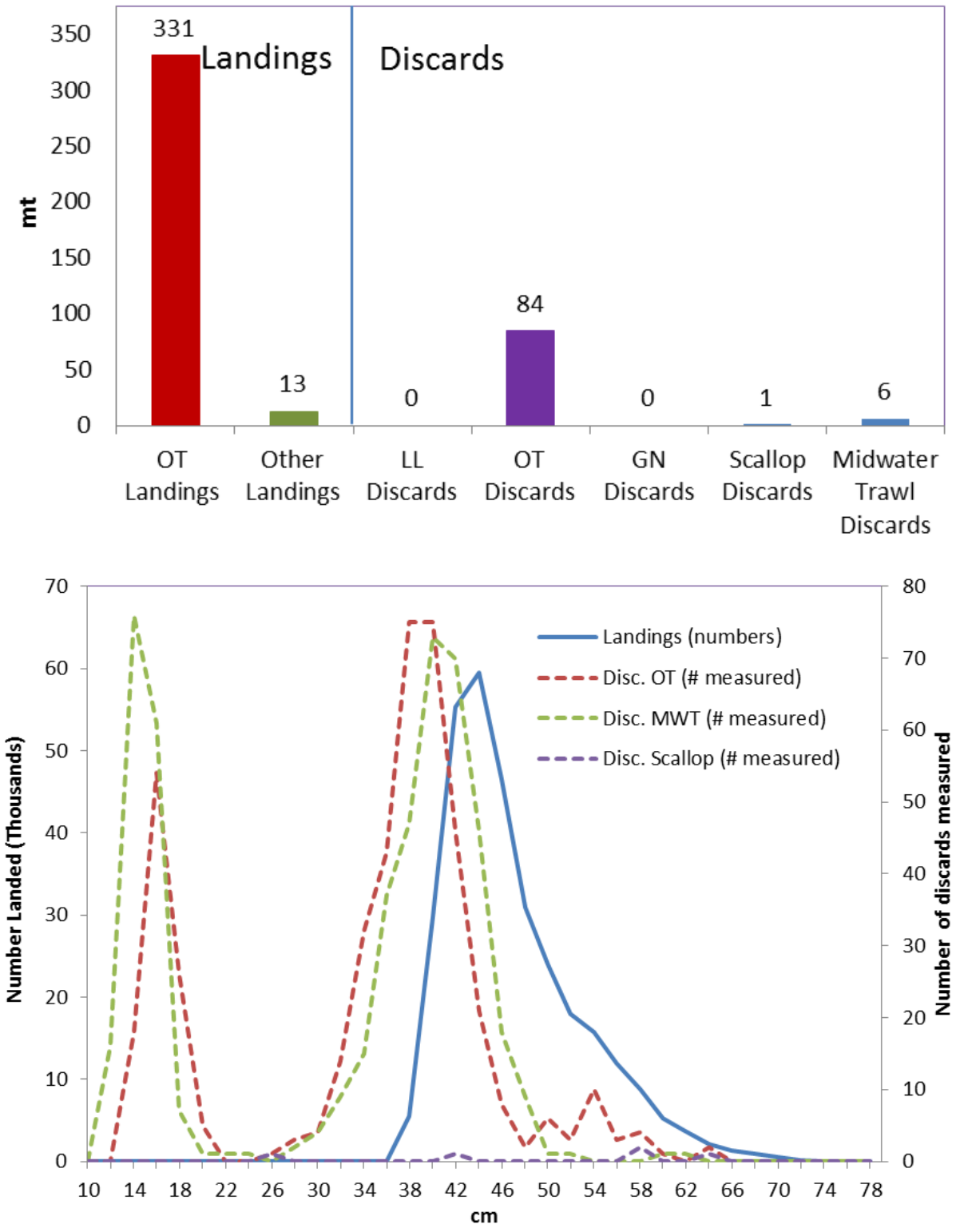


*Figure 7. Haddock landings and discards by gear in metric tonnes (upper) and length composition (lower; total numbers for landings and numbers measured for discards) by the United States from eastern Georges Bank in 2013.*

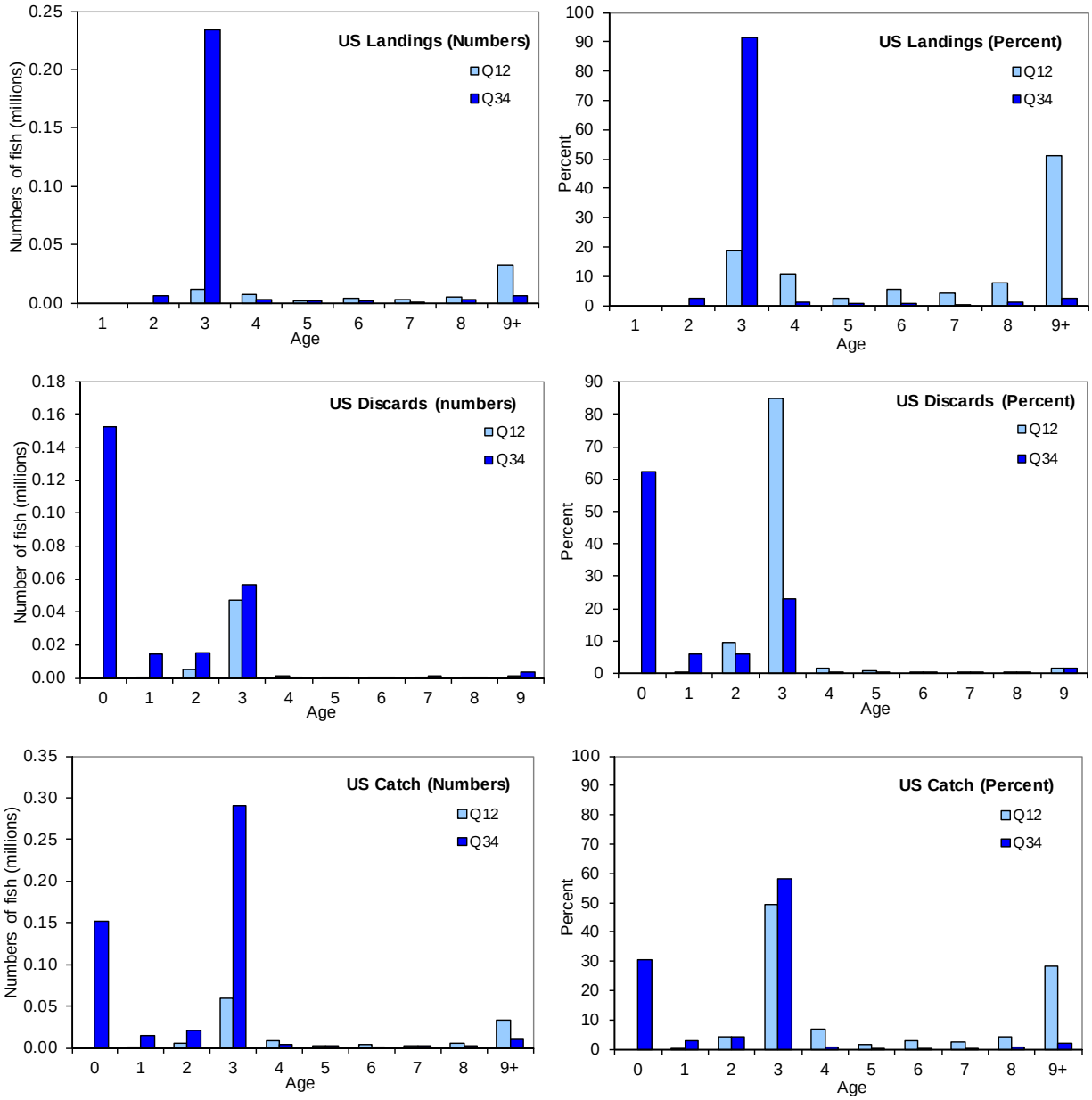


*Figure 8. Haddock landings and discards at age in numbers and percent by half year from the USA eastern Georges Bank groundfish fisheries in 2013.*

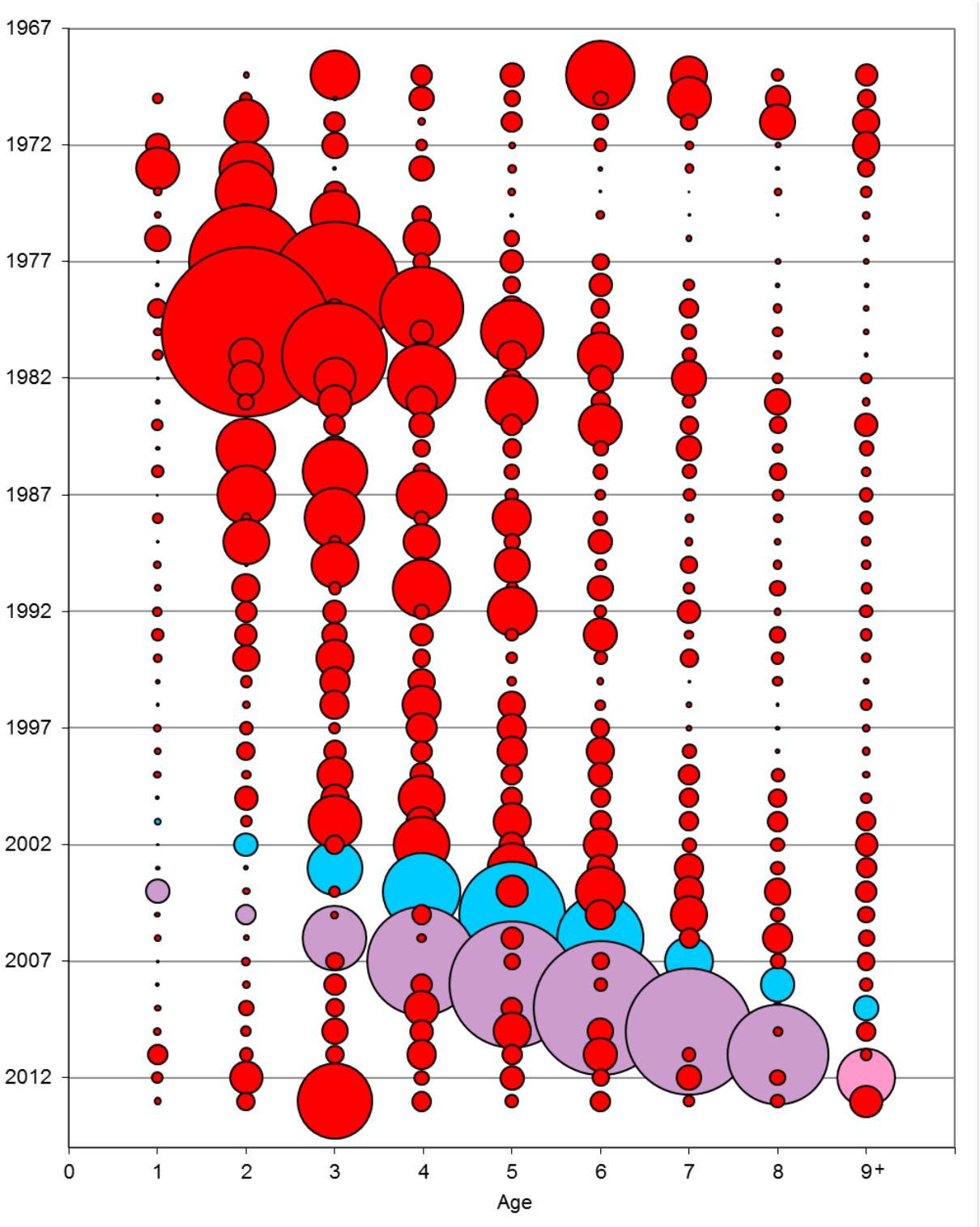


*Figure 9. Total commercial catch at age (numbers) of eastern Georges Bank haddock during 1969-2013. The 2000 and 2003 year classes are indicated in blue and purple, respectiviely. The bubble area is proportional to catch magnitude.*

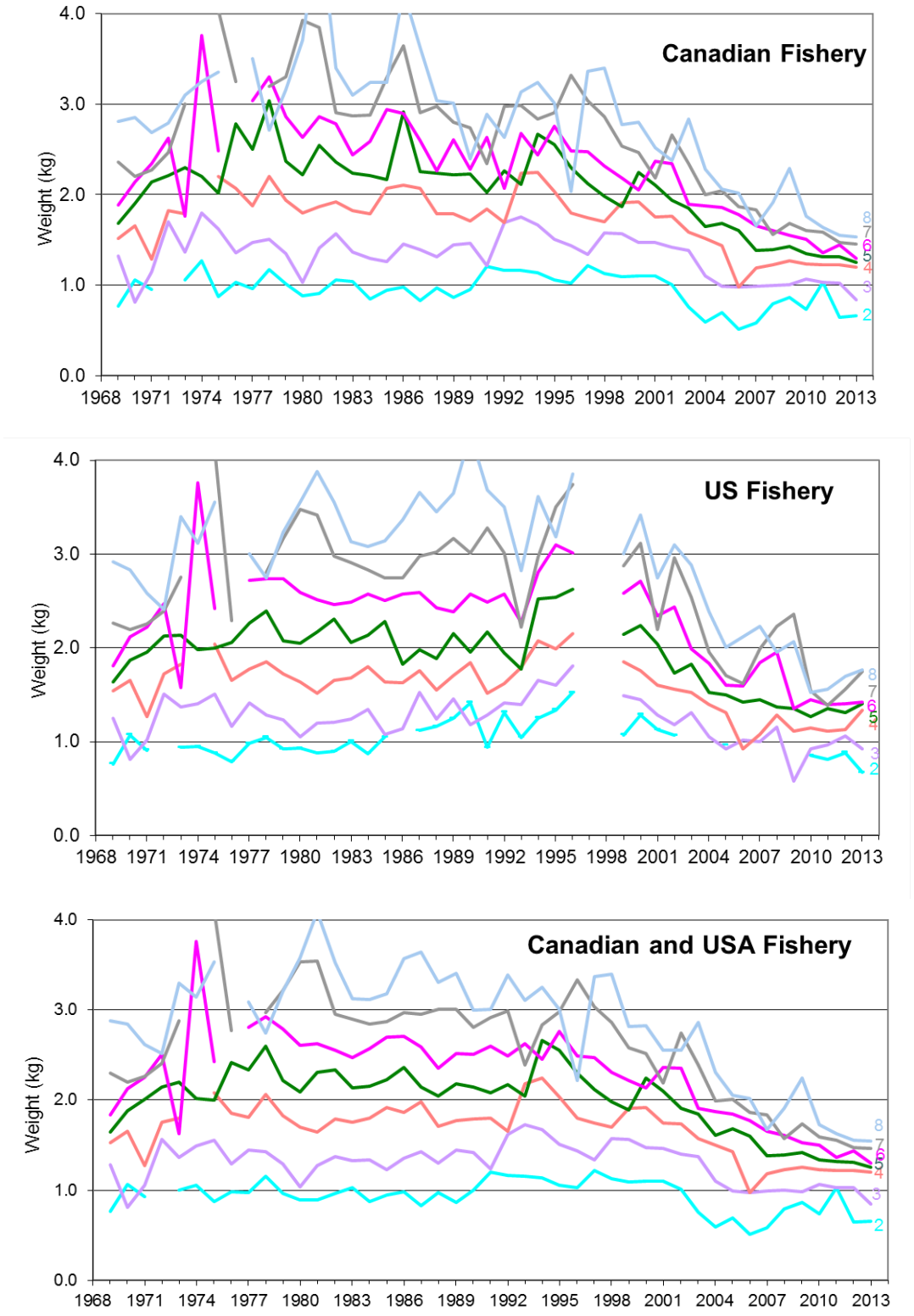


*Figure 10. Average weights at age for eastern Georges Bank haddock from the Canadian, USA and combined commercial groundfish fishery during 1969-2013. From 1969 to 1973 only USA fishery sampling for lengths and ages was available. Between 1974 and 1984 a mix of USA and Canadian samples was used (Gavaris and Van Eeckhaute 1990).*

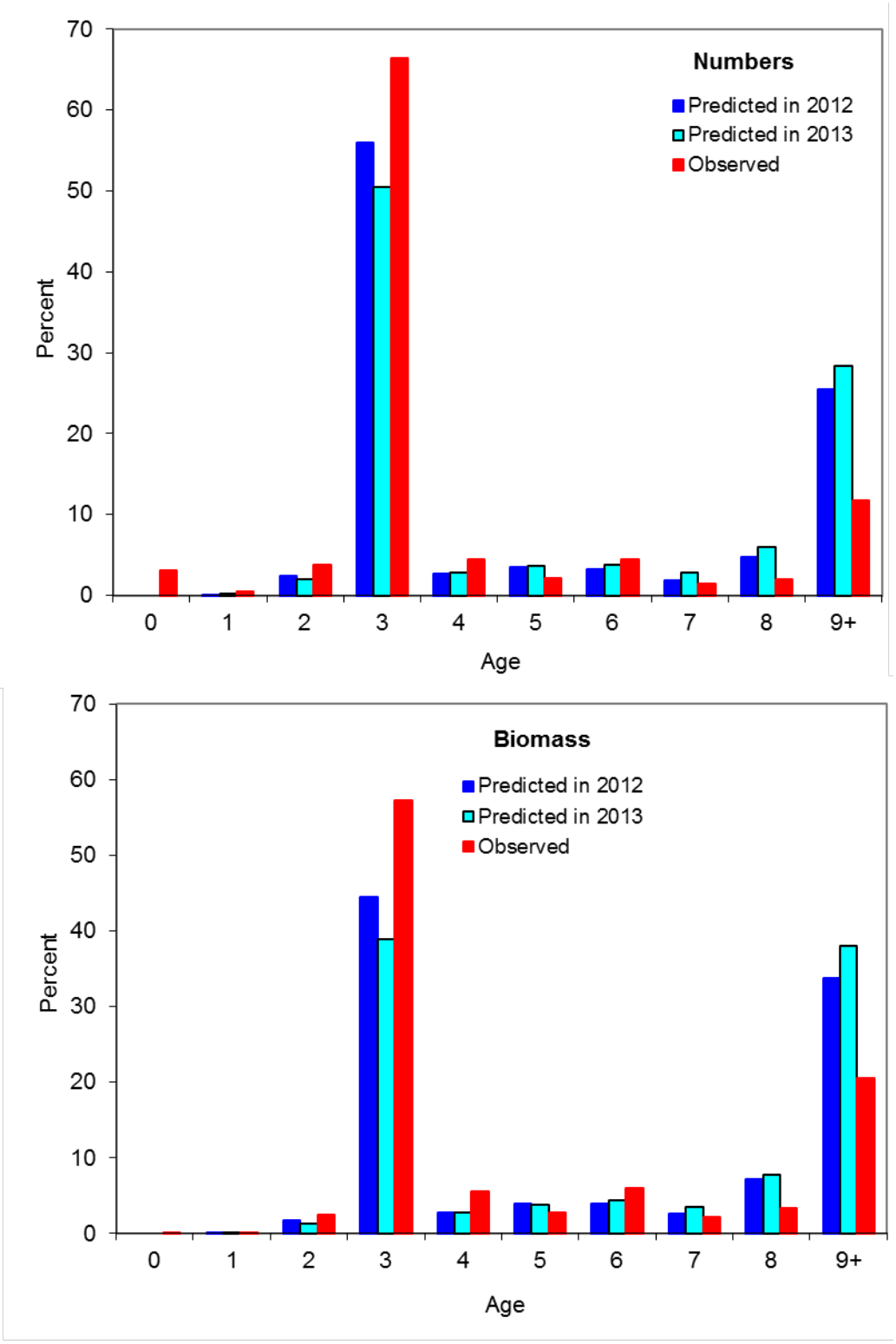


*Figure 11. Percent compostion in numbers and biomass of 2013 observed eastern Georges Bank haddock landings projected in 2012, upon which the quota was based, and in 2013.*

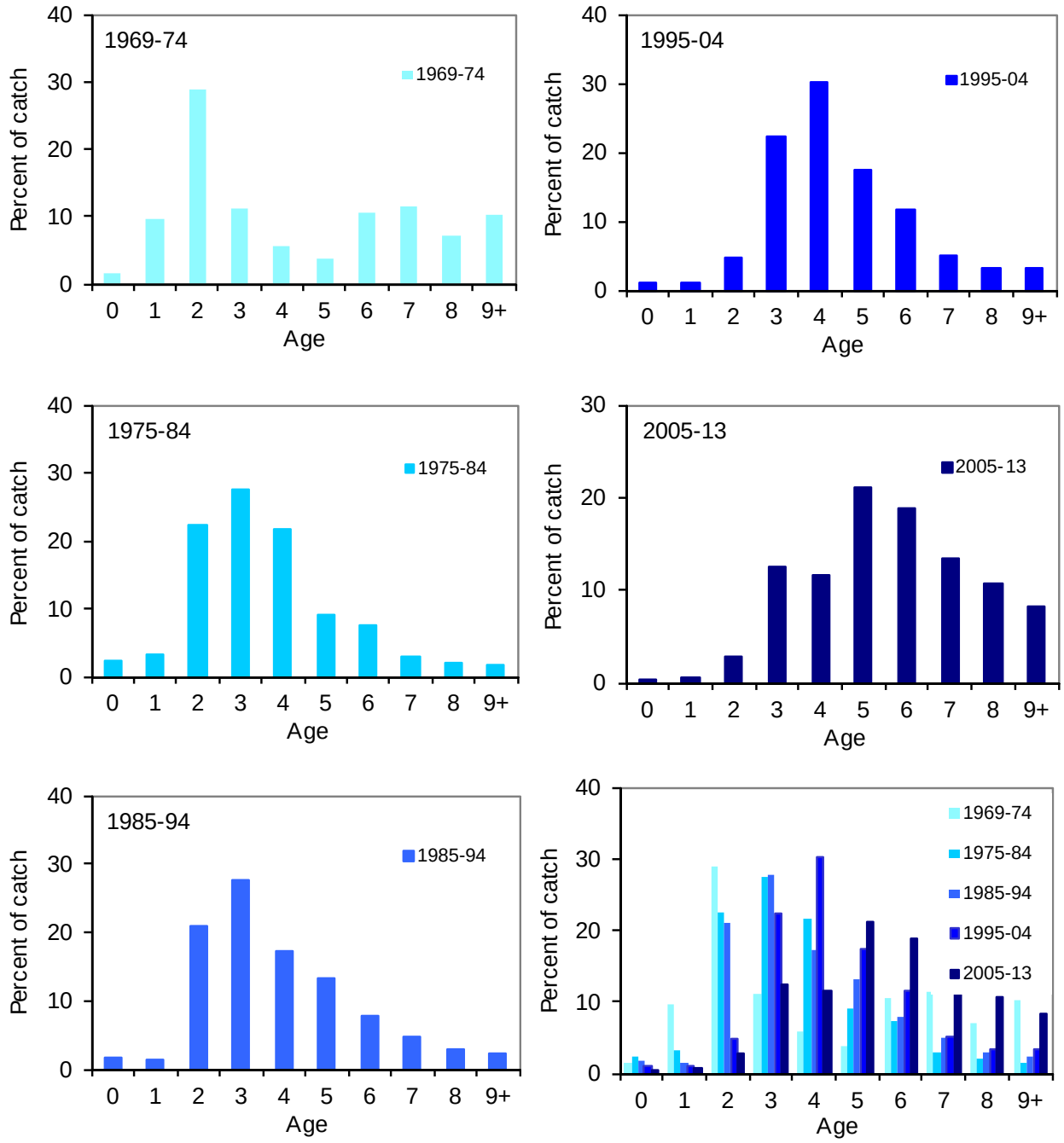


*Figure 12. Average of annual age compositions of the haddock catch for the eastern Georges Bank commercial fishery during 1969-1974, 1975-1984, 1985-1994, 1995-2004, and 2005-2013.*

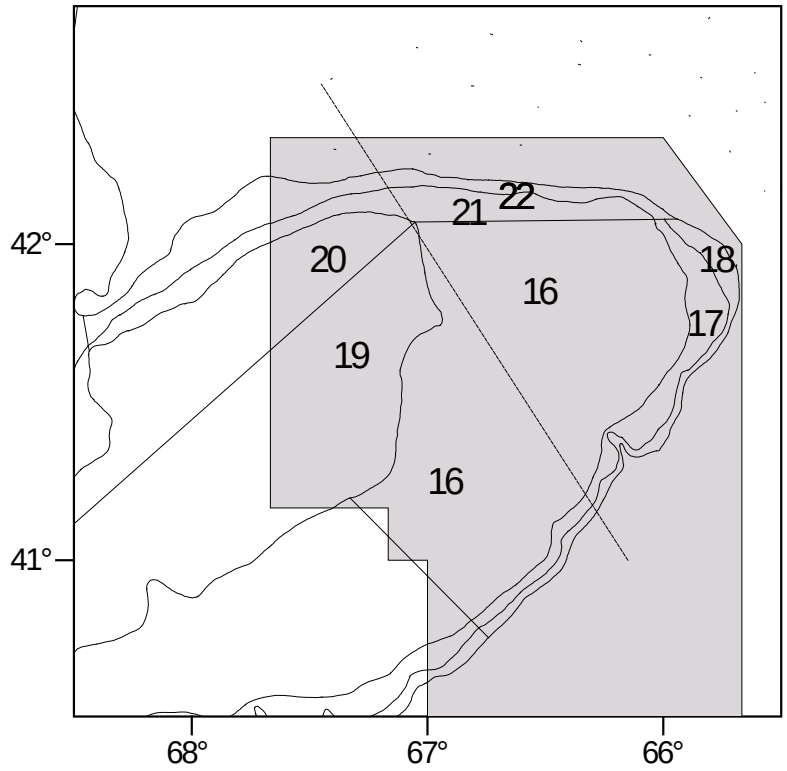


*Figure 13. Stratification scheme used for National Marine Fisheries Service surveys. The eastern Georges Bank management area is indicated by shading.*

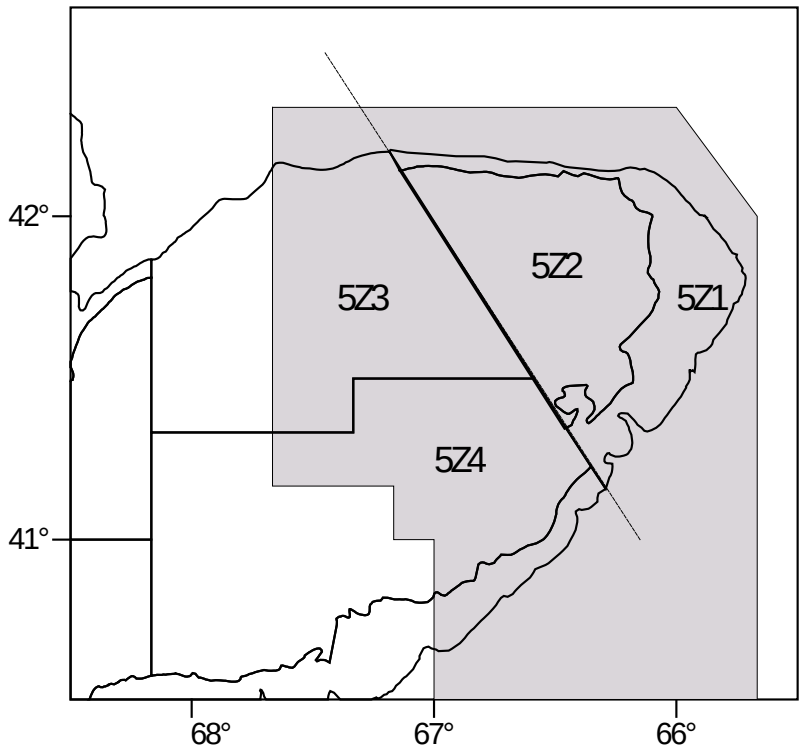


*Figure 14. Stratification scheme used for the Canadian Department of Fisheries and Oceans survey. The eastern Georges Bank management area is indicated by shading.*

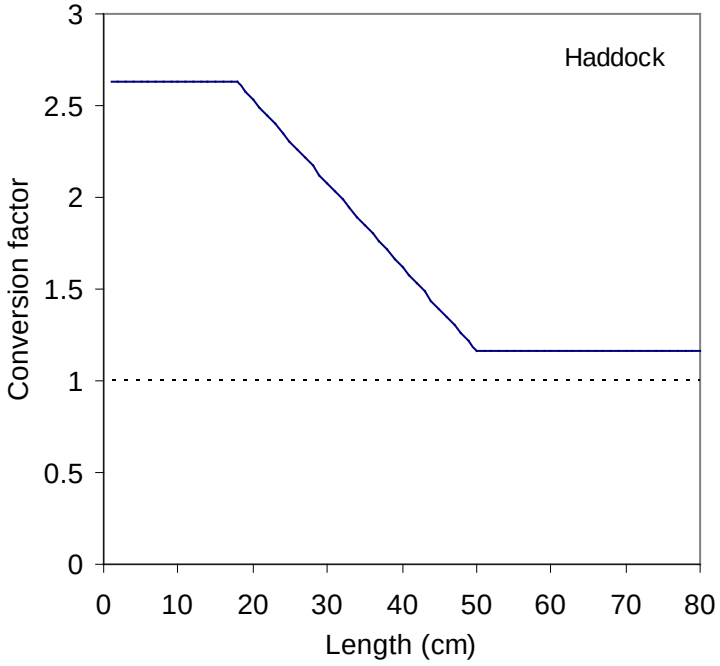


*Figure 15. Conversion factors for NMFS surveys conducted by the Henry B. Bigelow since 2009. Factors are applied by dividing the Bigelow catch at length by the length specific conversion factor to make them equivalent to Albatross IV catches.*

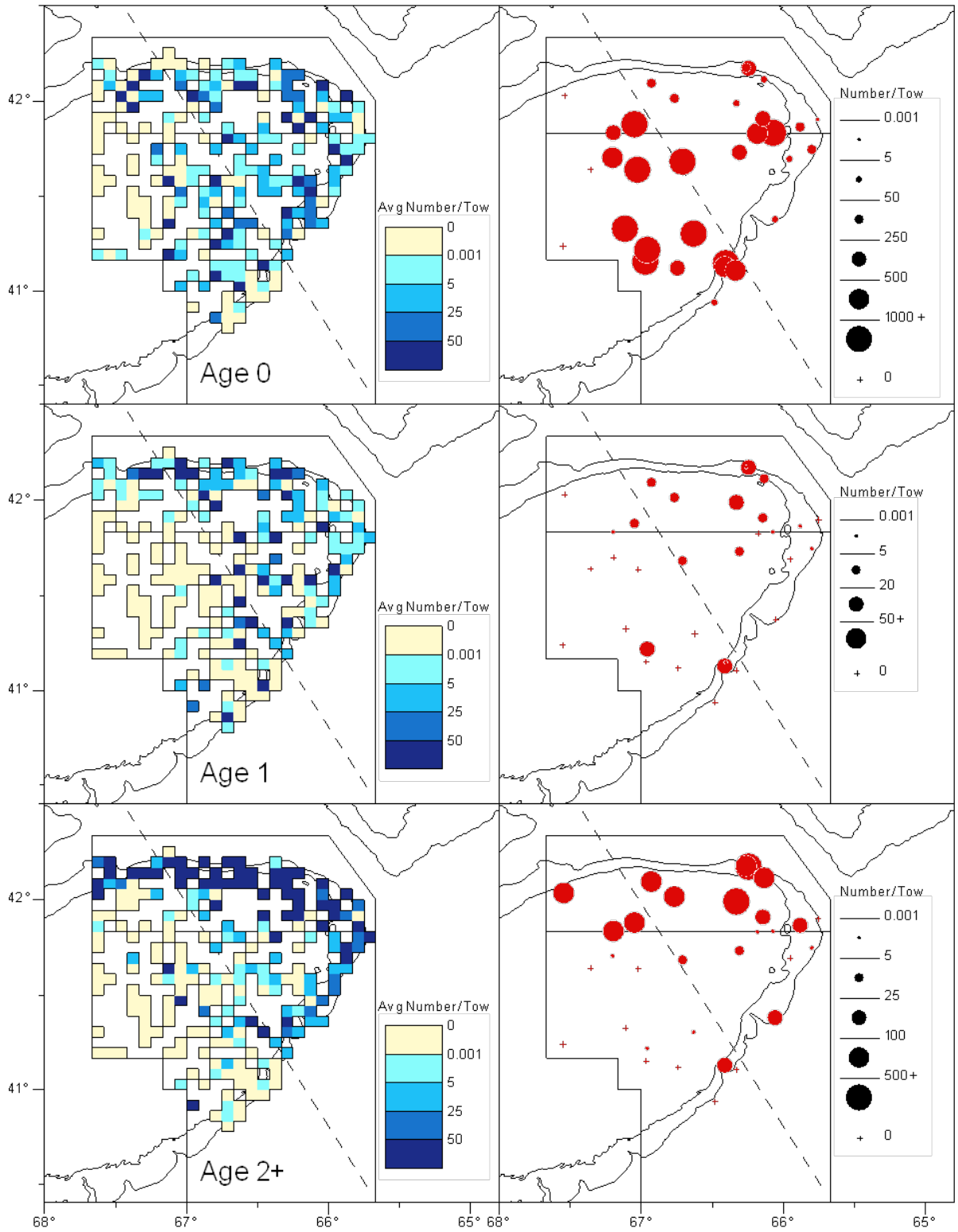


*Figure 16. Distribution of eastern Georges Bank haddock abundance (number/tow) as observed from the National Marine Fisheries Service **fall** survey. The squares (left panels) are shaded relative to the average survey catch for 2003 to 2012. The expanding symbols (right panels) represent the **2013** survey catches. Length based conversion coefficients have been applied since the 2009 survey to make them comparable to surveys undertaken by the Albatross IV.*

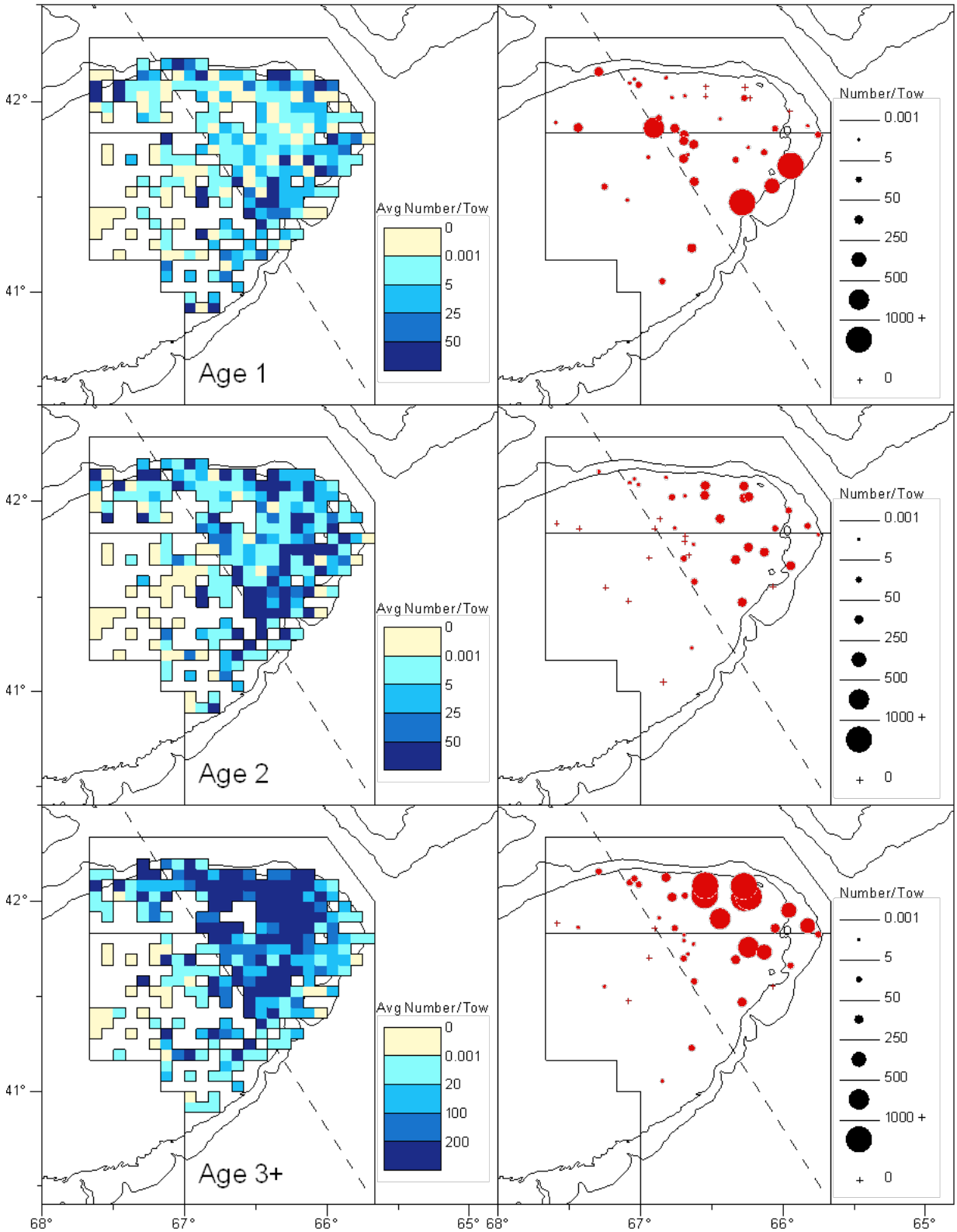


*Figure 17. Distribution of eastern Georges Bank haddock abundance (number/tow) as observed from the Canadian Department of Fisheries and Oceans survey. The squares (left panels) are shaded relative to the average survey catch for 2004 to 2013. The expanding symbols (right panels) represent the **2014** survey catches.*

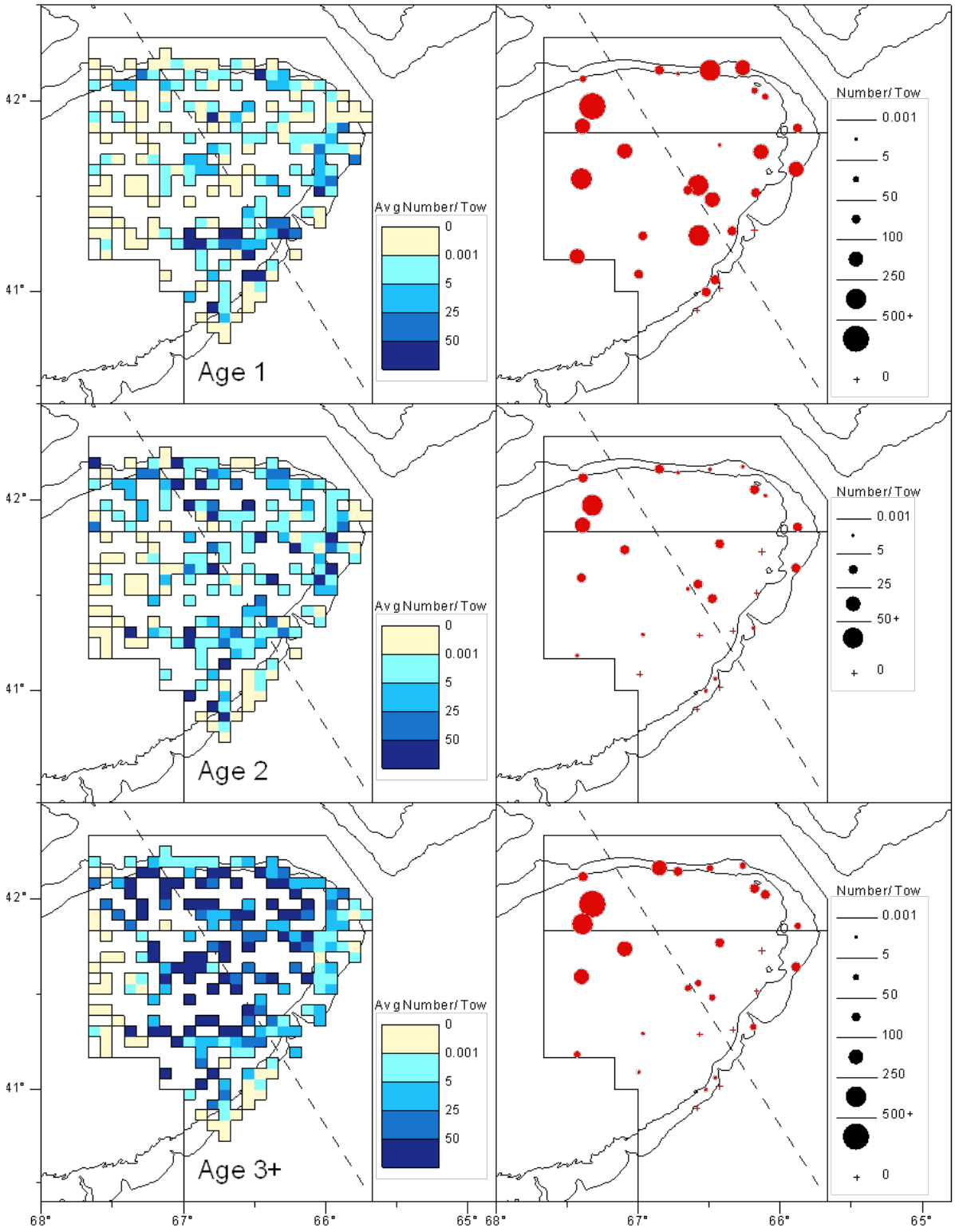


*Figure 18. Distribution of eastern Georges Bank haddock abundance (number/tow) as observed from the National Marine Fisheries Service **spring** survey. The squares (left panels) are shaded relative to the average survey catch for 2004 to 2013. The expanding symbols (right panels) represent the **2014** survey catches. Length based conversion coefficients have been applied since the 2009 survey to make them comparable to surveys undertaken by the Albatross IV.*

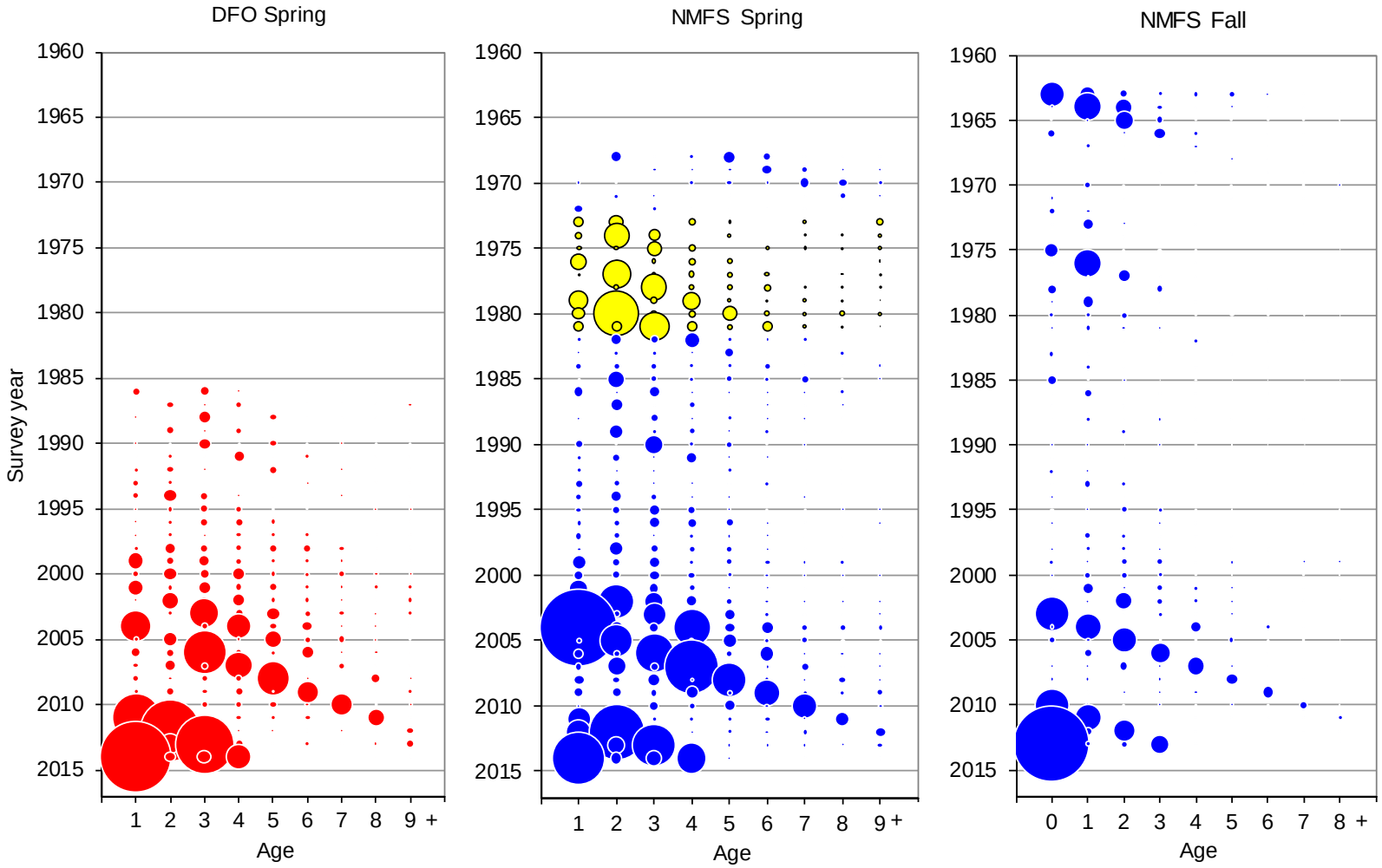


*Figure 19. Estimated abundance at age (numbers in 000's) of eastern Georges Bank haddock for the Canadian Department of Fisheries and Oceans (DFO) for 1986 to 2014, the National Marine Fisheries Service (NMFS) spring survey for 1968 to 2014 and the NMFS fall survey for 1963 to 2013. Bubble area is proportional to magnitude (see Tables 18-20). Conversion factors to adjust for changes in door type and survey vessel were applied to the NMFS surveys. From 1973-81 (yellow circles), a 41 Yankee trawl was used for the NMFS spring survey while a 36 Yankee was used in the other years. Length based conversion coefficients have been applied to the NMFS surveys since the 2009 survey to make them comparable to surveys undertaken by the Albatross IV. Symbol size has not been adjusted between surveys for the catchability of the survey.*

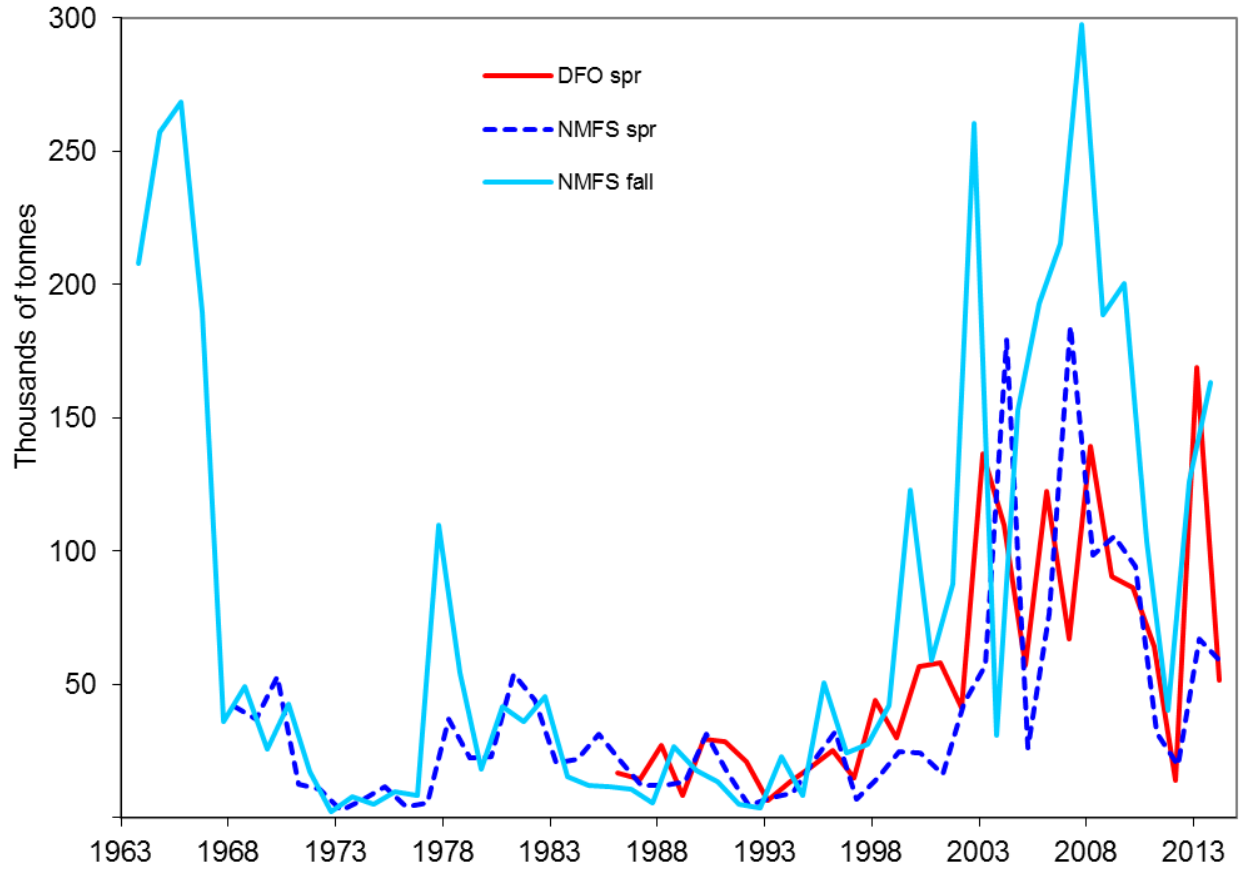


*Figure 20. Biomass from National Marine Fisheries Service (NMFS) fall (ages 2-8), NMFS spring (ages 3-8) and Canadian Department of Fisheries and Oceans (DFO) (ages 3-8) research surveys for eastern Georges Bank haddock during 1963-2013, 1968-2014, 1986-2014, respectively (scaled by calibration constants). Conversion factors to adjust for changes in door type and survey vessel were applied to the NMFS surveys. From 1973-81 a 41 Yankee trawl was used for the NMFS spring survey while a 36 Yankee was used in the other years. Length based conversion coefficients have been applied to the NMFS surveys since the 2009 survey to make them comparable to surveys undertaken by the Albatross IV.*

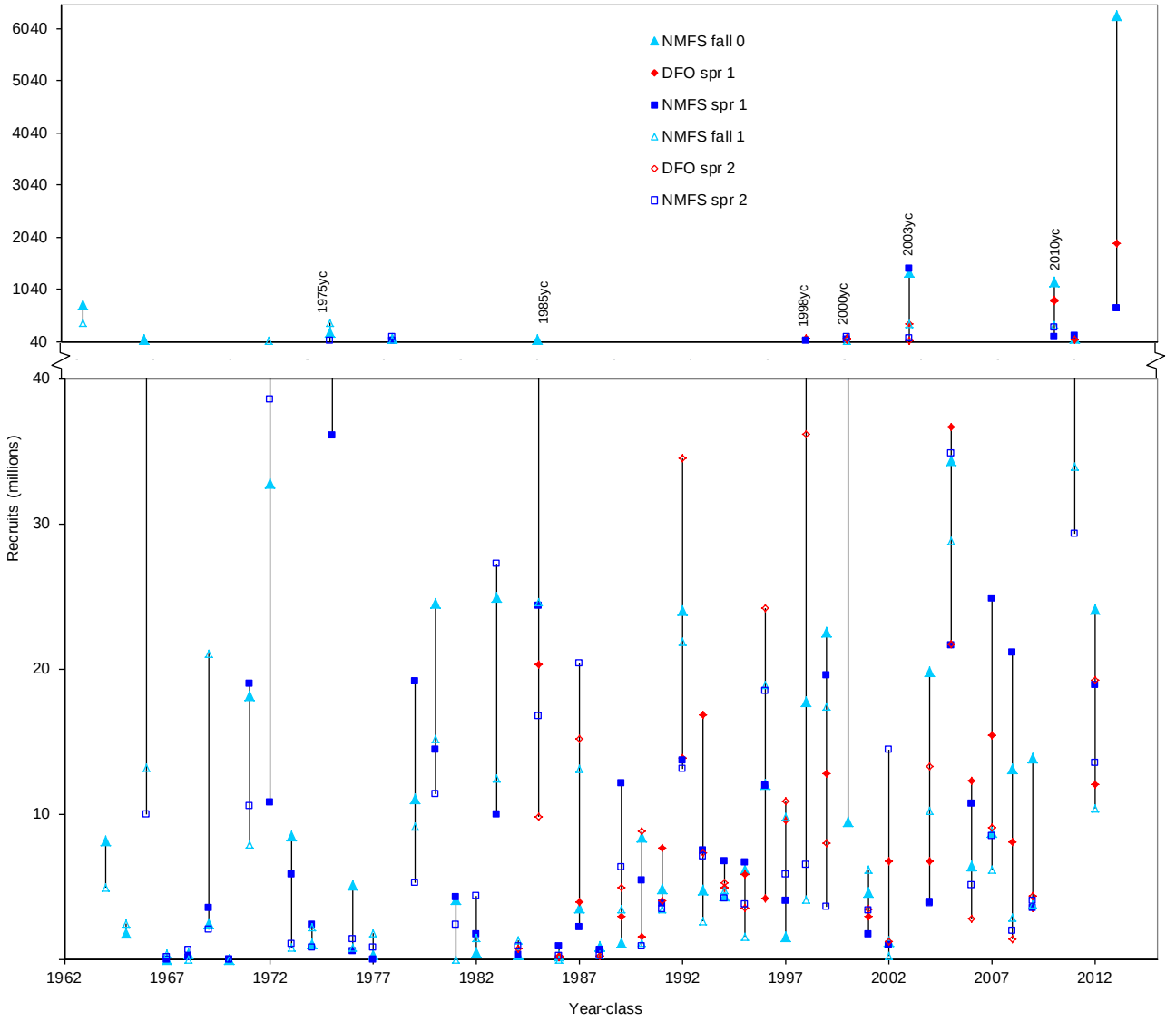


*Figure 21. Year-class abundance for ages 0 and 1 from the National Marine Fisheries Service (NMFS) fall survey for 1963-2013 and ages 1 and 2 from the NMFS spring survey for 1968-2014 and the Canadian Department of Fisheries and Oceans (DFO) research survey for 1986-2014 (scaled by calibration constants) for eastern Georges Bank haddock. Conversion factors to adjust for changes in door type and survey vessel were applied to the NMFS surveys. From 1973-81 a 41 Yankee trawl was used for the NMFS spring survey while a 36 Yankee was used in the other years. Length based conversion coefficients have been applied to the NMFS surveys since the 2009 survey to make them comparable to surveys undertaken by the Albatross IV.*

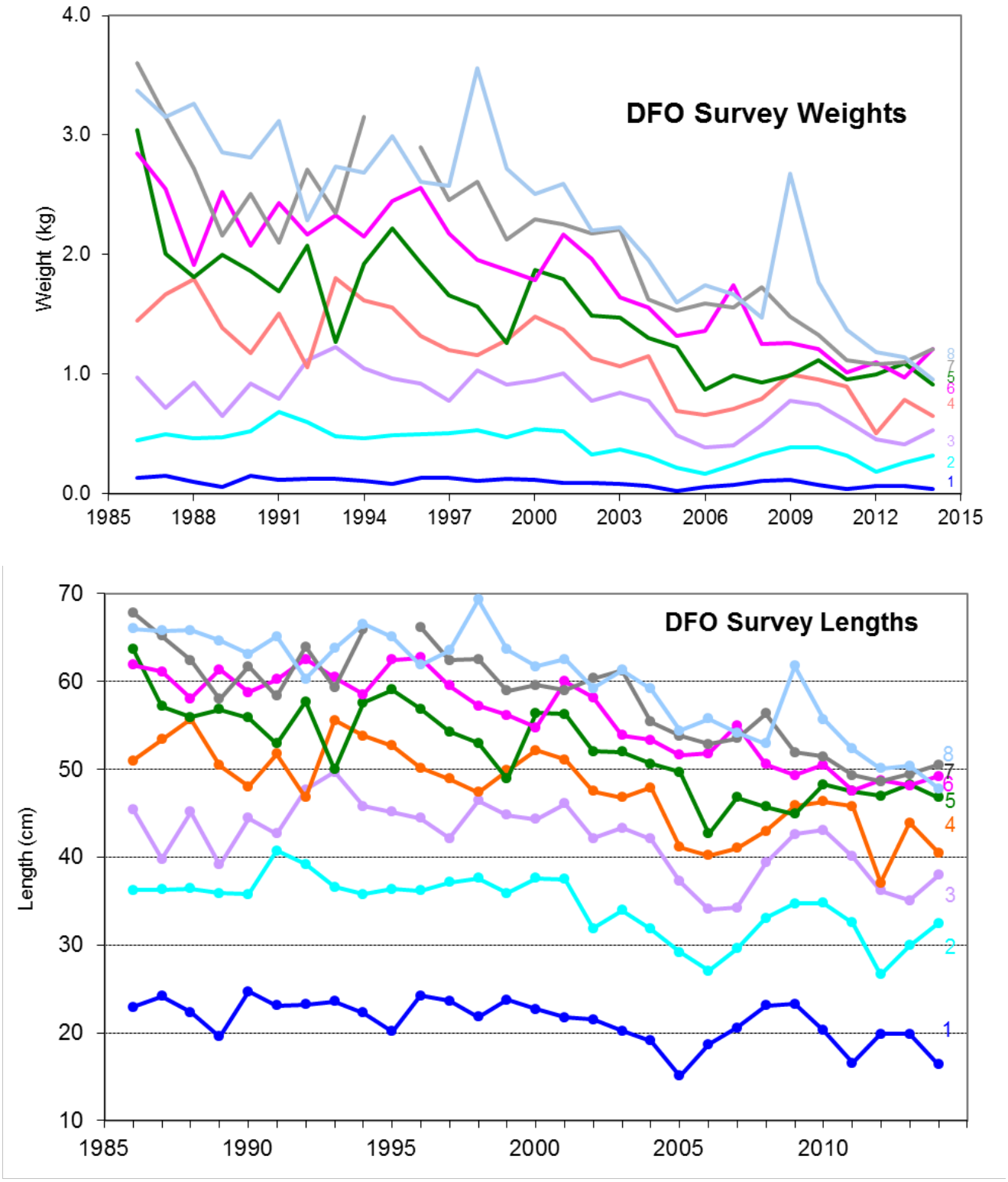


*Figure 22. Average weights (upper panel) and lengths (lower panel) at age for eastern Georges Bank haddock derived from Canadian Department of Fisheries and Oceans surveys during 1986-2014.*

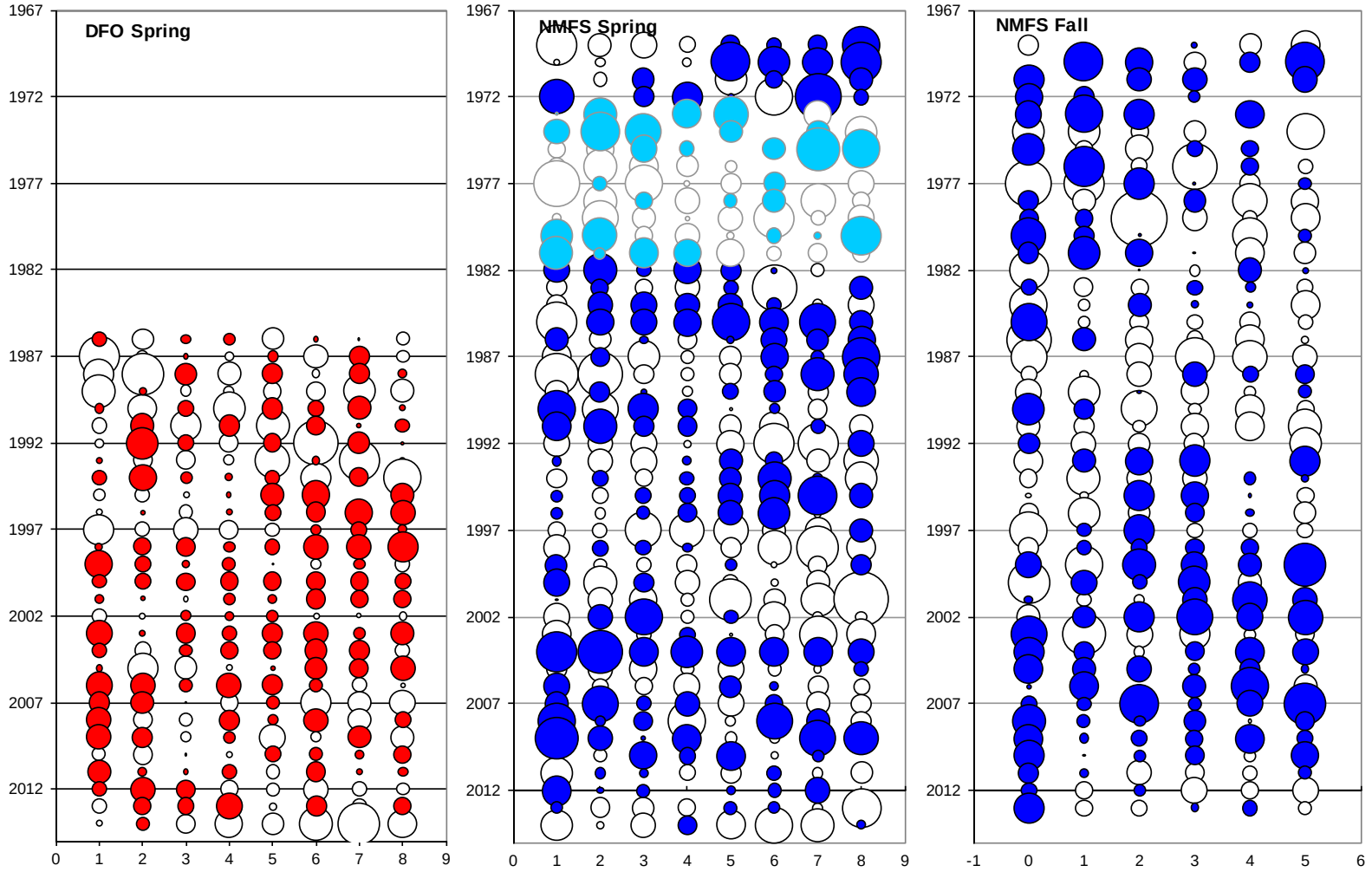


*Figure 23. Residuals of survey abundance indices, by year and age group, from the Canadian Department of Fisheries and Oceans (DFO) research survey 1986 to 2014 and the National Marine Fisheries Service (NMFS) spring and autumn surveys during 1969 to 2014 and 1969 to 2013, respectively, for eastern Georges Bank haddock. Solid symbols indicate positive values, open symbols indicate negative values. Bubble area is proportional to magnitude. From 1973-81 (light blue circles), a Yankee 41 trawl was used for the NMFS spring survey while a Yankee 36 trawl was used in the other years.*

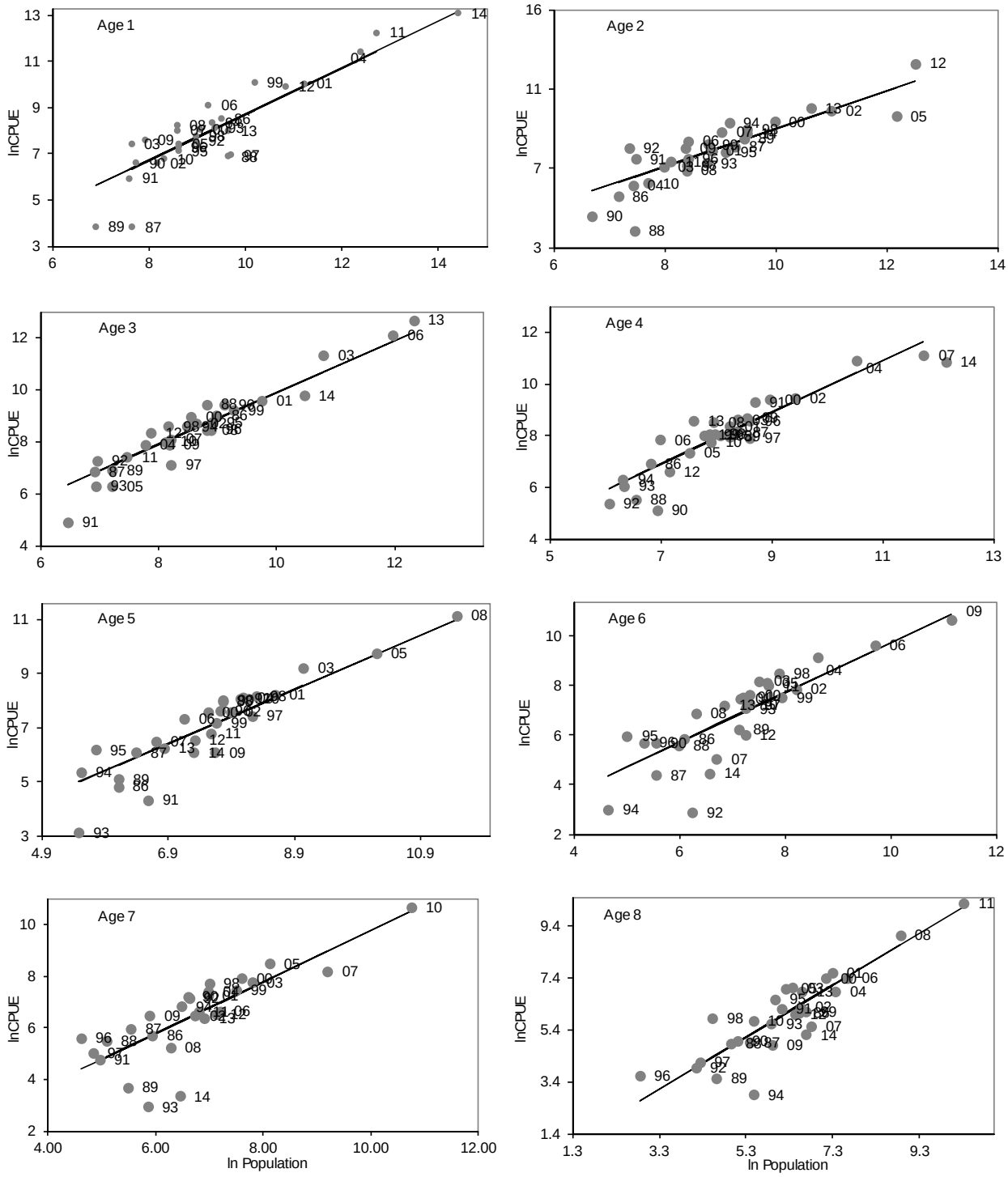


*Figure 24. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for eastern Georges Bank haddock from the Department of Fisheries and Oceans survey during 1986-2014.*

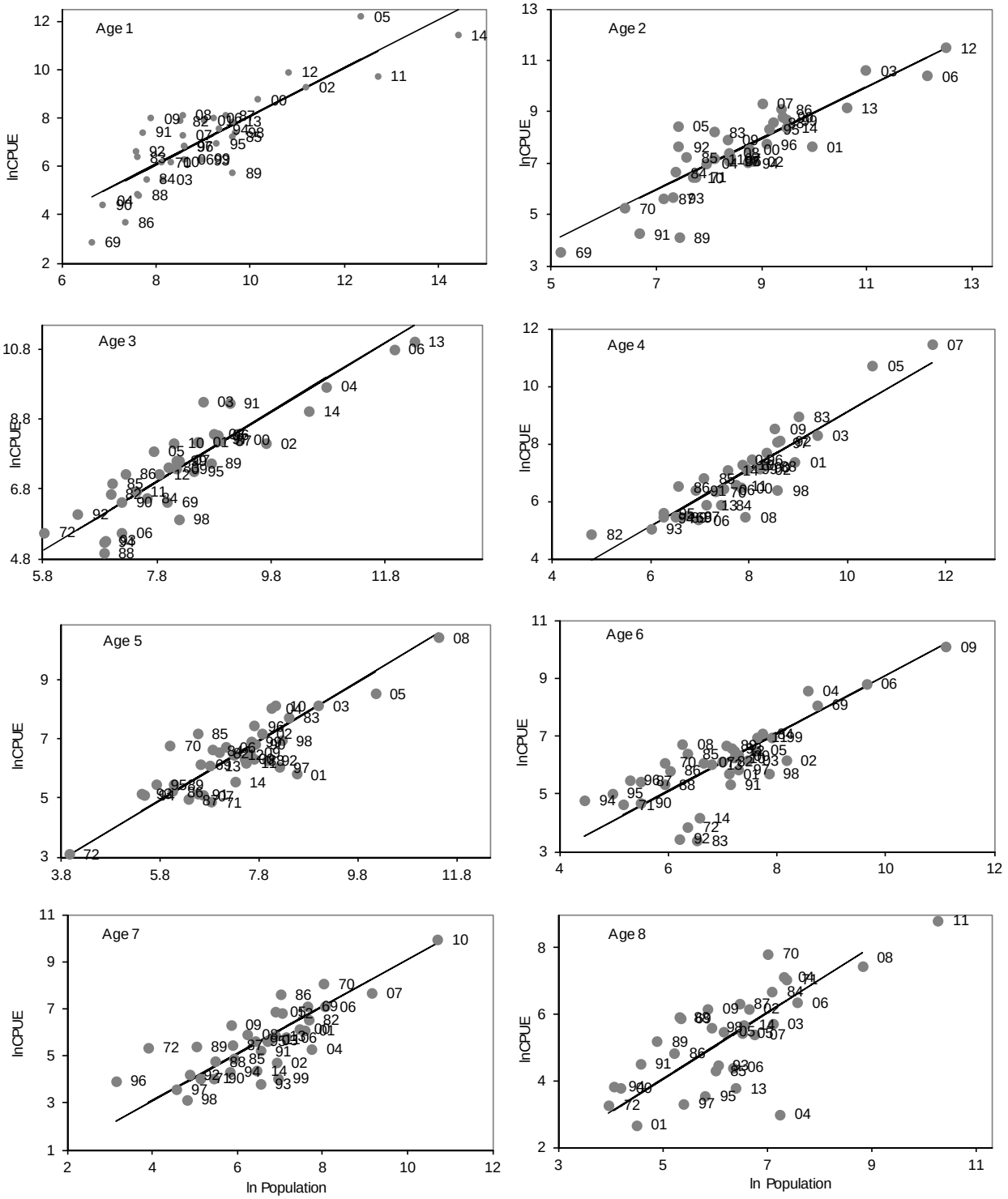


*Figure 25. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for eastern Georges Bank haddock from the National Marine Fisheries Service **spring** survey with a Yankee 36 net during 1969-1972 and 1982-2014.*

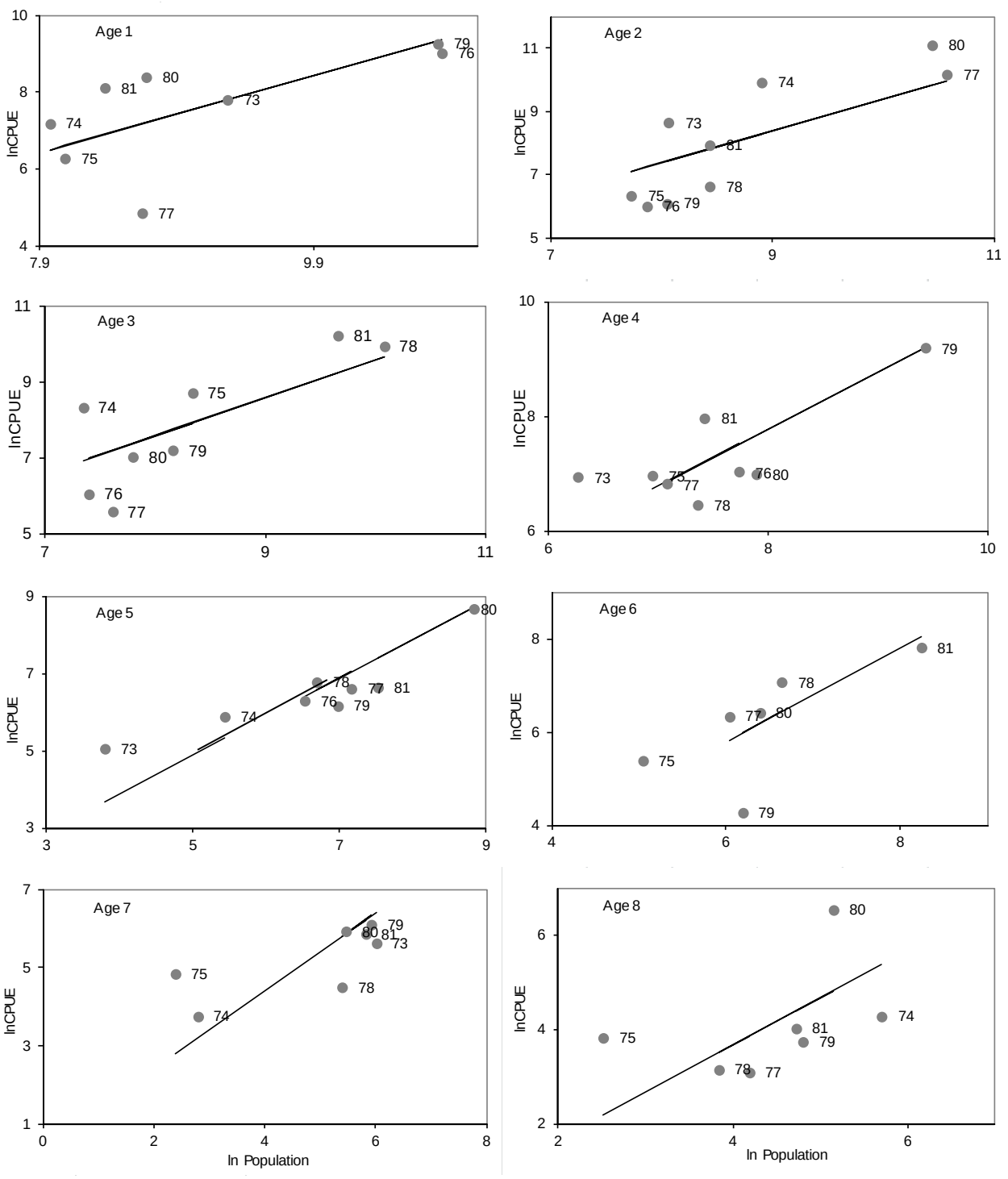


*Figure 26. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for eastern Georges Bank haddock from the National Marine Fisheries Service **spring** survey with a Yankee 41 net during 1973-1981.*

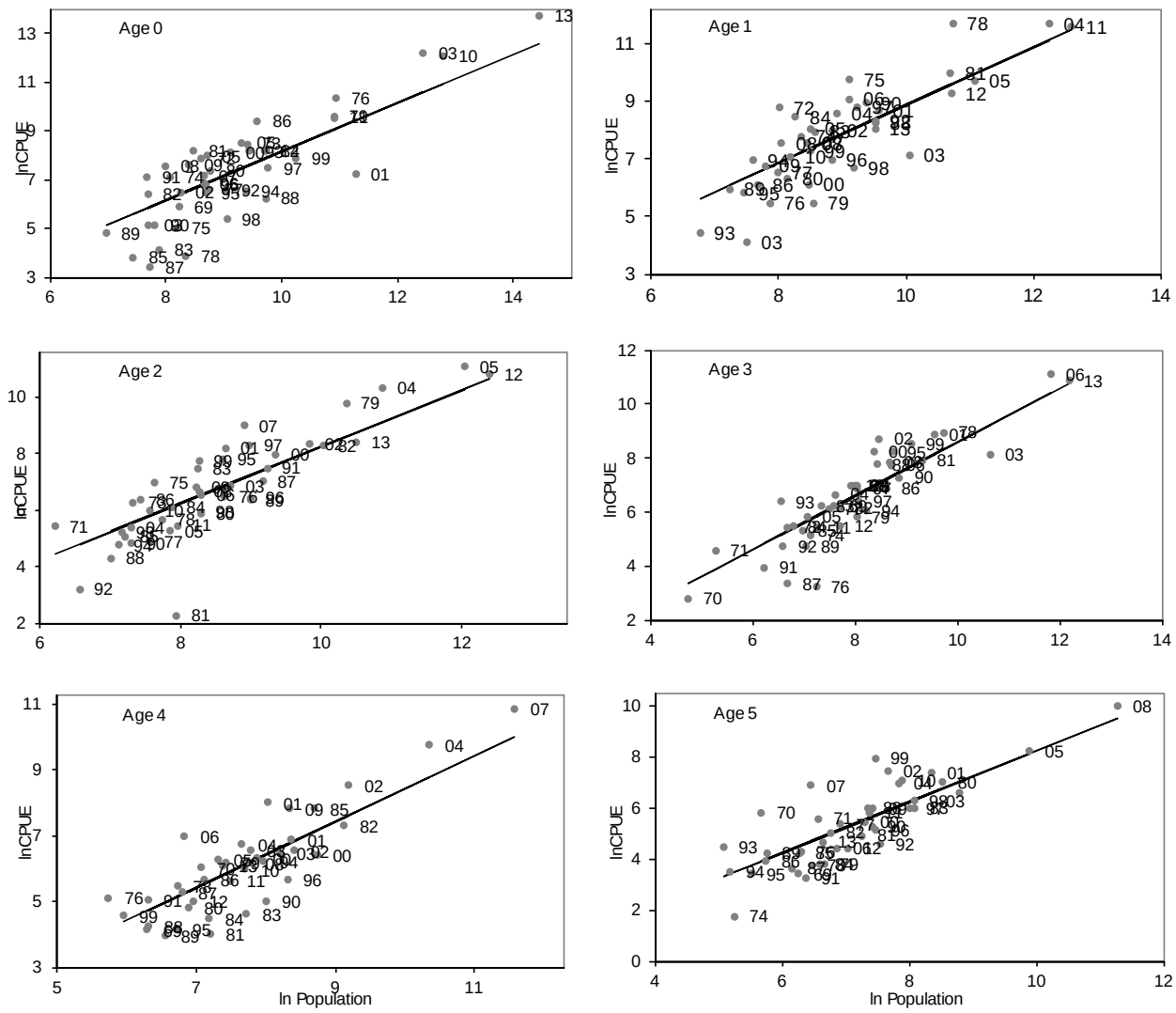


*Figure 27. Age by age plots of the observed and predicted ln abundance index versus ln population numbers for eastern Georges Bank haddock from the National Marine Fisheries Service **fall** survey 1969-2013.*

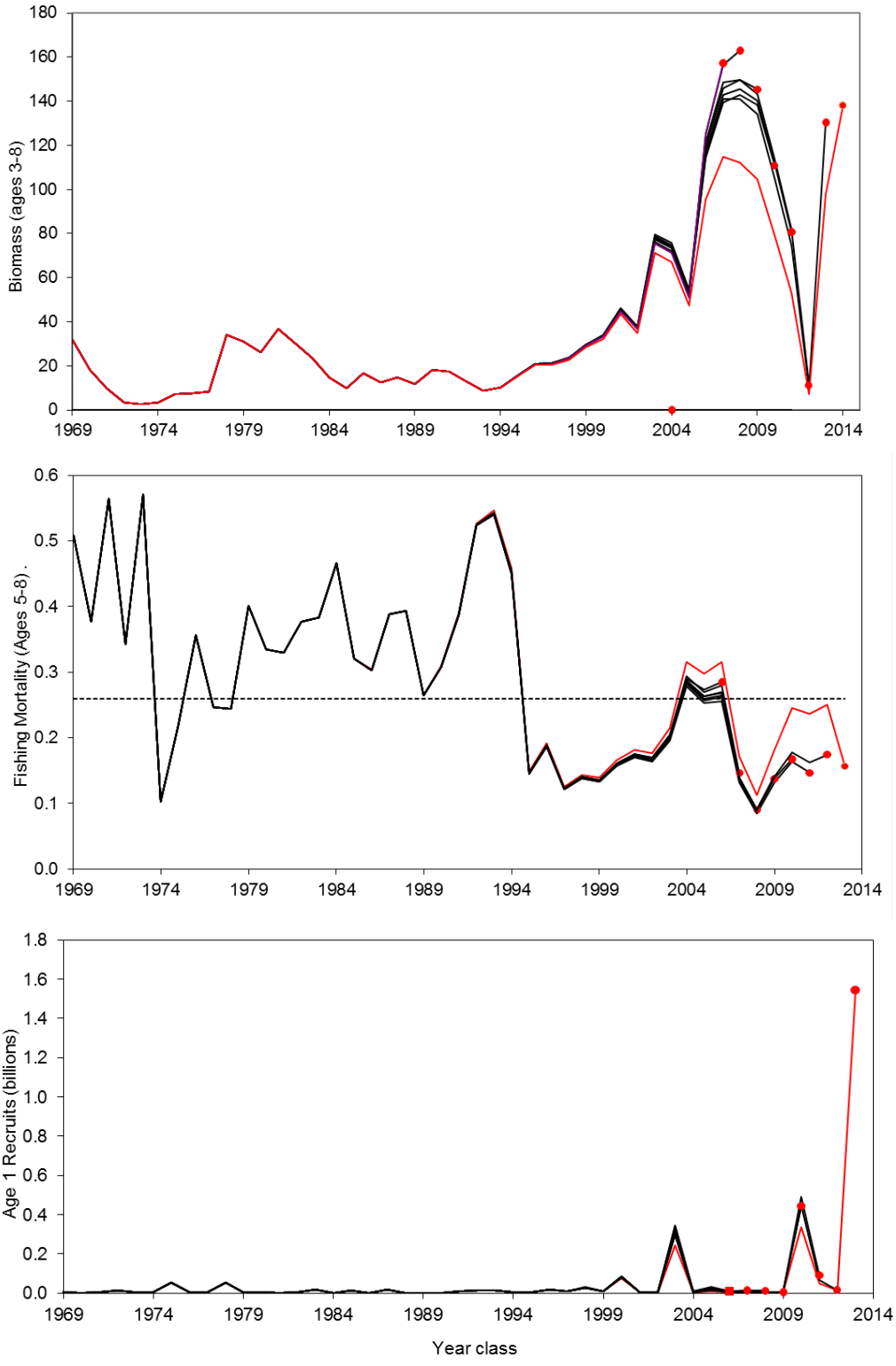


*Figure 28. Retrospective results from virtual population analysis of eastern Georges Bank haddock for biomass (ages 3-8), fishing mortality (ages 5-8) and recruits (age 1) as successive years of data are excluded in the assessment. The present assessment (2014) is indicated in red.*

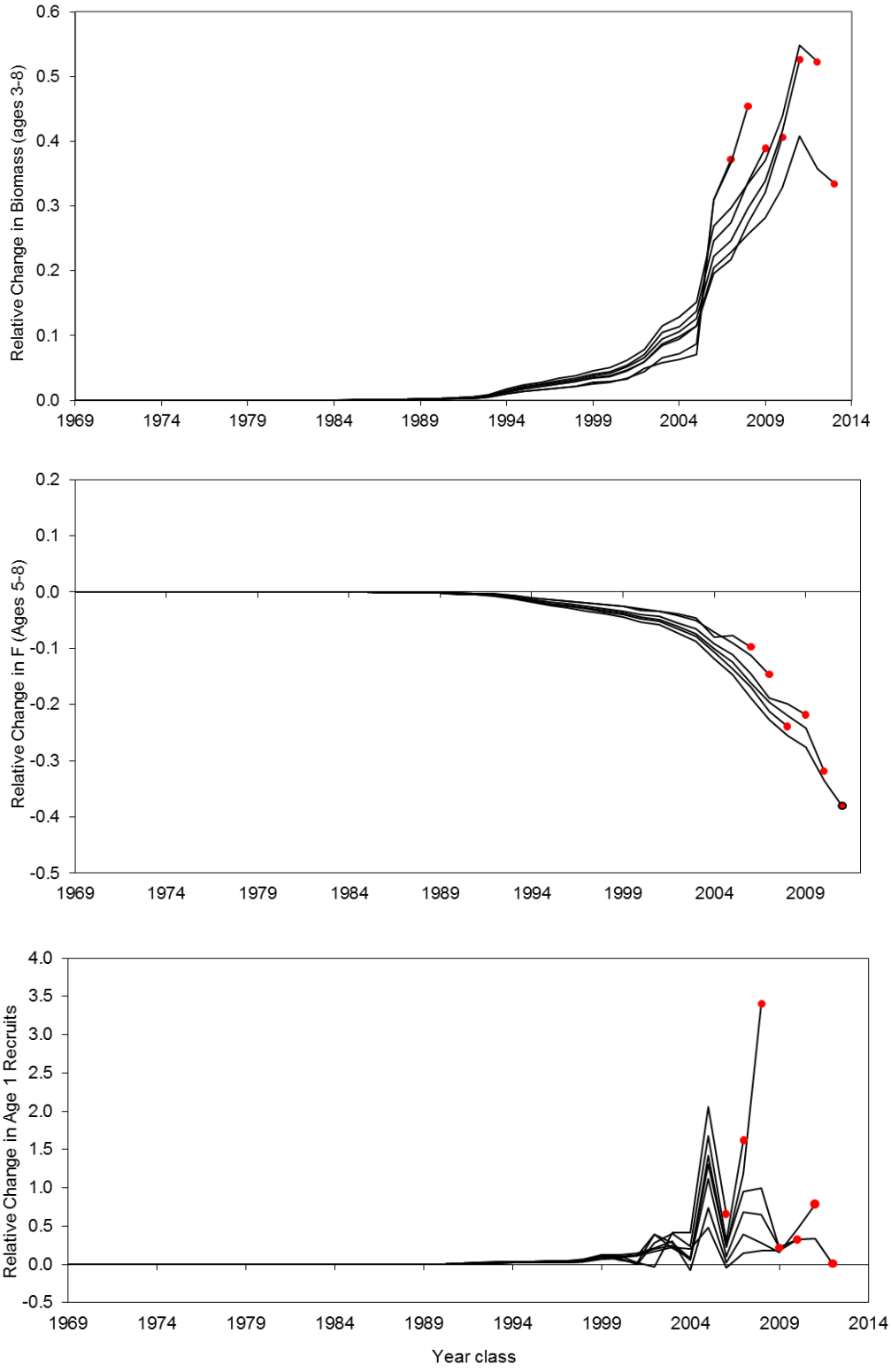


*Figure 29. Relative retrospective results from virtual population analysis of eastern Georges Bank haddock for biomass (ages 3-8), fishing mortality (ages 5-8) and recruits (age 1) as successive years of data are excluded in the assessment. Differences are relative to the 2014 assessment.*

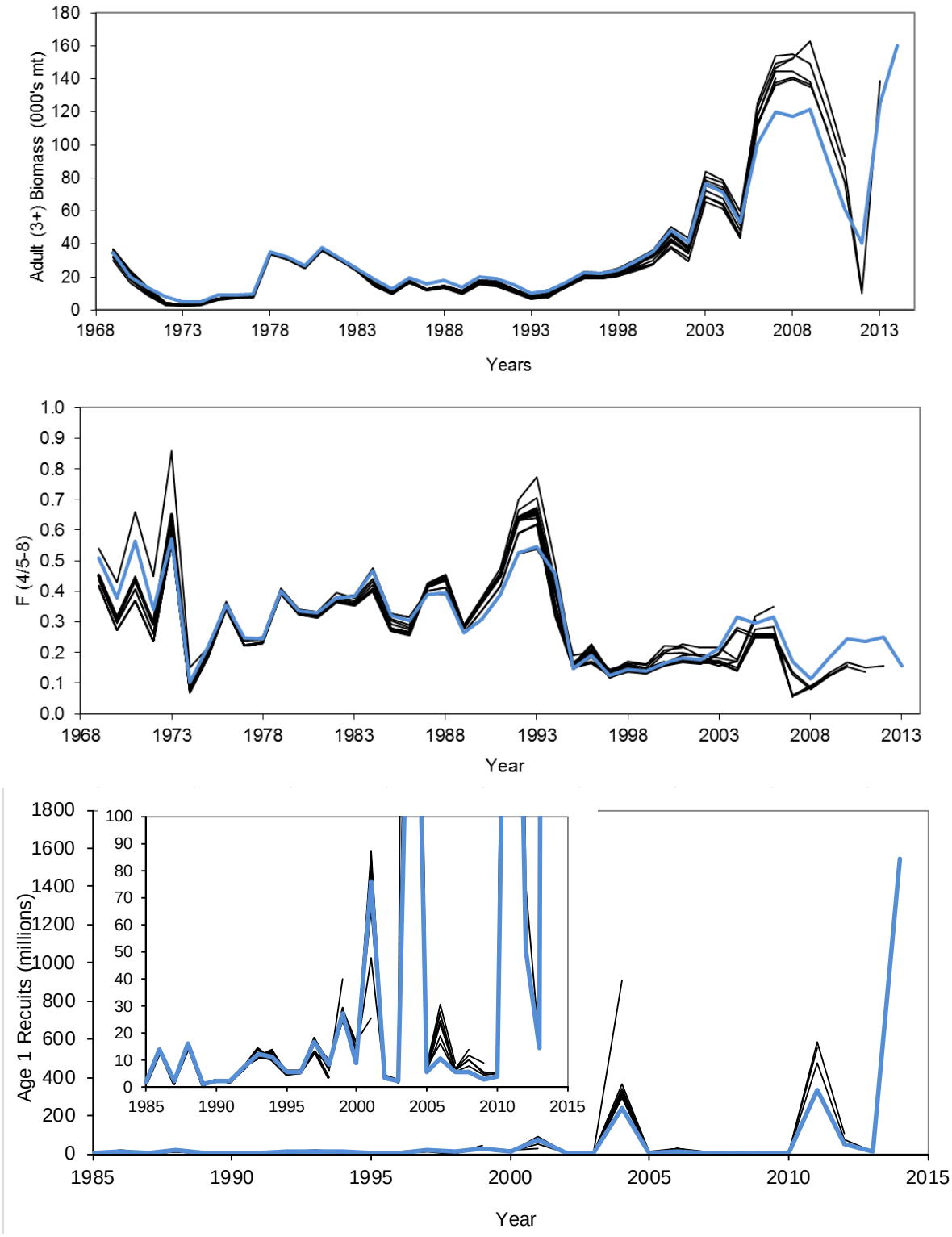


*Figure 30. Historical retrospective analysis of 1969 to 2014 3+ biomass (top panel), age 4/5-8 population weighted fishing mortality (middle panel) and 1984 to 2013 recruitment (lower panel) from the 1998 to 2014 eastern Georges Bank haddock assessments. The insert in the lower panel is an expansion of the 0 to 100 million recruitment axis. The 1998 assessment is the last benchmark. The 2014 assessment is indicated in blue.*

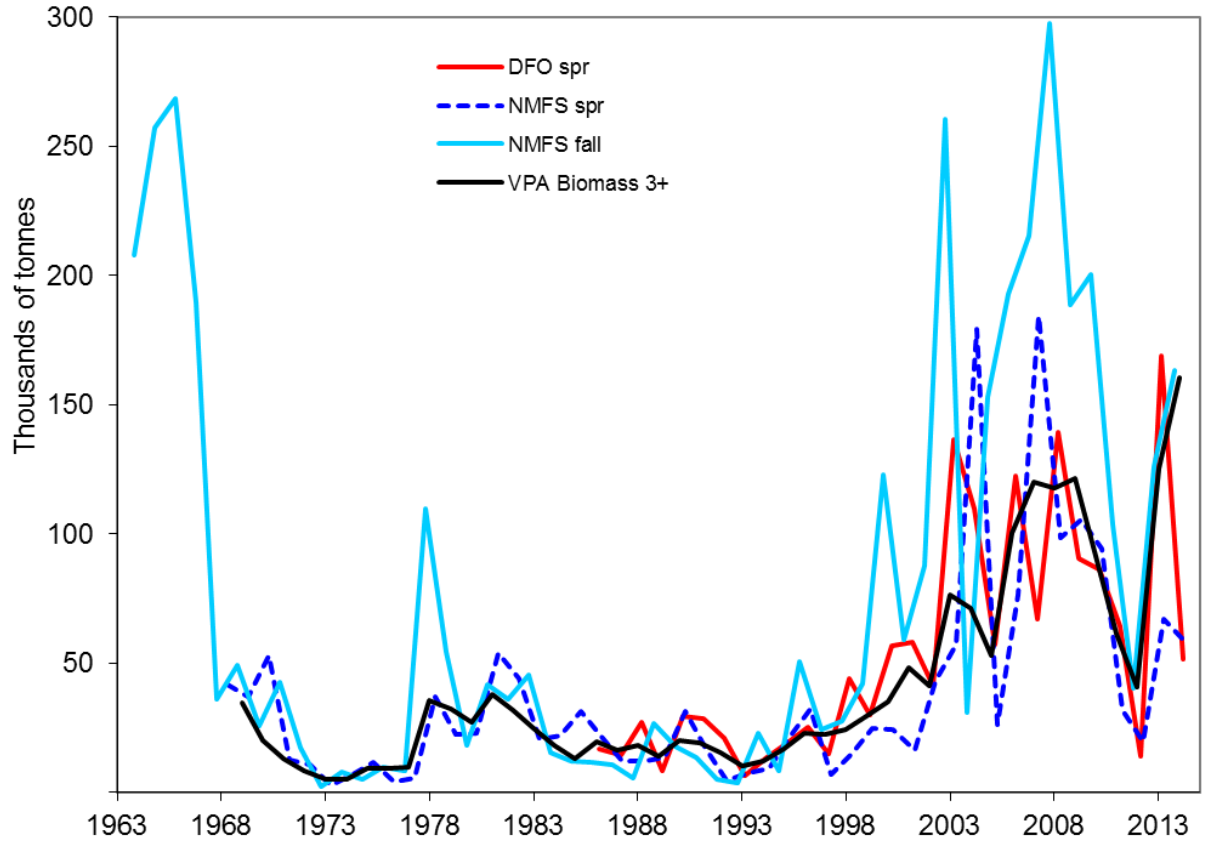


*Figure 31. The 1969 to 2014 eastern Georges Bank adult haddock (ages 3+) biomass trend from virtual population analysis compared with the survey adult biomass (scaled with catchabilities) trends.*

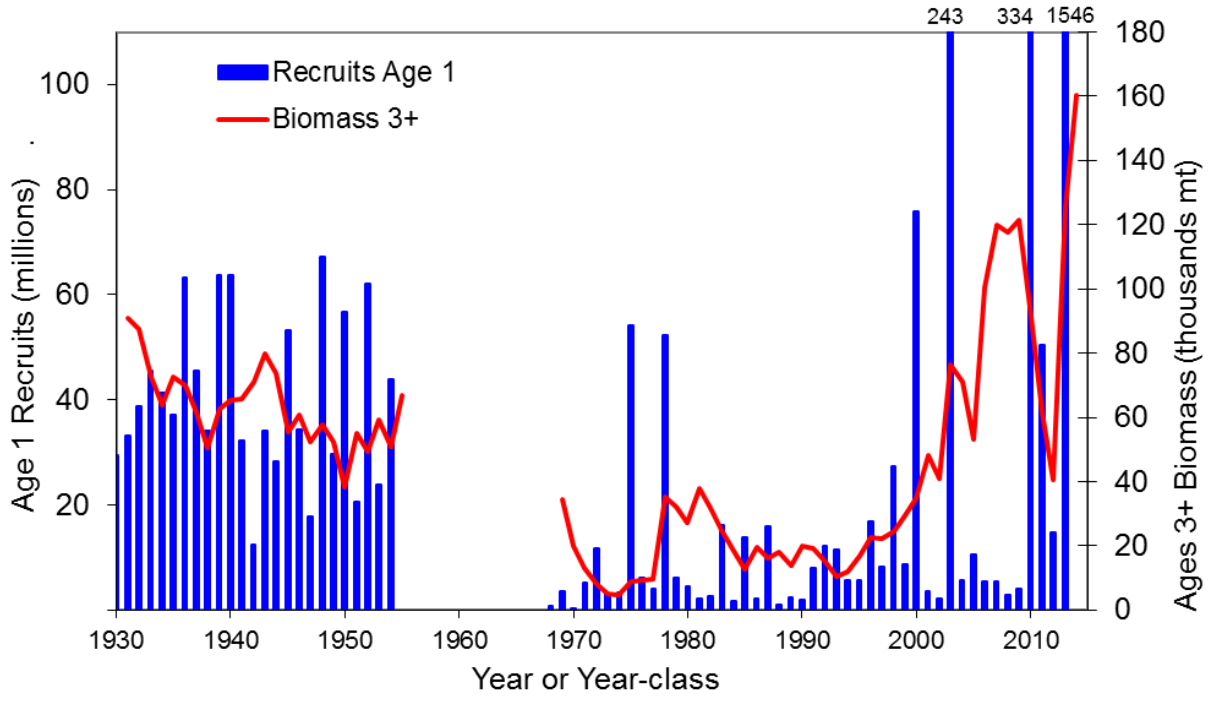


*Figure 32. Beginning of year adult (3+) biomass and number of age 1 recruits for eastern Georges Bank haddock during 1931-1955 and 1969-2014.*

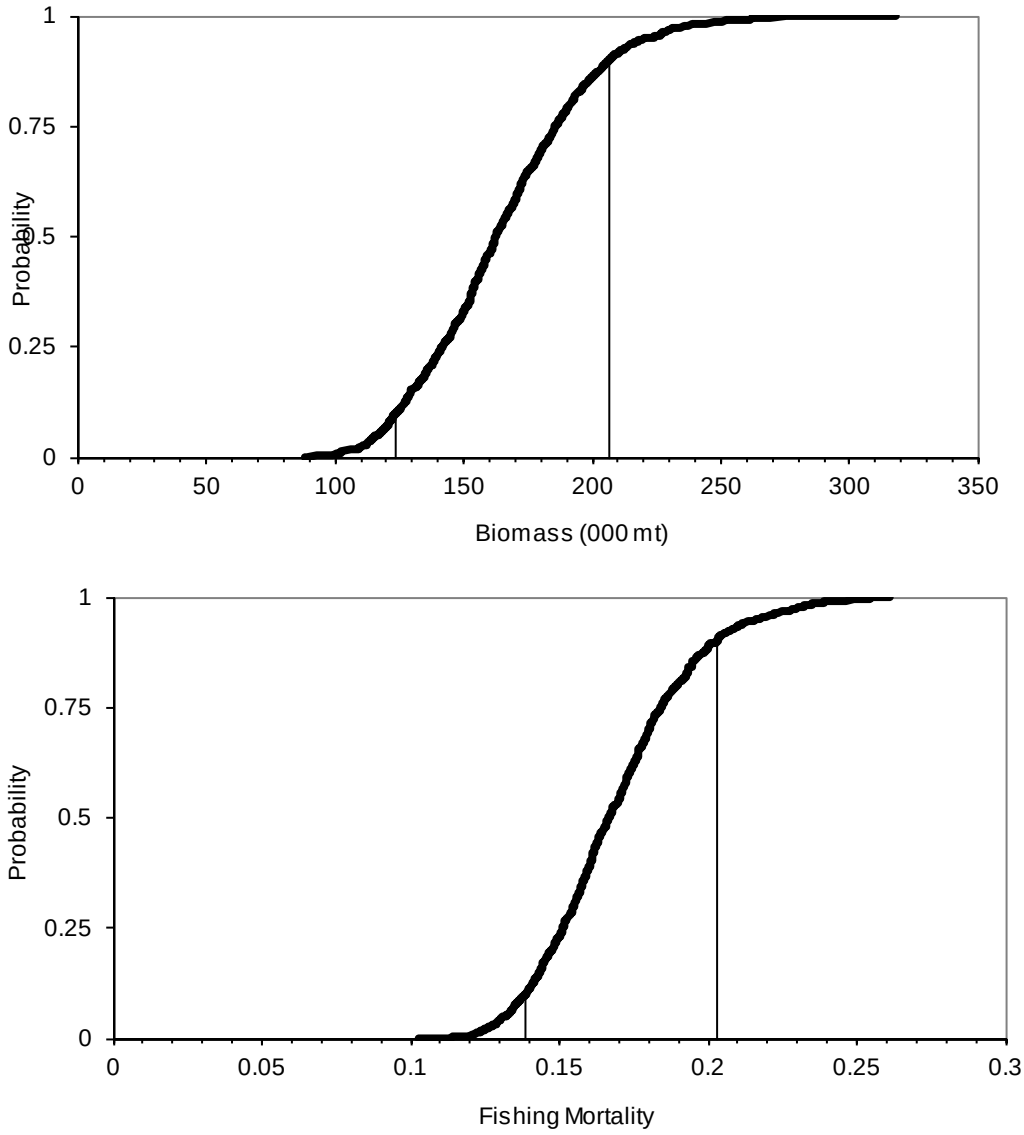


*Figure 33. Cumulative probability distribution with 80% confidence intervals for 2014 age 3+ biomass (000 mt) and 2013 age 5-8 fishing mortality for eastern Georges Bank haddock.*

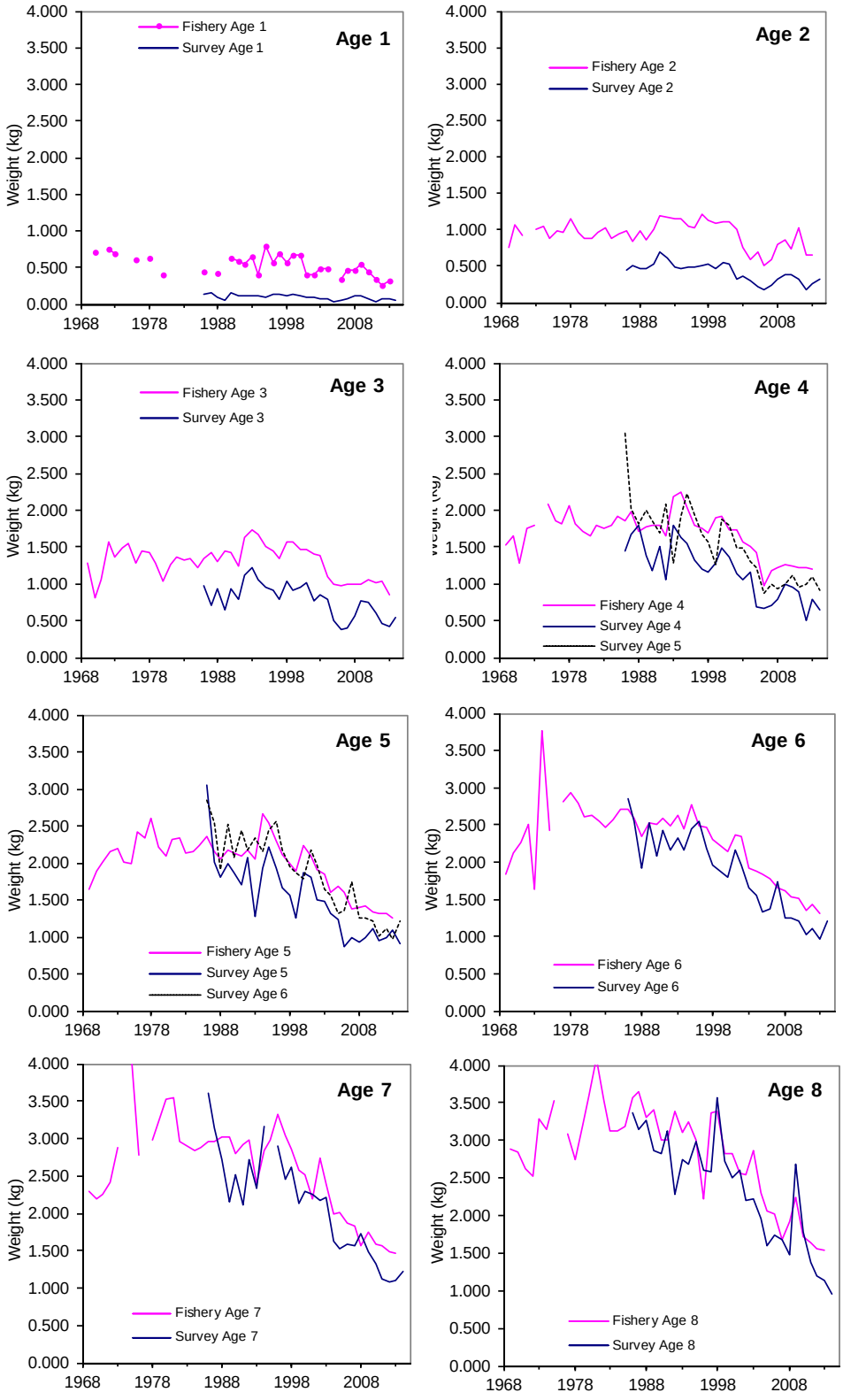


*Figure 34. Average weights at age for eastern Georges Bank haddock from the Canada/USA commercial groundfish fishery during 1969-2013 and from the Canadian Department of Fisheries and Oceans survey during 1986-2014.*

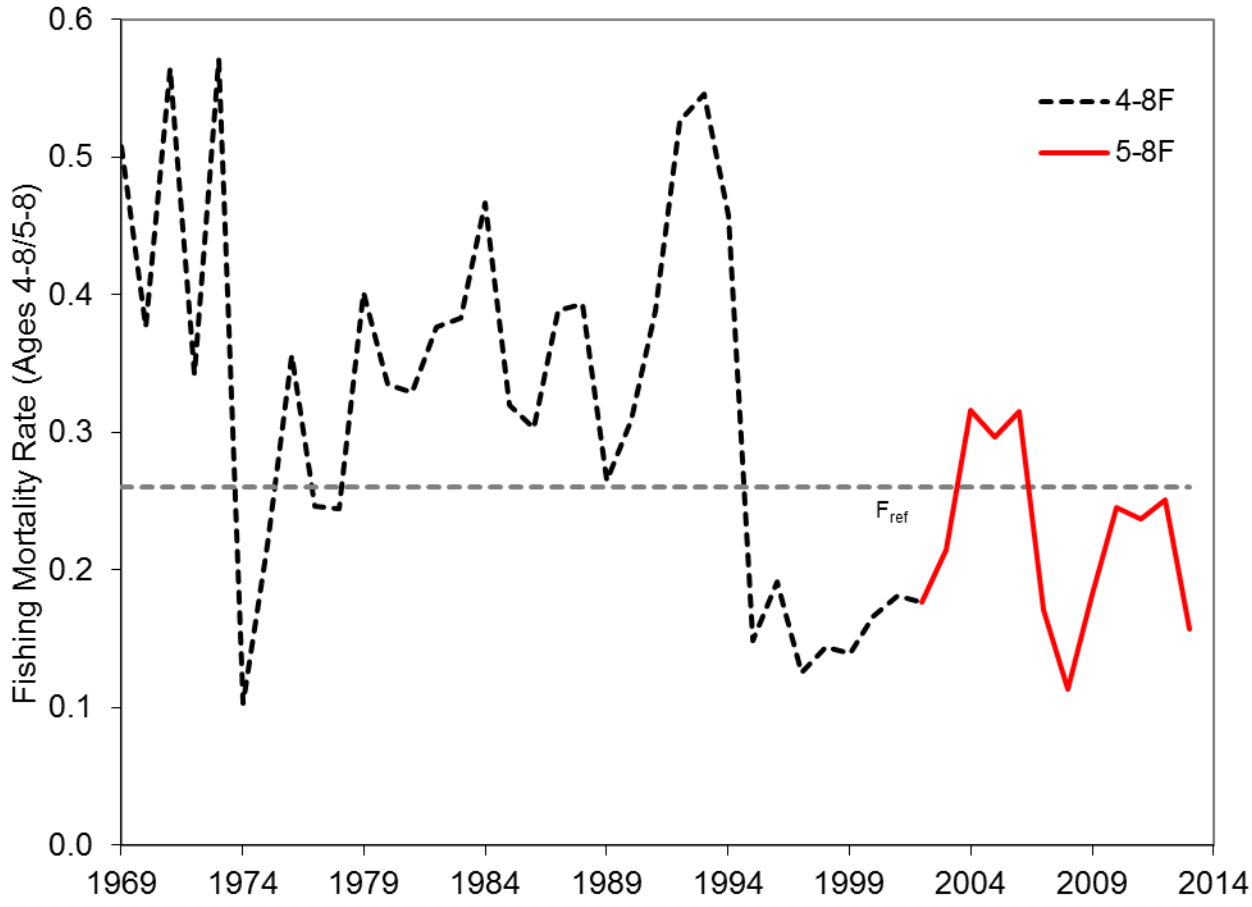


*Figure 35. Fishing mortality rate (weighted by population) for eastern Georges Bank haddock ages 4+ and 5+ during 1969-2013 and the fishing mortality threshold reference established at $F_{ref}$ = 0.26.*

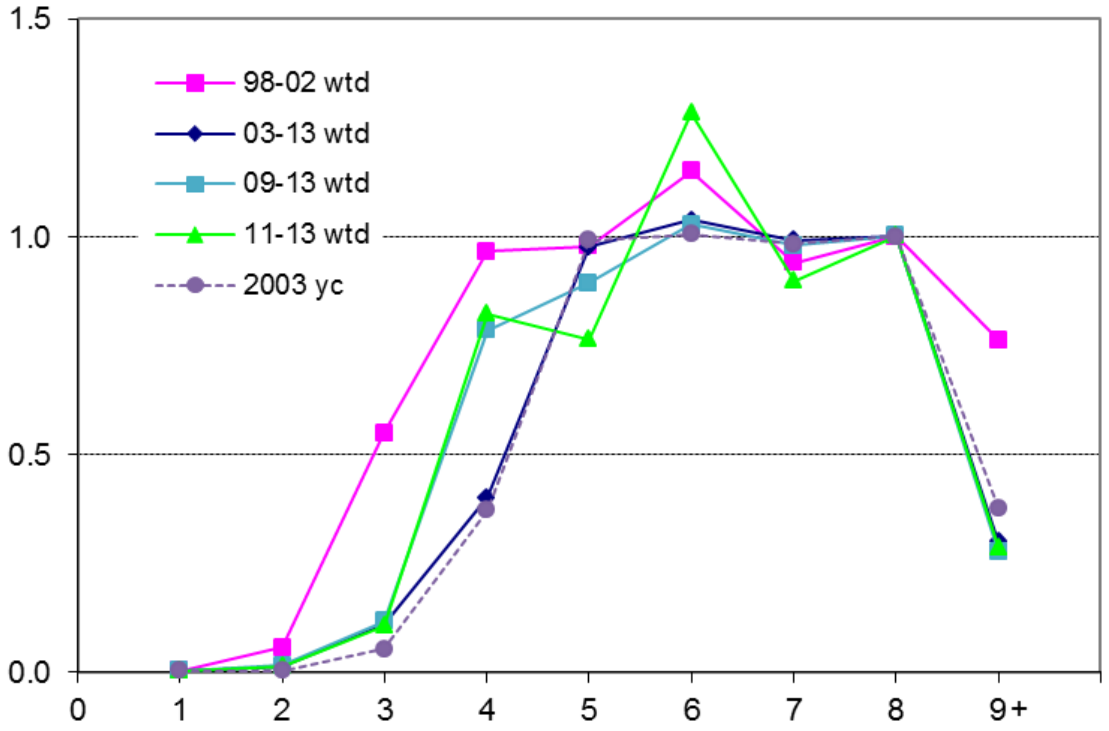


*Figure 36. Partial recruitment of eastern Georges Bank haddock for the population weighted average of 1998 to 2002, 2003 to 2013, 2009 to 2013 and 2011 to 2013 and for the 2003 year class. The partial recruitment is normalized to ages 4-8 for years before 2003 and to ages 5-8 for years after 2002.*

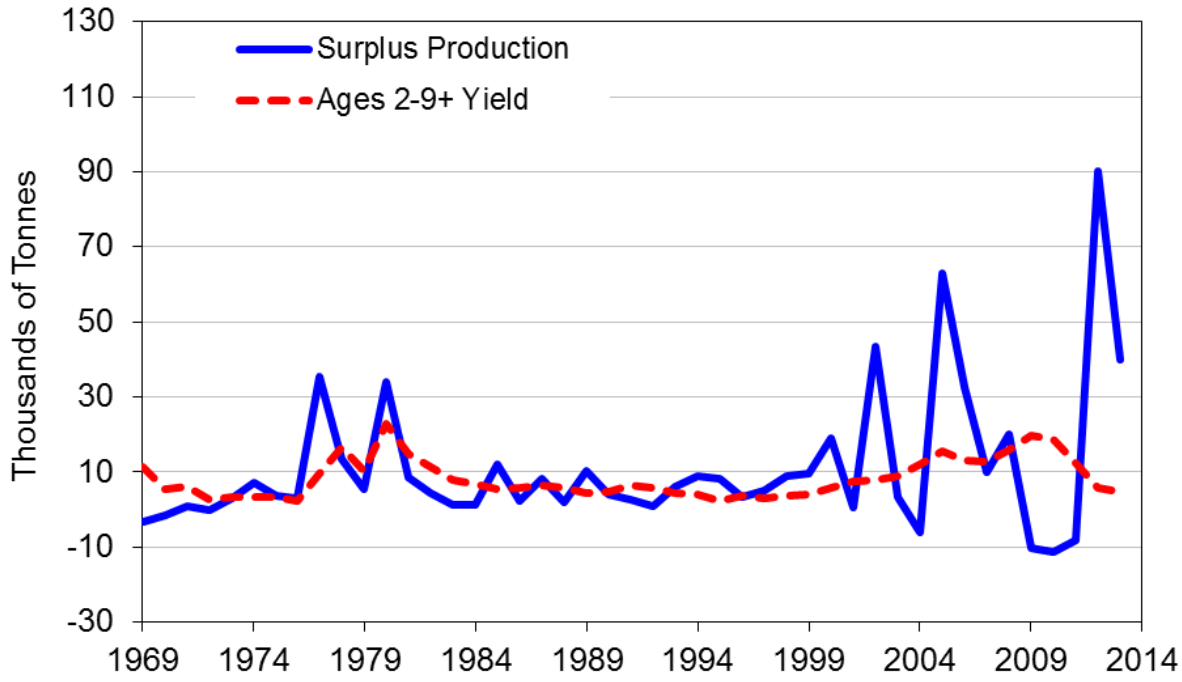


*Figure 37. Surplus production of eastern Georges Bank haddock available to the commercial fishery compared to the harvested yield during 1969-2013.*

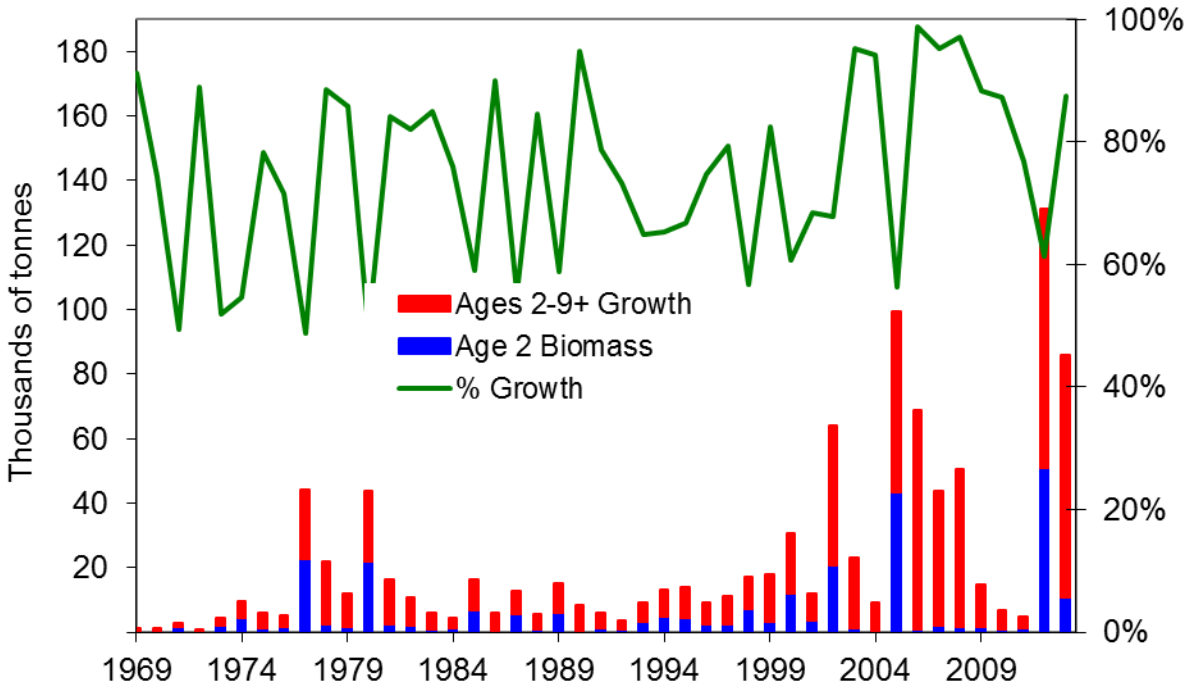


*Figure 38. Amount of productivity attributible to growth (ages 2 to 9+) of eastern Georges Bank haddock and the amount contributed by recruitment (age 2) during 1969-2012.*

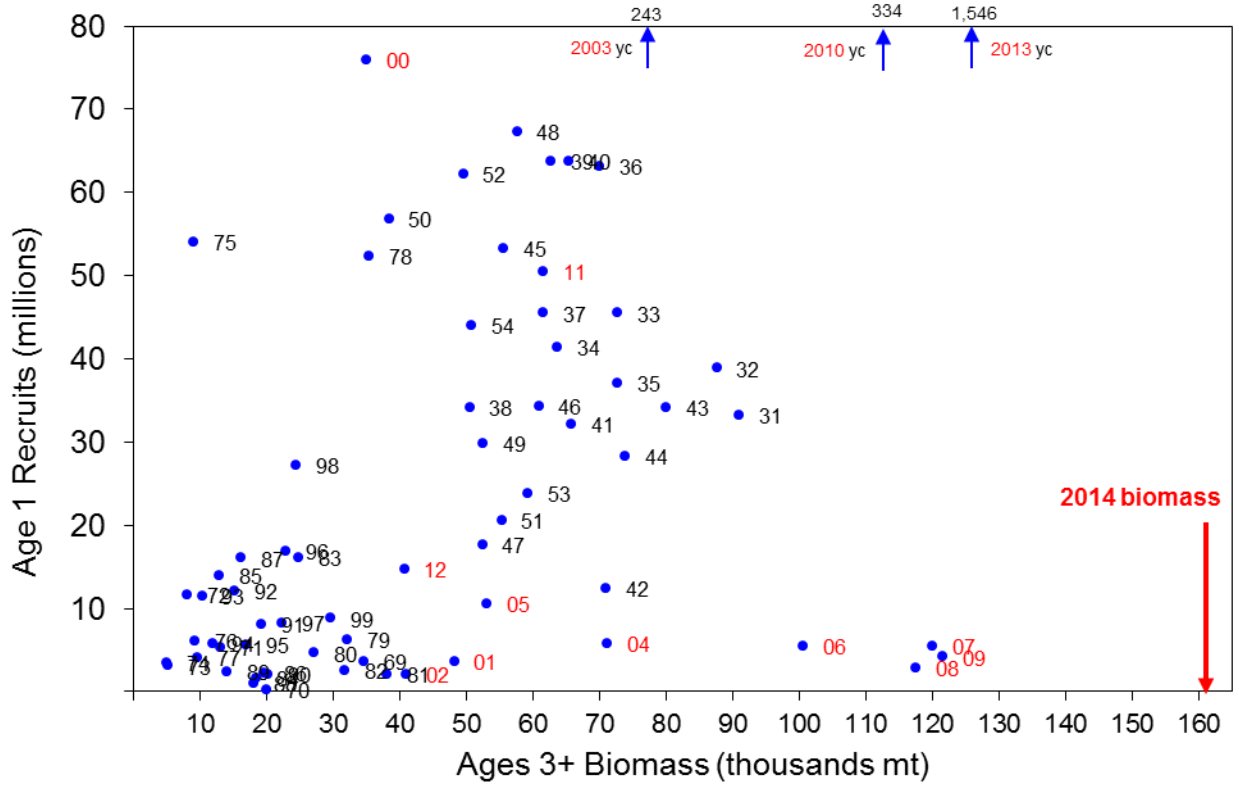


*Figure 39. Relationship between eastern Georges Bank adult (ages 3+) haddock biomass during 1931-1955 and 1969-2013 and recruits at age 1. The year classes since the 2000 are labeled in red font.*

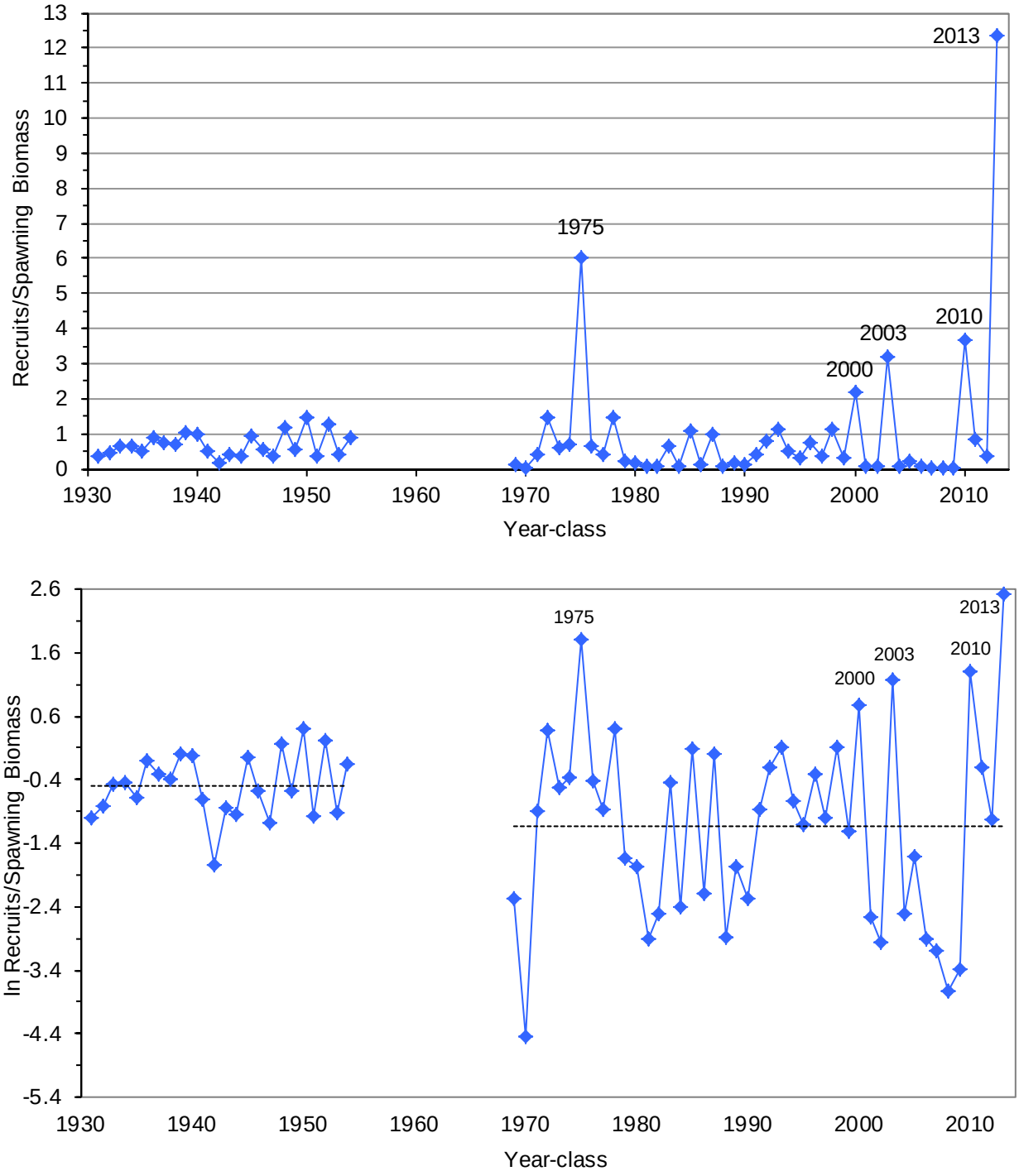


*Figure 40. Ratio of recruits (numbers at age 1) to spawning biomass (kg) for eastern Georges Bank haddock during 1931-1955 and during 1969-2013. Upper graph is in absolute numbers, lower graph is on a ln scale. Dotted lines in lower graph indicate averages over the two periods.*

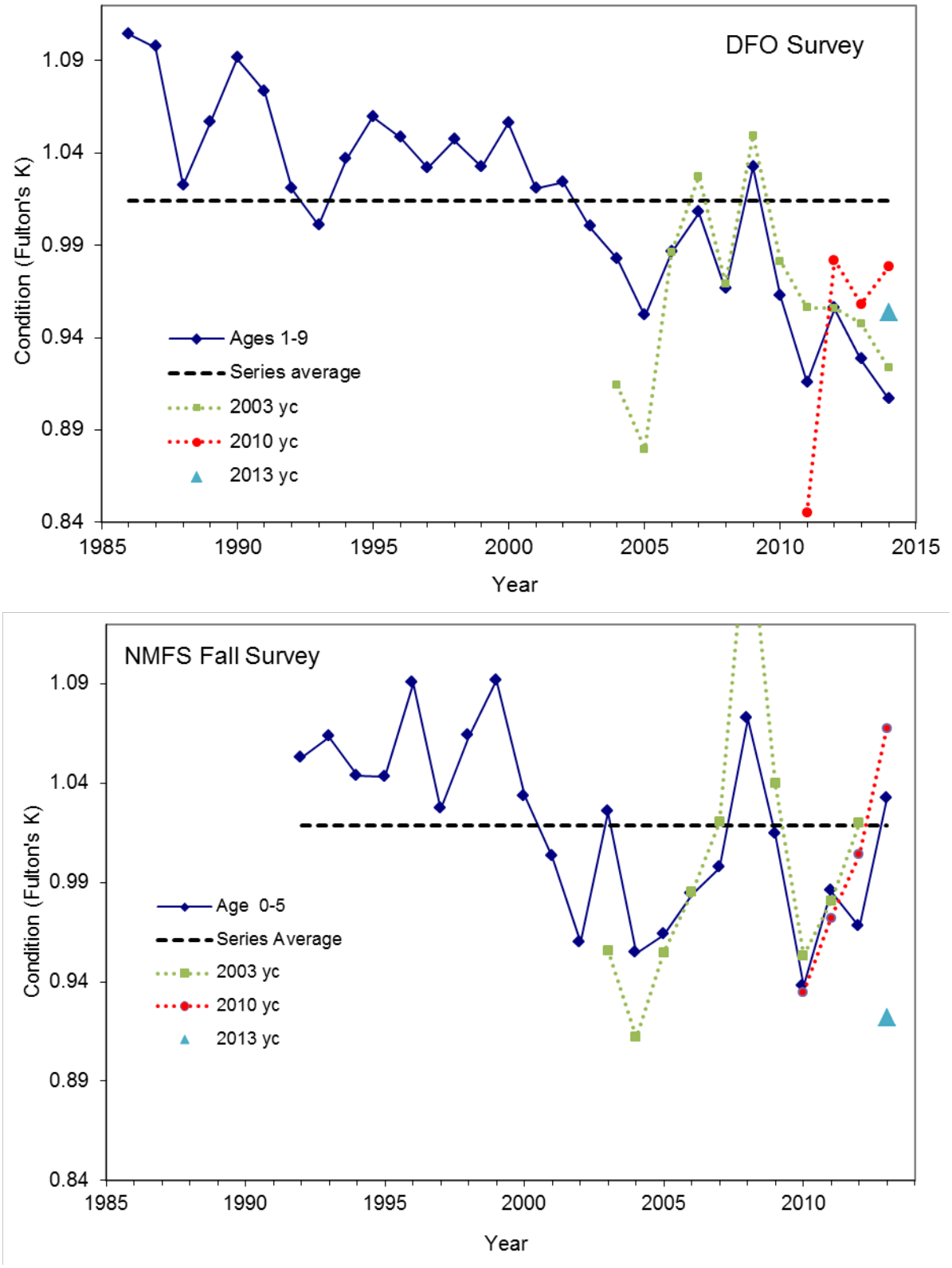


*Figure 41. Condition as indicated by Fulton's K for eastern Georges Bank haddock from the Canadian Department of Fisheries and Oceans survey for age group 1-9 during 1986-2014 (upper panel) and from the NMFS fall survey for ages 0-5 (lower panel) compared to the average for each time series. The 2003, 2010 and 2013 year classes are also shown.*

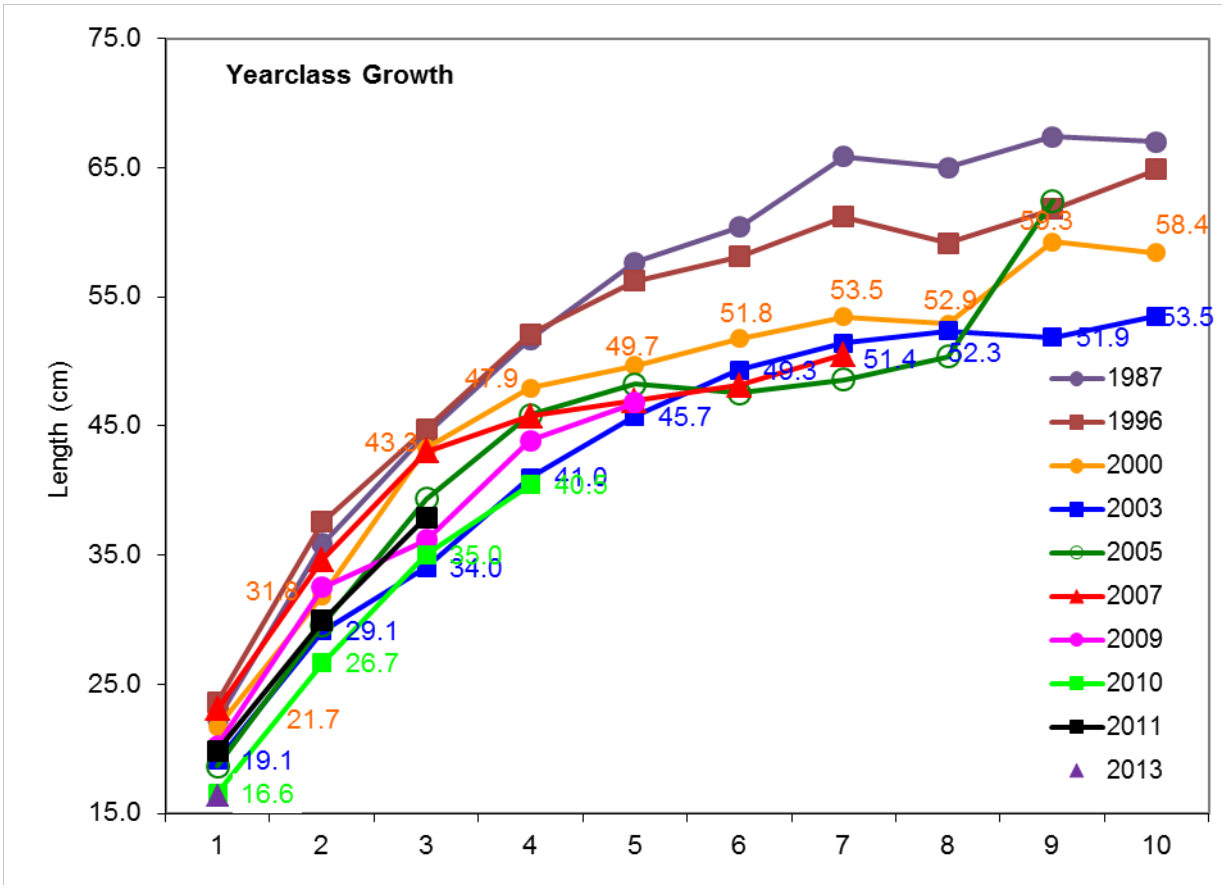


*Figure 42. Length at age of eastern Georges Bank haddock year classes from the DFO survey.*

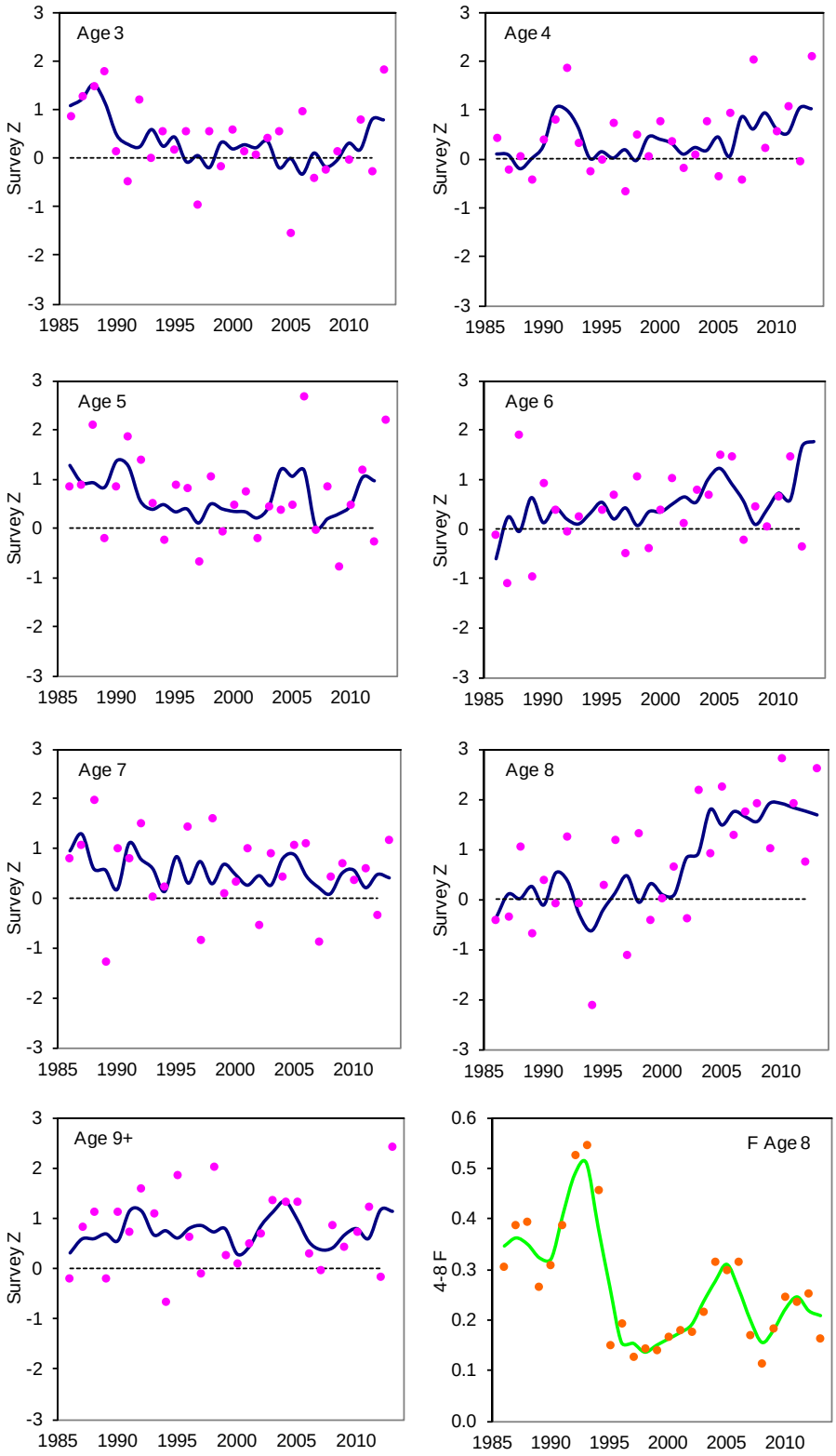


*Figure 43. Eastern Georges Bank haddock total mortality (Z's) for ages 3 to 9+ for 1986 to 2013 from the Canadian Department of Fisheries and Oceans survey and the age 8 fishing mortality from VPA (bottom right).*

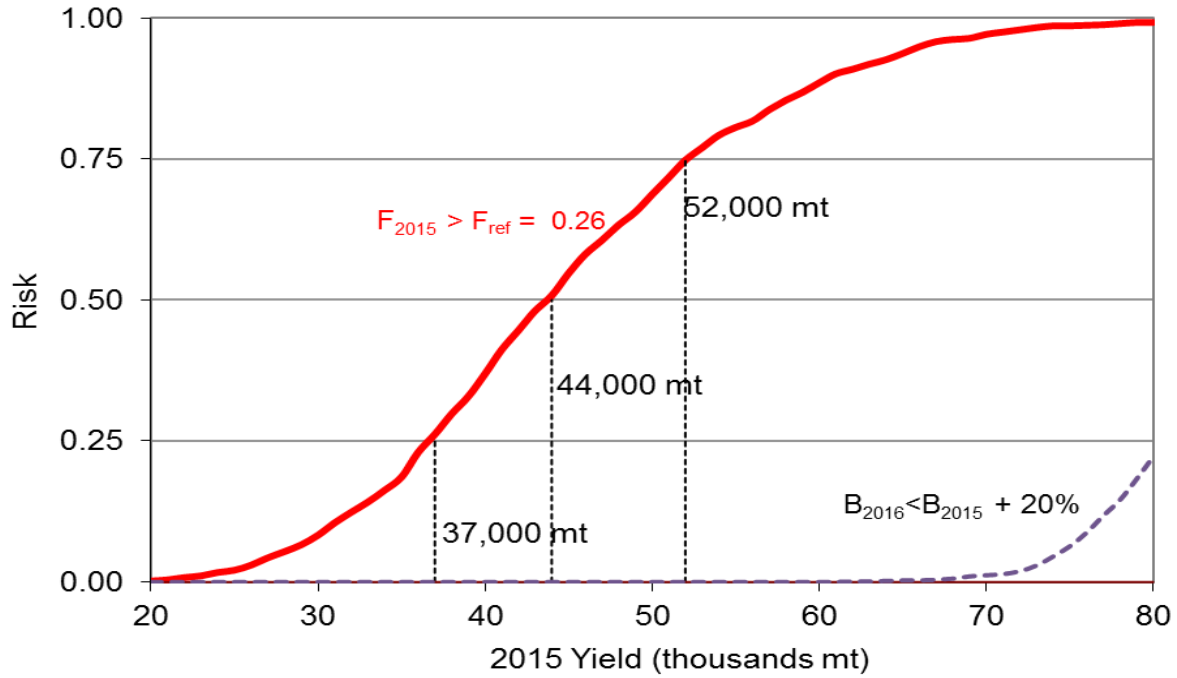


*Figure 44. Risk of 2015 fishing mortality exceeding $F_{ref}$ = 0.26 for eastern Georges Bank haddock for increasing catch quotas.*

# APPENDIX

*Comparison of EGB haddock TRAC catch advice, TMGC quota decision, actual catch, resulting fishing mortality and biomass changes. All catches are calendar year catches. In the "Results" column, values in italics are assessment results in the year immediately following the catch year; values in normal font are results from the 2013 assessment. This table was kindly provided by Tom Nies (New England Fisheries Management Council) in 2011 and updated to the 2013 assessment.*

| TRAC | Catch Year | TRAC Analysis/Recommendation | | TMGC Decision | | Actual Catch/ Compared to Risk Analysis | Results | Comments[2] |
|---|---|---|---|---|---|---|---|---|
| | | Amount | Rationale/Biomass | Amount | Rationale | | | |
| 1999[1] | 1999 | 6,300 mt | $F_{0.1}$ | NA | NA | 4,093 mt | *Below $F_{0.1}$* | |
| 2000[1] | 2000 | 8,800 mt | $F_{0.1}$ | NA | NA | 5,774 mt | *Below $F_{0.1}$* | |
| 2001[1] | 2001 | 9,700 mt | $F_{0.1}$ | NA | NA | 7,597 mt | *Below $F_{0.1}$* | |
| 2002[1] | 2002 | 10,700 mt | $F_{0.1}$ | NA | NA | 7,623 mt | *Below $F_{ref}$ = 0.26* | |
| *Transition to TMGC process in following year; note catch year differs from TRAC year in following lines F's below are based on Age 5+* | | | | | | | | |
| 2003 | 2004 | (1) 20,000 mt<br>(2) 8,000 mt | (1) Low risk of exceeding $F_{ref}$<br><br>(2) Neutral risk of biomass decline | 15,000 mt | Low risk of exceeding $F_{ref}$ and reduction in biomass > 10% | 11,919 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2004}$ = 0.17*<br>*Age 3+ biomass decrease of 27% 2004 to 2005*<br>*3+ $B_{2005}$ = 49,900 mt*<br><br>$F_{2004}$ = 0.316<br>Age 3+ biomass decreased 25% 2004 to 2005<br>3+ $B_{2005}$ = 53,000 mt | In projection, PR on age 4 (2000 year class) was set to 1. Realized was 0.3. Fully recruited ages now 5 – 8. |
| 2004 | 2005 | 26,000 mt | Neutral risk of exceeding $F_{ref}$<br><br>Adult biomass will increase substantially<br>3+ $B_{2006}$ = 513,700 mt | 23,000 mt | Low risk of exceeding $F_{ref}$<br><br>Adult biomass will increase substantially | 15,257 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2005}$ = 0.29*<br>*Age 3+ biomass increase of 142% 2005 to 2006*<br>*3+ $B_{2006}$ = 122,700 mt*<br><br>$F_{2005}$ = 0.297<br>Age 3+ biomass increased 89% 2005 to 2006<br>3+ $B_{2006}$ = 100,500 mt | Higher F due to lower realized PR and weights at age for 2003 year class and lower weights for 2000 year class.<br><br>Large biomass increase due to 2003 year class. |
| 2005 | 2006 | 22,000 mt/18,000 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2007}$=157,400 mt | 22,000 mt | Neutral risk of exceeding $F_{ref}$ | 12,630 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2006}$ = 0.36*<br>*Age 3+ biomass increase of 26% 2006 to 2007*<br>*3+ $B_{2007}$ = 145,300 mt*<br><br>$F_{2006}$ = 0.316 | Higher F due to lower realized PR and weights at age for 2003 year class and lower weights for 2000 year |

| TRAC | Catch Year | TRAC Analysis/Recommendation | | TMGC Decision | | Actual Catch/ Compared to Risk Analysis | Results | Comments[2] |
|---|---|---|---|---|---|---|---|---|
| | | Amount | Rationale/Biomass | Amount | Rationale | | | |
| | | | | | | | Age 3+ biomass increased 19% 2006 – 2007<br>3+ $B_{2007}$ = 120,100 mt | class. |
| 2006 | 2007 | 19,000 mt/ 16,000 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2008}$ = 161,900 mt | 19,000 mt | Neutral risk of exceeding $F_{ref}$ | 12,510 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2007}$ = 0.14*<br>*Age 3+ biomass increase of 4% 2007 – 2008*<br>*3+ $B_{2008}$ = 158,100 mt*<br>$F_{2007}$ = 0.171<br>Age 3+ biomass decreased 2% 2007 to 2008<br>3+ $B_{2008}$ = 117,500 mt | 2003 year class specific values for projection inputs. |
| 2007 | 2008 | 26,700 mt/ 23,000 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2009}$ = 145,700 mt | 23,000 mt | Low risk of exceeding $F_{ref}$ | 16,003 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2008}$ = 0.09*<br>*Age 3+ biomass increase of 7% 2008 to 2009*<br>*3+ $B_{2009}$ = 155,600 mt*<br>$F_{2008}$ = 0.113<br>Age 3+ biomass increased 3% 2008 to 2009<br>3+ $B_{2009}$ = 121,500 mt | 2003 year class specific values for projection inputs. |
| 2008 | 2009 | 33,000 mt/ 28,000 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2010}$ = 125,500 mt | 30,000 mt | Low to neutral risk of exceeding $F_{ref}$ | 19,855 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2009}$ = 0.13*<br>*Age 3+ biomass decrease of 21% 2009 to 2010*<br>*3+ $B_{2010}$ = 125,100*<br>$F_{2009}$ = 0.182<br>Age 3+ biomass decreased 25% 2009 to 2010<br>3+ $B_{2010}$ = 91,400 mt | 2003 year class specific values for projection inputs. |
| 2009 | 2010 | 29,600 mt/ 25,900 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2011}$ = 94,700 mt | 29,600 mt | Low to neutral risk of exceeding $F_{ref}$ | 18,794 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2010}$ = 0.148*<br>*Age 3+ biomass decrease of 28% 2010 to 2011*<br>*3+ $B_{2011}$ = 93,400 mt*<br>$F_{2010}$ = 0.246<br>Age 3+ biomass decreased 33% 2010 to 2011<br>3+ $B_{2011}$ = 61,500 mt | 2003 and 2005 year class specific values for projection inputs. |
| 2010 | 2011 | 22,000 mt/ 19,000 mt | Neutral/low risk of exceeding $F_{ref}$<br>3+ $B_{2012}$ = 67,800 mt | 22,000 mt | Neutral risk of exceeding $F_{ref}$ | 12,656 mt<br>Low risk of exceeding $F_{ref}$ | *$F_{2011}$ = 0.135*<br>*Age 3+ biomass decrease of 29% 2011 to 2012*<br>$F_{2011}$ = 0.237<br>Age 3+ biomass decreased 34% 2011 to 2012 | 2003 and 2005 year class specific values for projection inputs. |

| TRAC | Catch Year | TRAC Analysis/Recommendation | | TMGC Decision | | Actual Catch/ Compared to Risk Analysis | Results | Comments[2] |
|---|---|---|---|---|---|---|---|---|
| | | Amount | Rationale/Biomass | Amount | Rationale | | | |
| | | | | | | | 3+ $B_{2012}$ = 40,600 mt | |
| 2011 | 2012 | 16,000 mt/ 13,900 mt | Neutral/low risk of exceeding $F_{ref}$ Adult biomass will increase substantially from 2012 to 2013 (2010 year class) 3+ $B_{2013}$ = 188,700 mt | 16,000 mt | Neutral risk of exceeding $F_{ref}$ | 5,633 mt Low risk of exceeding $F_{ref}$ | *$F_{2012}$ = 0.157 Age 3+ biomass increased 193% 2012 to 2013 3+ $B_{2013}$ = 183,600 mt* $F_{2012}$ = 0.251 Age 3+ biomass increased 208% 2012 to 2013 3+ $B_{2013}$ = 125,165 mt | 2003, 2005 and 2010 year class specific values for projection inputs. $PR_{9+}$ for projection higher than model estimate. |
| 2012 | 2013 | 10,400 mt/ 9,300 mt | Neutral/low risk of exceeding $F_{ref}$ Adult biomass will increase substantially from 2012 to 2013 (growth of 2010 year class) 3+$B_{2014}$ = 306,200 mt | 10,400 mt | Neutral risk of exceeding $F_{ref}$ | 5,066 mt Low risk of exceeding $F_{ref}$ | *$F_{2013}$ = 0.157 Age 3+ biomass increased 28% 2013 to 2014 3+ $B_{2014}$ = 160,300 mt* | 2003 year class values for 2010 year class inputs. Model estimate for $PR_{9+}$ used for projection. |
| 2013 | 2014 | 31,500 mt/ 27,000 mt | Neutral/low risk of exceeding $F_{ref}$ Adult biomass will decrease slightly from series maximum projected for 2014. 3+$B_{2015}$ = 240,000 mt | 27,000 mt | Low risk of exceeding $F_{ref}$ | N/A | N/A | 2003 year class values for 2010 year class inputs. Model estimate for $PR_{9+}$ used for projection. |
| 2014 | 2015 | 44,000 mt/ 37,000mt | Neutral/low risk of exceeding $F_{ref}$ Adult biomass will increase substantially from 2015 to 2016 3+$B_{2016}$ = 231,200 mt | N/A | N/A | N/A | N/A | 2013 year class downsized to size of 2010 year class for projection. |

[1] Prior to implementation of USA/CAN Understanding
[2] Comments by L. Van Eeckhaute